Effects of Error Correction During Assessment Probes on the Acquisition of Sight Words for Students with Moderate Intellectual Disabilities

ACCEPTANCE

This dissertation, THE EFFECTS OF ERROR CORRECTION DURING ASSESSMENT PROBES ON THE ACQUISITION OF SIGHT WORDS FOR STUDENTS WITH MODERATE INTELLECTUAL DISABILITIES, by REBECCA E. WAUGH, was prepared under the direction of the candidates Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Doctor of Philosophy in the College of Education, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chair, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty. The Dean of the College of Education concurs.

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ABSTRACT

THE EFFECTS OF ERROR CORRECTION DURING ASSESSMENT PROBES ON THE ACQUISITION OF SIGHT WORDS FOR STUDENTS WITH MODERATE INTELLECTUAL DISABILITIES
by
Rebecca E. Waugh

Simultaneous prompting is an errorless learning strategy designed to reduce the number of errors students make; however, research has shown a disparity in the number of errors students make during instructional versus probe trials. This study directly examined the effects of error correction versus no error correction during probe trials on the effectiveness and efficiency of simultaneous prompting on the acquisition of sight words by three middle school students with moderate intellectual disabilities. A single-case adapted alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985) was employed to examine the effects of error correction during probe trials in order to reduce error rates. A functional relation was established for two of the three students for the use of error correction during probe sessions to reduce error rates. Error correction during assessment probes required fewer sessions to criterion, resulted in fewer probe errors, resulted in a higher percentage of correct responding on the next subsequent trial, and required less total probe time. For two of the three students, probes with error correction resulted in a more rapid acquisition rate requiring fewer sessions to criterion.

EFFECTS OF ERROR CORRECTION DURING ASSESSMENT PROBES ON THE ACQUISITION OF SIGHT WORDS FOR STUDENTS WITH MODERATE INTELLECTUAL DISABILITIES

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ABBREVIATIONS

CTD	Constant Time Delay
MID	Mild Intellectual Disabilities
MoID	Moderate Intellectual Disabilities
PTD	Progressive Time Delay
SID	Severe Intellectual Disabilities

CHAPTER 1

SIMULTANEOUS PROMPTING A REVIEW OF THE LITERATURE AND ERROR CORRECTION PROCEDURES EMPLOYED WITH STUDENTS WITH INTELLECTUAL DISABILITIES

Errorless learning is an instructional approach designed to reduce the number of errors students make in traditional trial-and-error approaches (Mueller, Palkovic, & Maynard, 2007). During errorless learning procedures stimulus control is transferred from the controlling prompt, the prompt that ensures the correct response, to the discriminative stimulus using response prompting strategies. Response prompting strategies consist of additional information which results in the correct response being emitted (Wolery, Ault, & Doyle, 1992). Various response prompting strategies can be employed to ensure errorless learning. Terrace (1963a) first examined the concept of errorless learning by teaching pigeons to discriminate between a red and a green light. Initially the green light, which represented the discriminative stimulus and resulted in reinforcement, was presented in isolation. Gradually the red light, which represented the stimulus delta that did not result in reinforcement, was presented in brief periods and a lower intensity. Overtime, the length of presentation of the stimulus delta (i.e., red light) increased as the intensity of the light increased until it matched that of the discriminative stimulus (i.e., green light). Terrace was able to demonstrate discrimination training with minimal errors. Terrace (1963b) later demonstrated that the transfer of stimulus control as

demonstrated with the experiment using red and green lights could be applied to vertical and horizontal lines by superimposing the lines onto the previously discriminated red and green lights and gradually fading the light color until stimulus control was transferred to the individual line presentation.

The underlying purpose of errorless learning is the transfer of stimulus control from a response prompt to the natural stimulus. Wolery and Gast (1984) identified four common response prompting strategies that commonly are employed to transfer stimulus control: (a) most-to-least prompts, (b) least-to-most prompts, (c) graduated guidance, and (d) time delay. Most-to-least prompts consist of employing the most intrusive prompt needed to assist the student in emitting the correct response in the presence of the discriminative stimulus and gradually reducing the intensity of the prompt until the student is correctly responding to the discriminative stimulus independently. Least-to-most prompts provide the student with an opportunity to respond independently to the discriminative stimulus. If the student responds incorrectly then a prompt is provided which gradually increases in intensity until the student responds correctly to the discriminative stimulus. “Graduated guidance is a technique combining physical guidance and fading in which the physical guidance is systematically and gradually reduced and then faded completely” (Foxx, 1982, p. 129). Graduate guidance relies heavily on the teacher’s judgment whether or not a prompt is required or the degree of prompt required at any given moment during instruction. There are two forms of graduated guidance. During one form a teacher shadows a student’s movement when teaching a task in order to provide guidance during each step as he/she determines appropriate or to remove the physical prompt during each step as needed. During a

second form of graduated guidance the teacher may provide constant contact but gradually and systematically reduce the intrusiveness of the prompt (Foxx, 1981; Heller, Forney, Alberto, Schwatzman, & Goeckel, 2000).

Time delay is the fourth common response prompting strategy which results in near errorless learning by transferring stimulus control from a controlling prompt to the discriminative stimulus by inserting a delay between the presentation of the discriminative stimulus and the controlling prompt (Snell & Gast, 1981; Touchette, 1971). Two forms of time delay are reported in the literature, progressive time delay (PTD) and constant time delay (CTD). During PTD a systematically increased delay is inserted between the presentation of the discriminative stimulus and the controlling prompt (Cooper, Heron, & Heward, 2007). In contrast, CTD consists of only two prompting conditions, a zero-second delay condition and a three-or five-second delay condition. During the zero-second delay condition, the stimulus and controlling prompt are delivered concurrently. During the three-or five-second delay condition the stimulus is presented with the specified delay inserted prior to the delivery of the controlling prompt to allow for independent responding. Acquisition during both PTD and CTD is measured by correct responses during the delayed trials in which the student responds to the stimulus prior to the presentation of the controlling prompt.

Purpose

There are two purposes of this paper. The first purpose is to review the research literature on simultaneous prompting, a fifth prompting strategy that results in near errorless learning. This review includes skills and individuals taught using simultaneous

prompting and strengths and weaknesses of simultaneous prompting as identified in the literature. The second purpose is to examine error-correction procedures employed with students with intellectual disabilities.

Simultaneous Prompting

Simultaneous prompting is a response prompting strategy that results in near errorless learning. During this procedure the instructional cue and controlling prompt are presented concurrently or simultaneously with probes conducted prior to the instructional session to measure skill acquisition (Gibson & Schuster, 1992; Schuster, Griffen, & Wolery, 1992). Simultaneous prompting consists of three components (a) baseline or full probe sessions, (b) assessment or daily probe sessions, and (c) instructional sessions. During baseline/full probe sessions data are collected on the students' identification or completion of all stimuli within the program. Baseline/full probe sessions are presented prior to the beginning of instruction and typically following mastery of a set of stimuli prior to presentation of the next set of stimuli. Full probe sessions may serve as baseline conditions as well as maintenance conditions. Assessment/daily probe sessions which measure acquisition of the stimuli targeted for instruction, are presented prior to each instructional session. Assessment/daily probe sessions provide for independent responding opportunities for the students. Instructional sessions are conducted following assessment/daily probe sessions each day. During instructional sessions the stimulus and the controlling prompt are presented concurrently.

Demographic Variables

Participants. A total of 35 published studies spanning eighteen years (1992-2010) and one review of the literature on simultaneous prompting are included. In an initial review of the literature Morse and Schuster (2004) identified 18 published studies which examined simultaneous prompting including 74 participants. Since the initial review of the literature an additional 17 studies have been identified with an additional 62 participants for a total of 35 published studies and 136 participants. Tables 1 and 2 present data for the 17 most recently published articles on simultaneous prompting.

Simultaneous prompting has been employed predominately with elementary school (Akmanoglu & Batu, 2004; Batu, 2008; Birkan, 2005; Griffen, Schuster, & Morse, 1998; Kurt & Tekin-Iftar, 2008; Parrott, Schuster, Collins, & Gassaway, 2000; Schuster & Griffen, 1993; Schuster et al, 1992; Singleton, Schuster, & Ault, 1995; Tekin & Kircaali-Iftar, 2002; Tekin-Iftar, 2008; Tekin-Iftar, Kurt, & Acar, 2008; Waugh, Fredrick, & Alberto, 2009) but also has been implemented with students in preschool (Akmanogu-Uludag & Batu, 2005; Colozzi, Ward, & Crotty, 2008; Dogan & Tekin-Iftar, 2002; Gibson & Schuster, 1992; MacFarland-Smith, Schuster, & Stevens, 1993; Reichow & Wolery, 2009; Sewell, Collins, Hemmeter, & Schuster, 1998), middle school (Alberto, Waugh, & Fredrick, in press; Fickel, Schuster, & Collins, 1992; Gursel, Tekin-Iftar, & Bozkurt, 2006; Rao & Kane, 2009; Rao & Mallow, 2009; Riesen, McDonnell, Johnson, Polychronis, & Jameson, 2003; Tekin-Iftar, 2003; Tekin-Iftar, Acar, & Kurt, 2003), and high school students (Fetko, Schuster, Harley, & Collins, 1999; Johnson, Schuster, & Bell, 1996; Parker & Schuster, 2002; Singleton, Schuster, Morse, & Collins, 1999), and with adults (Maciag, Schuster, Collins, & Cooper, 2000; Palmer, Collins, & Schuster, 1999). The procedure has been employed in 19 studies with a total of 48 participants with

Table 1

Summary of Demographic and Procedural Variables

Authors	*Participants (Target Participants)*	*Setting Pupil: Teacher Ratio*	*Dependent Variable*	*Independent Variable (Controlling Prompt)*	*Error Rates*
		Preschool			
Akmanoglu-Uludag & Batu (2005)	2 with Autism; 5.5 years old	Classroom for children with Autism in a university unit for children with development delays (1:1)	Expressive identification of relatives	Modeling prompt paired with verbal prompt	Instruction = 10.4% Probe = 45%
Colozzi, Ward, & Crotty (2008)	4 with pervasive developmental disorder and developmental disabilities; 3-4 years old; Para delivered instruction	Public preschool Classroom (1:1 and 4:1)	(1) acquisition and training trials of target pretend play expressive vocabulary skills (2) pretend play motor skill (3) instructive feedback - expressive vocabulary skills	Full physical prompt to perform play action paired with a verbal model of language	Instruction = (1:1) Verbal = 38.5%, Motor = 0%; (4:1) Verbal = 49%, Motor = 0% Probe = (1:1) = Verbal, Motor, and Instructive Feedback = 41.6%; (4:1) = Verbal = 25%, Motor = 24.2%, Instructive Feedback = 30%

Reichow & Wolery (2009)	1 with speech language impairment, 1 English Language Learner, 1 with typical development, 1 at-risk for school failure; 4-5 years old	Classroom (1:1)	14 transportation words and 11 line drawings (2 words per condition; 3 conditions = Everyday probes, Every fourth day probes and control)	Verbal model of correct response	Instruction = Everyday probes = 0-3.5% Every 4th day probes = 0-4.3% Probes = First 8 days = 50% First 2 every 4th day = 28.1%
		Elementary			
Akmanoglu & Batu (2004)	3 with Autism; 6-17 years old	Classroom at university school (1:1)	Receptive identification of numerals 1-9	Modeling plus verbal prompt	Instruction = 34-64% Probe = not reported
Batu (2008)	4 with Developmental Delays (IQ 41-50); 6-9 years old; Caregiver -delivered instruction	Home-based instruction	(1) Caregiver implementation (2) Acquisition of home-living skills (e.g., wearing socks, making bed, etc)	Verbal direction paired with modeling	Not Reported
Birkan (2005)	1 MID, 2 MoID; 6-13 years old	Classroom at research university (1:1)	3 discrete tasks (sight words, receptive identification of digits, telling time	Verbal Model of correct response	Instruction = 0% Probes = 26-35%
Kurt & Tekin-Iftar (2008)	4 with Autism; 6-8 years old	School - Classroom, cafeteria, free-play area, and hall	Turning on CD player ar taking a digital picture	CTD) vs ıltaneous ıpting (Intermittent probes)	Instruction = Not reported Probes = (CTD = 1-16%) (SP = 2-15%)
Tekin-Iftar (2008)	3 with Autism, 1 with MoID; 7-12 years old; Parent-delivered instruction	Community settings (grocery store, pastry shop, and dry cleaning store)	11 - 15 step task analysis for purchasing	Model with verbal description	Instruction = 0% Probes = 14-19%

Tekin-Iftar, Kurt, & Acar (2008)	2 with mental retardation;7-8 years old	University Unit (1:1)	Tool identification with instructive feedback; intermittent probe Conditions	Verbal Model of correct response	Instruction = 0.3% Probes = 7.5%
Waugh, Fredrick, & Alberto (2009)	3 students with MoID; 9-11 years old	Self-contained classroom in public school (1:1)	Correct reading of sight-words, letter-sound correspondences, and blending skills	Verbal model of correct response	Instruction = not reported Probes = not reported
		Middle School			
Alberto, Waugh, & Fredrick (in press)	5 with MoID (IQ = 40-46); 12-15 years old	Self-contained classroom in public school (2:1 and 3:1)	Verbal reading and motoric demonstration of comprehension of individual sight words and connected text	Verbal Model of correct response	Not reported
Gursel, Tekin-Iftar, & Bozkurt (2006)	3 with MID, 2 with MoID; 11-14 years	Classroom (2:1); heterogeneous dyadic grouping	Discrete skills - identification of provinces, rivers, and border countri on Turkish map and expressive identification o math symbols	al prompt d with a l	Instruction = 2.14% Probes = 6.57%
Rao & Kane (2009)	2 with Educable Mental Impairement	Self-contained classroom (1:1)	12-step task analysis for subtraction with decimals	Verbal prompt paired with a model	Not reported
Rao & Mallow (2009)	2 with cognitive impairments (IQ = 49 & 62)	Classroom (1:1)	Recall of multiplication Facts	Verbal of correct response	Instruction = 8.6% - 17.6% Probes = 15.2% - 26.4%
Riesen et al. (2003)	1 with autism, 2 with multiple disabilities (IQ = 50-55), 1 with MID (IQ = 58-70); 2 paraprofessionals	Special education and general education classrooms (large group)	Different discrete tasks - (1) expressively read words from general education vocabulary lists (2) Verbally define key vocabulary words	CTD vs Simultaneous Prompting	Not reported

