EFFECTS OF ERROR CORRECTION PROCEDURES ON OBSERVATIONAL LEARNING

by

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(Under the direction of Scott P. Ardoin)

ABSTRACT

Students can learn by observing their peers' instruction but may not learn as effectively or efficiently as they do from direct participation in instruction (Doyle et al., 1990; Leaf et al., 2012). Research also suggests that emitting errors during direct instruction (DI) can impede acquisition, particularly if errors remain uncorrected (Kodak et al., 2016); however, it is unknown whether observing errors similarly affects observational learning (OL). This dissertation examined OL from two error correction procedures implemented during instruction directed to peers. Immediate Error Correction (IEC) involved providing immediate feedback and practice of the correct response whereas Multiple Attempts (MA) involved prompting multiple guesses prior to modelling the correct response.

The first study (Chapter 2), examined OL from scripted videos of a student receiving DI. Four first-grade students watched instruction in which the video model emitted the correct response or emitted an error and received feedback via IEC or MA. Two participants mastered at least one condition and the effectiveness of procedures varied across participants, with no universally superior condition. These results align with reports of idiosyncratic effects of error correction procedures during one-on-one instruction (e.g., Kodak et al., 2016; McGhan, &

Lerman, 2013; Turan et al., 2012); however, potential extraneous influences and the contrived nature of the study limit conclusions on the generality of effects to applied contexts.

The second study (Chapter 3), examined learning from DI and observation of DI within an applied context. Three dyads of second- and third-grade students participated in small-group instruction in which an examiner used IEC and MA to teach different sets of targets to each participant. Five participants mastered both error correction conditions for their DI targets, with idiosyncratic effects of IEC and MA across participants. Regarding OL from observation of DI, IEC was associated with more correct responding for all six participants and resulted in quicker mastery for four of the five participants who mastered at least one OL condition. These results provide preliminary evidence that although the effects of error correction procedures during DI may vary across learners, certain procedures (e.g., IEC) may yield superior OL outcomes.

INDEX WORDS: Error correction, observational learning, opportunities to respond

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CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

Today's educators must provide effective instruction to students with diverse educational needs. As such, there is a high demand for teaching practices that maximize instructional effectiveness and efficiency for the greatest number of students. Teachers can increase on-task behavior and promote skill acquisition by providing frequent opportunities to respond (OTRs; MacSuga-Gage & Simsen, 2015; Skinner et al., 1996; Sutherland & Wehby, 2001).

Opportunities to Respond

An OTR consists of three main components: an antecedent, a response, and a consequence. In schools, the antecedent is often a teacher's question that evokes a student response followed by teacher feedback. For example, a teacher might present a math problem, one or more students respond, and the teacher provides feedback on the accuracy of responding. This basic three-term contingency goes by many names, such as learning trial (Skinner et al., 1996) or learn unit (Greer & McDonough, 1999). Discrete-trial instruction employs a specialized version of the OTR (Smith, 2001) in which a teacher prompt increases the likelihood of correct responding and a brief inter-trial interval occurs between OTRs.

Whereas students may passively attend to lecture-based instruction, OTRs promote active engagement by requiring overt responses directly related to instruction. Research documents the effectiveness of OTRs across a variety of formats, including group and individual delivery (Haydron et al., 2010; Wolery et al., 1992), distributed and mass-trial schedules (Chiara et al., 1995; McDonnell et al., 2006), and alternative response modalities (e.g., response cards; Narayan et al., 1990). Choral responding in which an entire group or class responds provides more OTRs for each student compared to OTRs directed at one student at a time (MacSuga-Gage & Simonsen, 2015); however, group instruction is traditionally rich in individually-directed OTRs. Teachers may favor individually-directed OTRs when they wish to monitor individual performance or target different skills across students (Sindelar et al., 1986). In some situations, a mix of individually-directed and group-directed OTRs may promote on-task behavior better than either type in isolation (Haydon et al., 2010).

Observational Learning During Opportunities to Respond

When observing OTRs directed to their peers, students who do not respond overtly may still acquire target responses through observational learning (OL; Bandura, 1977b). Learning via observation is well-documented in studies of small-group instruction with students with disabilities such as learning disabilities, intellectual disabilities, and autism spectrum disorders (e.g., Keel & Gast, 1992; Leaf et al., 2012; Ledford et al., 2008). Although OTRs also occur during general education instruction, researchers have yet to examine OL during OTRs for students without diagnosed disabilities.

Despite the occurrence of OL during small-group instruction, students often fail to exhibit the same level of proficiency with instructional targets presented to their peers as they do with targets for which they receive direct instruction (e.g., Doyle et al., 1990; Leaf et al., 2012). In fact, skills learned through observation may require additional practice and direct reinforcement for some students to attain mastery (Doyle et al., 1990). Given these findings and the popularity of posing individually-directed OTRs, there is a need for OTR procedures that promote OL.

Procedural modifications aimed at improving OL target the antecedent and consequent components of OTRs. Antecedent prompts promote observer attention to the discriminative stimulus (e.g., Alig-Cybriwsky et al., 1990; Keel et al., 2001; Wolery et al., 1991), whereas consequence-based manipulations promote discrimination between reinforcing and punishing consequences (e.g., Delgado & Greer, 2009; DeQuinzio & Taylor, 2015). Discrimination of consequences is important in that governs whether students repeat an observed behavior, as they should for reinforced responses, or whether they refrain from repeating it, as they should for punished responses. Given that students learning new skills are prone to errors, it is important that students who observe incorrect responses learn not to repeat them.

Effects of Errors on Learning

Cognitive researchers suggest observing others emit errors may be beneficial if the observer has limited prior success with the task (Schunk, 1987). For students with low baseline skill levels, watching models similar to one's self struggle, then persevere, is thought to improve learning by promoting self-efficacy (Bandura, 1977a). However, the cognitive literature examining the effectiveness of proficient and non-proficient models reports mixed results (e.g., Schunk, 1989; Schunk & Hanson, 1985; Schunk et al., 1987). Behaviorists, on the other hand, might question the value of modelling errors to a struggling student if a more proficient model is available. The author is unaware of any peer-reviewed studies examining the effects of observing errors during OTRs; however, the literature related to one-on-one instruction suggests errors produced by learners during one-on-one instruction can impede the efficiency with which they master skills (Stoddard & Sidman, 1967) and negatively affect long-term retention (Fentress & Lerman, 2012). Research with students with disabilities indicates potential detrimental effects of leaving errors uncorrected (Kodak et al., 2016) or correcting them after a delay (Barbetta et al., 1994). Additionally, lean reinforcement schedules that result from frequent errors may evoke problematic behaviors that further interfere with learning (Munk & Repp, 1994), further building the case for instructional practices that increase correct responding and minimize errors.

Error Correction

In the OTR literature, one of three consequences typically follow errors: feedback the response is incorrect (e.g., Haydon & Hunter, 2011), corrective feedback (e.g., Narayan et al., 1990), and corrective feedback with additional practice of the correct response (e.g., Wolery et al., 1992). The relative effectiveness of these consequences in facilitating OL during group instruction is unknown; however, the one-on-one instruction literature supports immediately correcting errors rather than providing no feedback or correcting them after delays (e.g., Barbetta et al., 1994; Kodak et al., 2016). In some cases, the requirement of an active student response (i.e., practicing the correct answer) provides greater benefit than just corrective feedback (e.g., Barbetta et al., 1993; Drevno et al., 1994), perhaps because this extra practice ensures the ratio of incorrect exposures to correct exposures favors correct responses.

Despite the evidence supporting error correction, teachers may not correct student errors or encourage students to make multiple guesses prior to correcting their errors. During discrete-trial instruction, allowing a second attempt prior to correcting errors is effective for some learners during a procedure called “no-no prompting” (Fentress & Lerman, 2012; Leaf et al., 2010); however, it is unknown whether this “trial-and-error” procedure (Gast, 2011) is more effective than providing corrective feedback after a single error. Teachers’ desire to allow students to err multiple times before providing feedback could be due in part to their theoretical orientations (e.g., belief in trial-and-error learning) or apprehension about damaging student self-esteem by correcting errors (Heward, 2003). Some teachers may intend to correct errors using empirically validated procedures but simply do so with poor fidelity. Whatever the reason, sub-optimal error correction likely has implications for both students who emit errors and those who observe them.

Purpose

Small-group instruction is popular due in part to its potential to facilitate greater individualization than large-group instruction while requiring fewer resources than one-on-one instruction (Ledford et al., 2012). However, small-group instruction is not always as effective or efficient as one-on-one instruction (Chiara et al., 1995; Jenkins et al., 1974), possibly due to use of procedures that are not the most efficacious for groups with varying educational needs. It is also possible that the observation of errors hinders learning, but researchers have yet to systematically investigate this within the context of OTRs. Given the popularity of group instruction, it is imperative that teachers understand the effects of observed errors and have access to procedures that mitigate adverse effects.

This dissertation featured two studies designed to examine the effects of errors and error correction procedures on OL, with the goal of investigating whether best practices in error correction during one-on-one instruction also facilitate OL. In both studies, participants observed other students engage in OTRs featuring two different error correction procedures: multiple attempts (MA) or immediate error correction (IEC). In the MA condition, students produced multiple responses prior to receiving error correction. This condition approximated no-no prompting (Fentress & Lerman, 2012; Leaf et al., 2010) and other "trial-and-error" methods the author observed in classrooms in which teachers encouraged students to try several times before delivering corrective feedback. In the IEC condition, errors resulted in the examiner immediately modelling the correct response, then prompting the student to practice the correct response. This condition incorporated elements of research-supported error correction practices used during one-on-one instruction of students with disabilities (e.g., Barbetta et al., 1993; Barbetta et al., 1994; Barbetta & Heward, 1993; Drevno et al., 1994; Kodak et al., 2016; Rodgers & Iwata, 1991).

In Study 1 (Chapter 2), participants watched scripted videos of OTRs delivered to another student. The scripted format allowed for control of the video model's errors, ensuring participant exposure to errors and to error correction procedures within a contrived setting. In Study 2 (Chapter 3), participants engaged in OTRs in a small-group setting in which the examiner directly taught each participant a unique set of instructional targets while the partner observed the instruction. This design allowed for the comparison of the relative efficiencies of the two error correction procedures and comparison of direct instruction and OL within an applied context.

CHAPTER 2

OBSERVATIONAL LEARNING FROM VIDEOS

Historically, academic interventions for struggling students took place during one-on-one instruction. In recent decades, a shift has occurred toward small-group instruction, which provides more opportunities for peer interactions and requires fewer resources than one-on-one intervention (Ledford et al., 2012; Polloway et al., 1986). Educators may further maximize small-group resources by teaching each student a unique instructional target, thereby creating opportunities for observational learning (OL) of peers' targets. Compared to presenting the same target to each student, varying targets across students may facilitate more efficient use of resources by decreasing the amount of time, trials, and errors to mastery (Doyle et al., 1990).

Another benefit of small-group instruction is the potential for frequent opportunities to respond (OTRs). An OTR, also known as a learning trial (Skinner et al., 1996) or learn unit (Greer & McDonough, 1999), is a three-term contingency consisting of an antecedent, a student behavior, and a consequence. During an OTR, a teacher presents a discriminative stimulus (e.g., question or instruction), one or more students respond, and the teacher provides feedback. These brief trials promote active engagement and skill acquisition by requiring students to perform overt task-relevant behaviors and providing direct feedback on those behaviors (for reviews, see MacSuga-Gage & Simonsen, 2015; Sutherland & Wehby, 2001).

Teachers can embed OTRs within typical classroom instruction (e.g., Sutherland et al., 2003) or present them in rapid succession with other OTRs during drills, like the one-on-one practice of discrete-trial instruction (e.g., Leaf et al., 2012). When teachers direct OTRs to individual students during whole-class instruction, the rate of OTRs delivered to each student and the rate of responses by each student are generally low (Haydon et al., 2010; Narayan et al., 1990). During small-group instruction, on the other hand, teachers spread OTRs across fewer students, thereby providing higher rates of OTRs per student.

Observational Learning During Opportunities to Respond

Advocates of small-group instruction tout it as a more efficient use of resources than one-on-one instruction due in part to the potential for OL during OTRs presented to peers (Keel et al., 2001; Ledford et al., 2012). Research documents OL during small-group instruction for students with disabilities, however, students often fail to perform observed skills to mastery criteria by the time they master directly taught targets (e.g., Doyle et al., 1990; Leaf et al., 2012; Ledford, Gast et al., 2008). For example, Doyle et al. (1990) reported that when participants with autism spectrum disorder (ASD) mastered their own instructional targets, they demonstrated correct responding for their peers' targets for a mean of 44% of trials (range: 17-67%). With additional exposure and direct reinforcement for responding, their correct responding increased to a mean of 92% (range: 67-100%), suggesting additional instruction may be necessary to promote mastery during observation of typical OTR procedures. As such, there is a need for procedures that maximize OL, thereby reducing the necessity of supplementary instruction.

Successful OL requires pre-requisite skills related to each component within the three-term OTR contingency: (a) attention to the discriminative stimulus (antecedent), (b) imitation of observed responses (behavior), and (c) evaluation of the consequences of the modelled behavior (consequence; Taylor & DeQuinzio, 2012). Students who do not readily learn via observation during typical OTR procedures may learn to do so via interventions that target one or more of these components. For example, attentional cues (e.g., prompts to look at, repeat, or copy the discriminative stimulus) can promote OL for students with disabilities (Schoen & Ogden, 1995; Wolery et al., 1991). Prompts to imitate a peer's response during an OTR can also improve learning (Taylor et al., 2012) but may be ineffective if observers do not discriminate between behaviors they should repeat (e.g., correct responses) and those they should not (e.g., errors).

Imitating a behavior without regard to its consequences can result in repeating undesirable behaviors (e.g., emitting a peer's incorrect response). Instead, students must learn to repeat behaviors that produce reinforcement and inhibit behaviors that do not (Taylor & DeQuinzio, 2012). For example, a student might observe a peer state "2 + 2 = 5" and receive feedback that the response is incorrect. The observer should evaluate the feedback as punishing and as a result, inhibit future responding of that answer. Students who do not readily make this discrimination can learn to do so and may improve their OL as a result (Delgado & Greer, 2009; DeQuinzio & Taylor, 2015).

When teachers provide feedback for errors and do not model the correct response, students may learn to inhibit imitation of the incorrect response without learning to emit the appropriate response in its place. For example, DeQuinzio and Taylor (2015) taught students with ASD to repeat a model's response when it was followed by praise and to say, "I don't know" when presented targets for which the model received negative feedback. Students learned not to repeat errors but did not acquire correct responses because the examiner never modelled the correct response during feedback. These results demonstrate that failing to provide explicit error correction can impede OL.

