Establishment of Conditioned Reinforcement for Reading Content and Effects on Reading
Achievement for Early-Elementary Students

Lara M. Gentilini

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ABSTRACT

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Reading interest is a significant predictor of reading achievement, with effects on both reading comprehension and vocabulary. We measured students' interest in reading as an estimate of duration of observable reading using whole intervals of silent-reading time. In Experiment 1, we assessed associations among interest in reading (i.e., reinforcement value of reading) and the reading comprehension and vocabulary of 34 second-grade students. There were significant correlations between reading interest and these dependent measures. In Experiment 2, we simultaneously conducted a combined preintervention and postintervention design with multiple probe logic to test the effect of the establishment of a high interest in reading (i.e., conditioned reinforcement for reading) via a collaborative shared reading procedure with a teacher on reading comprehension and vocabulary. This procedure involved periods of reciprocal reading and related collaborative reading activities designed to increase students' interest in reading. The establishment of a high interest in reading for 7 of the participants resulted in grade-level increases from 0.1 to 2.2 grades on various measures of reading achievement in less than 9 sessions (315 min). In Experiment 3, we implemented a combined small-*n* experimental-control simultaneous treatment design and a single-case multiple-probe design with multiple-probe logic. We tested and compared the effects of the establishment of conditioned reinforcement for reading, via the collaborative shared reading procedure with a teacher versus a peer, on participants' gains in reading comprehension and vocabulary. All participants for whom conditioned reinforcement for reading was established in Experiment 3 ($n = 7$) demonstrated

gains in reading achievement after a maximum of nine sessions (412 min), with grade-level increases between 0.2 and 2.5 on measures of reading comprehension and 0.3 to 3.1 on measures of vocabulary. Based on a comparison of the dependent variables included in both Experiments 2 and 3, the modified teacher-yoked collaborative shared reading procedure in Experiment 2 resulted in greatest relative average gains in reading achievement for participants who acquired conditioned reinforcement for reading ($n = 3$). However, the modified collaborative shared reading procedure with a peer required the least amount of teacher mediation and may be more viable for teachers. This trans-disciplinary effort proposes an account of motivation to read as conditioned reinforcement for reading content and its effects on reading achievement, with the educationally-significant goal of establishing reinforcers for continued learning.

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DEDICATION

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Chapter I

Establishment of a High Interest in Reading and Effects on Reading Achievement for Early-

Elementary Students

Abstract

Reading interest is suggested to be a key component of reading achievement, which affects later academic performance. We measured students' interest in reading as an estimate of duration of observable reading behavior using whole intervals of silent-reading time. We assessed associations among interest in reading and the reading comprehension and vocabulary of 34 second-grade students. There were significant correlations between reading interest and multiple measures of both reading comprehension and vocabulary. We simultaneously conducted a combined preintervention and postintervention design with multiple probe logic to test the effect of the establishment of a high interest in reading, via a collaborative shared reading intervention with a teacher, on reading comprehension and vocabulary. This procedure involved periods of reciprocal reading and related collaborative reading activities designed to increase students' interest in reading. The establishment of a high interest in reading for 7 participants resulted in grade-level increases from 0.1 to 2.2 grades on various measures of reading achievement in less than 9 sessions (315 min). The results of this study suggest that it is not enough to learn the structure of reading: rather, one must learn to 'love to read' in order to derive meaning from text in his or her development of comprehension and vocabulary.

Keywords: reading achievement, reading comprehension, reading interest, reinforcement value, vocabulary

Establishment of a High Interest in Reading and Effects on Reading Achievement for Early-Elementary Students

Early reading abilities are a strong predictor of later reading achievement and overall academic performance. For example, three-fourths of students considered poor readers in third grade are also classified as poor readers in high school, demonstrating higher rates of retention in grade and more behavioral and social problems in successive grades compared to students with higher literacy achievement (Annie E. Casey Foundation; Miles & Stipek, 2006). Alas, only 36% of fourth-grade and 34% of eighth-grade students were considered to be on or above the *Proficient* level on the *National Assessment of Educational Progress (NAEP)* reading assessment, which measures both reading and comprehension skills (U.S. Department of Education, 2015). Furthermore, there was a decline in the overall average reading score for U.S. fourth-graders between 2011 and 2016, according to the *Progress in International Reading Literacy Study (PIRLS)* report (Warner-Griffin, Liu, Tadler, Herget, & Dalton, 2017). Considering that reading competence is a prerequisite for a wide range of academic skills (Cunningham & Stanovich, 1997; Juel, 1988; Stanovich, 1993), it is critical to determine which factors are associated with literacy development. Extensive research has suggested that reading achievement is comprised of inherent overlap between both “skill and will” (Watkins & Coffey, 2004), such that “motivation is what activates behavior” (Guthrie & Wigfield, 2000, p. 406).