Tekin-Iftar (2003)	4 typical peers, 4 with developmental disabilities; 10-13 years old	Counselor's Office in a public school (tutor dyads)	Acquisition of community signs with instructive feedback	Verbal Model of correct response	Instruction = 1.1% Probes = 2.21%
Tekin-Iftar, Acar, & Kurt (2003)	3 with MID; 13-14 years old	Classroom in a public school (1:1)	Expressive identification of first aid materials and instructive feedback	Verbal Model of correct response	Instruction = 0% Probes = 29%

Table 2

Summary of Outcome Variables

Authors	Design	Results	Maintenance	Generalization	Social Validity
		Preschool			
Akmanoglu-Uludag & Batu (2005)	Multiple Probe	All students acquired targeted skills	1,2,and 4 weeks following mastery criterion	Across materials, settings, and trainers	Parent Questionnaire
Colozzi et al. (2008)	Multiple Probe	Simultaneous prompting effective - met criterion. No significant differences in probe errors for verbal and motor responses between 1:1 and small group	Does not specify when collected.	Across people, setting, and materials	Questionnaire – Parents, Preschool Teachers and Paraprofessionals
Reichow & Wolery (2009)	Adapted Alternating Treatment	3 of 4 participants acquired target stimuli under both simultaneous prompting conditions; 1 student acquired target stimuli in the every 4th day condition only	Not reported	Not reported	Not reported
		Elementary			

Akmanoglu & Batu (2004)	Multiple Probe	All students met Criterion	1, 2, and 4 weeks following demonstration of mastery	Across materials	Parent Questionnaire
Batu (2008)	Multiple Probe	All students met Criterion	1 and 3 weeks following demonstration of mastery	Across trainers	Semi-structured interview
Birkan (2005)	Multiple Probe	All students met Criterion	7, 18, and 25 days after criterion	Across setting and materials	Not reported
Kurt & Tekin-Iftar (2008)	Adapted Alternating Treatment Design	Both equally effective with mixed efficiency data.	1, 2, and 4 weeks following demonstration of mastery	Not reported	16 instructors and professors completed Questionnaire
Tekin-Iftar (2008)	**Multiple Probe**	All students met criterion	2 and 5 weeks following demonstration of mastery	Across settings	Mother and Student Questionnaire
Tekin-Iftar, Kurt, & Acar (2007)	Multiple Probe	All students met criterion	1, 2, and 4 weeks following demonstration of mastery	Multiple exemplars	Not reported
Waugh et al. (2009)	Changing Criterion	All 3 students met criterion through Blending Set 2, one student met criterion through Blending Set 5 and one student met criterion through Blending Set 3	Measured during the study due to summer break; not measured followed mastery of all phases of instruction	Across materials	Teacher Interview

		Middle School			
Alberto et al (in press)	Changing Criterion embedded in a Multiple Baseline across groups	All students met criterion	Not measured	Across materials	Teacher Questionnaire
Gursel et al. (2006)	Multiple Probe	All students met criterion	2 and 6 weeks following demonstration of mastery	Across people and materials	Not reported
Rao & Kane (2009)	Multiple Probe	Both students met criterion	10days following demonstration of mastery	Across settings, materials, and professionals	Not reported
Rao & Mallow (2009)	Multiple Probe	Both students met criterion	1 and 3 weeks following demonstration of mastery	Across format, setting, and personnel	Not reported
Riesen et al. (2003)	Adapted Alternating Treatment Design	3 students reached criterion under both conditions, 1 student reached criterion under simultaneous prompting condition only	Not reported	Not reported	Not reported
Tekin-Iftar (2003)	Multiple Probe	All met criterion	1 week following demonstration of mastery	Across people	Not reported
Tekin-Iftar, Acar, & Kurt (2003)	Multiple Probe	All met criterion	1, 2, and 4 weeks following demonstration of mastery	Not reported	Not reported

moderate intellectual disabilities (MoID) (Alberto et al., in press; Batu, 2008; Birkan, 2005; Dogan & Tekin- Iftar, 2002; Fickel et al., 1992; Griffen et al., 1998; Gursel et al., 2006; Maciag et al., 2000; Parker & Schuster, 2002; Parrott et al., 2000; Rao & Mallow, 2009; Riesen et al., 2003; Schuster & Griffen, 1993; Schuster et al., 1992; Singleton et al., 1995; Singleton et al., 1999; Tekin & Kircaali-Iftar; Tekin-Iftar, 2008; Waugh et al., 2009). The procedure also has been employed in 12 studies with a total of 21 participants with mild intellectual disabilities (MID) (Birkan, 2005; Dogan & Tekin-Iftar, 2002; Fickel et al., 1992; Gursel et al., 2006; Johnson et al., 1996; Palmer et al.,1999; Parker & Schuster, 2002; Rao & Kane, 2009; Rao & Mallow, 2009; Riesen et al., 2003; Tekin & Kircaali-Iftar, 2002; Tekin-Iftar et al., 2003), 6 studies with a total of 17 participants with autism(Akmanoglu & Batu, 2004; Akmanoglu-Uludag & Batu, 2005; Colozzi et al., 2008; Kurt & Tekin-Iftar, 2008; Riesen et al., 2003; Tekin-Iftar, 2008), 5 studies with a total of 10 participants with typical development (Fickel et al., 1992; Gibson & Schuster, 1992; Parker & Schuster, 2002; Reichow & Wolery, 2009; Tekin-Iftar et al., 2003), 4 studies with a total of 14 participants with severe intellectual disabilities (SID) (Colozzi et al., 2008; Fetko et al.,1999; Maciag et al., 2000; Parrott et al., 2000), 4 studies with 12 participants with developmental delays (Gibson & Schuster, 1992; MacFarland-Smith et al., 1992; Sewell et al., 1998; Wolery et al., 1993), 1 study with a total of 3 participants with learning disabilities (Johnson et al., 1996), one study with a participant with spina bifida (Gibson & Schuster, 1992), and one study which include a student with a speech-language impairment, a student who was classified as an English Language Learner, and a student identified as at-risk for school failure (Reichow & Wolery, 2009).

In the same way that simultaneous prompting has been employed with a variety of participants, a variety of individuals have implemented the procedure. While this procedure predominately has been implemented by classroom teachers (Griffen et al., 1998; Gursel et al., 2008; Waugh et al., 2009), it also has been implemented by paraprofessionals (Colozzi et al., 2008; Riesen et al., 2003), parents (Tekin-Iftar, 2008), caregivers (Batu, 2008), sibling tutors (Tekin & Kircaali-Iftar, 2002), and peer tutors (Tekin-Iftar, 2003). Simultaneous prompting is executed with a high level of procedural fidelity, ranging from 84 -100% across all implementers.

Instructional Grouping

The majority of studies which have employed simultaneous prompting have used individual instructional formats (Akmanoglu & Batu, 2004; Akamanoglu-Uludag & Batu, 2005; Batu, 2008; Birkan, 2005; Dogan & Tekin-Iftar, 2002; Fetko et al., 1999; Gibson & Schuster, 1992; Griffen et al., 1998; Parrott et al., 2000; Rao & Kane, 2009; Rao & Mallow, 2009; Reichow et al., 2009; Riesen et al., 2003; Schuster et al., 1992; Singleton et al., 1999; Tekin & Kircaali-Iftar, 2002; Tekin & Iftar, 2003; Tekin-Iftar et al, 2003; Tekin-Iftar et al, 2008). Six studies have implemented the instructional strategy in a group format, ranging from a 2:1 format to an 11:1 format. Singleton et al. (1995) were the first to examine simultaneous prompting in a group format using dyads. The researchers found that simultaneous prompting could be implemented effectively in dyads to teach basic discrete identification of community signs to students with MoID. Maciag et al. (2000) further examined the use of simultaneous prompting in teaching a chained vocational task in a dyadic group format to adults with SID. Gursel et al. (2006) also examined a heterogeneous dyadic group format in teaching discrete skills to students

with developmental disabilities. Fickel et al (1998) and Parker and Schuster (2002) further expanded the literature on simultaneous prompting in a group format by teaching a heterogeneous group of students discrete skills. Students were taught different tasks using different stimuli in a group format of 4:1 (Fickel et al., 1998) and 5:1 (Parker & Schuster, 2002). Johnson et al. (1996) conducted instructional sessions in the largest group format of 11:1 in teaching high school students with mild disabilities. Across all studies, simultaneous prompting implemented in both individual and group formats has been effective in teaching targeted skills.

Only one study directly compared the effects of simultaneous prompting in individual and group formats (Colozzi et al., 2008). Colozzi and colleagues compared the effectiveness of simultaneous prompting in individual format (1:1) and a group format (4:1) in teaching four students with autism pretend play vocabulary and motor skills. While group instruction required more instructional sessions and resulted in more instructional errors there were no significant differences in probe errors across the two instructional formats. Although group instruction required more instructional sessions to mastery, the implementation of group instruction may allow for the acquisition of additional skills through the use of nontargeted instructional feedback and observational learning.

Observational Learning and Instructive Feedback

Observational learning consists of learning through observing others engaging in an activity or being taught a specific activity. In order for observational learning to occur students must demonstrate imitative behaviors (Wolery et al., 1992). Some students with

moderate to severe intellectual disabilities who demonstrate imitative behaviors can acquire nontargeted skills through observational learning. Several studies which employed simultaneous prompting in a group format have examined the acquisition of nontargeted information through observational learning (Fickel et al., 1998; Gursel et al., 2006; Parker & Schuster, 2002; Singleton et al., 1999). Fickel et al. found that students acquired 66% to 100% of their peer's target stimuli through observational learning. Similarly, Gursel et al. found students acquiring 33% to 100% of their peer's target stimuli through observational learning. Parker and Schuster and Singleton et al., measured observational learning of target stimuli as well as instructive feedback.

Instructive feedback consists of additional information that provides the student with supplementary details about the target stimulus (Tekin-Iftar et al., 2008). Instructive feedback has been used widely in the teaching of target skills using simultaneous prompting (Colozzi et al., 2008; Griffen et al., 1998; Gursel et al., 2006; Parker & Schuster, 2002; Singleton et al., 1999; Tekin-Iftar, 2003; Tekin-Iftar et al., 2003; Tekin-Iftar et al., 2008). While observational learning requires a group format, instructive feedback can be implemented and measured in both individual and group formats. Wolery, Holcombe, Werts, and Cipolloni (1993) provided instructive feedback to teach classification of food and drink items while teaching receptive identification of rebus symbols of specific food and drink items to preschool students with developmental disabilities. Students were provided with information concerning the classification of when (e.g., We eat cereal for breakfast) and how (e.g., Juice is a drink). Two of the five students correctly classified all the target stimuli and the remaining three students correctly classified some of the target stimuli. Gursel et al. (2006) taught a heterogeneous

group of middle schools students with MID and MoID a variety of discrete skills ranging from map skills to mathematical symbol identification. Instructive feedback included additional geographical information. Students acquired 33 to 100% of the instructive feedback. Parker and Schuster taught a variety of discrete skills to two high school students with typical development and two students with MID/MoID. Three of four of the student students acquired some of their targeted instructive feedback (range 25-83% accuracy) and some of their group members targeted instructive feedback (range 9-38% accuracy). Singleton et al. reported similar findings with elementary-aged students with MoID acquiring some of their peer's target stimuli (47-54%) and instructive feedback (61-81%) through observational learning.

Targeted Skills

Simultaneous prompting has been used to teach a variety of discrete and chained skills. Skills taught using simultaneous prompting include literacy skills (Birkan, 2005; Gibson & Schuster, 1992; Griffen et al., 1998; Johnson, et al., 1996; Parker & Schuster, 2002; Reichow & Wolery, 2009; Riesen et al., 2003; Schuster et al., 1992; Singleton et al., 1995; Singleton et al., 1999; Tekin-Iftar, 2003; Waugh et al., 2009), math skills (Akmanoglu & Batu, 2004; Birkan, 2005; Fickel et al., 1998; Gursel et al., 2006; Rao & Kane, 2009; Rao & Mallow, 2009), communication skills (Akmanoglu-Uludag & Batu, 2005; Dogan & Tekin-Iftar, 2002; Fickel et al., 1998; Tekin & Kircaali-Iftar, 2002; Tekin-Iftar et al., 2003; Tekin-Iftar, 2008; Wolery et al., 1993), daily living skills (Batu, 2008; Fetko et al., 1999; Parrott et al., 2000; Schuster & Griffen, 1993; Sewell et al., 1998; Tekin-Iftar, 2008), leisure skills (Colozzi et al., 2008; Kurt & Tekin-Iftar, 2008), and vocational skills (Maciag et al., 2000).