Error Correction

Practicing incorrect responding can hinder acquisition, particularly when a student lacks the skills required to find the correct response independently (Heward, 2003). Errors left uncorrected are likely to occur again, making instructional procedures that correct errors and reduce their future likelihood favorable over instructional procedures that do not. Most studies examining error correction procedures involve one-on-one instruction for students with disabilities, typically within the context of discrete-trial instruction. Based on this research, Heward (2003) concluded that effective error correction should be *immediate* (i.e., at the time of the error rather than delayed), *direct* (i.e., provides or prompts the correct response), and *quick* (i.e., lasts only a few seconds), and should *require practice of the correct answer* (i.e., active student response; Barbetta et al., 1993). The literature generally supports these recommendations, although the relative superiority of various error correction procedures tends to be idiosyncratic across learners (e.g., Kodak et al., 2016; McGhan, & Lerman, 2013; Turan et al., 2012) and procedures that facilitate the quickest mastery during initial learning do not necessarily promote the best long-term retention (Fentress & Lerman, 2012).

Despite empirical support for error correction, teachers may fail to provide productive feedback during instruction, perhaps due in part to faulty beliefs about effective teaching practices (e.g., belief in trial-and-error learning, apprehension about damaging self-efficacy by correcting errors; Heward, 2003). Teachers may also fail to implement established instructional procedures with fidelity. For example, Carroll et al. (2013) noted frequent inappropriate teacher responses to student errors or failures to respond in their observations of eight educators (i.e., teachers, paraprofessionals) and a speech pathologist delivering one-on-one instruction to children with ASD. Common implementation pitfalls included presenting an instruction multiple times (as opposed to once) and failing to deliver an appropriate prompt after an error or no response.

Failing to provide feedback for errors or providing sub-optimal feedback (e.g., delayed correction, no model of the correct response) can have deleterious effects on learning during one-on-one instruction (e.g., Barbetta et al, 1994; Kodak et al., 2016; Rodgers & Iwata, 1991). Ineffective error correction may also have implications for students who observe it. However, researchers have yet to systematically evaluate the effects of error correction procedures within the context of OL.

Purpose

The benefits of error correction during one-on-one instruction (e.g., Kodak et al., 2016; McGhan, & Lerman, 2013) and the occurrence of OL during small-group instruction are well documented (e.g., Doyle et al., 1990; Leaf et al., 2013; Ledford et al., 2008). However, researchers have not examined the effects of error correction on OL. The purpose of the present study was to extend this literature by examining the effects of error correction procedures on OL during a contrived situation in which participants watched videos of a peer model engaging in OTRs. The scripted videos simulated what a student might observe during small-group instruction while allowing for systematic control over errors, ensuring participant exposure to error correction procedures. The randomization of targets across three instructional conditions (Correct Responding (CR); Multiple Attempts (MA); Immediate Error Correction (IEC)) and one control condition allowed for comparison of the relative effectiveness of each condition.

In the CR condition, the peer model emitted a correct response and the teacher in the video provided praise. The purpose of the CR condition was to measure OL in the absence of errors. In the two error correction conditions, the peer model exclusively emitted errors that the teacher corrected via one of two procedures. In the MA condition, the teacher encouraged the peer model to make several attempts (i.e., errors) before the teacher modelled the correct response. This procedure was based on the author's observations that teachers often encourage students to respond multiple times prior to correcting errors, similar to the practice of no-no prompting during discrete-trial instruction (Fentress & Lerman, 2012; Leaf et al., 2010). In the IEC condition, the teacher immediately modelled the correct response and prompted the peer model to practice it (i.e., active student response). This procedure was based on the literature supporting IEC and active student response during one-on-one instruction (Barbetta et al., 1993; Barbetta et al., 1994; Barbetta & Heward, 1993; Drevno et al., 1994; Kodak et al., 2016; Rodgers & Iwata, 1991). In the control condition, the teacher never presented the targets and the participant received no exposure to correct or incorrect responses. The purpose of the control condition was to measure learning in the absence of observation of instruction.

Method

Participants and Setting

Four first-grade general education students from a public elementary school in the southeastern United States served as participants. School administrators nominated students who regularly attended the school's afterschool program and who were able to imitate their peers, communicate vocally, and attend to instruction for at least 10 min. The students' teachers participated in an informal social validity interview following student completion of the study. Abel and Karla were in the same class and Meg and Sylvia were in the same class, resulting two general education teachers participating in social validity interviews.

Sessions took place in a relatively quiet room in the participants' school, with sessions conducted up to five days per week during the afterschool program. Participants attended sessions individually. Each baseline session lasted 5 min or less and each intervention session lasted 10 min or less.

Materials

Audio Recorder

The examiner audio recorded participant responses during data collection "cold probes" for a second observer to later independently record data to assess interobserver agreement.

Video Clips

Participants watched PowerPoint presentations in which each slide contained a video clip of a teacher delivering a block of three OTR trials to a peer model. An OTR trial consisted of a teacher-delivered discriminative stimulus, a student response, and teacher feedback. Each video clip featured three OTR trials, with one trial from each instructional condition (i.e., CR, MA, and IEC). Each target appeared across three different video clips within a PowerPoint. At the onset of intervention, each PowerPoint consisted of 12 video clips (i.e., 36 total OTR trials per session).

Token Board

In effort to reinforce attention to videos during sessions, the examiner intermittently delivered tokens and descriptive praise contingent upon attention to videos (e.g., "Good job paying attention"). Participants used a 5.75-in by 8-in board and six coin-shaped tokens.

Rewards

At the end of each session and after earning their tokens, participants selected an item from a small tote containing at least 10 types of tangible rewards (e.g., school supplies, stickers, candy). The examiner identified potential rewards from participant self-report prior to baseline and added novel items throughout the study based on participant requests.

Experimental Design

The experimental design was an adapted alternating treatments design (Sindelar et al., 1985) featuring four unique targets in each condition. The examiner analyzed the data throughout the study by visually inspecting graphs with regards to the level, trend, and variability of data.

Measurement

Percentage Correct During Cold Probes

The dependent variable was the percentage of independent correct responses during a “cold” probe at the beginning of each session, before participants watched the PowerPoint presentation. For each target, the examiner presented the discriminative stimulus, then waited up to 5 s before recording the participant’s response and presenting the next target. Participants received no feedback for their responses. The examiner presented each target once per cold probe and calculated the percentage of correct responses by dividing the number of correct responses by the total number of targets for that condition, then multiplying by 100. Mastery criterion was three consecutive sessions of 100% correct responding during cold probes.

Interobserver Agreement

A research assistant independently recorded participant responses during cold probes for at least 35% of each participant’s sessions. Agreement was calculated by dividing the number of agreements by the total number of trials, then multiplying by 100. Average agreement across participants and conditions was 99.3% (range = 91.7-100%).

Procedural Fidelity

A research assistant used a checklist to evaluate whether the teacher and peer model in the videos correctly carried out the procedures specific to each condition. The research assistant watched every OTR trial from each video and recorded whether (a) the teacher delivered the correct discriminative stimulus once, (b) the peer model emitted the appropriate response (i.e., correct or error), (c) the teacher allowed the peer model the correct number of opportunities to respond prior to corrective feedback, and (d) the teacher provided the correct feedback. Fidelity was calculated by dividing the number of correctly implemented steps by the total number of steps, then multiplying by 100. Across all videos, the teacher and peer model performed the procedures with 100% fidelity.

Procedures

Target Selection

The examiner conferred with participants' teachers to determine targets that were educationally meaningful but did not overlap with material in their curriculum. When given examples of potential categories, both teachers independently selected Spanish words. A professional Spanish-English interpreter assisted the examiner with the selection of two- and three-syllable words relevant to school (e.g., school supplies, classroom furniture). Targets in this initial target pool underwent a two-step pretest (Barbetta et al., 1993) in which the examiner presented each Spanish word to the participant twice in the absence of feedback. No participants provided the correct response for any words during either step of the pretest, resulting in all potential targets qualifying as "unknown."

After the two-step pretest, the examiner randomly assigned each target to a condition (i.e., CR, IE, MA, control) while counterbalancing by category and syllable length. This resulted in two complete target sets, with four targets per condition. Abel and Meg received one set Karla and Sylvia received the other. Table 1 displays each participant's targets.

Using these target sets, the examiner created 3-target blocks consisting of one target from each instructional condition (i.e., CR, MA, and IEC). During intervention, participants viewed each block in three different video clips each session, resulting in the presentation of three OTR trials for each target each session (i.e., 36 OTR total trials per session). Targets always appeared in their same block (i.e., with the same targets from other conditions) with their order randomly rotated across video clips. For three participants (i.e., Meg, Karla, and Sylvia), the examiner reduced the number of targets to three per condition after 2.5 weeks of intervention due to acquisition delays and time constraints (i.e., upcoming school break). For these participants, the videos continued to present the remaining targets, without the eliminated blocks, three times per session (i.e., 27 OTR total trials per session).

Reward Selection

Prior to baseline, each participant received a list of 10 potential rewards (e.g., school supplies, stickers, candy) and 10 blank spots in which to write in additional preferred items. The examiner asked each participant to rank items in order of preference and included each participant's top four items in the reward tote.

Baseline

Baseline consisted of a cold probe, conducted as described in the measurement section above. The baseline session took place immediately prior to the first intervention session in which the participant watched the OTR videos. Each participant partook in one baseline session to confirm the targets selected from the two-step pretest remained unknown.

Video Observation

Prior to each participant's first video observation intervention session, the examiner informed the participant he or she was going to watch videos of a teacher instructing another student. The examiner instructed the participant to listen quietly and to pay attention closely because she would ask participants to remember the words the next time they met. The examiner explained that she would award tokens for listening quietly and paying attention. A full token board (i.e., 6 tokens) resulted in the opportunity to select a reward at the end of the session.

Prior to each intervention session, the examiner conducted a cold probe to assess for acquisition following the previous intervention session. Cold probe procedures were identical to baseline, with the exception that after the cold probe, the participant watched approximately 5 min of videos presented on a PowerPoint presentation. In the videos, the teacher presented OTRs similar as in cold probes but with the addition of feedback for responses. An OTR consisted of the teacher presenting the discriminative stimulus, the peer model responding, and the teacher delivering feedback using the procedures described below.

During the first 3 weeks of the study, sessions ended following completion of the PowerPoint presentation. After 3 weeks of intervention, the examiner added a second probe following video presentation, during participants could earn an additional reward by improving their performance from that day's cold probe. The examiner did not provide feedback on the number or percentage of correct responses, rather she informed participants whether they exhibited more correct responding during the second probe and delivered a prize if they did. The purpose of the second probe was to increase participant motivation to attend to instruction following poor acquisition for three participants.

Correct Responding (CR). Following the teacher's presentation of the discriminative stimulus, the peer model emitted the correct response and the teacher provided descriptive praise containing the correct response (e.g., "That's right, escuela means school"). The peer model emitted the correct response on every trial.

Multiple Attempts (MA). The peer model emitted an error in response to the discriminative stimulus on every trial. Following an error, the teacher in the video labelled the response as incorrect, then represented the trial (e.g., “No, try again.”). The teacher prompted the peer model to try again two to three times, after which she modelled the correct response twice to hold the number of exposures to the correct response consistent across conditions. The number of attempts allowed in the videos were counterbalanced across targets, with two to four errors per OTR prior to feedback. The peer model never emitted the correct response.

Immediate Error Correction (IEC). Like in the MA condition, the peer model exclusively produced errors in response to the discriminative stimulus. Contingent upon an error, the teacher in the video immediately modelled the correct response, then prompted the peer model to repeat it (e.g., “No, escuela means school. Now you say it.”). The peer model repeated the correct response, then the teacher delivered brief general praise. The peer model only provided the correct response following error correction.

Control. The teacher in the videos never presented the control targets. Participants’ only exposure to control targets occurring during cold probes.

Maintenance. Procedures to assess maintenance consisted of cold probes only (i.e., no presentation of videos). The examiner conducted maintenance probes approximately two weeks following termination of the intervention, after a week-long school break.

Social Validity. Following maintenance probes, the examiner presented a piece of paper with a flowchart depicting one of the error correction procedures. The examiner briefly explained the procedure, then presented a brief video consisting of three OTRs delivered using the error correction procedure. After the video, the examiner asked the participant what he or she liked and did not like about how the teacher instructed the student. The examiner repeated this procedure for the second error correction condition. After presenting both videos, the examiner presented both error correction procedure flowcharts and asked the participant three questions:

(a) which procedure he or she liked watching the best, (b) which procedure he or she would want an adult to use to teach him or her, (c) which procedure helped him or her learn the best when watching the peer model, and (d) which procedure would help him or her learn the best if a teacher used it with him or her.

The examiner solicited feedback from both participants' teachers using the same procedures described for the student. After each video, the examiner asked the teacher what she liked and did not like about how the teacher corrected errors. After watching both videos, the examiner asked each teacher: (a) which procedure most closely aligns with her current classroom practices, (b) which procedure(s) she would find acceptable to use during instruction, (c) which procedure would best help students learn, and (d) what other strategies she uses to correct errors in her class.

Results

Observational Learning

Figure 1 depicts the percentage of correct responses during cold probes for each participant. During baseline, all four participants exhibited 0% correct responding across all four conditions. During intervention, all participants exhibited differentiated responding between the three instructional conditions and the control condition, with 0% or near-zero correct responding in the control condition for all four participants. Abel and Karla were the only to participants to attain mastery in any condition and Abel was the only participant to attain mastery prior to procedural modifications (i.e., cutting one target per condition and adding a second probe with reinforcement for improved responding). The effectiveness of instructional conditions varied across participants.

The top panel of Figure 1 depicts Abel's results. During intervention, Abel exhibited an immediate but modest increase in correct responding in the MA condition while correct responding remained at 0% across the three other conditions. Abel mastered MA first (Session 9), followed by CR (Session 11). He did not master the IEC or control conditions but did exhibit moderate to high IEC responding at the end of intervention (range: 25- 75%). Control responding remained at 0% across all sessions. Intervention levels maintained across conditions during the 2-week maintenance probe.

The second panel in Figure 1 depicts Meg's results. Meg exhibited minimal correct responding during the first eight intervention sessions, with intermittent low responding for MA and no correct responding in other conditions. Following the elimination of one target from each condition (Session 9), Meg's correct responding moderately increased, but remained variable across conditions. After addition of the post-video probe with reinforcement (Session 12), her correct responding for CR and IEC maintained at 33.3% and IEC increased to 66.6% during the final intervention session. Correct responding for MA and control targets remained low and variable throughout intervention. Intervention levels maintained across conditions during maintenance.

The third panel of Figure 1 depicts Karla's results. Karla did not emit any correct responses during the first five intervention sessions. Following the elimination of one target from each condition (Session 6), Karla exhibited an increase in correct responding for IEC, followed by increases for MA and CR that corresponded with the addition of the post-video probe with reinforcement (Session 9). Karla mastered IEC during Session 13 while correct responding in the MA and CR conditions remained low to moderate (range: 33.3-66.6%), with the exception of 100% correct responding for MA during Session 10. Correct responding in the control condition remained at zero throughout intervention. Intervention levels maintained across conditions during follow up.

The bottom panel in Figure 1 depicts Sylvia's results. During intervention, Sylvia exhibited low and variable levels of correct responding for MA and no correct responding for the IEC or the control. The elimination of one target from each condition (Session 9) did not result in any immediate significant changes and her CR responding increased to and maintained at 33.3% following the addition of the post-video probe with reinforcement. Intervention levels maintained during follow up, except for an increase for MA to 66.6%, which was Sylvia's performance greater than 33.3% correct responding at any point during the study.