Literacy Skills. The most common skill taught employing simultaneous prompting is literacy instruction. Of the 35 studies conducted employing simultaneous prompting, 16 studies examined some component of literacy instruction with the majority of those studies focused on sight-word instruction. The words targeted for instruction include grocery words (Parker & Schuster, 2002; Schuster et al., 1992; Singleton et al., 1999), environmental words (Griffen et al., 1998), academic vocabulary words (Johnson et al., 1996; Riesen et al., 2003), occupational words (Parker & Schuster, 2002), community words and/or signs (Singleton et al., 1995; Tekin-Iftar, 2003), thematic words (Reichow & Wolery, 2009), and controlled vocabulary (Alberto et al., in press; Birkan, 2005; Gibson & Schuster, 1992;Waugh et al., 2009). Simultaneous prompting was employed with a total of 50 participants ranging from typically developing students (Reichow & Wolery, 2009) to students with MoID (e.g., Waugh et al., 2009) and was effective in teaching sight words to 49 of 50 participants. While most studies taught sight words in isolation, two studies expanded upon the individual approach to sight-word instruction to include reading of connected (Alberto et al., in press) and expanding to phonics instruction (Waugh et al., 2009). Alberto et al. systematically taught five students with MoID to read individual sight words composed of various parts of speech. Students also were taught to read the individual sight words in various forms of connected text and demonstrate comprehension of what was read. All five students read the sight words in both individual and connected text formats and were able to demonstrate comprehension. Waugh et al. also expanded on the use of simultaneous prompting to teach sight words to students with MoID by first teaching three elementary students with MoID to read targeted sight words and then teaching corresponding phonics skills. The students were

taught to read four sight words using simultaneous prompting. Once students reached mastery on the four sight words, they were taught the corresponding letter-sound correspondences for the graphemes in each word. Students were then taught the skill of blending to read the previously taught sight words. The students successfully acquired the sight words and various numbers of the blending words. The students were able to read some but not all generalization words.

Math Skills. Of the 35 studies which implemented simultaneous prompting, six of the studies addressed math skills. Of these six studies, five taught discrete skills, such as number identification (Akmanoglu & Batu, 2005; Birkan, 2005), math symbol identification (Gursel et al., 2006), multiplication facts identification (Rao & Mallow, 2009), addition facts identification (Fickel et al., 1992), and telling time (Birkan, 2005). Only one study examined the use of simultaneous prompting to teach the chained math skill of subtraction with decimals (Rao & Kane, 2009). Using simultaneous prompting Rao and Kane taught the chained academic skills of subtraction to two students (reported IQ scores 47-50). Students mastered subtraction with regrouping in 25 or fewer sessions and maintained and generalized the math skills. Simultaneous prompting was employed with a total of 11 participants and was effective in teaching math skills all of the participants.

Communication skills. Simultaneous prompting has been used to teach communication skills in 7 of the 35 published studies. Communication skills taught include expressive naming of relatives for preschool students with autism (Akmnaoglu-Uludag & Batu, 2004), receptive identification of occupation picture cards for two preschool students with MoID and one preschool student with MID (Dogan & Tekin-

Iftar, 1998), manual sign production of six communication symbols for three middle school students with MID/MoID and one student without disabilities (Fickel et al., 1998), receptive identification of animals for three elementary students with MID/MoID (Tekin & Kircaali-Iftar, 2002), expressive identification of first aid materials for three middle school students with MID (Tekin-Iftar et al., 2003), and expressive identification of tools for two elementary students with intellectual disabilities (Tekin-Iftar et al., 2008). The one receptive skill taught was identification of rebus symbols by five preschool students with developmental disabilities (Wolery et al., 1993). Across these seven studies simultaneous prompting was effective in teaching 21 of 23 participants with the remaining two participants not reaching mastery criteria but demonstrating an increase in performance over baseline.

Daily living skills. Of the 35 studies examining simultaneous prompting, six studies examined the acquisition of daily skills (Batu, 2008; Fetko et al., 1999; Parrott et al., 2000; Schuster & Griffen, 1993; Sewell et al., 1998; Tekin-Iftar, 2008). Simultaneous prompting was employed to teach home living skills, such as setting the table, preparing sandwiches, hanging clothes, folding clothes, etc (Batu, 2008), making juice (Schuster & Griffen, 1993) dressing skills (Sewell et al., 1998), opening a key lock (Fetko et al., 1999), handwashing skills (Parrott et al., 2000), and purchasing skills (Tekin-Iftar, 2008). This strategy was successful in teaching 20 of the 23 participants.

The use of simultaneous prompting to teach daily living skills was implemented predominately by classroom teachers. Tekin-Iftar (2008) was the first to examine the effectiveness of implementation of the procedure in a natural setting by a parent. Four students with developmental delays were taught purchasing skills in the natural setting

(i.e., grocery store, pastry shop, and dry cleaning store). The students acquired the targeted purchasing skills and were able to generalize those skills to purchasing of items in different locations. The parents effectively delivered simultaneous prompting with at an average of 91% accuracy. Batu (2008) further examined the implementation of caregiver-delivered simultaneous prompting to teach home skills (e.g., setting the table, preparing food, hanging clothes, etc) to four elementary students with developmental delays. All four students acquired the targeted stimuli and maintained the skills over time. Students were able to generalize the skills across individuals in the naturalistic setting. This study provided initial support for the implementation of simultaneous prompting with caregivers of students with disabilities. Across all students and caregivers, reliability data were reported at a range of 87%-100% accuracy. These studies also support the ease with which simultaneous prompting can be implemented reliably.

Leisure skills. Colozzi et al. (2008) and Kurt and Tekin-Iftar (2008) examined the effects of simultaneous prompting in teaching leisure/play skills to students with autism. Colozzi et al. analyzed the effects of simultaneous prompting in teaching pretend play skills to preschool students with autism in both individual and group instructional formats. Students were taught vocabulary and motor skills to represent the pretend play activity. All students acquired the targeted skills and maintained the skills at 100% accuracy, and individual instruction was more efficient, requiring fewer instructional sessions than group instruction. However, group instruction allowed for the acquisition of observational learning responses. Kurt and Tekin-Iftar compared the response prompting strategies of CTD and simultaneous prompting in teaching four students with autism to engage in two leisure skills of turning on a compact disc player and taking a digital

picture. Both procedures were effective in teaching the targeted leisure skills to students with autism. Efficiency data produced mixed results as in previous studies with two students requiring the leisure skills in fewer sessions with CTD and two students requiring fewer sessions with simultaneous prompting.

Vocational task. To date one study has examined the effectiveness of simultaneous prompting in teaching a vocational task. Ten adults with MoID and SID were taught to assemble boxes at a sheltered work site in groups of two (Maciag et al., 2000). Simultaneous prompting was effective for teaching 4 of the 5 dyads. The remaining dyad was unable to complete the task to criterion due to time constraints. The employees acquired the targeted skill within a maximum of twenty sessions and maintained the skill fifteen weeks after instruction at a range 73-93% accuracy.

Comparison of Instructional Strategies

In order to determine the effectiveness and efficiency of simultaneous prompting, researchers have compared simultaneous prompting to other response prompting strategies. Simultaneous prompting has been compared to CTD (Kurt & Tekin-Iftar, 2008; Riesen et al., 2003; Schuster et al., 1992; Tekin & Kircaali-Iftar, 2002) and antecedent-prompt and test procedure (Singleton et al., 1999). Simultaneous prompting is considered an adaptation of these two differing response prompting procedures (Schuster et al., 1992). Simultaneous prompting also is comparable to the zero-second delay interval of CTD (Schuster et al., 1992). However, simultaneous prompting does not transition to delayed intervals as in CTD.

During the antecedent-prompt and test procedure the teacher presents the stimulus and controlling prompt together and then provides an opportunity for the student to respond independently to the stimulus during probe or test trials (Wolery, Ault, & Doyle, 1992). In the antecedent-prompt and test procedure trials in which the stimulus and controlling prompt are presented together always occur prior to probe trials (Wolery et al., 1992). In contrast, during simultaneous prompting probes are conducted prior to instructional sessions.

Constant time delay. Schuster et al. (1992) first examined the effectiveness of simultaneous prompting by comparing the procedure to CTD in teaching four elementary students with MoID to read grocery words. While both procedures were effective in teaching sight words to students with MOID, simultaneous prompting required fewer instructional sessions and less instructional time and resulted in fewer errors. It should be noted that the reduction in instructional time with simultaneous prompting was minimal for three of the four students ranging from 30-seconds to 3-minutes and substantial for one student (11-minutes). Maintenance data for the procedure was mixed with two students producing better maintenance with words taught with CTD and two students producing better maintenance with words taught with simultaneous prompting. This study provided initial support for the use of simultaneous prompting in teaching students with MoID.

Riesen et al. (2003) further compared the effectiveness and efficiency of CTD and simultaneous prompting in teaching two junior high school students to read academic words and two junior high school students to define academic vocabulary words within an embedded-instruction format. Three students reached criterion under both conditions

while one student reached criterion only in the simultaneous prompting condition. This study further validated the use of simultaneous prompting as an effective instructional strategy for teaching literacy skills to students with disabilities.

Tekin and Kircaali-Iftar (2003) examined the effects of simultaneous prompting and CTD in teaching students with MID and MoID to receptively identify animals. Three students with MID/MoID were taught by sibling tutors to identify animals receptively. Both procedures were implemented with a high level of fidelity by sibling tutors. Both procedures were effective in teaching receptive identification of animals with no difference in maintenance data across the two procedures. Efficiency data were inconclusive with CTD more efficient in the number of sessions and number of trials to criterion and simultaneous prompting more efficient in the number of errors and total training time to criterion.

Kurt and Tekin-Iftar (2008) compared the effects of simultaneous prompting and CTD in teaching the leisure skills of turning on a CD player and taking a digital picture to four boys with autism. Both procedures were equally effective in the acquisition and maintenance of the targeted skills. Efficiency data were inconclusive with CTD more efficient for two students and simultaneous prompting more efficient for two students. Across the four studies that have compared simultaneous prompting to CTD, the data have showed minimal differences between the two strategies with both strategies demonstrating effectiveness in teaching discrete skills and demonstrating mixed results in efficiency with simultaneous prompting more efficient for some students and CTD more efficient for some students.

Antecedent-prompt and test procedure. Singleton et al. (1999) compared the effectiveness of simultaneous prompting and the antecedent-prompt and test procedure in teaching four students with MoID to read grocery words. Both procedures were effective. However, efficiency data supported the antecedent-prompt and test procedure over simultaneous prompting. The antecedent-prompt and test procedure required fewer sessions, less probe time, and resulted in fewer probe errors to criterion. Despite the data supporting the antecedent-prompt and test procedure, maintenance data supported simultaneous prompting with students maintaining a higher percentage of words taught in the simultaneous prompting condition. These data indicate an important difference between simultaneous prompting and the antecedent-prompt and test procedure. During the antecedent-prompt and test procedure probes are conducted following instruction thereby indirectly measuring transfer of skills to short-term memory. However, simultaneous prompting conducts probes prior to instruction each day measuring transfer of skills to long-term memory.

Strengths and Weaknesses of Simultaneous Prompting

Simultaneous prompting may provide certain advantages over other response prompting strategies for various reasons. First, simultaneous prompting does not require changes in teacher behavior as in CTD (Schuster et al., 1992), system of least prompts, most prompts, and graduated guidance. Each instructional session is completed in the same sequence until mastery is reached, decreasing the likelihood that teachers will emit procedural errors. Second, simultaneous prompting does not require differential reinforcement because only one correct response is reinforced (Schuster et al., 1992). Third, unlike CTD in which students must exhibit a wait response, simultaneous

prompting eliminates the need for this response (Schuster et al., 1992). Simultaneous prompting also reduces the need to keep direct data during instructional sessions because transfer of stimulus control is measured during probes. Avoiding the need to keep data during instructional sessions may be preferred by teachers when conducting group instruction because it eliminates the problems associated with keeping track of multiple students' responses and maintaining student attention and focus.

Across 35 peer-reviewed studies, simultaneous prompting has an effectiveness rate of 93%, with 126 out of 136 participants reaching criterion during instruction with simultaneous prompting. Ten participants across the 35 studies did not reach criterion. Rationale for not reaching criterion is often noted as time constraints associated with the end of the school year. Although the number of participants who did not reach criterion is minimal and all students demonstrated an increase in performance over baseline, the literature does reveal some problems associated with simultaneous prompting. The goal of errorless learning procedures is to ensure that students do not have opportunities to make errors or practice incorrect responses. While instructional sessions attempt to control the production of errors by providing a controlling prompt concurrently with the discriminative stimulus, errors can often be emitted during probe sessions when students have an opportunity to independently respond to the discriminative stimulus. As such, error rates vary greatly between daily probes (4-54% of trials) and instructional sessions (0-5% of trials) (Morse & Schuster, 2004). A second obstacle noted concerning simultaneous prompting is the need to conduct probe sessions and thereby impact efficiency (Schuster et al., 1992). Alternate response prompting strategies allow students to respond independently during instructional trials, however, in order for students to

have an opportunity to respond independently to a stimulus during simultaneous prompting, a probe session must be conducted; thereby adding to the amount of time required to fully employ the strategy. Despite the fact that probe time is often minimal, it is in addition to instructional time.

Error Correction

Various forms of corrective feedback can be used during instruction to provide information on the accuracy of the response. Feedback for correct responses is often provided through positive reinforcement (Wolery et al., 1992). The most common form of positive reinforcement used in the area of sight-word instruction is verbal praise (Browder & Lalli, 1991). Feedback for errors may include drawing the student's attention to the error (i.e., "No, that is incorrect") or indicating the response was incorrect while also providing information about how to correctly respond to the stimulus (i.e., "No, this word is __.")(Wolery et al., 1992). Error correction for individuals with intellectual disabilities should be direct, immediate, and ensure active student responding.

Barbetta, Heward, and Bradley (1993) compared the effects of a direct word-supply approach to a word-analysis approach in providing error correction during sight-word instruction for students with MID. Direct error correction procedures, such as word supply, were more effective than procedures which gradually prompted student responses, such as word-analysis. Sing and Singh (1985, 1988) examined word-supply/overcorrection and word-analysis error correction procedures during oral reading passages for students with MoID. In both studies, word-supply/overcorrection and word-analysis procedures were more effective than a no-intervention control condition in

which the students received no feedback. In both studies word analysis was more effective over time than word supply. This finding may be related to the level of sight-word knowledge, as in both studies students were reading passages instead of individual words indicating an intermediate level of sight-word knowledge. Barbetta, Heward, Bradley, and Miller (1994) and Worsdell, Iwata, Dozier, Johnson, Neidert, and Thomason (2005) compared the effects of immediate feedback versus delayed feedback in the acquisition of sight words by students and adults with MID and MoID. While both procedures were more effective than conditions which provided no feedback, immediate feedback was more effective than delayed feedback.

Researchers also examined the effects of active student responding during error correction in the acquisition of sight words (Barbetta, Heron, & Heward, 1993; Worsdell et al., 2005). Barbetta, Heron et al. examined the effects of active student responding (i.e., teaching providing corrective feedback and a second opportunity for student to respond to the stimulus) versus a no-response condition (i.e., teacher provide corrective feedback with no opportunity for student to respond to the stimulus). Active student responding increased the rate of acquisition of sight words for students with intellectual disabilities. Worsdell et al. (2005) examined the effects of three conditions of error correction (i.e., no student response, single response, and multiple responses) on sight word acquisition for students with MID and MoID. Multiple responses consisted of the student repeating the word five times following error correction by the teacher. Both single and multiple responses were more effective than no responses during error correction for students with MID and MoID.

Future Research Areas

There are currently four main areas for future research on simultaneous prompting. The first is to expand the procedure to examine its effectiveness with individuals with profound intellectual disabilities (Morse & Schuster, 2004). To date, no studies have investigated the effectiveness of the procedure with individuals with profound intellectual disabilities and only a few studies have been conducted with individuals with severe intellectual disabilities. Second, researchers have recommended that future investigations examine the effects of previous learning histories on the effects of simultaneous prompting (Singleton et al., 1995). Does previous experience with errorless learning strategies impact acquisition rates?

The third and fourth recommendations are designed to examine methods for reducing the number of errors students emit during probe sessions in order to increase the degree of errorless learning associated with simultaneous prompting. The third recommendation is to provide error correction during daily/assessment probes (Birkan, 2005; Colozzi et al., 2008; Dogan & Tekin-Iftar, 2002; Fickel et al., 2002; Tekin-Iftar, 2003; Tekin-Iftar et al., 2003). Traditional procedures during daily/assessment probes are to provide verbal reinforcement for correct responses and to ignore incorrect or no responses. To date five studies have provided error correction during daily/assessment probes (Alberto, Waugh, & Fredrick, in press; Johnson et al., 1996; Parker & Schuster, 2002; Tekin-Iftar, 2003; Waugh et al., 2009) and one study has directly compared the effects of traditional simultaneous prompting and simultaneous prompting with error correction during daily/assessment probes (Johnson et al., 1996). Johnson et al. conducted a direct comparison of simultaneous prompting with error correction during

daily probes and simultaneous prompting without error correction during daily/assessment probes in teaching science vocabulary words to five high school students with learning disabilities and mild intellectual disabilities. Both conditions were effective for teaching science vocabulary. Compared to sessions in which no error correction was provided fewer sessions to criterion were required and fewer errors were emitted when error correction was provided during daily/assessment probes. Social validity indicated that students preferred when they were provided with error correction during daily/assessment probes. Four other studies have included error correction during daily/assessment probes but have not directly examined the impact of error correction. While simultaneous prompting with error correction may be more efficient in the acquisition of targeted stimuli, this procedural modification has been examined only with a limited number of participants and in a limited disability area. Further research should be conducted with individuals with various disabilities to determine if daily/assessment probes with error correction are more efficient than without error correction.

The fourth recommendation for future research is to provide intermittent probes versus daily/assessment probes (Birkan, 2005; Dogan & Tekin-Iftar, 2002; Fickel et al., 2002; Gibson & Schuster, 1992; Griffen et al., 1998; Johnson et al., 1996; Maciag et al., 2000; Parker & Schuster; 2002; Tekin-Iftar et al., 2008; Wolery et al., 1993). Intermittent probes are probe conducted prior to every second or third session of instruction instead of prior to each session. By conducting probes prior to every second or third session of instruction students are allowed fewer opportunities to respond independently to the stimulus and possibly make fewer errors. To date two studies have employed intermittent probes (Reichow & Wolery, 2009; Tekin-Iftar et al., 2008). Tekin-

Iftar et al. employed intermittent probes to examine the effects of simultaneous prompting in teaching object identification to two students with intellectual disabilities (level of functioning not reported). Researchers conducted probes prior to every third instructional session. Tekin-Iftar et al. report that employing intermittent probes did not reduce the number of errors emitted during probe sessions, although a direct comparison was not made. Without a direct comparison, it is unclear if these students would have produced lower error rates with intermittent versus daily probes. Reichow and Wolery recently conducted a direct comparison of daily versus intermittent probes during simultaneous prompting. The researchers taught four preschool students to read vehicle transportation words (i.e., car, bus, truck, etc). The students included one student with a speech language impairment, one student who was an English Language Learner, one typically developing student, and one student identified as at-risk for school failure. Reichow and Wolery provided no error correction during probe sessions. All four students reached mastery during intermittent probe conditions with three of the four students reaching mastery during the daily probe conditions. Efficiency data were mixed with the one student who did not reach mastery in the daily probe condition, one student who reached mastery in fewer sessions during intermittent probes, one student who required the same number of sessions across both conditions and one student who required fewer sessions during daily probe conditions. While the researchers did not report direct percentages of error rates across probe and instructional sessions, they did provide initial data to support intermittent probes. During the first 8 sessions during daily probes 50% of student trials resulted in errors versus the first 2 sessions of the intermittent probe condition which resulted in errors in 28.1% of student trials. However,

due to the limited number of participants and the lack of details concerning characteristics of the participants (i.e., IQ scores, etc), further research should be conducted to determine if intermittent probes produce more efficient student learning when employing simultaneous prompting.

Simultaneous prompting is an errorless learning strategy with a research base to support its use to teach a variety of skills across various groups of ability levels. Despite the research base to support its usage, continued research is needed to further examine alternatives to increase its efficiency and examine its usage with students with profound intellectual disabilities.

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CHAPTER TWO

EFFECTS OF ERROR CORRECTION DURING ASSESSMENT PROBES ON THE ACQUISITION OF SIGHT WORDS FOR STUDENTS WITH MODERATE INTELLECTUAL DISABILITIES

Errorless learning is an instructional approach designed to reduce the number of errors students emit in traditional trail-and-error approaches (Mueller, Palkovic, & Maynard, 2007). Terrace (1963) first examined a method of errorless learning by examining the effects of stimulus fading which consists of gradually reducing the intensity of the more salient stimulus and thereby transferring stimulus control to the discriminative stimulus. Response prompting strategies are designed to produce errorless learning by providing a prompt prior to a student's initial response and gradually fading the prompt (Wolery, Ault, & Doyle, 1992). Various response prompting strategies have been employed with students with moderate intellectual disabilities (MoID). The four most common response prompting strategies are most-to-least prompts, least-to-most prompts, graduated guidance, and time delay (Wolery & Gast, 1984).

Most-to-least prompts consists of employing the most intrusive prompt needed to assist the student in performing the correct response in the presence of the discriminative stimulus and gradually reducing the intensity of the prompt until the student is correctly responding independently to the discriminative stimulus. Least-to-most prompt provides the student with an opportunity to respond independently to the discriminative stimulus.

If the student responds incorrectly a prompt is provided which gradually increases in intensity until the student responds correctly to the discriminative stimulus. “Graduated guidance is a technique combining physical guidance and fading in which the physical guidance is systematically and gradually reduced and then faded completely” (Foxx, 1982, p. 129). Graduate guidance relies heavily on teacher judgment whether or not a prompt is required or the degree of prompt required at any given moment during instruction (Foxx, 1982). Time delay is a strategy which results in near errorless learning by transferring stimulus control from a controlling prompt to the discriminative stimulus by inserting a delay between presentation of the discriminative stimulus and the controlling prompt (Snell & Gast, 1981; Touchette, 1971). Two forms of time delay are reported in the literature, progressive time delay (PTD) and constant time delay (CTD). CTD consists of two prompting conditions, a zero-second delay condition and a three- or five-second delay condition. During the zero-second delay condition, the stimulus and controlling prompt are delivered concurrently. During the three- or five-second delay condition the stimulus is presented with the specified delay inserted prior to the delivery of the controlling prompt to allow for independent responding. Acquisition during CTD is measured by correct responses during the delayed trials in which the student responds to the stimulus prior to the presentation of the controlling prompt.

A fifth errorless learning procedure that has a growing body of research literature, is simultaneous prompting. During simultaneous prompting the instructional cue and controlling prompt are presented concurrently, with probes conducted prior to each instructional session to measure skill acquisition (Gibson & Schuster, 1992; Schuster, Griffen, & Wolery, 1992). Simultaneous prompting is considered an adaptation of two

response prompting procedures, antecedent prompt and test procedure and CTD (Schuster et al., 1992).During the antecedent prompt and test procedure the teacher presents the stimulus and controlling prompt together and then provides an opportunity for the student to respond independently to the stimulus during probe or test trials (Wolery et al., 1992). In the antecedent prompt and test procedure, trials in which the stimulus and controlling prompt are presented together always occur prior to test or probe trials. A predetermined number of trials or sessions are conducted prior to the removal of the controlling prompt during probe trials (Wolery et al., 1992). In contrast during simultaneous prompting, probe trials are conducted each session prior to instructional sessions when the controlling prompt and the stimulus are presented together. Simultaneous prompting also is comparable to the zero-second delay interval of CTD. However, simultaneous prompting does not transition to delayed intervals as in CTD.

Simultaneous prompting consists of three components (a) baseline probe sessions, (b) assessment probe sessions, and (c) instructional sessions. During baseline probe sessions data are collected on the students' identification of all stimuli in the program prior to instructional sessions; and sometimes following mastery of a set of stimuli prior to presentation of the next set of stimuli. Assessment probe sessions which measure acquisition of the stimuli targeted for instruction, are conducted prior to each instructional session. During instructional sessions the stimulus and the controlling prompting are presented concurrently.

Simultaneous prompting has been used to teach a variety of skills including both discrete and chained tasks. Discrete tasks taught using simultaneous prompting include such skills as identification of sight words (Alberto, Waugh, & Fredrick, in press; Birkan,

2005; Gibson & Schuster, 1992; Griffen, Schuster, & Morse, 1998; Riesen, McDonnell, Johnson, Polychronis, & Jameson, 2003; Schuster et al., 1992; Singleton, Schuster, & Ault, 1995; Singleton, Schuster, Morse, & Collins, 1999; Tekin-Iftar, 2003; Waugh, Fredrick, & Alberto, 2009), identification of objects (MacFarland-Smith, Schuster, & Stevens, 1993; Tekin-Iftar, 2003; Tekin-Iftar, Kurt, & Acar, 2008), identification of numerals (Akmanoglu & Batu, 2004; Birkan, 2005; Gursel, Tekin-Iftar, & Bozkurt, 2006), identification of multiplication facts (Rao & Mallow, 2009), identification of rebus symbols (Wolery, Holcombe, Werts, & Cipolloni, 1993), identification of occupation cards (Dogan & Tekin-Iftar, 2002), identification of relatives (Akmanoglu-Uludag & Batu, 2005), identification of animals receptively (Tekin & Kircaali-Iftar, 2002), and identification of manual signs (Fickel, Schuster, & Collins, 1998; Palmer, Collins, & Schuster, 1999). Chained tasks taught using simultaneous prompting include daily living skills (Batu, 2008; Fetko, Schuster, Harley, & Collins, 1999; Parrott, Schuster, Collins, & Gassaway, 2000; Schuster & Griffen, 1993; Sewell, Collins, Hemmeter, & Schuster, 1998; Tekin-Iftar, 2008), vocational skills (Maciag, Schuster, Collins, & Cooper, 2000), leisure skills (Colozzi, Ward, & Crotty, 2008; Kurt & Tekin-Iftar, 2008), blending skills (Waugh et al., 2009), and subtraction with regrouping (Rao & Kane, 2009). While simultaneous prompting has been implemented with a variety of ability levels it predominately has been implemented with students with MoID. It also has been implemented with a high level of fidelity by a variety of individuals with varying educational experience, including classroom teachers (e.g., Gibson & Schuster, 1992), peer tutors (Tekin-Iftar, 2003), and parents (e.g., Tekin-Iftar, 2008).

Although simultaneous prompting is an effective strategy for a variety of individuals and across a variety of skills, researchers have noted increased error rates within assessment probe sessions as compared to instructional sessions (Birkan, 2005; Colozzi et al., 2008; Dogan & Tekin-Iftar, 2002; Fickel et al., 1998; Johnson, Schuster, & Bell, 1996; Maciag et al., 2000; Morse & Schuster, 2004; Singleton et al., 1995). In a review of the literature on simultaneous prompting, Morse and Schuster reported error rates during daily/assessment probe sessions ranging from 4% to 54% of trials with error rates ranging from 0% to 5% of trials during instructional sessions. An increased error rate can be expected due to the independent response opportunity during assessment probes as compared to the prompted response opportunity during instructional sessions. While a discrepancy between error rates during assessment probes and instructional sessions would be expected, the range of errors that occur may hinder the acquisition of the targeted skill and reduce the overall effects of the errorless learning strategy. This discrepancy between error rates during probe and instructional sessions has resulted in researchers calling for alternatives or modifications to the traditional procedures of simultaneous prompting in order to reduce error rates during probe sessions and increase the degree of errorless learning. Researchers have proposed two adaptations to reduce the rate of errors during daily/assessment probes (a) provide corrective feedback during daily/assessment probes (Birkan, 2005; Colozzi et al., 2008; Dogan & Tekin-Iftar, 2002; Fickel et al., 1998; Tekin-Iftar, Acar, & Kurt, 2003) and (b) conduct intermittent probes in lieu of daily/assessment probes (Birkan, 2005; Dogan & Tekin-Iftar, 2002; Fickel et al., 1998; Gibson & Schuster, 1992; Griffen et al., 1998; Johnson et al., 1996; Maciag et al., 2000; Parker & Schuster, 2002; Tekin-Iftar et al., 2003; Wolery et al., 1993).