Social Validity

When asked their perceptions of the IEC procedure, student participants reported liking various aspects of the procedures, with no common theme across respondents. Preferred aspects of the procedure included students "trying their best," the teacher providing an opportunity to guess, the teacher providing the correct answer, and the teacher providing opportunity for practice. Participants did not report disliking any specific procedural components, but two participants identified dislikes of general procedural components not specific to IEC (e.g., Spanish words being "so hard to learn," dislike of filming during instruction). Regarding the MA procedure, all four student participants reported they liked the opportunity to respond multiple times. One participant expressed that trying again "makes you get more smart" and another reported it provided an opportunity to "think about more answers." Only one participant reported a procedure-relevant dislike, which was the teacher providing the correct response.

When asked about their preferences between procedures, all student participants exhibited consistency between the procedure they reported they most liked watching and the procedure they would want teachers to use with them (i.e., they either selected IEC or MA for both questions). Participants varied on which procedure they preferred. Two participants initially reportedly they would want a teacher to use both procedures but selected one after receiving a prompt to do so. When asked which procedure they thought helped the peer model learn best and which one would help them learn best, responses varied across participants and questions (i.e., if a participant selected IEC for the first question, he or she selected MA for the second question). Again, participants varied on which procedure they favored for each question.

When asked their perceptions of IEC, both teachers reported they liked that it resulted in immediate correction. Additionally, Abel and Meg's teacher reported that she liked that error correction consisted of a full sentence rather than simply providing the answer. Karla and Sylvia's teacher reported that she liked that the student had to fix their error. Regarding MA, Abel and Meg's teacher reported that she liked repeating the correct answer twice. Karla and Sylvia's teacher reported that she liked that it made students "think more." Abel's teacher reported she did not like that the MA procedure involved simply giving the correct answer rather than requiring practicing the correct response. She also reported she disliked prompts to try again did not include any cues to guide them toward the correct answer. Karla and Sylvia's teacher reported she worried the procedure could result in student frustration.

When asked about their preferences between procedures, both teachers reported they use certain aspects of either procedure (e.g., requiring an active student response, providing multiple opportunities to respond) based on task and student characteristics (e.g., rote memorization vs. conceptual learning, student skill level). Teachers did not identify one procedure as universally preferable over the other.

Discussion

The purpose of this study was to examine the effects of error correction procedures within the context of OL during OTRs. Consistent with the previous literature examining error correction during direct one-on-one instruction (e.g., Kodak et al., 2016; McGhan, & Lerman, 2013; Turan, Moroz, & Croteau, 2012), the effectiveness of procedures varied across participants with no universally superior procedure across participants. Only two of four participants mastered any condition and no participant mastered all three teaching conditions.

Abel, Meg, and Sylvia initially exhibited more correct responding for MA, which was ultimately the most efficient procedure (i.e., first mastered) for Abel. However, for Meg and Sylvia, the difference in cumulative correct responses between MA and CR at the end of intervention was just one response, with neither participant mastering either condition. Karla exhibited some correct responding in the MA condition, but the condition that initially and ultimately facilitated the most correct responding for her was IEC. For the other three participants, IEC facilitated the lowest levels of correct responding, after the control condition.

Regarding social validity, student participants unanimously reported they liked teachers allowing students multiple attempts to provide the correct answer. Reported preferences between IEC and MA varied across participants and questions, with no universally favored procedure. Given observed participant hesitation when responding and inconsistent reports across questions, it is unclear whether their choices reflected true preferences or haphazard responding to forced-choice questions. Additionally, some participants expressed indifference between IEC and MA and only selected one after the examiner provided a prompt to do so.

Teachers of student participants reported appreciation for various aspects of each procedure and expressed desire to use both IEC and MA, either by using selected components together or using different procedures based on student and/or task characteristics. For example, Abel and Meg's teacher reported that she provides students multiple opportunities to respond in addition to requiring an active student response following corrective feedback. Karla and Sylvia's teacher reported she immediately corrects errors for students who are easily frustrated or for skills requiring rote memorization, but she requires multiple attempts on tasks involving spelling or comprehension.

Limitations and Future Directions

Although the present results align with prior reports of idiosyncratic effects of error correction procedures in one-on-one instructional contexts (e.g., Kodak et al., 2016; McGhan, & Lerman, 2013; Turan, Moroz, & Croteau, 2012), this study has several limitations that call for caution when interpreting its results. First, although the examiner counterbalanced targets across conditions based on category and syllable length of the Spanish word, other characteristics may have impacted difficulty (e.g., familiarity of the object, phonological similarities between Spanish and English words). Additionally, multiple participants reported practicing words outside of session, despite receiving instruction not to do so. Given the small number of targets in each condition, the presence of any extraneous variables for one or more targets could have substantially inflated treatment effects for a given condition.

Utilization of larger sets of targets could minimize the effects of extraneous variables but may do so at the risk of slowing acquisition due to increased task demands. Alternatively, teaching one target per condition and introducing novel targets following mastery would allow for frequent treatment replications and may promote quicker skill acquisition for each target. The present study did not utilize these procedures due to feasibility constraints pertaining to the creation of videos and PowerPoint presentations. Administering alternating treatments within an experimental design that allows for multiple intervention phases across target sets (e.g., multiple probe design) would also allow for evaluation of the reliability of effects. Such modifications are often absent in adapted alternating treatment designs (e.g., Vladescu & Kodak, 2013; Wolery et al., 1993), although they may be warranted given that differentiation does not always replicate across target sets (e.g., Vladescu & Kodak, 2013; Stevens et al., 2011).

Other potential threats to internal validity arise from general procedure and/or participant characteristics that may have hindered performance across conditions. For example, the repetitive and passive nature of the intervention may have deterred engagement, as evidenced by occasional off-task comments and expressed displeasure over repeatedly watching the same videos. In small-group formats, students often directly participate in instruction for their own targets even if they do not participate in instruction for peers' targets (e.g., Keel & Gast, 1992; Leaf et al., 2013; Ledford et al., 2008). Requiring intermittent responding may promote engagement and circumvent fatigue or distractibility that may have occurred in the present study. Forms of active participation shown to improve learning within the context of observation learning include engaging in an observing response after presentation of the discriminative stimulus (e.g., Schoen & Ogden, 1995; Wolery, 1991), imitating the correct response (e.g., Cannella-Malone et al., 2011; Taylor et al., 2012), and engaging in a response to indicate whether the observed response was correct or incorrect (e.g., Delgado & Greer, 2009; DeQuinzio & Taylor, 2015). This study did not include these components as they are often absent in OTRs delivered within typical classroom settings and the goal was to examine OL in the absence of direct participation.

To encourage attending, the examiner delivered tokens contingent upon orienting one's gaze toward the video in the absence of off-task behaviors; however, participants could have emitted this behavior without attending to instruction with the intent to learn (e.g., “spacing out”). As such, the procedures incentivized looking at videos rather than learning from them. The end-of-session probe added weeks into the intervention included an opportunity to earn an additional reward contingent upon improved performance, but at best improved correct responding for one participant (i.e., Karla). However, her increase may have been the result of maturation rather than motivation.

Although the present study demonstrates that learning can occur by observing videos of OTRs, it provides little evidence as to whether certain error correction procedures better facilitate OL than others. The effects of feedback procedures on OL may be idiosyncratic across learners, as is the case during direct instruction (e.g., Kodak et al., 2016; McGhan, & Lerman, 2013; Turan et al., 2012). Additionally, while students can learn from observation during in-vivo small-group instruction, OL is generally not as effective or efficient as direct OTR participation (e.g., Doyle et al., 1990; Leaf et al., 2012; Ledford et al., 2008). Thus, while it may be helpful to identify ways that help students learn through observation, educational resources may be best allocated toward increasing opportunities for active student responding, such as through use of class-wide responding (e.g., Narayan et al., 1990). Given the evidence that increasing student active participation in OTRs improves both on-task behavior and skill acquisition (MacSuga-Gage & Simonsen, 2015), evaluation of when and how individually directed OTRs are beneficial over group responding could assist teachers in planning allocation and formatting of OTRs.

Table 1. *Participants' Targets for Video Observation.*

Participants	CR	MA	IEC	CONTROL
Abel Meg	Pega (Glue) Regla (Ruler) Mochila (Backpack) *Prueba (Quiz)*	Lapiz (Pencil) Libro (Book) Basura (Trash) *Columpio (Swing)*	Puerta (Door) Tiza (Chalk) Tarea (Homework) *Alfombra (Rug)*	Silla (Chair) Papel (Paper) Escuela (School) *Carpeta (Binder)*
Karla Sylvia	Silla (Chair) Papel (Paper) Tijera (Scissors) *Carpeta (Binder)*	Puerta (Door) Tiza (Chalk) Ventana (Window) *Alfombra (Rug)*	Lapiz (Pencil) Libro (Book) Pasillo (Hallway) *Columpio (Swing)*	Pega (Glue) Regla (Ruler) Pelota (Ball) *Prueba (Quiz)*

Note: *Italicized* targets were removed from PowerPoint presentations after 2.5 weeks of intervention for Meg, Karla, and Slyvia.

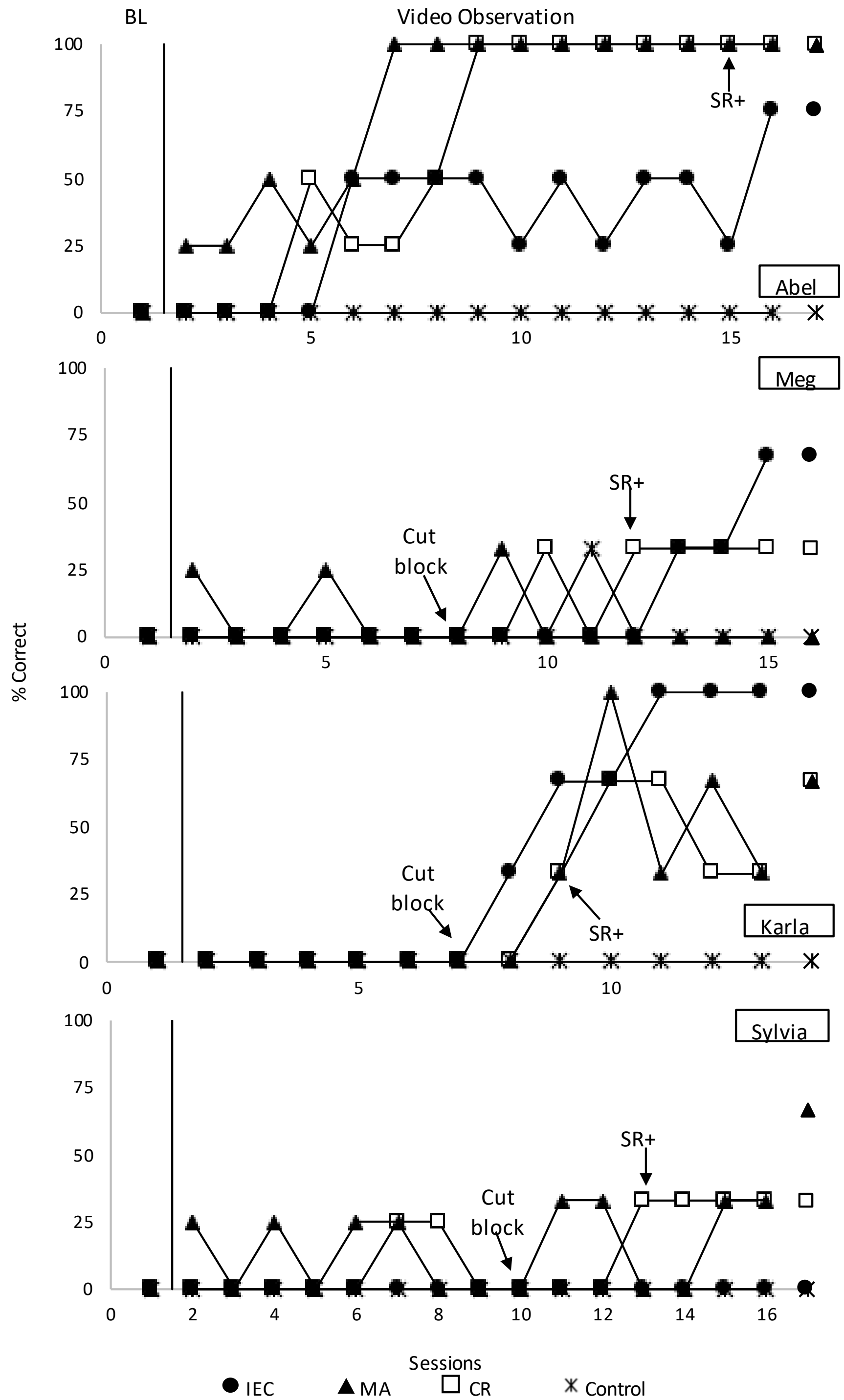

Figure 1. Correct Responding During Cold Probes. *Note:* "Cut block" denotes the elimination of one target per condition. "SR+" denotes the addition of a post-video probe with reinforcement for improved performance.

CHAPTER 3

OBSERVATIONAL LEARNING FROM SMALL-GROUP INSTRUCTION

In recent decades, small-group instruction has become an increasingly popular means of delivering intervention to students with academic difficulties. This arrangement, which typically consists of instruction delivered to two to five students, is effective for students ages 3 and older (Ledford et al., 2012). Compared to traditional one-on-one intervention, small-group instruction typical requires fewer resources and provides more opportunities for peer interactions and observational learning (OL; Ledford et al., 2012; Polloway et al., 1986).

In studies of small-group instruction for students with disabilities, teaching trials are often delivered in a three-part format in which a teacher presents an antecedent (e.g., a question) that evokes a student response (e.g., answer to question), and is followed by a consequence (e.g., praise, error correction). This three-term contingency is often referred to as an opportunity to respond (OTR; Sutherland & Wehby, 2001), learning trial (Skinner et al., 1996), or learn unit (Greer & McDonough, 1999). Research suggests that providing frequent OTRs improves on-task behavior and skill acquisition in both small-group and whole-class formats (see MacSuga-Gage & Simonsen, 2015; Sutherland & Wehby, 2001 for reviews). During small-group instruction, OTRs are often delivered back-to-back in drill formats (e.g., Sindelar et al., 1986), similar to discrete-trial instruction used during one-on-one intervention (e.g., Leaf et al., 2012).

Instructional procedures for OTRs differ on a variety of components, including who responds (e.g., one student at a time, group choral responding), how students respond (e.g., vocal, written), and how teachers correct errors (e.g., modelling the correct response, prompting an active student response). Research suggests the optimal procedure may vary across learners and instructional contexts. For example, by using choral responding in which all students respond rather than calling on one student at a time, teachers can increase the number of OTRs across all students without increasing the total number of OTRs the teacher must deliver (Wolery et al., 1992; Sindelar et al., 1986). However, monitoring individual student progress during choral responding can be difficult for teachers (Wolery et al., 1992) and in some cases, a mixture of individual-directed and group-directed OTRs may be most effective for managing student behavior (Haydon et al., 2010). During individually directed OTRS, only one student actively participates in instruction, but through OL other group members may acquire the instructional targets presented to a peer (Bandura, 1977).

Observational Learning During OTRs

Research on small-group instruction, conducted primarily with students with disabilities, provides evidence of OL (e.g., Doyle et al., 1990; Leaf et al., 2012; Ledford et al., 2008). However, that research also indicates that when students learn through observation, they often fail to perform skills to mastery criteria in the absence of additional practice and reinforcement (Doyle et al., 1990). That is, observation of commonly used OTR procedures is often insufficient to produce acceptable levels of a new skill or does not facilitate learning as efficiently as direct teaching procedures (e.g., Doyle et al., 1990; Leaf et al., 2012). As such, there is a need for OTR procedures that maximize OL, thereby increasing the efficiency of small-group instruction.

Research on procedural modifications of the teacher-delivered components of OTRs (i.e., antecedents and consequences) show promise in facilitating OL. Related to the antecedent, attentional cues (e.g., prompts to look at, repeat, or copy the discriminative stimulus) can promote acquisition of peers' targets (Keel et al., 2001; Wolery et al., 1991). Research on the consequence component of OTRs has primarily focused on teaching students to discriminate between reinforcing and punishing consequences delivered to others (Delgado & Greer, 2009; DeQuinzio & Taylor, 2015). This discrimination is a pre-requisite to OL in that imitating a behavior without consideration of its consequences can result in the emittance of behaviors that produce punishment (e.g., incorrect academic responses). To successfully learn through observation, a student must imitate behaviors that yield reinforcement while refraining from repeating behaviors that do not (i.e., errors; Taylor & DeQuinzio, 2012).

Although it is important that students learn not to repeat errors, simply inhibiting the incorrect behavior without emitting the correct response in its place is of limited value. Learning that the correct response to "two plus two" is not five is beneficial but is not as useful as knowing the answer is four. As such, it is important that consequences for incorrect responses both specify that the behavior was incorrect and provide the correct response. This is achieved through evidence-based error correction procedures (e.g., Barbetta et al., 1993; Barbetta et al., 1994; Barbetta & Heward, 1993; Drevno et al., 1994; Kodak et al., 2016; Rodgers & Iwata, 1991).

Error Correction

Research of one-on-one instruction for students with disabilities shows that errors that are not immediately corrected can impede learning (Barbetta et al., 1994; Kodak et al., 2016; Rodgers & Iwata, 1991). However, when addressed appropriately, errors provide opportunities for additional instruction and learning (Heward, 2003). When a student errs, it signals to the teacher that the student needs more practice engaging in the correct response and prompts an occasion to provide this support. However, some teachers shy away from correcting errors, an avoidance that Heward (2003) suggested may be due to a desire to allow students to "find their own way" or concern over negatively impacting student self-esteem. Heward countered that what ultimately damages self-esteem is low achievement that can result from practicing errors rather than the correct response. Instead, he suggested that error correction should be provided: (a) immediately (i.e., right away), (b) directly (i.e., explicitly), (c) quickly (i.e., brief feedback), and (d) with an active student response (i.e., practice of the correct response).

Research with students with disabilities supports the use of Heward's (2003) recommendations; however, the relative efficiency and effectiveness of various error correction procedures often varies across students (Kodak et al., 2016; McGhan, & Lerman, 2013; Turan et al., 2012). For example, results from several studies suggest that requiring an active student response facilitates more efficient learning than a teacher simply modelling the correct response (e.g., Barbetta et al., 1993; Barbetta & Heward, 1993; Drevno et al., 1994). However, others report that modelling the correct response is as effective or more effective than requiring an active student response (e.g., Isenhower et al., 2018; McGhan & Lerman, 2013). Some children benefit from prompting procedures that prevent or minimize opportunities to emit errors at all (e.g., errorless learning; Mueller et al., 2007), whereas others learn quicker when given the opportunity to emit multiple responses, and possibly multiple errors, prior to receiving corrective feedback (e.g., no-no prompting; Leaf et al., 2010).

Despite idiosyncratic effects of various error correction procedures across learners, it is recommended that errors are corrected rather than left unchecked (Heward, 2003). Although much is known about the benefits of error correction during one-on-one instruction, researchers have yet to examine its effects on OL. In the study presented in Chapter 2, four first-grade students watched a peer video model receive OTR instruction via two error correction procedures, with idiosyncratic effects on OL across participants. This first study provides some preliminary evidence that the effects of error correction procedures on OL may also vary across learners; however, the contrived and scripted nature of the videos precludes conclusions about the generalization of these results to in-vivo instruction. Given the widespread use of small-group instruction and the potential for observing errors emitted by peers during such instruction, it is important that educators have access to error correction procedures that are effective for both students who emit errors and those who observe them. It is also important that researchers examine use of these procedures with typically developing students as most prior studies provide instruction to students with disabilities.

Purpose

The special education literature related to one-on-one instruction has identified several components of effective error correction (Heward, 2003). However, it remains unknown whether these best practices during one-to-one instruction also produce the most efficient OL. The need for strategies that maximize the instructional efficiency of OTRs is further highlighted by the finding that students often fail to acquire instructional targets via OL at the same rate at which they acquire targets for which they receive direct instruction (DI; e.g., Doyle et al., 1990; Leaf et al., 2012). The purpose of the proposed study was to address this need by examining the effects of two error correction procedures on learning in the contexts of direction instruction and OL.

In the present study, dyads of participants received small-group instruction in which each participant received DI for two sets of targets and observed his or her partner receive DI for two sets of targets. One participant's DI targets served as the other participant's OL targets. Each participant's DI targets were divided equally across two error correction conditions: Multiple Attempts [MA] and Immediate Error Correction [IEC].

In the MA condition, the examiner encouraged the participant to provide multiple responses prior to providing error correction. This procedure was based on the author's observation that classroom teachers often withhold error correction until a student produces guesses or multiple students respond, thereby providing exposure to multiple errors prior to the correct response. Although this practice is like no-no prompting during one-on-one instruction, teachers may not necessarily provide the correct response after two errors, as necessitated for no-no prompting (Leaf et al., 2010). In the IEC condition, the examiner immediately corrected the error, then prompted the student to repeat the correct response. This procedure was based on research documenting the benefits of immediate error correction and active student responding during one-on-one instruction (e.g., Barbetta et al., 1993; Barbetta et al., 1994; Barbetta & Heward, 1993; Drevno et al., 1994; Kodak et al., 2016; Rodgers & Iwata, 1991).

Method

Participants and Setting

Six general education elementary school students in the southeastern United States participated in this study. The examiner conferred with school administrators to recruit students who regularly attended the school's afterschool program, could imitate their peers, were verbally proficient, and were able to attend to instruction for at least 10 min. The examiner paired participants in dyads based on their availability. Allie and her partner, Brad, were in the same second-grade class. Clay and his partner, Dan, were in another second-grade class. Evan and his partner, Fred, were in second- and third-grade classrooms, respectively. Brad and Clay were twins. Sessions took place three to five times per week in a quiet room during the afterschool program. Baseline sessions lasted approximately 10 min and intervention sessions lasted approximately 15 min.

Materials

Data Sheets

The examiner used pencil and paper data sheets to record the dependent variable (i.e., responding during a "cold" probe prior to small-group instruction) and responding during small-group instruction. Target order was counterbalanced in blocks of four (i.e., one DI target from each intervention condition for each participant).

Video Recorder

The examiner audio recorded cold probes and video recorded small-group instruction for purposes of assessing interobserver agreement and treatment fidelity.

Token Board

During small-group instruction, each dyad earned tokens for on-task behavior unrelated to the target skills (e.g., responding when called upon, waiting quietly, attending to instruction). Both dyad members used the same token board, working toward a common goal under the same reinforcement contingency (i.e., interdependent group contingency; Litow & Pumroy, 1975). After presenting one to three blocks of targets (mean = 2), the examiner scanned participant behavior and, if appropriate, delivered a token and descriptive praise. Participants selected a reward at the end of session after earning six tokens to fill the board.

Rewards

Participants chose rewards from a plastic tote containing 10 to 20 different tangible items identified as preferred by at least one participant using the selection procedures described below.

Experimental Design

Using an adapted alternating treatments design (Sindelar et al., 1985), conditions rapidly rotated within sessions with unique targets of similar difficulty used in each condition. Within each dyad, each participant had two distinct sets of DI targets (i.e., one MA set and one IEC set) and both participants shared the same set of control targets. The examiner presented targets in blocks of four, such that each block contained one DI target from each condition (i.e., MA and IEC) for each participant. As such, within a given block, each participant received instruction for two DI targets and observed his or her partner receive DI for two targets. One participant's DI targets served as his or her partner's OL targets. The examiner used visual inspection of data to evaluate intervention effectiveness and efficiency, with consideration of the level, trend, and variability of data in each condition.

Measurement

Percent Correct During Cold Probe

The percentage of correct responses during cold probes served as the dependent variable. The examiner conducted the cold probe with each participant individually, prior to small-group instruction. The cold probe for a given session occurred the day following its corresponding small-group instruction session (i.e., the first intervention cold probe occurred the day after the first small-group instruction session, immediately prior to the second small-group instruction session). Responses during the cold probes, rather than responses during small-group instruction, served as the dependent variable as participants did not have the opportunity to respond to control targets or their peer's DI targets during instruction.

For each target presented during cold probes, the examiner presented the discriminative stimulus, waited up to 5 s for a response, then recorded the response (i.e., correct or error) or lack thereof. The examiner did not provide feedback on response accuracy during cold probes and presented the next target after recording data. Percentage of correct responses was calculated each session by dividing the number of correct responses by the total number of targets (15), then multiplying by 100. Mastery criterion for each condition was three consecutive sessions of 100% correct responding during cold probes.

Percentage Correct During Small-Group Instruction

The examiner collected data on participant responding via pencil-and-paper recording during small-group instruction. For each trial, the examiner presented the discriminative stimulus, waited up to 5 s for a response, then provided the appropriate consequence (described in the procedures below). Each participant had six DI targets that were equally split across the IEC and MA conditions and each target was presented during three OTR trials per session, resulting in 36 OTR trials per session. The percentage correct was calculated each session by dividing the total number of correct responses by total number of attempts to respond and multiplying by 100%.

Interobserver Agreement

A trained research assistant independently recorded participant responses during cold probes for 42% of sessions across participants. Interobserver agreement was calculated by dividing the number of agreements by the total number of targets and multiplying by 100%. Average interobserver agreement across participants was 98.3% (range: 93.3-100%).

Procedural Fidelity

The examiner evaluated small-group instruction procedural fidelity for 36% of trials across dyads using an implementation checklist consisting of three steps for each OTR trial: (a) examiner directed OTR trial to correct participant, (b) examiner delivered correct discriminative stimulus, and (c) examiner delivered correct consequence. Token delivery throughout the session accounted for six additional steps. Fidelity was calculated by dividing the number of correctly implemented steps by the total number of steps, then multiplying by 100. Average fidelity across dyads was 99.2% (range: 97.4-100%).

Procedures

Target Selection

Target selection occurred prior to baseline. The examiner consulted with participants' teachers to identify targets that that would not overlap with the school curriculum. When given a list of potential target domains, all three teachers selected Spanish words and their English equivalents. The examiner consulted with a Spanish interpreter to create a pool of potential targets using words relevant to the school setting (e.g., meals, colors, school supplies). Then, the examiner used a two-round pretest (Barbetta, Heward, & Bradley, 1993) to select targets for the study. During the first round, the examiner individually presented each target to each participant by presenting the discriminative stimulus and waiting up to 10 s for a response. The examiner provided no feedback for correct or incorrect responses. An incorrect response resulted in the target's inclusion in the second round of the assessment, during which the examiner represented the targets using the same procedures as the first round. A correct response would have resulted in discarding that target; however, no participants exhibited any correct responding during the first or second round of assessment.

From the initial pool of unknown targets, the examiner divided targets into three groups (i.e., one for each dyad) while counterbalancing them based on domain (e.g., weather, color, school supply) and syllable length (i.e., two or three). From each dyad's group of 15 targets, the examiner divided targets into five counterbalanced groups. The examiner directly taught two groups to one dyad member and two groups to the other dyad member. The remaining group served as a control targets that never appeared during small-group instruction. Table 2 presents each participant's targets.

Reward Selection

Reward selection occurred prior to baseline, immediately following target selection. Each participant received a list of 10 potential reward (e.g., school supplies, stickers, candy) and had the opportunity to write in up to 10 other preferred items. The examiner asked each participant to rank all items on his or her list in order of preference. The examiner removed any items that cost more than one dollar and included the top five remaining items for each participant in a “reward box.” Additional items were added throughout the study based on participant requests.

Baseline

The examiner conducted one baseline session to verify that the targets identified through the two-step selection process were unknown. During baseline, the examiner administered cold probes individually to each participant using the measurement procedures described above. Only one participant was in the room at a time during cold probes. The examiner presented each DI, OL, and control target once and provided no feedback for responding. After the cold probe, the examiner told the participant he or she could select a reward from the reward box.

Small-Group Instruction Introduction and Role Play

Prior to a dyad’s first intervention session, the examiner briefly explained the small-group instruction procedures. The examiner explained that she would teach them Spanish words and would call on them individually to respond to certain words. She informed them they would work together as a team to fill a token board by (a) paying attention to the examiner, (b) responding when called upon, and (c) quietly listening to the other participant when he or she was called upon. If the dyad earned all six tokens by the end of the session, each participant could pick an item from the reward box.

The examiner explained that she would point to the participant who was to respond, during which the other participant should watch quietly and listen carefully. Participants were instructed to respond individually only when the examiner pointed to them. The examiner practiced this procedure with each dyad and provided feedback during an approximately 3-min role play that continued until both participants exhibited appropriate responding to the point prompt. The examiner informed participants they should make their best guess if they did not know the correct response.

Small-Group Instruction

Immediately prior to small-group instruction, the examiner conducted a cold probe with each participant to assess acquisition following the previous day's small-group instruction. One dyad member participated in the cold probe while the other waited in the hall, after which they switched. After cold probes, both members of the dyad engaged in approximately 5 min of small-group instruction together, during which the examiner presented targets in blocks of four consisting of one DI-MA target and one DI-IEC target for each participant. Target order randomly rotated across blocks and all three blocks (i.e., 12 targets) were presented prior to repeating any targets. Each block was presented three times per session, resulting in 36 total OTR trials per session (i.e., 9 DI OTR trials per condition, per participant). The examiner briefly paused between OTR trials for an inter-trial interval of approximately 3 s, during which she recorded participant responses.

Mastery criterion was set at three consecutive cold probe sessions of 100% correct responding. The discontinue criteria for intervention were both participants mastering their DI conditions, with differentiation between OL conditions or up to five additional sessions. One dyad (Evan and Fred) met a mastery criterion prior to the participants' spring break; however, the dyad inadvertently participated in an additional small-group instruction session due to examiner oversight. Intervention ceased for the remaining to participants on the second-to-last day prior to participants' spring break due to the natural discontinuity in instruction (i.e., final intervention session occurred the Thursday before break and final cold probe occurred that Friday).