Intermittent probes are probes conducted prior to every second or third session of instruction instead of prior to each session. Intermittent probes are designed to allow more time for learning between assessment probe sessions.

Various forms of corrective feedback can be used during instruction to provide information on the accuracy of the response (Wolery et al., 1992). Feedback for correct responses is often provided through positive reinforcement (Wolery et al., 1992). The most common form of positive reinforcement used in sight-word instruction is verbal praise (Browder & Lalli, 1991). Feedback for errors may include drawing the student's attention to the error (i.e., "No, that is incorrect") or error correction procedures (Wolery et al., 1992). Error correction procedures include the process of indicating the response was incorrect while also providing information about how to correctly respond to the stimulus (i.e., "No, this word is ___.") (Wolery et al., 1992). Error correction for individuals with intellectual disabilities should be direct (Barbetta, Heward, & Bradley, 1993), immediate (Barbetta, Heward, Bradley, & Miller, 1994; Worsdell, Iwata, Dozier, Johnson, Neidert, & Thomason, 2005), and ensure active student responding (Barbetta, Heron, & Heward, 1993; Worsdell et al., 2005).

Barbetta, Heward, et al. (1993) compared the effects of a direct word-supply approach to a word-analysis approach in providing error correction during sight-word instruction for students with mild intellectual disabilities (MID). They demonstrated that direct error correction procedures, such as word supply, were more effective than procedures which gradually prompt student responses, such as word-analysis. Singh and Singh (1985, 1988) examined word-supply/overcorrection and word-analysis error correction procedures during oral reading passages for students with MoID. In both

studies, word-supply/overcorrection and word-analysis procedures were more effective than a nonintervention control condition in which the students received no feedback. In both studies word analysis was more effective over time than word supply. This finding may be related to the students' current level of sight-word knowledge. In both studies students were reading passages instead of individual words indicating an intermediate level of sight-word knowledge. Barbetta et al. (1994) and Worsdell et al. (2005) compared the effects of immediate feedback versus delayed feedback in the acquisition of sight words by students and adults with MID and MoID. While both procedures were more effective than conditions which provided no feedback, researchers demonstrated that immediate feedback was more effective than delayed feedback in teaching sight words to students with intellectual disabilities. Researchers also examined the effects of active student responding during error correction on the acquisition of sight words (Barbetta, Heron, et al., 1993; Worsdell et al., 2005). Barbetta, Heron, et al. examined the effects of active student responding (i.e., teacher providing corrective feedback and a second opportunity for student to respond to the stimulus) versus a no-response condition (i.e., teacher provides corrective feedback with no opportunity for student to respond to the stimulus). Active student responding increased the rate of acquisition of sight words for students with intellectual disabilities. Worsdell et al. examined the effects of three conditions of error correction (i.e., no student response, single response, and multiple responses) on sight-word acquisition for students with MID and MoID. Multiple responses consisted of the student repeating the word five times following error correction by the teacher. Researchers found that both single and multiple responses were

more effective than no responses during error correction for students with MID and MoID with multiple responses more effective than single responses.

While each of these studies examined error correction through a trial and error approach, the findings have direct impact on how errors may be addressed in combination with response prompting strategies. Each of the four common response prompting strategies identified by Wolery and Gast (1984) is designed to address errors directly and immediately. During most-to-least prompts, the teacher provides an initial trial at a less intrusive prompt level than previously required. If the student does not respond correctly on the initial trial then the teacher immediately increases the prompt level for the remaining trials of that session. In least-to-most prompts the student is given an opportunity to respond independently to the task, if the student makes an error the teacher then increases the prompt level until the student responds correctly. In graduate guidance, the teacher may shadow the student's movement to provide error correction if the student begins to respond incorrectly or the teacher may maintain consistent contact but increase the intrusiveness of the prompt if the student begins to make an error. In CTD, errors are addressed immediately by providing a prompt that will assist the student in emitting the correct response. During each of these response prompting approaches, if students make an independent response that results in an error, they receive corrective feedback for that response. However, in simultaneous prompting because all independent responses occur during probe sessions which traditionally do not include error correction, students receive no direct and immediate feedback concerning their response.

Despite the importance of error correction during sight-word acquisition, the substance of research employing simultaneous prompting does not provide corrective

feedback during assessment probes in which students are provided an opportunity to respond independently to the stimulus (Morse & Schuster, 2004). Contrary to traditional simultaneous prompting procedures, five studies have included corrective feedback during assessment probes conducted following the initial instructional session of simultaneous prompting in teaching sight words (Alberto, et al., in press; Johnson et al., 1996; Parker & Schuster, 2002; Tekin-Iftar, 2003; Waugh et al., 2009). Johnson et al. examined the effects of error correction during assessment probes on the acquisition of science vocabulary words for students with mild disabilities (e.g., learning disabilities and MID). Simultaneous prompting with error correction was "slightly more efficient" than simultaneous prompting without error correction. Since the initial comparison of probe sessions with and without error correction, four studies have employed error correction during assessment probes (Alberto, et al., in press; Parker & Schuster, 2002; Tekin-Iftar, 2003; Waugh, et al., 2009). By providing error correction during assessment probes students are provided with increased opportunities for learning. However, the literature lacks research which examines the effects of error correction during assessment probes for students with MoID in the acquisition of sight words.

The purpose of this study was to assess the effectiveness and efficiency of error correction during assessment probes to reduce error rates in teaching sight words to students with MoID.

METHODOLOGY

Research Design

This experiment employed an adapted alternating treatments design (Sindelar, Rosenberg, & Wilson, 1985) embedded in a multiple baseline across words sets and replicated across students. An adapted alternating treatments design allows for the comparison of two independent variables across different but equally difficult behaviors (i.e., word sets) (Holcombe, Wolery, & Gast, 1994). The adapted alternating treatments design allows for the examination of skills that are irreversible (Holcombe et al., 1994). The two independent variables were counterbalanced across word sets and time of day. Two sessions were conducted each day, one morning session and one afternoon session. By embedding the adapted alternating treatments design within a multiple baseline across word sets, the design controlled for carry-over effects by measuring a third independent behavior of equal difficulty which was not receiving the intervention (i.e., baseline probes for tier 2).

Participants

Participants included 3 students with MoID, ages 15-16 years old. Inclusion criteria included (a) documented eligibility in MoID range (IQ range 40-55), (b) ability to attend to an activity for 15 minutes as indicated by the teacher, (c) ability to verbally imitate teacher's model, (d) visual acuity to attend to the stimulus as measured by presentation of pictures of familiar objects in dimensions of sight-word cards, (e) auditory acuity to hear discriminative stimulus as determined by an imitative measure, (f) served in a special education classroom, and (g) parental consent to participate. All three

students were served in a self-contained special education classroom for students with MoID. The classroom teacher provided all instruction to the students. See Table 3 for participant description.

Table 3

Participant Demographics

Participants	Jen	Kyle	Chloe
Gender	F	M	F
Age	15	16	15
Intelligence Test	WISC IV	Stanford Binet	WISC III
Score	40	43	42
Adaptive Behavior	ABAS II	Vineland	Vineland
Score	52	42	1.11*
Etiology	Down syndrome	Down syndrome	not specified

*Composite Score not reported, age equivalent reported.

Jen is a fifteen year old female with a diagnosis of Down syndrome. She had a prior instructional history with the errorless learning strategy of simultaneous prompting. Jen could read approximately 30 sight words as determined by her classroom teacher. Kyle is a sixteen year old male with Down syndrome. He had no previous instructional history with simultaneous prompting. Kyle's previous literacy instruction consisted of

instruction of Dolch words, but was not successful with acquisition and maintenance of these words. Chloe, a fifteen year old female, had a previous instructional history with simultaneous prompting. She also had received literacy instruction using Dolch words but had not been successful with acquisition and maintenance of these sight words. Her teacher estimated that she could read fewer than 10 sight words.

Independent and Dependent Variables

The independent variables examined were simultaneous prompting with and without error correction during assessment probes. Simultaneous prompting with error correction during assessment probes consisted of corrective feedback for incorrect responses paired with a second opportunity to respond to the stimulus and verbal praise for correct responses. Simultaneous prompting without error correction during assessment probes consisted of no corrective feedback for incorrect responses and verbal praise for correct responses. The no error correction condition followed traditional simultaneous prompting procedures. The dependent variables examined were (a) number of probe sessions to criterion, (b) number of probe errors to criterion, (c) number of instructional errors to criterion, (d) length of probe and instructional sessions in minutes, and (e) number of responses maintained over a two- and four-week period.

Materials

Materials included a total of six word sets with one word set assigned to each condition within a tier (a) simultaneous prompting with assessment probes with error correction and (b) simultaneous prompting with assessment probes without error correction. Words were presented on 5x8 inch white index cards in 2-inch block letters

using a computer generated font (i.e., comic sans). Words selected for instruction included nouns which could be represented by an object and were in the students' vocabulary. Nouns were selected in order to allow the student to demonstrate comprehension by selecting concrete objects which represented the written word. See Table 4 for a list of sight words targeted for instruction. Students were assigned to four of the six matched word sets, resulting in each word set being assigned to two students. Word sets were counterbalanced across students, probing conditions, and time of day. See Table 5 for the counterbalance schedule for each of the three students. Materials also included a video camera in order to videotape all probe and instructional sessions. Probe and instructional sessions were videotaped in order to accurately record the amount of probe and instructional time in each condition. The primary researcher viewed all video footage to record the amount of time for each condition, editing out any time in which the teacher had to stop instruction to deal with another student in the class or interact with other staff members. A second observer viewed 20% of all probe and instructional sessions to ensure fidelity in the reporting of minutes of probe and instructional sessions. The primary researcher and second observer reached agreement on 94% of the probe sessions viewed. The difference in the observers' probe times averaged 3.7 seconds. The primary researcher and second observer reached agreement on 92% of instructional sessions viewed. The difference in the observers instructional times averaged 4 seconds.

Table 4

Sight-Word Sets

Word Set 1	Word Set 2	Word Set 3	Word Set 4	Word Set 5	Word Set 6
box	bed	bat	bell	book	bike
cap	car	chair	chalk	coat	coke
desk	drum	tape	truck	money	marker

Table 5

Counterbalancing Schedule

Student	Tier	Time of Day	Days of Instruction									
			1	2	3	4	5	6	7	8	9	10
Jen	T1	AM	4	3	4	3	4	3	4	3	4	3
		PM	3	4	3	4	3	4	3	4	3	4
	T2	AM	5	6	5	6	5	6	5	6	5	6
		PM	6	5	6	5	6	5	6	5	6	5
Kyle	T1	AM	2	1	2	1	2	1	2	1	2	1
		PM	1	2	1	2	1	2	1	2	1	2
	T2	AM	4	3	4	3	4	3	4	3	4	3
		PM	3	4	3	4	3	4	3	4	3	4
Chloe	T1	AM	6	5	6	5	6	5	6	5	6	5
		PM	5	6	5	6	5	6	5	6	5	6
	T2	AM	1	2	1	2	1	2	1	2	1	2
		PM	2	1	2	1	2	1	2	1	2	1

Shaded boxes represent assessment probe conditions without error correction. Unshaded boxes represent assessment probe conditions with error correction.

Setting

Both assessment probes and instructional sessions were conducted in the special education self-contained classroom in a 1:1 instructional format. The classroom teacher

conducted all probe and instructional sessions during the course of the study. All sessions were conducted at a table in the rear of the classroom in order to minimize distractions.

Procedures

Teacher training. Prior to instruction the researcher trained the classroom teacher in the instructional procedures for each intervention. The researcher met with the teacher to first explain each step of the intervention. The researcher then modeled the instructional procedures and had the teacher role play with the researcher. The teacher was required to reach a mastery criterion of 100% procedural fidelity for both assessment probe conditions and instructional sessions across two consecutive sessions before implementing the procedures with the targeted students. See Appendix A, *Teacher Behavior Check Sheet: Assessment Probes with Error Correction,* Appendix B, *Teacher Behavior Check Sheet: Assessment Probes without Error Correction,* and Appendix C, *Teacher Behavior Check Sheet: Instructional Sessions*.

Baseline probe. Prior to instruction a minimum of three baseline probe sessions were conducted. During baseline probe sessions each of the words targeted for instruction in each word set were presented to the students. The teacher presented the stimulus card, gained the student's attention (e.g., "Touch the card") and provided the instructional cue (e.g., "What word?"). The teacher waited 4-seconds for the student's response. Correct and incorrect responses were recorded. Students received verbal praise for attending to the teacher's directions. No feedback for correct or incorrect responses was provided. Each word was presented once during baseline probe sessions.

In order to ensure that each targeted sight word was in the student's vocabulary, the student was presented with each item and then asked to name the item. Students were able to identify each item, but occasionally called the item by an alternate name than the targeted sight word (e.g., soda for coke; jacket for coat). To ensure that the targeted sight word was in the students' vocabulary, a receptive score for each object was established. Students were asked to point to each named object. All students were able to receptively identify each of the objects associated with the targeted sight word with 100% accuracy.