After three weeks of intervention and participant complaints regarding working on the same words every day, the examiner added a post-instruction probe to each session. This probe took place immediately following small-group instructions and participants could earn an additional reward by improving their performance from that day's cold probe. The same procedures employed during cold probes were employed during post-instruction probes, with the addition of feedback on whether the participant exceeded his or her cold probe performance. Participants did not receive feedback for specific targets or on the exact number of correct responses they emitted. The purpose of the post-instruction probe was to promote motivation to attend to instruction.

Multiple Attempts (MA). To initiate a trial, the examiner pointed to one participant, presented the discriminative stimulus, and waited up to 5 s for a response. If the participant emitted the correct response within 5 s, the examiner provided descriptive praise that included the correct response (e.g., "Good, escuela means school!"). If the participant emitted an error, the examiner delivered general feedback that the response was incorrect, then prompted the participant to try again (e.g., "Not quite. Try again."). If the participant did not respond within 5 s, the examiner prompted him or her to guess (e.g., "Make your best guess."). If the participant emitted a correct response within 5 s of the discriminative stimulus or a prompt to try again or guess at any point during a trial, the examiner provided descriptive praise. The examiner prompted the participant to try again or guess two or three times, depending on the target. The number of attempts allowed per target was determined prior to intervention and remained consistent throughout the study. If the participant did not emit the correct response within 5 s of the final prompt to guess or to try again, the examiner modelled the correct response two times to keep the number exposures to the correct response consistent across conditions, regardless of student responding (i.e., two correct exposures per trial).

Immediate Error Correction (IEC). The examiner pointed to a participant, presented the discriminative stimulus, and waited up to 5 s for a response. If the participant emitted a correct response within 5 s, the examiner provided descriptive praise that included the correct response. If the participant emitted an error or did not respond within 5 s, the examiner immediately modelled the correct response, then prompted the participant to practice it (e.g., "No, escuela means school. You do it.").

Maintenance

Approximately two weeks after the final intervention session, the examiner conducted maintenance probes using procedures identical to baseline (i.e., cold probes only). No small-group instruction occurred between the final intervention cold probe and the maintenance probe.

Social Validity

After completing the maintenance probe, each participant provided feedback on the procedures after they watched videos of an adult delivering three OTRs to a student using novel targets. One video featured the MA procedure, which the examiner labelled as the "try again" procedure, and the other featured the IEC procedure, which the examiner labelled as the "practice" procedure. Prior to showing a video, the examiner announced the condition name and presented a visual of the steps corresponding to the procedure. After the participant watched the video, the examiner asked open-ended questions regarding what the participant liked and disliked about the way the adult taught the student. After the participant answered the open-ended questions for both procedures, the examiner presented the visuals of both procedures and asked the participant to select: (a) which procedure he or she would prefer to watch when another student makes an error, (b) which procedure he or she would prefer an adult to use to teach him or her directly, and (c) which procedure he or she thinks helped him or her learn the best when he or she worked with the examiner and a partner.

The examiner also conducted a brief, informal interview with each participant's teacher. The examiner asked each teacher to describe what she would do if a student responded incorrectly during group instruction. The examiner then presented the two videos using the same procedures described above and asked the teacher what he or she liked and did not like about each video. Finally, the examiner presented the visuals of each procedure and asked: "(a) which procedure most closely aligns with his or her current classroom practices, (b) which procedure(s) he or she would find acceptable to use during instruction, and (c) which procedure he or she thinks would help students learn the best."

Results

Cold Probe and Small-Group Instruction Responses

Figures 2 through 7 present participants' correct responses during cold probes and small-group instruction. In each figure, the top panel displays cold probe responding for the participant's DI and control targets, the middle panel displays cold probe responding for the participant's OL targets (i.e., his or her partner's DI targets), and the bottom panel displays the participant's partner's responding during small-group instruction (i.e., the responses the participant observed the other dyad member emit). All six participants exhibited 0% correct responding across all conditions during baseline. Except for Dan, participants consistently exhibited 0% correct responding in the control condition throughout the study. Dan exhibited one correct response the control condition during session six.

Figure 2 depicts Allie's results. During cold probes, Allie initially exhibited low levels of correct responding for DI-MA while DI-IEC remained at 0% until Session 6, after which both DI conditions exhibited increasing trends, with generally higher responding for DI-IEC. Allie exhibited 100% correct responding in both DI conditions during the two-week maintenance probe. Allie exhibited variable responding for both OL conditions throughout intervention, with initially higher levels in OL-IEC. She exhibited 100% correct responding for both OL conditions during maintenance. Regarding sessions to mastery, Allie mastered DI-MA first (Session 13), followed by DI-IEC three sessions later, and OL-IEC during the maintenance probe. During small-group instruction, Allie's partner, Brad exhibited gradual increasing trends for both DI conditions, with a more immediate increase and earlier mastery for DI-IEC.

Figure 3 depicts Brad's results. During cold probes, Brad exhibited an immediate increasing trend in DI-IEC responding while DI-MA responding remained low to moderate and variable until Session 7, after which it increased. Brad exhibited 100% correct responding for both DI conditions during maintenance. Regarding OL, Brad's correct responding for OL-IEC was consistently equal to or greater than his correct responding for OL-MA. During maintenance, Brad exhibited 100% correct responding for OL-MA and 66.6% correct responding for OL-IEC. Regarding sessions to mastery, Brad mastered DI-IEC first (Session 9), followed by OL-IEC during the next session, then DI-MA (Session 14). During small-group instruction, Brad's partner, Allie exhibited increasing trends for both DI conditions, with initially higher levels for DI-MA and earlier mastery for DI-IEC.

Figure 4 depicts Clay's results. During cold probes, Clay's responding for DI-IEC was consistently equal to or greater than responding for DI-MA, except for Session 5. He exhibited 100% correct responding for both DI conditions during maintenance. Regarding OL, he initially exhibited a slight increase in OL-MA while OL-IEC remained at 0%, but he exhibited higher levels for OL-IEC during the final three sessions of intervention. During the maintenance probe, Clay exhibited 100% correct responding for OL-IEC and 33.3% correct responding for OL-MA. Regarding sessions to mastery, Clay first mastered DI-IEC (Session 8), followed by MA five sessions later. Clay did not master either OL condition. During small-group instruction, Clay's partner, Dan, exhibited a slight increasing trend for both DI conditions throughout intervention, with generally higher levels for DI-IEC and overall low to moderate levels for both conditions.

Figure 5 depicts Dan's results. During cold probes, Dan consistently exhibited generally low to moderate responding in both DI conditions, with no clear differentiation between DI-IEC and DI-MA. Regarding OL, Dan initially displayed no correct responding in either condition, followed by a slight increase in both conditions starting with the addition of the post-instruction probe and reinforcement component (Session 7). He demonstrated an increasing trend in OL-IEC during the latter part of intervention while OL-MA responding remained generally low, apart from the final intervention session. During maintenance, Dan exhibited 100% correct responding for OL-IEC and 33.3% correct responding for OL-MA. Regarding sessions to mastery, Dan did not master any conditions during intervention, but his responding met mastery criteria for OL-IEC during the maintenance probe. During small-group instruction, Dan's partner, Clay, exhibited gradual increasing trends for both DI conditions, with generally higher levels and earlier mastery for DI-IEC.

Figure 6 depicts Evan's results. During cold probes, Evan initially exhibited an increasing trend for both DI conditions, with responding for DI-MA reaching 100% prior to DI-IEC. Evan exhibited 100% correct responding for both DI conditions during maintenance. Regarding OL, Evan exhibited variable, but generally low, responding in both conditions, followed by an increase to OL-IEC followed by a gradual increase for OL-MA. Evan exhibited 100% correct responding for both OL conditions during maintenance. Regarding sessions to mastery, Evan first mastered DI-MA and OL-IEC (Session 12), followed by mastery of DI-EIC and OL-MA three and four sessions later, respectively. During small-group instruction, Evan's partner, Fred, exhibited a gradual increasing trend for both conditions, with generally higher levels for DI-IEC until Session 8, after which his DI-MA levels consistently exceeded or met DI-IEC levels.

Figure 7 depicts Fred's results. During cold probes, Fred initially exhibited variable responding for DI-IEC while DI-MA remained at zero until responding in both DI conditions increased, with DI-MA reaching 100% prior to DI-IEC. During maintenance, Fred exhibited 100% correct responding for both DI conditions. Regarding OL, Fred initially exhibited a slight increase in OL-IEC followed by increasing trends in both OL conditions, with no clear differentiation between conditions. Fred exhibited 100% correct responding for both OL conditions during maintenance. Regarding sessions to mastery, Fred mastered DI-MA first (Session 11), followed by OL-MA one session later, and both IEC conditions the session after that. During small-group instruction, Fred's partner, Evan, exhibited a gradual increasing trend for both DI conditions, with consistently higher responding for DI-IEC, except for Session 11.

Social Validity

Regarding their perceptions of IEC, five student participants reported they liked receiving the answer and one participant reported disliking immediately receiving the answer. This same participant reported liking nothing about the procedure. One participant suggested that practicing helped him learn, although he also stated he disliked having to practice. Two participants indicated they disliked the active student response during IEC. Regarding MA, four participants reported liking having multiple opportunities to respond whereas one participant reported a dislike for having to wait for the correct response. One participant stated a desire for up to five opportunities to produce the correct response whereas another participant described the repeated opportunities as “torture.” Two participants expressed they liked that they did not have to practice the correct response during MA.

When asked to choose between procedures, participants reported variable preferences across the four questions and no participant exclusively selected the same procedure across the board. Despite an overall preference for MA, participants were more likely to favor IEC when considering learning outcomes. Five participants reported a preference for watching the MA procedure; however, only two of these participants reported they believed MA helped them learn better from observation. Four participants stated they would rather have the MA procedure used on them, but only two participants indicated they thought MA helped them learn better.

When asked their perceptions of IEC, all three teachers reported they liked that students received immediate corrective feedback. One teacher reported the procedure made students aware of the error and another teacher reported she liked that the practice of the correct response seemed similar to self-correction. This teacher also reported concern that the procedure moved too quickly for students to “absorb” information. The other two teachers did not report any aspects of IEC that they disliked. Regarding MA, two teachers reported they liked that students received multiple opportunities to get the correct response and the other teacher reported she liked that the procedure made students think about their errors. Two teachers reported concerns for students sustaining attention throughout the multiple attempts and one teacher reported concerns that students could guess and practice the wrong answer.

When asked which procedures align with their current instructional practices, all three teachers indicated they use both types of error correction, sometimes in conjunction with one another. One teacher reported she was more likely to use a correction procedure like MA during small-group instruction and more likely to use one like IEC during whole-group instruction in order to promote engagement, whereas another teacher reported she would use the procedures in opposite contexts. The third teacher reported she would likely use IEC when introducing new material or with students on individualized education plans but would prefer using MA outside of these contexts. Two teachers reported they found MA acceptable to use during instruction and the third teacher reported finding both procedures acceptable. Two teachers indicated they believed IEC would promote better learning than MA due to the practice component, whereas the third teacher reported she thought MA would lead to better learning due to providing "think time." When asked if they did anything different to correct errors in their classrooms, all three teachers indicated that they used components of both procedures, but with additional strategies (e.g., guiding the student to the answer rather than providing the correct answer, talking through the error, have students pair up to find the correct answer).

Discussion

The purpose of this study was to examine OL during small-group OTR instruction while comparing two error correction procedures (i.e., IEC and MA). Of the six participants, five mastered both of their DI conditions and five mastered at least one OL condition, as measured by responding during cold probes. These results replicate previous reports of idiosyncratic effects of error correction procedures across learners during one-on-one DI (e.g., Kodak et al., 2016;

McGhan, & Lerman, 2013; Turan et al., 2012), with DI-MA resulting in the quickest mastery for three participants (i.e., Allie, Evan, and Fred), DI-IEC resulting in the quickest mastery for two participants (i.e., Brad and Clay), and neither DI condition resulting in mastery for Dan. Due to inconsistent attendance, Dan and Clay participated in 12 intervention sessions, whereas the other dyads participated in at least 16 intervention sessions. Compared to other participants' progress after 12 sessions of small-group instruction, Dan exhibited lower levels of responding.

All five participants who mastered an OL condition mastered a DI condition first, with three participants (i.e., Brad, Dan, and Evan) mastering an OL condition the session following mastery of a DI condition. In prior small-group instruction research, it is common for participants to acquire DI targets quicker than OL targets, but it typically takes more than one session to master the latter, if mastery is attained at all (e.g., Doyle et al., 1990; Leaf et al., 2012). It is possible the present instructional procedures better facilitate OL than those used in prior research, but it is more probable that participant and/or procedural differences account for the smaller discrepancies between DI and OL mastery (e.g., participant disability status, mastery criteria, target skill, number of trials per session, number of targets per set).

Over the course of small-group instruction, DI-IEC resulted in a higher ratio of correct responses to incorrect responses compared to DI-MA for all six participants. Given that three participants mastered DI-MA prior to any other condition, the proportion of correct to incorrect responses during small-group instruction was not predictive of sessions to mastery for DI. In fact, Evan and Fred, who both mastered DI-MA first, accumulated more incorrect responses than correct responses for DI-MA compared DI-IEC during small-group instruction.

Although higher ratios of correct responses to incorrect responses emitted during small-group instruction were not predictive of quicker DI mastery, they were associated with OL cold probe performance. Over the course of the study, all six participants accumulated more cold probe correct responses for OL-IEC compared to OL-MA despite five participants accumulating more correct small-group responses for DI-MA targets compared to DI-IEC targets. So, although participants generally observed their partners accumulate more correct responses during DI-MA, they also exhibited their partners accumulate more errors. Of the five participants who mastered at least one OL condition, three (i.e., Allie, Brad, and Dan) exhibited consistent differentiation between conditions, with generally higher levels for OL-IEC. Fred was the only one of these five participants who did not master OL-IEC first – he mastered OL-MA the session prior to mastering OL-IEC.

Visual inspection suggests that partner's performance during small-group instruction did not reliably predict OL performance during cold probes. However, of the three dyads, Clay and Dan exhibited the closest correspondence between one partner's DI performance and the other partner's OL cold performance. Dan emitted more errors than correct responses for both DI conditions during small-group instruction. However, Clay ended intervention and maintenance with higher levels for OL-IEC, which was the DI condition for which Dan exhibited the most correct small-group responding overall. The only condition Dan mastered during cold probes was OL-IEC, which was also the DI condition for which Clay exhibited a higher ratio of correct responses to incorrect responses during small-group instruction.

Regarding social validity, student participants and their teachers had mixed perceptions of the two procedures, with no procedure emerging as universally preferred by either group. Student participants generally indicated a preference for observing or participating in MA despite expressing that IEC facilitated better learning, both when receiving instruction or observing it. Teachers reported using a mixture of the two procedures in their classrooms, varying their approach based on a variety of factors, such as instruction format (e.g., small group vs. whole class, familiarity of material, student characteristics).

Limitations and Future Directions

The present study replicates previous research documenting idiosyncratic effects of error correction procedures during DI (e.g., Kodak et al., 2016; McGhan, & Lerman, 2013; Turan, Moroz, & Croteau, 2012) and the occurrence of OL during small-group OTR instruction (e.g., Doyle et al., 1990; Leaf et al., 2012; Ledford et al., 2008). The present study extends this literature by providing preliminary evidence that in an applied setting, observing correct responses more consistently than incorrect responses may promote more efficient OL. However, the generality of these findings should be interpreted with caution due to the limited number of targets per set and the lack of replication across sets of targets calls for caution. Despite efforts to counterbalance targets across conditions based on features of the Spanish word (i.e., category, syllable length), it is possible that extraneous variables affected their difficulty (e.g., familiarity of the object, phonological similarities between Spanish and English words, unsanctioned practice outside of session). Repeating the procedures across an additional target set could test the reliability of effects but was not feasible during the present study due to feasibility constraints.

In the present study, IEC generally facilitated better OL outcomes; however, the procedures did not parse apart the presumably interactive effects of error correction procedures and peer responses. Statistical analyses to control for error rates, which varied across sessions and participants, were beyond the scope of this applied study due to the limited numbers of targets and participants. Responding during small-group instruction provided a context in which to interpret graphs of the primary dependent variable (i.e., cold probe responding), but future research could incorporate utilize more robust samples to perform statistical analyses of the relative effects of error rates and error correction procedures on OL. This information could aid teachers in maximizing their instructional resources to improve student outcomes.

The results of the present study align with research demonstrating that students can learn by observing peers' instruction but typically learn quicker through active participation and direct feedback (e.g., Doyle et al., 1990; Leaf et al., 2012; Ledford et al., 2008). Thus, while OL may be a "perk" of DI, if the goal is to teach a student a certain target, that student would benefit from his or her own DI in addition to observing a peer's DI. Given that students typically receive a mixture of direct and observed OTRs in classrooms, future research could investigate various ratios of each type of trial, with the goal of finding a range of proportions that maximizes learning and on-task behavior for the greatest number of students. Researchers could also investigate teachers' actual use of various OTRs and feedback procedures as well as the factors that predict how they allocate delivery among different types. For example, do teachers allocate their OTR delivery in proportion to student success with each type of OTR? Continuing to build the literature on what works best for students and what teachers do in their classrooms will help guide meaningful instructional changes in the place where it matters most – in the schools.

Table 2. ***Participants' Targets for Small-Group Instruction.***

Participant	DI-IEC	DI-MA	Control
Allie	Lapiz (Pencil) Reloj (Clock) Mochila (Backpack)	Regla (Ruler) Puerta (Door) Tarea (Homework)	Silla (Chair) Papel (Paper) Prueba (Quiz)
Brad	Pega (Glue) Tiza (Chalk) Tijera (Scissors)	Libro (Book) Pared (Wall) Columpio (Swing)	Silla (Chair) Papel (Paper) Prueba (Quiz)
Clay	Libreta (Notebook) Boligrafo (Pen) Soleado (Sunny)	Carpeta (Binder) Verde (Green) Nublado (Cloudy)	Almeurzo (Lunch) Armarillo (Yellow) Rojo (Red)
Dan	Escritorio (Desk) Marrón (Brown) Lluviosa (Rainy)	Basura (Trash) Desayuno (Breakfast) Blanco (White)	Almeurzo (Lunch) Armarillo (Yellow) Rojo (Red)
Evan	Borrador (Eraser) Azul (Blue) Lapiz (Pencil)	Escuela (School) Verde (Green) Regla (Ruler)	Prueba (Quiz) Rojo (Red) Silla (Chair)
Fred	Alfombra (Rug) Marrón (Brown) Pega (Glue)	Pelota (Ball) Blanco (White) Libro (Book)	Prueba (Quiz) Rojo (Red) Silla (Chair)

Note. Each participant’s DI targets served as his or her partner’s OL targets.

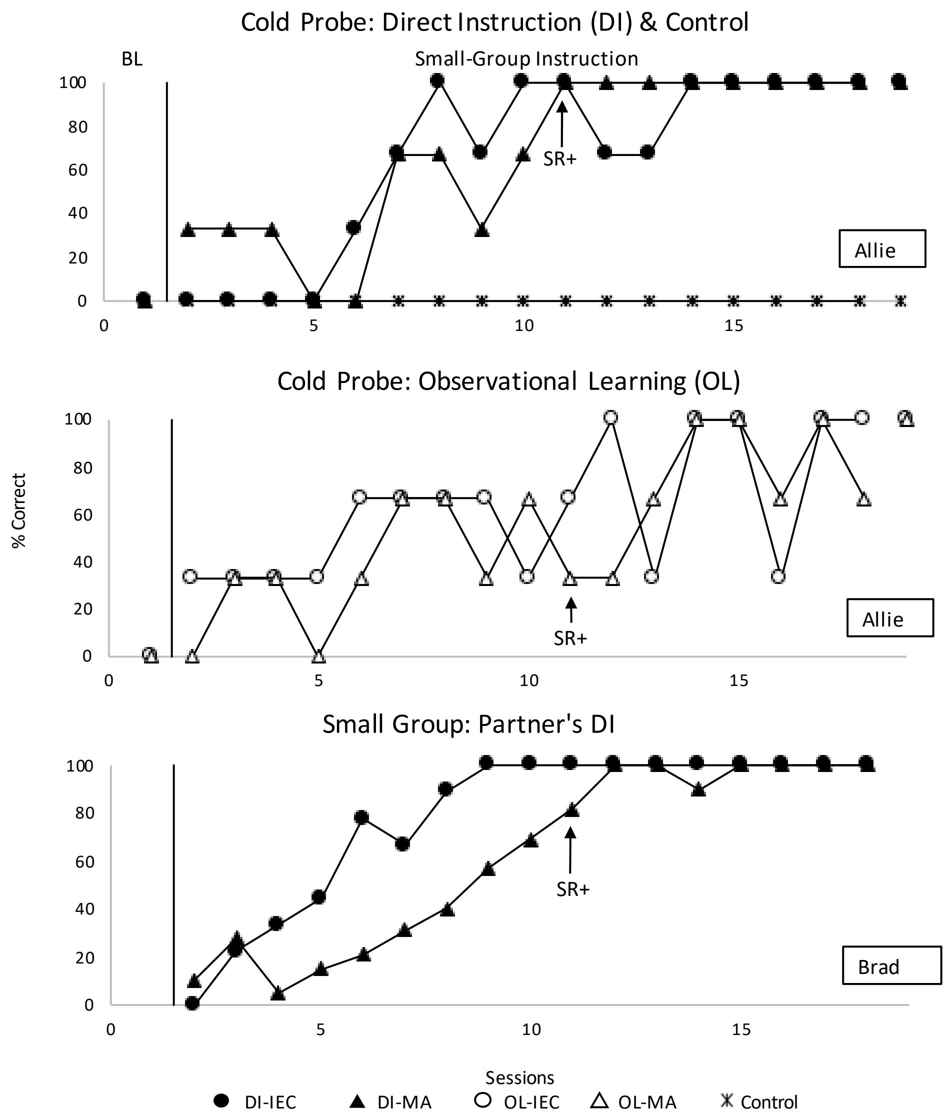

Figure 2. Allie's Cold Probe Responses and Observed Small-Group Instruction Responses.

Note: "SR+" denotes the addition of a post-instruction probe with reinforcement for improved performance.

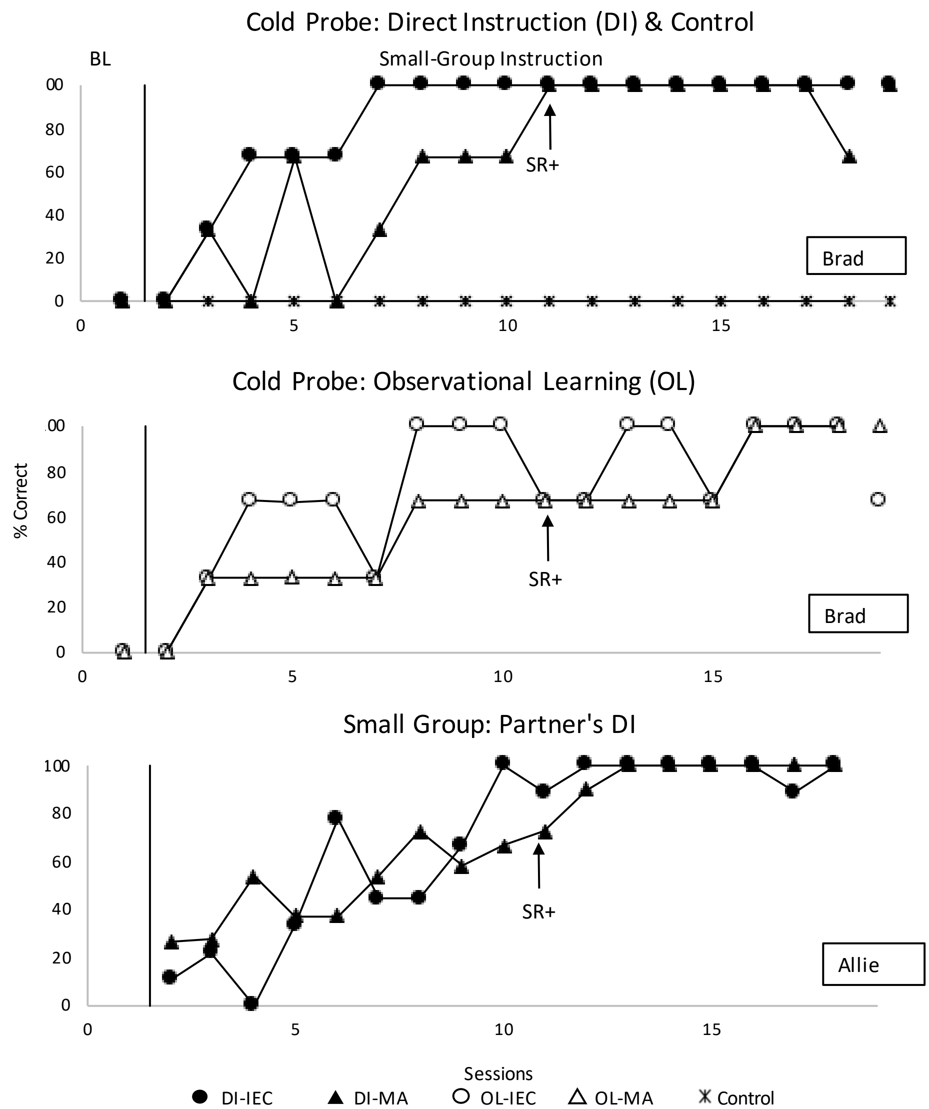

Figure 3. ***Brad's Cold Probe Responses and Observed Small-Group Instruction Responses.***

Note: "SR+" denotes the addition of a post-instruction probe with reinforcement for improved performance.

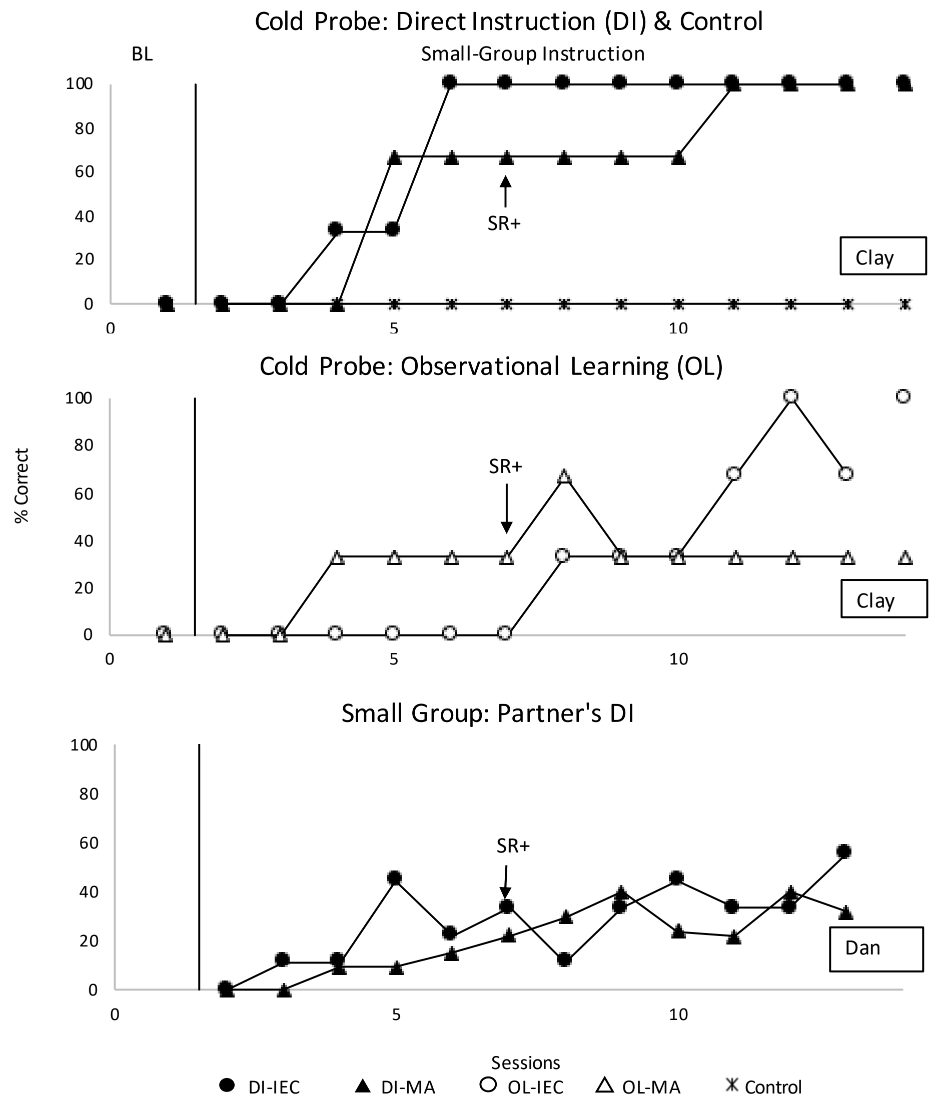

Figure 4. ***Clay's Cold Probe Responses and Observed Small-Group Instruction Responses.***

Note: "SR+" denotes the addition of a post-instruction probe with reinforcement for improved performance.