Assessment probes with and without error correction. Assessment probes were conducted prior to instruction each session except for the first session of instruction in which the students received an instructional session in isolation to control for errors between conditions of assessment probes with and without error correction. Probe sessions with error correction and without error correction were counterbalanced with one session occurring in the morning and one session in the afternoon. At the beginning of each probe session the teacher asked the student to shuffle the word cards to randomize the presentation order.

During the error correction condition, the teacher presented each of the stimulus cards within the targeted word set, individually, along with an attentional cue to ensure that the student was attending to the stimulus (i.e., "Touch the card). Once the student's attention was secured the teacher provided the instructional cue (i.e., "What word?"), the teacher provided a response interval of 4-seconds. If the student responded correctly to the word the teacher provided verbal praise along with a prompt to find the object from an array of three items (i.e., "Good reading. Find one."). Prior to correctly reading the word, the objects were kept out of sight in order to ensure that the students did not have

additional cues to possible correct responses. If the student found the corresponding object the teacher provided verbal praise. If the student did not find the corresponding object, the teacher provided error correction for the comprehension component of the trial. If the student read the word incorrectly or did not respond after the 4-second response interval, the teacher provided the controlling prompt along with a second opportunity for the student to respond (i.e., "No, this word is ___. What word?"). If the student responded correctly to the error correction procedure the teacher provided verbal praise for reading the word correctly (i.e., "Good reading."). If the student responded incorrectly to the error correction, then the teacher repeated the error correction with an additional opportunity to respond. If the student did not respond correctly to the second error correction opportunity, the teacher presented the next trial. Each word within the set was presented three times per probe session for a total of 9 trials.

During the without error correction condition, the teacher presented each of the stimulus cards within the targeted word set, individually, along with an attentional cue to ensure that student was attending to the stimulus (i.e., "Touch the card) Once the teacher gained the student's attention the teacher presented each of the stimulus cards within the targeted word set, individually, along with an attentional cue to ensure that student was attending to the stimulus (i.e., "Touch the card). The teacher then provided the instructional cue (i.e., "What word?") and provided a response interval of 4-seconds. If the student responded correctly the teacher provided verbal praise paired with a prompt to demonstrate comprehension (i.e., "Good reading, can you find one?"). If the student did not read the word correctly, the teacher presented the next word card with no feedback. If

the student did not respond to the instructional cue, the teacher waited 4-seconds and then presented the next trial.

Mastery criterion for each condition was set at 9 trials correct for two consecutive sessions per word set. When the student met the mastery criteria for one condition, he/she continued to receive instruction for the second condition in which he or she had not met mastery criteria. Once the students reached mastery for the two word sets taught within the first tier of the multiple baseline design, the student began instruction following the same procedures for the two new word sets in tier two.

Instructional sessions. Instructional sessions for simultaneous prompting both with and without error correction during assessment probes followed the standard simultaneous prompting procedures. The teacher gained the student's attention by having the student touch the sight-word card. Once the student's attention was secured the teacher provided the instructional cue and the controlling prompt simultaneously (i.e., "What word? cap). If the student responded correctly the teacher provided verbal praise (i.e., "Good reading") and then provided a prompt to measure comprehension (i.e., "Can you find one?"). If the student responded incorrectly or did not respond, the teacher provided error correction and asked the student to demonstrate comprehension (i.e., "No, this word is cap. What word?"). If the student did not respond or responded incorrectly to the second prompt, the teacher presented the next trial with the next word. The teacher recorded correct and incorrect responses during instructional sessions. During instructional sessions each word was presented three times for a total of 9 trials per session.

Maintenance. Following mastery of the two word sets within a tier of instruction, the students were probed at two- and four-weeks. Each student was presented with the previously mastered sight words. The teacher presented one word card at a time, gained the student's attention (i.e., "Touch the card."), and asked the instructional cue (i.e., "What word?"). The teacher waited four-seconds for the student to respond. If the student responded correctly, he/she was asked to find the related object from an array. If the student responded incorrectly or did not respond within the response interval, the teacher presented the next trial. Each word was presented three times during maintenance probes. The teacher recorded correct and incorrect responses.

Procedural fidelity. Procedural fidelity was calculated across both probe conditions and all instructional sessions through the use of a teacher behavior checklist. The number of observed teacher behaviors was divided by the number of expected teacher behaviors and multiplied by 100%. Procedural fidelity for Jen was calculated for 30 % of probes with and without error correction at 100% accuracy. Procedural fidelity was calculated for 30% of instructional sessions across both conditions for Jen at 99% (range 87-100%). Fidelity for Kyle was calculated for 30% of probes with error correction at 99.9% (range 98-100%) and 30% of probes without error correction at 99.7% (range 98-100%). Fidelity was calculated for 30% of Kyle's instructional sessions at 99.8% (range 98-100%). Procedural fidelity for Chloe was calculated for 30% of probes with error correction at 99.9% (range 98-100%) and for 30% of probes without error correction at 99.9% (range 98-100%).

Interobserver agreement. Interobserver agreement was measured using point by point agreement. The primary researcher reviewed videotaped sessions and

simultaneously collected data of the probe and instructional session. The researcher compared student responses recorded by the primary data collector, the classroom teacher, and the responses recorded by the researcher. Interobserver agreement for Kyle was calculated for 30% of probes with error correction at 99.8% (range 89-100%) and 30% of probes without error correction at 99% (range 89-100%). Agreement for Kyle's instructional sessions across conditions was calculated for 30% of sessions at 99% (range 89-100%). Interobserver agreement for Chloe was calculated for 30% of probes with error correction at 99% (range 89-100%) and 30% of probes without error correction at 99.7% (range 89-100%). Agreement for Chloe's instructional sessions across conditions was calculated for 30% of sessions at 100%. Interobserver agreement for Jen was calculated for 30% of probes with and without error correction at 100%. Agreement for Jen's instructional sessions across conditions was calculated for 30% of sessions at 100% agreement.

Social validity. The classroom teacher and the participants completed social validity questionnaires following completion of the experiment. The researcher provided the classroom teacher with a six item questionnaire in which the teacher responded to each statement based on a five-point likert-type scale (Appendix D, *Teacher Social Validity Questionnaire*). The teacher strongly agreed to each of the six items on the questionnaire. The student questionnaire was administered to the student by the classroom teacher (Appendix E, *Student Social Validity Questionnaire*). The teacher asked each student individually a set of five yes/no questions. The teacher recorded each student's response. All three students responded yes to four of the five questions. When

the students were asked if they like it when the teacher did not correct their mistakes, two of the three students responded no.

Results

Figures 1-3 present the reading data for three students across four word sets. Students were taught each word set using simultaneous prompting with acquisition measured under two different probing conditions (i.e., assessment probes with error correction and assessment probes without error correction) within an adapted alternating treatments embedded in a multiple baseline design across word sets. The adapted alternating treatments design allows for the comparison of two conditions across stimuli while allowing for comparison of efficiency data by examining the number of sessions to mastery across both conditions. The two conditions were counterbalanced across word sets, time of day, and students. The mastery criterion for movement from one tier to the next was nine correct trials for two consecutive sessions for both conditions. Across all three students a functional relation was established through the multiple baseline design for the acquisition of sight words through simultaneous prompting. A functional relation was established for error correction during probes for two of the three students across word sets.

Figure 1 presents the reading for Jen. During the first tier of instruction, Jen required 4 sessions to mastery for probes with error correction and 6 sessions to mastery for probes without error correction. There was a slight fractionation in the data; however, in general her data were undifferentiated. Jen had a mean reading performance score of 8.5 words read correctly for probes with error correction and a mean reading score of 6.8

words read correctly for probes without error correction. During the second tier of instruction, Jen required 6 sessions to mastery for probes with error correction and 4 sessions to mastery for probes without error correction. Her mean reading performance score was 7.25 words read correctly for probes with error correction. Her mean reading performance score was 7.8 words read correctly for probes without error correction. Percent of All Nonoverlapping Data (PAND) points was calculated at 100% for both conditions across both tiers. During the first tier of instruction, Jen maintained all three sight words taught in the probes with error correction condition at two and four weeks after criterion. However, she only maintained one of the three words in the probes without error correction condition at two and four weeks after criterion was met. During the second tier of instruction, Jen maintained two of the three words taught in the probes without error correction at the two-week maintenance probe, but did not maintain any of the words taught in the probes with error correction condition at the two-week maintenance probe. However, at the four-week maintenance probe Jen correctly read all three words from both of the probe conditions.

Figure 2 presents the reading data for Kyle. During the first tier of instruction, Kyle required 20 sessions to mastery for probes with error correction and 27 sessions to mastery for probes without error correction. There was not a clear fractionation of the data. However, there were slight differences in mean reading performance across the two conditions. Kyle had a mean reading performance of 6.55 words read correctly for probes with error correction. His mean reading performance score was 5.37 words read correctly for probes without error correction. During the second tier of instruction, Kyle required 28 sessions to mastery for probes with error correction and 30 sessions to mastery for

probes without error correction. His mean reading performance score was 6.29 words read correctly for probes with error correction. His mean reading performance was 4.47 words read correctly for probes without error correction. PAND was calculated for both conditions across both tiers. PAND for probes with error correction was calculated at 95% in the first tier and 100% in the second tier. PAND for probes without error correction was calculated at 100% in the first tier and 77% in the second tier. During the first tier of instruction, Kyle maintained two of the three words taught in the with error correction probes and one of three words taught without error correction probes at two-weeks after criterion was met. Four weeks after instruction of the first two word sets, Kyle maintained one of the three words in both probe conditions. In the second tier of instruction Kyle maintained one of the three words with error correction probes and two of the three words without error correction probes two-weeks after criterion was met. During the four-week maintenance probe Kyle correctly read one of the three words in each probe condition.

Figure 3 presents the reading data for Chloe. During the first tier of instruction, Chloe required 20 sessions to mastery for probes with error correction and 22 sessions to mastery for probes without error correction. Even though there was no clear fractionation of the data there was a clear difference in mean reading performance scores across the conditions. Chloe's mean reading performance for probes with error correction was 6.05 words read correctly. Her mean reading performance for probes without error correction was 4.27 words read correctly. During the second tier of instruction, Chloe required 28 sessions to mastery for probes with error correction and 32 sessions to mastery for probes without error correction. Initially there appeared to be a slight fractionation in the data

across the first 38 instructional sessions of probe data, but during the remaining sessions the data were undifferentiated. However, there was a difference in the mean reading performance data across the two conditions. Chloe's mean reading performance for probes with error correction was 6.29 words read correctly. Her mean reading performance for probes without error correction was 2.66 words read correctly. PAND was calculated across both conditions and both tiers. Across both tiers, PAND for probes with error correction was 100%. PAND for probes without error correction was 73% for the first tier and 75% for the second tier. During the first tier of instruction, Chloe maintained only one of the three words from each probe condition at the two-week maintenance probe. However, during the four-week maintenance probe she correctly read two of the three words in the probe with error correction and all three words in the probe without error correction. During the second tier of instruction, Chloe read correctly one of the three words in the probe with error correction at the two-week probe and two of the three words in the probe with error correction at the four-week probe. She was unable to read correctly any of the words from the probes without error correction at both the two- and four-week maintenance probes.

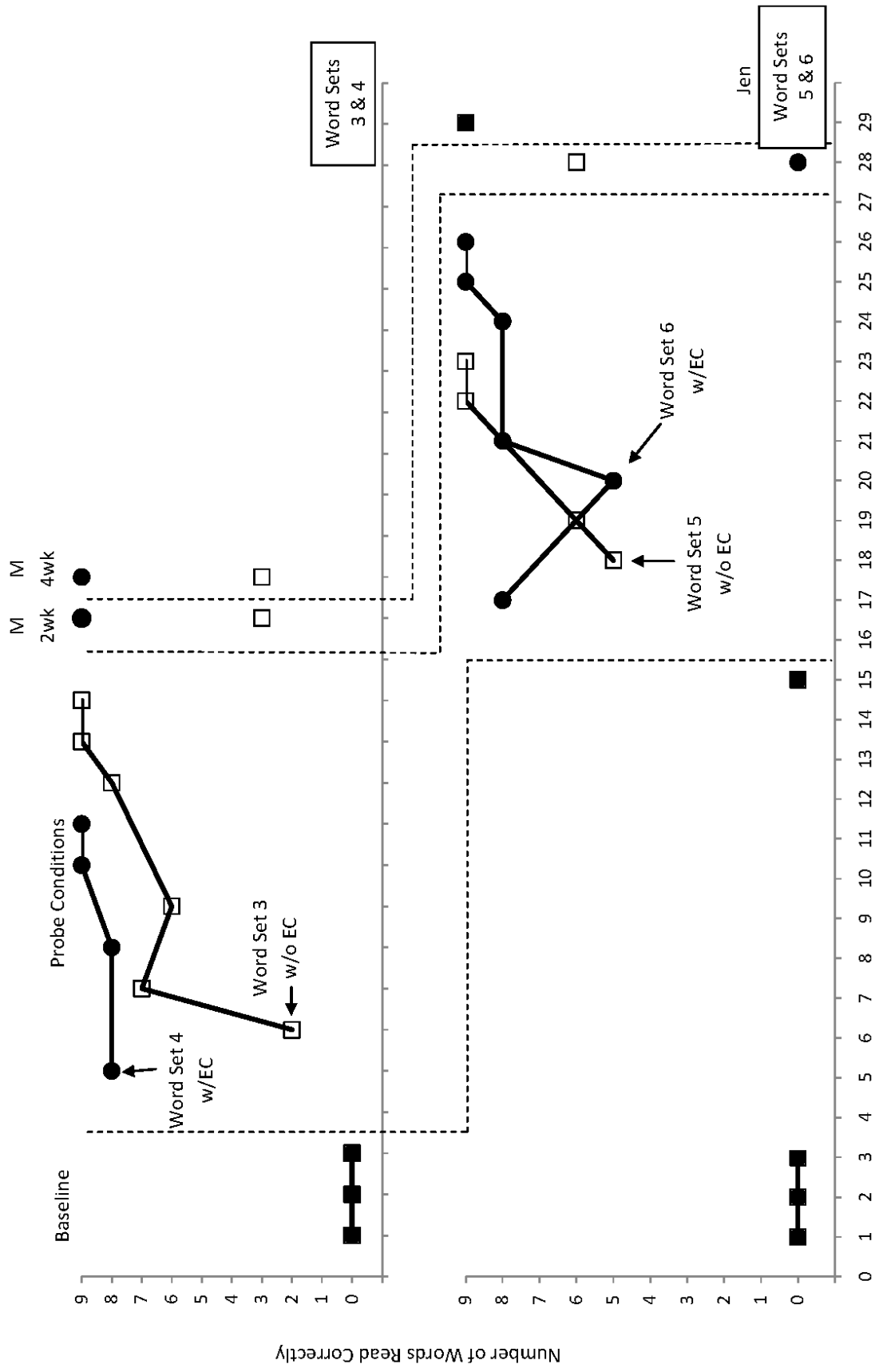

Figure 1. Presents the reading data for Jen in an adapted alternating treatment embedded in a multiple baseline design across word sets. M represents a maintenance probe.

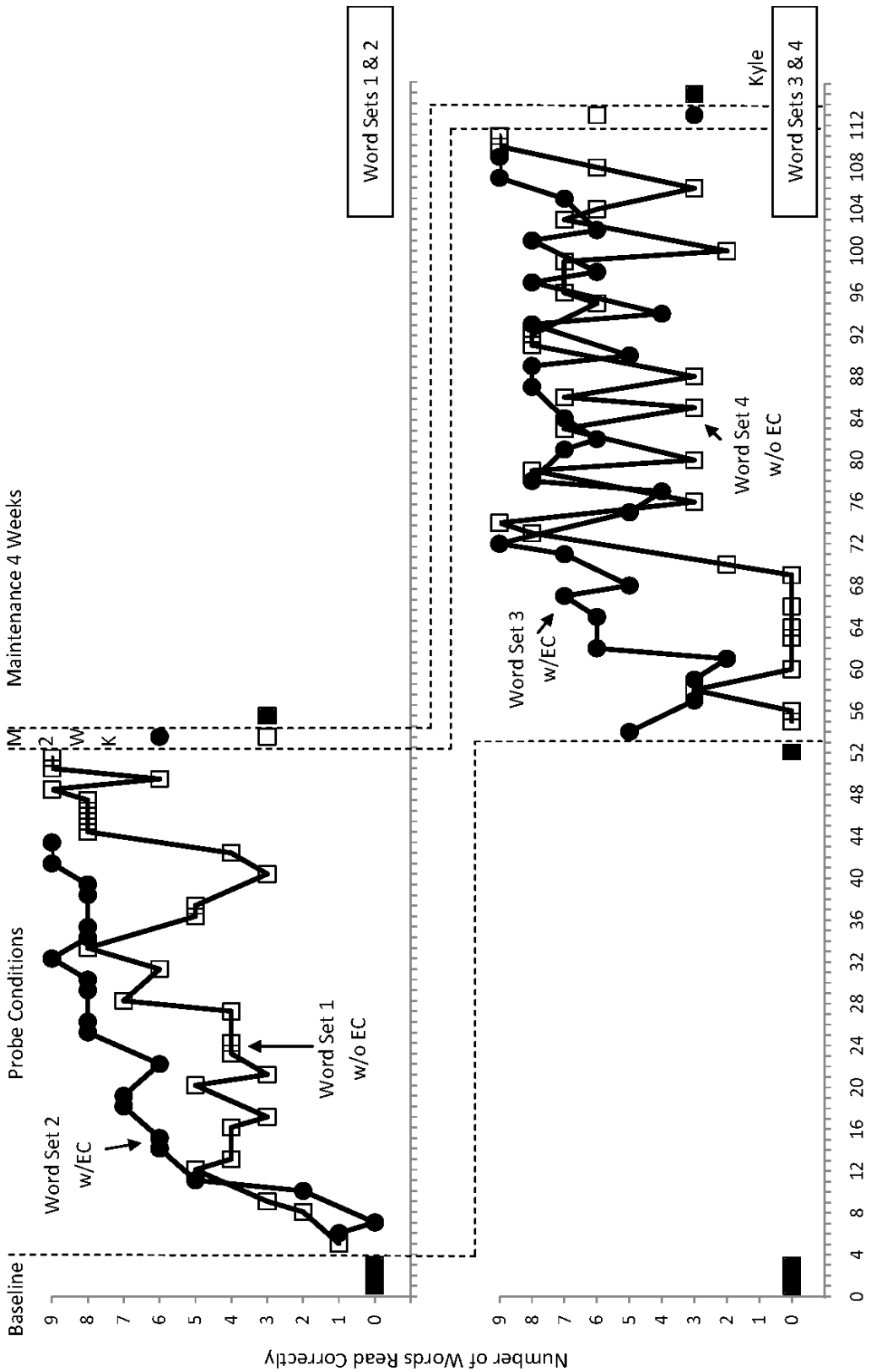

Figure 2. Presents the reading data for Kyle in an adapted alternating treatment embedded in a multiple baseline design across word sets. M represents maintenance probe.

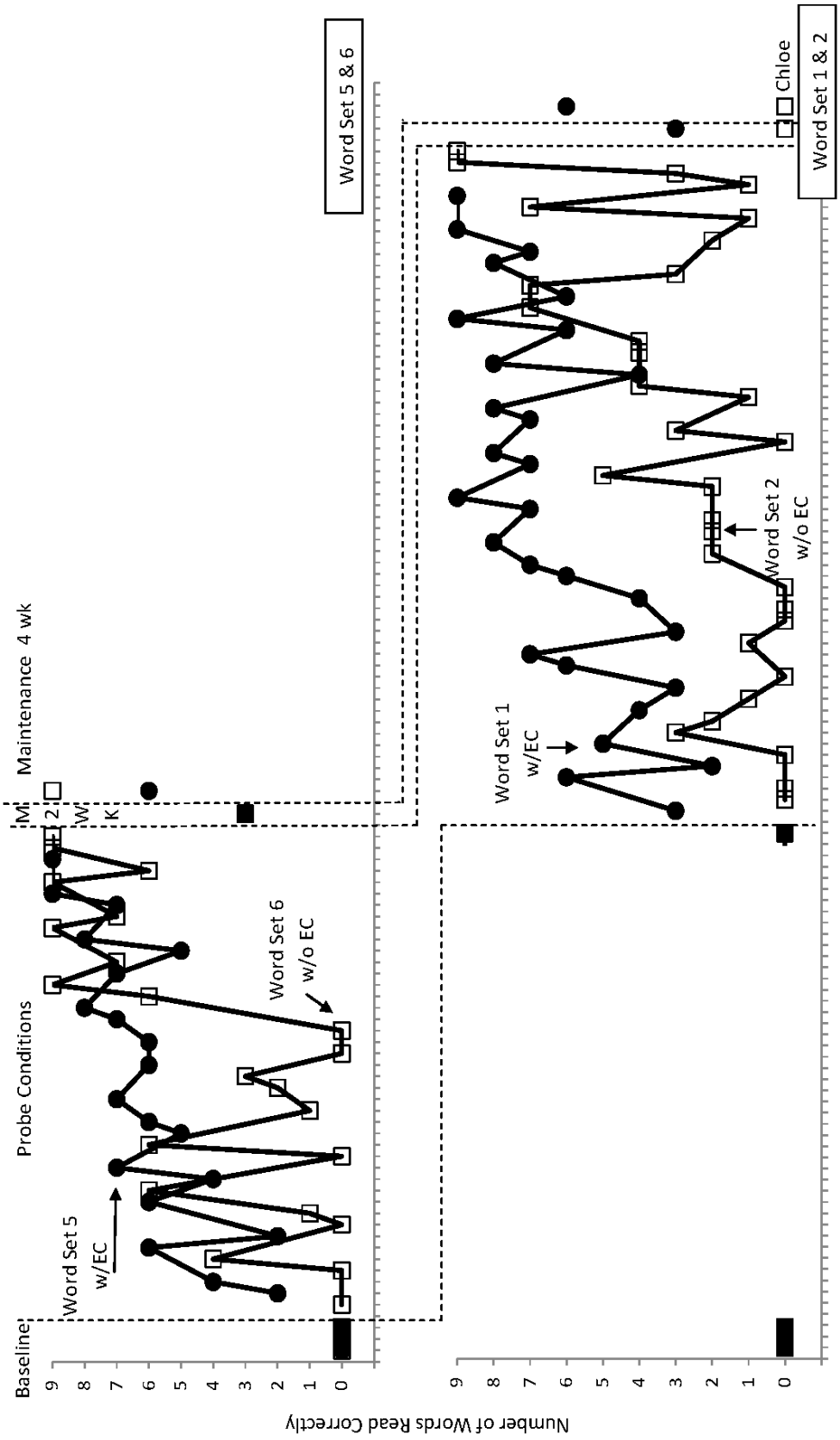

Figure 3. Presents the reading data for Chloe in an adapted alternating treatment embedded in a multiple baseline design across word sets. M represents a maintenance probe.

Table 6 present the comprehension data for the three students across the four word sets. Baseline data were collected on the student's receptive ability to identify each of the objects that corresponded with the written sight words. Because the students were unable to read any of the sight words during baseline probes no data were collected for baseline comprehension. Comprehension data consists of the same number of sessions as each student's individual reading data. During probe sessions students were only asked to demonstrate comprehension of a written word if they were able to read the word correctly. When Jen correctly read the word, she demonstrated comprehension at 100% across all conditions. Kyle was able to correctly identify comprehension of each word read correctly in both tiers of instruction for the with error correction probe condition. However, during the probes without error correction Kyle incorrectly demonstrated comprehension for seven words during the first tier and for one word read in the second tier. Chloe correctly demonstrated comprehension for all words read in the probes with error correction condition across both tiers of instruction and only misidentified comprehension for one word read in the without error correction probe condition.

Tables 7 and 8 contain efficiency data for both probing and instructional sessions. Table 3 presents the data concerning the number of errors emitted by each student in each condition. There is considerable variation in the error rates between the two probing conditions. Probes with error correction resulted in a total of 269 errors out of a total of 954 trials for an error rate of 29%. Probes without error correction resulted in a total of 561 errors out of a total of 1089 trials for an error rate of 52%. Each participant emitted fewer errors during probes with error correction than probes without error correction. Across all instructional sessions for both conditions, Kyle was the only student to emit an

Table 6

Comprehension Data

Student	Word Sets	Number of Probe Comprehension Errors
Jen	4	0
	3	0
	5	0
	6	0
Kyle	2	0
	1	7
	4	1
	3	0
Chloe	6	0
	5	0
	1	0
	2	1

error. He made one error during the instructional sessions for each probe condition. All remaining trials during instruction resulted in a zero percent error rate. In order to further examine the effects of error correction on the students' response to the same stimuli over spaced trials, the researcher calculated the percent of probe trials with and without error correction that resulted in correct responses on the next subsequent probe trial of the same word during that probe session, "next-trial corrects" (Drevno, et al., 1994, p.179).

For Jen in the first tier of instruction, she correctly responded to the next subsequent trial in which she received error correction for 7% of trials. She did not respond incorrectly on any subsequent trials for which she had received corrective feedback. For trials in which she did not receive error correction, she responded incorrectly on 17% of subsequent trials and correctly on 5% of subsequent trials. In the second tier of instruction with error correction, Jen responded correctly on 14% of subsequent trials and incorrectly on 3% of subsequent trials. For trials in which she did not receive error correction, Jen responded correctly and incorrectly for 8% of subsequent trials in which she did not receive feedback. For Kyle, the data were mixed. During the first tier of instruction, Kyle correctly responded to the next subsequent trial in which he received error correction for 13% of trials. Without error correction Kyle responded correctly on 14% of subsequent trials. During the second tier of instruction when Kyle received corrective feedback he responded correctly on 26% of the next subsequent trial of the same word. When he did not receive feedback he responded correctly on 15% of the next subsequent trial of the same word. Chloe responded correctly on 26% of subsequent trials in which she received corrective feedback and 11% of subsequent trials in which she did not receive feedback during the first tier of instruction. During the second tier of instruction, Chloe responded correctly on 28% of subsequent trials for which she received corrective feedback and she responded correctly on 14% of subsequent trials for which she did not receive corrective feedback.

Table 7

Errors across Word Sets

Student	Word Set	No. of Errors during Probes w/EC	% of Errors during Probes w/EC	No. of Errors during Probes w/o EC	% of Errors during Probes w/o EC	No. Errors during Instructional Sessions	% of Errors during Instructional Sessions
	3	X	X	13	24%	0	0%
Jen	4	2	6%	x	X	0	0%
	5	X	X	7	19%	0	0%
	6	7	13%	x	X	0	0%
	1	X	X	98	40%	1	0.4%
Kyle	2	49	27%	x	X	1	0.5%
	3	76	30%	x	X	0	0%
	4	X	X	136	50%	0	0%
	5	59	33%	x	X	0	0%
Chloe	6	X	X	104	53%	0	0%
	1	76	30%	x	X	0	0%
	2	X	X	203	70%	0	0%

Probes with error correction required fewer sessions to criterion than probes without error correction. Across all three students, probes with error correction required 15 fewer sessions to criterion than probes without error correction. Jen was the only student who required fewer sessions to mastery during probes without error correction for Word Set 5 during the second tier of instruction. Both Kyle and Chloe required fewer sessions to mastery during probes with error correction across both tiers of instruction.