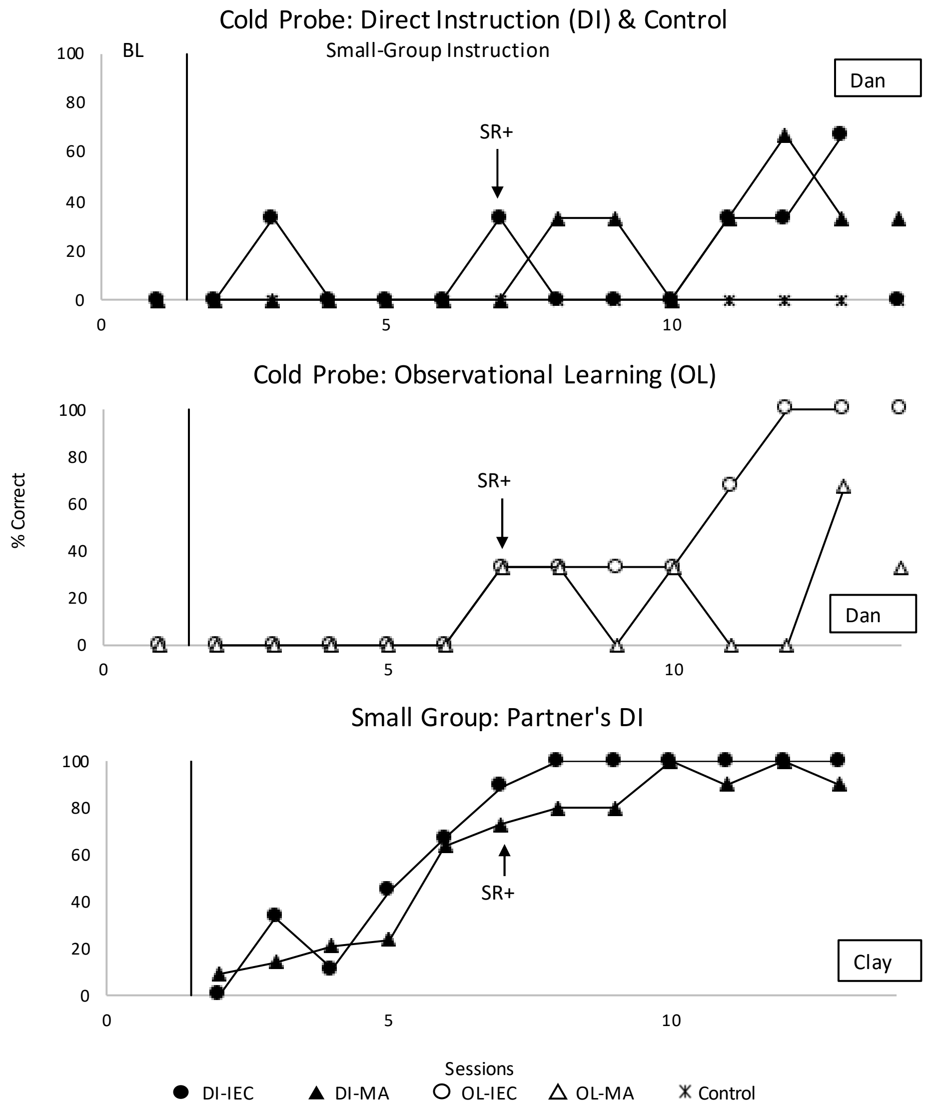

Figure 5. ***Dan's Cold Probe Responses and Observed Small-Group Instruction Responses.***

Note: "SR+" denotes the addition of a post-instruction probe with reinforcement for improved performance.

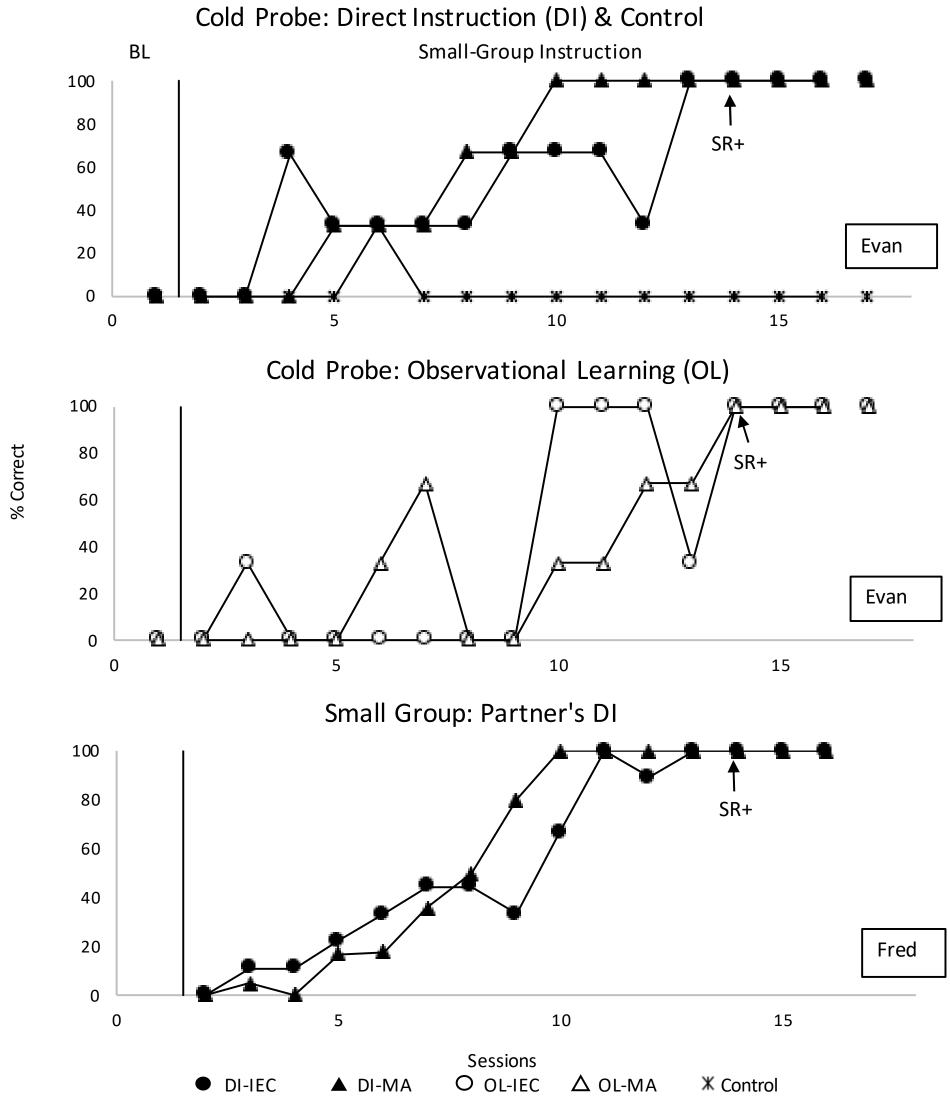

Figure 6. ***Evan's Cold Probe Responses and Observed Small-Group Instruction Responses.***

Note: "SR+" denotes the addition of a post-instruction probe with reinforcement for improved performance.

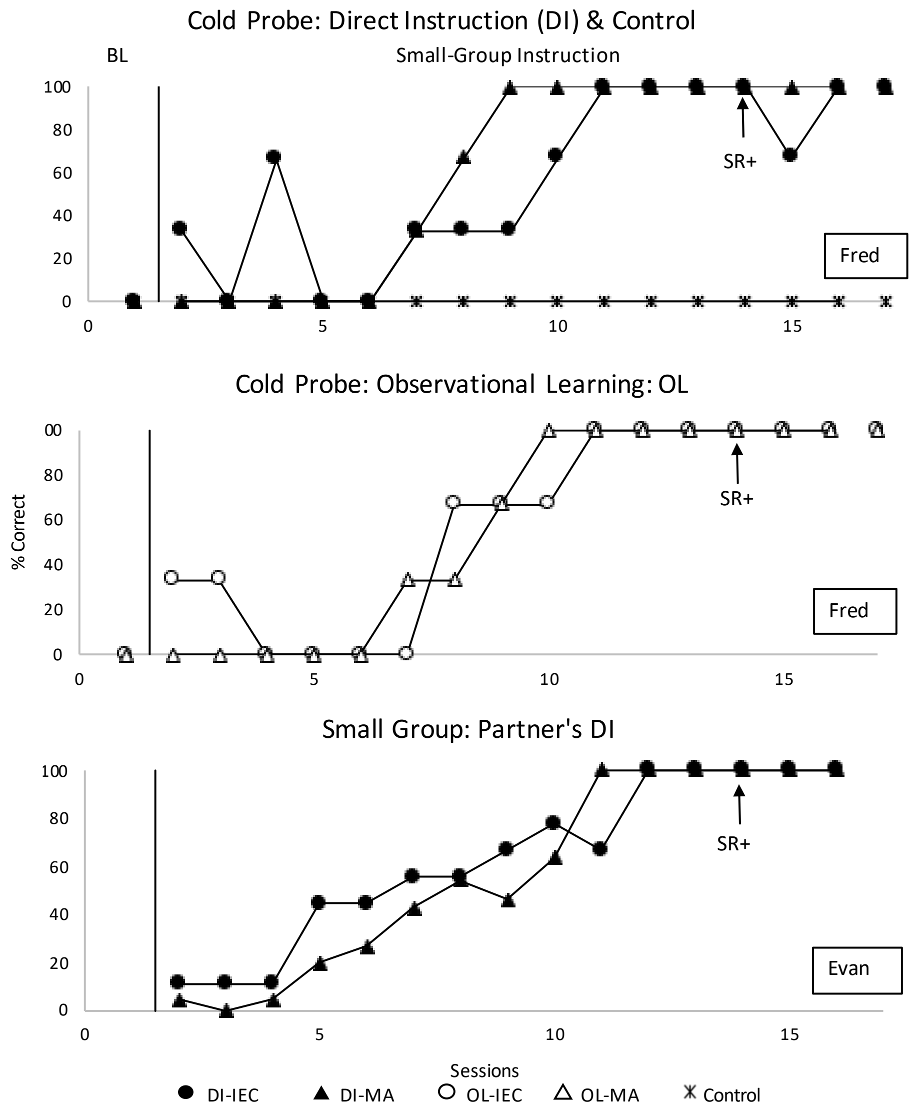

Figure 7. ***Fred's Cold Probe Responses and Observed Small-Group Instruction Responses.***

Note: "SR+" denotes the addition of a post-instruction probe with reinforcement for improved performance.

CHAPTER 4

GENERAL DISCUSSION

This dissertation examined observational learning (OL) from two types of error correction procedures implemented during opportunities to respond (OTRs) directed to peers. Immediate error correction (IEC) consisted of providing corrective feedback directly after an error, followed by practice of the correct response. Multiple attempts (MA) consisted of prompting two or three attempts to “try again” before providing corrective feedback on errors. Whereas previous error correction research focused on the effects of instructional procedures on learning during one-on-one direction instruction (DI), the present studies are unique in that they examine learning when observing DI delivered to peers. The literature suggests that some general components of error correction tend to promote learning during DI (e.g., immediate and direct feedback, practice of the correct response; Heward 2003), but the effectiveness of procedures containing these elements tends to be idiosyncratic across learners (e.g., Kodak et al., 2016; McGhan, & Lerman, 2013; Turan et al., 2012).

The present studies also extend the previous small-group instruction literature by examining OL of general education students rather than students with disabilities (e.g., autism, intellectual disabilities, learning disabilities), who were typically the participants in existing research (e.g., Keel & Gast, 1992; Leaf et al., 2012; Ledford et al., 2008). The literature indicates that children with disabilities can learn by observing their peers’ instruction, but typically do not learn as efficiently from observation as they do from DI (e.g., Doyle et al., 1990; Leaf et al., 2012). Additionally, these studies typically report OL as a by-product of a single instructional procedure rather than as a primary dependent variable examined across multiple instructional conditions.

Chapter 2 Summary

The study presented in Chapter 2 examined OL within the context of a contrived situation in which four first-grade students watched videos of peer models participating in OTRs for instruction on Spanish words and their English equivalents. The scripted videos allowed for control of correct and incorrect responses during OTRs that was not possible during the live small-group instruction conducted during the study presented in Chapter 3. Participants watched OTRs for targets split across three conditions: correct responding (CR), IEC, and MA. The CR condition consisted of the peer model in the video emitted the correct response and receiving descriptive praise. A fourth set of targets served controls to measure learning in the absence of observing OTRs and did not appear in the videos.

Participants exhibited differences in responding across conditions, with no consistent superior condition across participants. Of the two participants who mastered at least one condition, one participant mastered MA before mastering CR and the other only mastered IEC. The two remaining participants both initially exhibited more correct responding for MA but ended intervention with generally higher levels for CR; however, overall these two participants exhibited variable and low responding across conditions. With the exception of the control condition, three of the four participants exhibited the fewest cumulative correct responses for IEC over the course of intervention, whereas the remaining participant exhibited the most cumulative correct responses for IEC.

The lack of a superior OL condition across participants aligns with the literature reporting differential effects of various error correction procedures during DI of children with disabilities (e.g., Kodak et al., 2016; McGhan, & Lerman, 2013; Turan et al., 2012). Given that two participants exhibited overall low levels of correct responding across conditions, it is possible that condition-irrelevant factors impaired acquisition (e.g., target characteristics, participant fatigue, poor motivation). The one-on-one DI literature indicates that simply observing OTRs can be ineffective or require substantially more exposures than actively participating in OTRs (e.g., Doyle et al., 1990; Leaf et al., 2012). It is possible that the participants in the present study could have learned additional targets with more exposures or with direct participation in OTRs. Ultimately, the results of this study indicate a need for further research to examine the relative effectiveness of various error correction procedures in facilitating OL.

Chapter 3 Summary

The study in Chapter 3 offers a more applied examination of OL from error correction procedures in the context of live small-group instruction for three dyads of participants in second and third grade. Within each dyad, each participant received DI for a set of targets taught using IEC and a set of targets taught using MA. One dyad member's DI targets served as his or her partner's OL targets, resulting in four instructional conditions per participant (i.e., DI-IEC, DI-MA, OL-IEC, OL-MA), plus one control condition.

Participants exhibited different acquisition rates for DI-IEC and DI-MA, replicating previous reports of inconsistent instructional efficiency for different error correction procedures during one-on-one instruction (e.g., Kodak et al., 2016; McGhan, & Lerman, 2013; Turan et al., 2012). During small group instruction, the ratio of correct to incorrect responses was higher for IEC than MA for all six participants and given that three participants mastered DI-MA first, this proportion seemingly was not a determinant of DI target acquisition speed. Whereas participants in the video modelling study in Chapter 2 did not consistently exhibit better OL outcomes for one error correction procedure, the participants in the present applied study exhibited more correct responses for OL-IEC than for OL-MA. Of the OL conditions, four participants mastered OL-IEC first, one participant mastered OL-MA first, and one participant mastered neither OL condition but demonstrated higher levels of correct responding for OL-IEC at the end of the study.

Participants exhibited more overall correct responding for OL-IEC than OL-MA regardless of their partner's responding during small-group DI. That is, participants did not just perform better on OL-IEC targets because their partners performed better on their DI-IEC targets during small-group instruction. Although replications and extensions are necessary to assess the reliability and generality of these results, the provide a promising area for future research that could help teachers improve the efficiency of their instruction.

Limitations and Future Directions

The two studies presented in this dissertation extend the previous literature by examining OL in the context of OTR error correction procedures. However, the small number of targets in each condition and the small sample sizes call for caution in interpreting these results. Future research should replicate these procedures, potentially with the modifications described in Chapters 2 and 3, across various student populations and instructional targets. Larger target sets or use of a multiple-probe design across target sets would allow for stronger demonstration of experimental control. In the present studies, extraneous variables such as inconsistent attendance and student motivation may have impeded acquisition; however, these factors are also often present in the applied settings in which teachers correct student errors. As such, their presence may provide some ecological validity at the expense of experimental control.

Although the present results provide insufficient evidence to warrant recommending changes in educational practices, they do provide areas for consideration related to how educators correct students' errors. First, although there are several empirically validated forms of error correction for one-on-one instruction with children with disabilities, there is limited information about the effects of these procedures in general education settings, where most students receive some or most of their schooling. The literature is also lacking on the effects of these procedures on OL for students with and without disabilities. Given that general education teachers must educate classes with diverse skill levels and needs, it is imperative that researchers continue to examine ways to increase instructional efficiency for diverse student populations. Future research should continue to compare various OTR and error correction procedures, with the goal of identifying procedures that are optimally effective for the greatest number of students.

It is also important that future research continues to investigate the social validity of various OTR and error correction procedures to identify educational practices that teachers find acceptable and are likely to use. Acceptability of a procedure does not necessarily predict its fidelity or use in applied settings (Noell et al., 2005). In the present study, informal self-reports of social validity revealed no universally preferred procedure across participants or their teachers. Instead, informants reported general preferences for combinations of the two error correction procedures, with teachers reporting they tailored their techniques based on student and task characteristics. As research continues to improve instructional practices, researchers must also strive to promote use of these practices beyond research contexts to ensure student access evidence-based instruction. Examinations of real-world indicators of social validity (e.g., choice among procedures, voluntary implementation in applied settings) will be vital in this endeavor.

REFERENCES

Alig-Cybriwsky, C., Wolery, M., & Gast, D. L. (1990). Use of a constant time delay procedure in teaching preschoolers in a group format. *Journal of Early Intervention*, *14*(2), 99-116.

Bandura, A. (1977a). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review*, *84*, 191-215.

Bandura, A. (1977b). *Social learning theory.* Englewood Cliffs, NJ: Prentice-Hall.

Barbetta, P. M., Heron, T. E., & Heward, W. L. (1993). Effects of active student response during error correction on the acquisition, maintenance, and generalization of sight words by students with developmental disabilities. *Journal of Applied Behavior Analysis*, *26*, 111-119.

Barbetta, P. M., Heward, W. L., & Bradley, D. M. (1993). Relative effects of whole-word and phonetic-prompt error correction on the acquisition and maintenance of sight words by students with developmental disabilities. *Journal of Applied Behavior Analysis*, *26*, 99-110.

Barbetta, P. M., Heward, W. L., Bradley, D. M., & Miller, A. D. (1994). Effects of immediate and delayed error correction on the acquisition and maintenance of sight words by students with developmental disabilities. *Journal of Applied Behavior Analysis*, *27*, 177-178.

Barbetta, P. M., & Heward, W. L. (1993). Effects of active student response during error correction on the acquisition and maintenance of geography facts by elementary students with learning disabilities. *Journal of Behavioral Education*, *3*, 217-233.

Cannella-Malone, H. I., Fleming, C., Chung, Y. C., Wheeler, G. M., Basbagill, A. R., & Singh, A. H. (2011). Teaching daily living skills to seven individuals with severe intellectual disabilities: A comparison of video prompting to video modeling. *Journal of Positive Behavior Interventions*, *13,* 144-153.

Carroll, R. A., Kodak, T., & Fisher, W. W. (2013). An evaluation of programmed treatment-integrity errors during discrete-trial instruction. *Journal of Applied Behavior Analysis*, *46*, 379-394.

Chiara, L., Schuster, J. W., Bell, J. K., & Wolery, M. (1995). Small-group massed-trial and individually-distributed-trial instruction with preschoolers. *Journal of Early Intervention*, *19*, 203-217.

Delgado, J. A. P., & Greer, R. D. (2009). The effects of peer monitoring training on the emergence of the capability to learn from observing instruction received by peers. *The Psychological Record*, *59,* 407-434.

DeQuinzio, J. A., & Taylor, B. A. (2015). Teaching children with autism to discriminate the reinforced and nonreinforced responses of others: Implications for OL. *Journal of Applied Behavior Analysis*, *48*, 38-51.

Dotterer, A. M., & Lowe, K. (2011). Classroom context, school engagement, and academic achievement in early adolescence. *Journal of Youth and Adolescence, 40*, 1649-1660.

Doyle, P. M., Gast, D. L., Wolery, M., Ault, M. J., & Farmer, J. A. (1990). Use of constant time delay in small group instruction: A study of observational and incidental learning. *The Journal of Special Education*, *23*, 369-385.

Drevno, G. E., Kimball, J. W., Possi, M. K., Heward, W. L., Gardner, R., & Barbetta, P. M. (1994). Effects of active student response during error correction on the acquisition, maintenance, and generalization of science vocabulary by elementary students: A systematic replication. *Journal of Applied Behavior Analysis*, *27*, 179-180.

Fentress, G. M., & Lerman, D. C. (2012). A comparison of two prompting procedures for teaching basic skills to children with autism. *Research in Autism Spectrum Disorders*, *6*, 1083-1090.

Gast, D. L. (2011). A rejoinder to Leaf: What constitutes efficient, applied, and trial and error. *Evidence-Based Communication Assessment and Intervention*, *5*, 234-238.

Greer, R. D., & McDonough, S. H. (1999). Is the learn unit a fundamental measure of pedagogy?. *The Behavior Analyst*, *22*, 5-16.

Grow, L. L., Carr, J. E., Gunby, K. V., Charania, S. M., Gonsalves, L., Ktaech, I. A., & Kisamore, A. N. (2009). Deviations from prescribed prompting procedures: Implications for treatment integrity. *Journal of Behavioral Education*, *18*, 142-156.

Haydon, T., Conroy, M. A., Scott, T. M., Sindelar, P. T., Barber, B. R., & Orlando, A. M. (2010). A comparison of three types of opportunities to respond on student academic and social behaviors. *Journal of Emotional and Behavioral Disorders*, *18*, 27-40.

Haydon, T., & Hunter, W. (2011). The effects of two types of teacher questioning on teacher behavior and student performance: A case study. *Education and Treatment of Children*, *34*, 229-245.

Heward, W. L. (2003). Ten faulty notions about teaching and learning that hinder the effectiveness of special education. *The Journal of Special Education*, *36*, 186-205.

Isenhower, R. W., Delmolino, L., Fiske, K. E., Bamond, M., & Leaf, J. B. (2018). Assessing the Role of Active Student Response During Error Correction in Discrete Trial Instruction. *Journal of Behavioral Education*, *27*, 1-17.

Jenkins, J. R., Mayhall, W. F., Peschka, C. M., & Jenkins, L. M. (1974). Comparing small group and tutorial instruction in resource rooms. *Exceptional Children*, *40*, 245-250.

Keel, M. C., & Gast, D. L. (1992). Small-group instruction for students with learning disabilities: Observational and incidental learning. *Exceptional Children*, *58*, 357-368.

Keel, M. C., Slaton, D. B., & Blackhurst, A. E. (2001). Acquisition of content area vocabulary for students with learning disabilities. *Education and Treatment of Children*, *24*, 46-71.

Kodak, T., Campbell, V., Bergmann, S., LeBlanc, B., Kurtz-Nelson, E., Cariveau, T., ... & Mahon, J. (2016). Examination of efficacious, efficient, and socially valid error-correction procedures to teach sight words and prepositions to children with autism spectrum disorder. *Journal of Applied Behavior Analysis*, *49*, 532-547.

Leaf, J. B., Sheldon, J. B., & Sherman, J. A. (2010). Comparison of simultaneous prompting and no-no prompting in two-choice discrimination learning with children with autism. *Journal of Applied Behavior Analysis*, *43*, 215-228.

Leaf, J. B., Tsuji, K. H., Lentell, A. E., Dale, S. E., Kassardjian, A., Taubman, M., ... & Oppenheim-Leaf, M. L. (2012). A comparison of discrete trial teaching implemented in a one-to-one instructional format and in a group instructional format. *Behavioral Interventions*, *28*, 82-106.

Ledford, J. R., Gast, D. L., Luscre, D., & Ayres, K. M. (2008). Observational and incidental learning by children with autism during small group instruction. *Journal of Autism and Developmental Disorders*, *38*, 86.

Ledford, J. R., Lane, J. D., Elam, K. L., & Wolery, M. (2012). Using response-prompting procedures during small-group direct instruction: Outcomes and procedural variations. *American Journal on Intellectual and Developmental Disabilities*, *117*, 413-434.

Litow, L., & Pumroy, D. K. (1975). A brief review of classroom group-oriented contingencies. *Journal of Applied Behavior Analysis*, *8*, 341-347.

MacSuga-Gage, A. S., & Gage, N. A. (2015). Student-level effects of increased teacher-directed opportunities to respond. *Journal of Behavioral Education*, *24*, 273-288.

MacSuga-Gage, A. S., & Simonsen, B. (2015). Examining the effects of teacher-directed opportunities to respond on student outcomes: A systematic review of the literature. *Education and Treatment of Children*, *38*, 211-239.

McDonnell, J., Johnson, J. W., Polychronis, S., Riesen, T., Kercher, K., & Jameson, M. (2006). Comparison of one-to-one embedded instruction in general education classes with small group instruction in special education classes. *Education and Training in Developmental Disabilities*, 125-138.

McGhan, A. C., & Lerman, D. C. (2013). An assessment of error-correction procedures for learners with autism. *Journal of Applied Behavior Analysis*, *46*, 626-639.

Mueller, M. M., Palkovic, C. M., & Maynard, C. S. (2007). Errorless learning: Review and practical application for teaching children with pervasive developmental disorders. *Psychology in the Schools*, *44*, 691-700.

Munk, D. D., & Repp, A. C. (1994). The relationship between instructional variables and problem behavior: A review. *Exceptional Children*, *60*, 390-401.

Narayan, J. S., Heward, W. L., Gardner, R., Courson, F. H., & Omness, C. K. (1990). Using response cards to increase student participation in an elementary classroom. *Journal of Applied Behavior Analysis*, *23*, 483-490.

Noell, G. H., Witt, J. C., Slider, N. J., Connell, J. E., Gatti, S. L., Williams, K. L., ... & Duhon, G. J. (2005). Treatment implementation following behavioral consultation in schools: A comparison of three follow-up strategies. *School Psychology Review*, *34*, 87-106.

Polloway, E. A., Cronin, M. E., & Patton, J. R. (1986). The efficacy of group versus one-to-one instruction: A review. *Remedial and Special Education, 7*, 22-30.

Rodgers, T. A., & Iwata, B. A. (1991). An analysis of error-correction procedures during discrimination training. *Journal of Applied Behavior Analysis, 24*, 775-781.

Schoen, S. F., & Ogden, S. (1995). Impact of time delay, observational learning, and attentional cuing upon word recognition during integrated small-group instruction. *Journal of Autism and Developmental Disorders*, *25*, 503-519.

Schunk, D. H. (1987). Peer models and children's behavioral change. *Review of Educational Research*, *57*, 149-174.

Schunk, D. H., & Hanson, A. R. (1985). Peer models: Influence on children's self-efficacy and achievement. *Journal of Educational Psychology, 77,* 313–322.

Schunk, D. H., & Hanson, A. R. (1989). Influence of peer-model attributes on children's beliefs and learning. *Journal of Educational Psychology, 81,* 431–434.

Schunk, D. H., Hanson, A. R., & Cox, P. D. (1987). Peer-model attributes and children's achievement behaviors. *Journal of Educational Psychology, 79*, 54–61.

Sindelar, P. T., Bursuck, W. D., & Halle, J. W. (1986). The effects of two variations of teacher questioning on student performance. *Education and Treatment of Children*, *9,* 56-66.

Sindelar, P. T., Rosenberg, M. S., & Wilson, R. J. (1985). An adapted alternating treatments design for instructional research. *Education and Treatment of Children*, 67-76.

Skinner, C. H., Fletcher, P. A., & Henington, C. (1996). Increasing learning rates by increasing student response rates: A summary of research. *School Psychology Quarterly*, *11*, 313.

Smith, T. (2001). Discrete trial training in the treatment of autism. *Focus on autism and other developmental disabilities*, *16,* 86-92.

Stevens, C., Sidener, T. M., Reeve, S. A., & Sidener, D. W. (2011). Effects of behavior-specific and general praise, on acquisition of tacts in children with pervasive developmental disorders. *Research in Autism Spectrum Disorders*, *5,* 666-669.

Stoddard, L. T., & Sidman, M. (1967). The effects of errors on children's performance on a circle-ellipse discrimination. *Journal of the Experimental Analysis of Behavior*, *10*, 261-270.

Sutherland, K. S., Alder, N., & Gunter, P. L. (2003). The effect of varying rates of opportunities to respond to academic requests on the classroom behavior of students with EBD. *Journal of Emotional and Behavioral Disorders*, *11*, 239-248.

Sutherland, K. S., & Wehby, J. H. (2001). Exploring the relationship between increased opportunities to respond to academic requests and the academic and behavioral outcomes of students with EBD: A review. *Remedial and Special Education*, *22,* 113-121.

Taylor, B. A., & DeQuinzio, J. A. (2012). Observational learning and children with autism. *Behavior Modification*, *36*, 341-360.

Taylor, B. A., DeQuinzio, J. A., & Stine, J. (2012). Increasing observational learning of children with autism: A preliminary analysis. *Journal of Applied Behavior Analysis*, *45,* 815-820.

Turan, M. K., Moroz, L., & Croteau, N. P. (2012). Comparing the effectiveness of error-correction strategies in discrete trial training. *Behavior Modification*, *36*, 218-234.

Vladescu, J. C., & Kodak, T. M. (2013). Increasing instructional efficiency by presenting additional stimuli in learning trials for children with autism spectrum disorders. *Journal of Applied Behavior Analysis*, *46*, 805-816.

Wolery, M., Ault, M. J., Doyle, P. M., Gast, D. L., & Griffen, A. K. (1992). Choral and individual responding during small group instruction: Identification of interactional effects. *Education and Treatment of Children*, 289-309.

Wolery, M., Cybriwsky, C. A., Gast, D. L., & Boyle-Gast, K. (1991). Use of constant time delay and attentional responses with adolescents. *Exceptional Children*, *57*, 462-474.

Wolery, M., Werts, M. G., Holcombe, A., Billings, S. S., & Vassilaros, M. A. (1993). Instructive feedback: A comparison of simultaneous and alternating presentation of non-target stimuli. *Journal of Behavioral Education*, *3*, 187-204.

Worsdell, A. S., Iwata, B. A., Dozier, C. L., Johnson, A. D., Neidert, P. L., & Thomason, J. L. (2005). Analysis of response repetition as an error-correction strategy during sight-word reading. *Journal of Applied Behavior Analysis*, 38, 511–527.