Although probes with error correction required fewer sessions to criterion than probes without error correction this resulted in minimal differences in the amount of time between the two probing conditions. Table 8 presents the data concerning the amount of probe and instructional time for each student in each condition. Probes with error

correction required a total of 2 hours, 5 minutes, 56 seconds across three students and two word sets. Probes without error correction required a total of 2 hours, 8 minutes, 21 seconds across three students and two words sets, for a difference of 2 minutes, 25 seconds between the two probing conditions. Jen required fewer overall total minutes of probe time without the error correction procedure; this was not clearly demonstrated across the two tiers. During the first tier of instruction she required fewer minutes of probing with error the correction procedure (i.e., 5 minutes, 30 seconds) in comparison to without the error correction procedure (i.e., 7 minutes, 31 seconds). However, in the second tier of instruction she required fewer minutes of probing without the error correction procedure (i.e., 4 minutes, 40 seconds) than with the error correction procedure (i.e., 6 minutes, 50 seconds). These findings were similar for Kyle, who required fewer minutes of probing with the error correction in the first tier and fewer minutes of probing without error correction in the second tier of instruction.

Table 8

Probe and Instructional Time

Student	Total Length of Probe Sessions w/EC (minutes)	Total Length of Probe Sessions w/o EC (minutes)	Average Length of Probe Session (minutes)	Total Length of Instructional Sessions (minutes)	Average Length of Instructional Sessions (minutes)
	X	7.31	1.15	6.45	0.58
Jen	5.30	X	1.23	5.09	1.01
	X	4.40	1.10	4.54	0.59
	6.50	X	1.08	6.46	0.58
	X	29.58	1.06	28.22	1.01
Kyle	25.29	X	1.16	20.13	0.58
	30.58	X	1.06	25.07	0.52
	X	28.38	0.57	26.46	0.52
	23.39	X	1.11	17.28	0.50
Chloe	X	24.29	1.06	17.22	0.45
	33.30	X	1.12	24.02	0.49
	X	33.05	1.02	24.22	0.44

DISCUSSION

The purpose of this study was to assess the effectiveness and efficiency of error correction during assessment probes to reduce error rates in teaching sight words to students with MoID. Simultaneous prompting has been demonstrated to be an effective strategy for teaching a variety of discrete skills, such as sight words to students with MoID (Birkan, 2005; Gibson & Schuster, 1992; Griffen et al., 1998; Riesen et al., 2003; Schuster et al., 1992; Singleton et al., 1995; Singleton et al., 1999; Tekin-Iftar, 2003; Waugh et al., 2009). However, researchers also have noted while the procedure is effective there is a disparity between the numbers of errors students emit during probe versus instructional sessions (Birkan, 2005; Colozzi et al., 2008; Dogan & Tekin-Iftar,

2002; Fickel et al., 1998; Johnson et al., 1996; Maciag et al., 2000; Morse & Schuster, 2004; Singleton et al., 1995). The goal of an effective and efficient strategy is to produce low rates of errors and rapid acquisition rates. The findings of this study provide further data to demonstrate effectiveness of simultaneous prompting in teaching sight words to students with MoID. This study also provides initial support for the use of error correction during assessment probes to reduce the discrepancy between errors emitted during probe and instructional sessions for students with MoID.

A functional relation was demonstrated for the effective use of simultaneous prompting to teach sight words in both probing conditions by the replication across word sets by each of the three students. Simultaneous prompting with error correction during assessment probes was slightly more efficient than simultaneous prompting without error correction during assessment probes for two of the three students. Error correction during assessment probes required fewer sessions to criterion, resulted in fewer probe errors, resulted in a higher percentage of correct responding on the next subsequent trial, and required less total probe time. For two of the three students, probes with error correction resulted in a more rapid acquisition rate requiring fewer sessions to criterion. However, this difference was often minimal with students requiring on average an additional three sessions (range 2-7 sessions). Mean error rates during assessment probes in which error correction was provided for incorrect responses was calculate at 29% with a range of 6-33% of trials. However, when students were not provided with error correction for incorrect responses during assessment probes mean error rates were calculated at 52% of trials with a range of 19-70% of trials resulting in errors. Although the total probe time was less with error correction than with probes without error correction, this finding

should be evaluated cautiously. Across all three students three out of six tiers required less time when error correction was provided for incorrect response.

Maintenance data were inconclusive as to the more effective probing condition for maintaining the sight words two- and four-weeks after mastery. For example, Jen demonstrated better maintenance with error the correction probe condition with the first two word sets for both the two- and four-week maintenance probes. However, during the second tier of instruction, Jen demonstrated better maintenance with words associated with the without error correction probes at 2-weeks after criterion, but produced better maintenance results with words associated with error correction probes at 4-weeks after criterion. Lack of maintenance across the two conditions may indicate that the mastery criteria were not effective in order for the students to maintain the sight words taught. The criterion was set at 100% accuracy (9 trials correct) for two consecutive sessions. Students may have required more sessions at that mastery criterion in order to maintain the words over time.

The findings as to error rates are commensurate with the findings of previous research with higher rates of errors occurring during probe sessions as compared to instructional sessions. The findings from this study coincide with Morse and Schuster's (2004) review of the literature on simultaneous prompting reports of error rates between 4-54% of trials during probes and 0-5% of trials during instructional sessions and Johnson et al. (1996) findings that error correction during assessment probes resulting in the emission of fewer errors with students with mild disabilities (e.g., learning disabilities, mild intellectual disabilities). Even though error rates were reduced when error correction was provided with assessment probes, future research should examine

combining error correction during probes and intermittent probes to further reduce the rate of errors. Previous researchers have recommended both of these modifications in order to reduce the rate of errors that occur in probe sessions (Birkan, 2005; Dogan & Tekin-Iftar, 2002; Fickel et al., 1998; Gibson & Schuster, 1992; Johnson et al., 1996; Maciag et al., 2000; Parker & Schsuter, 2002; Tekin-Iftar et al., 2003; Wolery et al., 1993). Several studies have examined the effects of each of these recommendations in isolation but none have examined the joint effects of these two procedures.

Simultaneous prompting is a simple procedure to implement within a classroom setting. Researchers have demonstrated that the procedure can be implemented by a variety of individuals at high levels of fidelity including teachers (e.g., Gibson & Schuster, 1992), paras (Colozzi et al., 2008), peer tutors (Tekin-Iftar, 2003), and parents (Tekin-Iftar, 2008). This study further supports these findings for teachers by demonstrating the high level of fidelity associated with the procedure. Another component of implementation of the procedure is the availability of time and the time requirement to implement the procedure. This study demonstrates that simultaneous prompting can be implemented and be effective in relatively short periods of time. The average probe session for the error correction condition required approximately 1minute, 12 seconds to implement per student and the instructional sessions required on average 55 seconds. The average probe session for the without error correction condition required approximately 1minute, 6seconds to implement per student and the instructional sessions required on average 53 seconds. The minimal probe and instructional time required in combination with the effectiveness of the procedure in teaching sight words to students with MoID may make simultaneous prompting an advantageous response prompting

strategy. Significantly less time was required for instructional sessions than probe sessions. This would be expected as in instructional sessions students are provided immediately with the controlling prompt and the teacher directly controls the pace of instruction. However, the fact that students were engaged in longer periods of time during probes than instruction suggests an imbalance between assessments and instruction. In the current study the ratio of probe to instructional trials was 1:1. If the goal is to reduce the number of errors that students make then it would seem advantageous to provide more instructional trials than probe trials. Future research may examine the most effective ratio of probe to instructional trials to assist students with the transfer of stimulus control from the controlling prompt to the discriminative stimulus.

While error correction reduced the percent and number of errors the students' emitted during probes it did not greatly impact the number of sessions to criterion. This finding may be the result of the frequency of instruction. Once the student reached criterion for one word set in one condition the remaining word set received instruction in the residual condition during the remaining sessions. As a result students often received instruction for the remaining word set two times per day. While this is the result of the selected experimental design, this frequency of instruction often is not replicated in typical classroom settings due to the fact that students often receive literacy only once per day allowing for larger amounts of time between instructional sessions than was demonstrated in this study.

In summary, this study supports the use of error correction during assessment probes associated with simultaneous prompting in order to reduce error rates and increase acquisition rates. The goal of response prompting strategies is to provide students with

prompt to assist them with admitting the correct response. While simultaneous prompting is an effective response prompting strategy, it is the only strategy that allows students to respond independently to a stimulus without providing corrective feedback. This study demonstrates that the effectiveness of simultaneous prompting can be further increased by providing corrective feedback during the independent response opportunities.

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APPENDIXES

APPENDIX A

TEACHER BEHAVIOR CHECK SHEET:

DAILY PROBES WITH ERROR CORRECTION

Student: Date:
Observer: Word Set:

Treatment Integrity Trials	1	2	3	4	5	6	7	8	9
1. Teacher has student shuffle the sight-word cards.									
2. Teacher presents the sight-word card and provides attentional cue (i.e., *Touch the card).*									
3. If student does not touch the card, teacher models the behavior and provides the attentional cue (i.e., *Touch the card.*).									
4. If student does not touch the card after the second attentional prompt, then the teacher provides physical guidance to touch the card.									
5. Teacher provides instructional cue (i.e., *What word?*).									
6. Teacher waits 4-seconds for student to respond before providing error correction.									
7. Correct word-recognition response, teacher provides verbal praise (i.e., *Good reading.)*									
8. Correct word-recognition response, teacher provides comprehension instructional cue (i.e., *Show me one.*).									
9. Correct comprehension response, teacher provides verbal praise.									
10. Incorrect comprehension response, teacher provides error correction (i.e., *No, this is a ___.)*.									
11. Incorrect word-recognition response, teacher provides error correction with a second opportunity to respond (i.e., *No, this word is ___. What word?*).									
12. Correct response on 2nd word-recognition trial, teacher provides verbal praise.									
13. Incorrect response on 2nd word-recognition trial, teacher corrects and presents next word trial.									
Student Response (IOA)									

APPENDIX B

TEACHER BEHAIVOR CHECK SHEET:

DAILY PROBES WITHOUT ERROR CORRECTION

Student: Date:
Observer: Word Set:

Treatment Integrity Trials	1	2	3	4	5	6	7	8	9
1. Teacher has student shuffle the word cards.									
2. Teacher presents the word card and provides attentional cue (i.e., *Touch the card).*									
3. If the student does not touch the card then the teacher models the behavior while providing the attentional cue (i.e., *Touch the card.*).									
4. If the student does not touch the card after the second attentional cue, then the teacher will provide physical guidance to touch the card.									
5. Teacher provides the instructional cue (i.e., *What word?).*									
6. Teacher waits 4-seconds for student to respond before providing verbal praise or presenting the next trial.									
7. Correct word-recognition response, teacher provides verbal praise (i.e., *Good reading.*).									
8. Correct word-recognition response, teacher provides comprehension cue (i.e., *Show me one?*).									
9. Correct comprehension response, teacher provides verbal praise.									
10. Incorrect comprehension response, teacher provides no feedback and presents the next trial.									
11. Incorrect word-recognition response, teacher provides no feedback and presents the next trial.									
Student Response (IOA)									

APPENDIX C

TEACHER BEHAVIOR CHECK SHEET:

INSTRUCTIONAL SESSIONS

Student: Date:
Observer: Word Set:

Treatment Integrity Trials	1	2	3	4	5	6	7	8	9
1. Teacher has student shuffle the sight-word cards.									
2. Teacher presents the word card and provides attentional cue (i.e., *Touch the card).*									
3. If the student does not touch the card, then the teacher models the behavior while providing the attentional cue (i.e., *Touch the card.).*									
4. If the student does not touch the card after the 2nd attentional cue, then the teacher provides physical guidance.									
5. Teacher provides instructional cue and controlling prompt concurrently (i.e., *What word? cup*).									
6. Teacher waits 4-seconds for student's response before providing feedback.									
7. Correct word-recognition response, teacher provides verbal praise (i.e., *Good reading).*									
8. Correct word-recognition response, teacher provides comprehension instructional cue (i.e., *Can you find one?*)									
9. Correct comprehension response, teacher provides verbal praise.									
10. Incorrect comprehension response, teacher provides error correction (i.e., *No, this is a __.)*									
11. Incorrect word-recognition response, teacher provides error correction with 2nd opportunity to respond (i.e., *No, this word is ___. What word?*)									
12. Incorrect response on 2nd word-recognition trial, teacher provides corrective feedback (i.e., *No, this word is ___. Say ___.*) and presents next trial.									
Student Response (IOA)									

APPENDIX D

SOCIAL VALIDITY QUESTIONNAIRE

(TEACHER QUESTIONNAIRE)

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. There was time during the class day to implement sight-word instruction.	1	2	3	4	5
2. The data demonstrate that my students learned to read words taught with sight-word instruction.	1	2	3	4	5
3. The data demonstrate that my students were able to demonstrate comprehension of what they read.	1	2	3	4	5
4. The data demonstrate that error correction during daily probes was more effective in acquisition of sight words for my students.	1	2	3	4	5
5. The use of error correction during daily probes was more efficient in the acquisition of sight words for my students.	1	2	3	4	5
6. I will continue to use these activities to teach sight words to my students.	1	2	3	4	5

APPENDIX E

SOCIAL VALIDITY QUESTIONNAIRE

(STUDENT QUESTIONNAIRE)

1. Did you learn to read new words?	**YES**	**NO**
2. Did you enjoy reading instruction?	**YES**	**NO**
3. Did you like it when I told you the correct answer when you made a mistake?	**YES**	**NO**
4. Did you like it when I did not correct your mistakes?	**YES**	**NO**
5. Would you like to learn to read more words?	**YES**	**NO**