In terms of reading skill, the ability to accurately and fluently decode words and the ability to comprehend spoken language are two of the most significant contributors to reading achievement (Kamhi & Catts, 2012). Other skill-based factors that mediate reading achievement include students’ background knowledge, as well as their inferencing and metacognitive abilities (Kamhi & Catts, 2012). However, the expansion and maintenance of one’s motivation to read is

also a critical prerequisite to the derivation of meaning from text, with much of the educational-research literature using the constructs of motivation, preference, and interest interchangeably despite conceptual differences (Conradi, Jang, & McKenna, 2014; Mazzoni, Gambrell, & Korkeamaki, 1999; Petscher, 2010; Schiefele, Schaffner, Möller, & Wigfield, 2012). Several studies have demonstrated a significant relation between intrinsic reading preference, reading amount, and comprehension, when controlling for variables such as reading achievement, background knowledge, and self-efficacy (e.g., Durik, Vida, & Eccles, 2006; Guthrie, Wigfield, Metsala, & Cox, 1999; Stutz, Schaffner, & Schiefele, 2016; Wigfield, Gladstone, & Turci, 2016; Wigfield & Guthrie, 1997a). Moreover, both reading motivation and reading amount have been established as important predictors of reading achievement (e.g., Becker, McElvany, & Kortenbruck, 2010; De Naeghel, Van Keer, Vansteenkiste, & Rosseel, 2012; Gottfried, Fleming, & Gottfried, 2001; Guthrie & Wigfield, 2000; Taboada, Tonks, Wigfield, & Guthrie, 2009). In addition to demonstrating that reading books is a primary predictor of increases in reading achievement, Anderson, Wilson, and Fielding (1988) reported that teachers significantly influence how much time children engage in reading outside of school, although it is not enough to simply assign more time for silent reading in the classroom to procure such effects (Bryan, Fawson, & Reutzel, 2003).

The evidence of the relation between reading interest, reading amount, and reading achievement is extensive. However, a major limitation of the existing body of research is that it is heavily rooted in qualitative and descriptive observational methods, often relying on ad hoc instruments such as retrospective self-report measures (Stutz et al. 2016; Wigfield et al., 2016). For example, researchers commonly employ attitude scales as measures of reading interest and motivation, including the initial *Motivations for Reading Questionnaire* (MRQ; Wigfield &

Guthrie, 1995, 1997a), *Motivation to Read Profile* (Gambrell, Palmer, Codling, & Mazzoni, 1996), and *Reading Motivation Questionnaire for Elementary Students* (Stutz, Schaffner, & Schiefele, 2017). These questionnaires are based on self-assessments of various aspects of reading motivations, with students rating their agreement with items across dimension such as curiosity (e.g., “I like to read about new things”), involvement (e.g., “I enjoy a long, involved story or fiction books), and efficacy (e.g., “I am a good reader) (Wigfield & Guthrie, 1995, 1997a). Such measures differ in both their underlying motivational theories and constructs, lacking a consistent theoretical frame of reference both within and across questionnaires (De Naeghel et al., 2012; Watkins & Coffey, 2004). Another limitation of the existing research on the role of motivation in reading is in its ability to offer consistent definitions of reading motivation that capture the construct’s multidimensionality in a valid and reliable way (Conradi et al., 2014; Petscher, 2010). For example, Murphy and Alexander (2000) reported in their review of motivation research that researchers explicitly defined only 38% of terms used, highlighting the need for a more precise and objective definition of such motivational constructs.

Whereas one might position ‘motivation,’ ‘preference,’ or ‘interest’ as the variables of interest from a psychological perspective, the theory of verbal-behavior development frames this construct in terms of the reinforcement value of reading (Catania, 1998; Greer & Ross, 2008; Greer & Speckman, 2009). This theory posits that when teaching a child to read, one must consider both the reinforcing value of reading, in addition to the functional features of the text (e.g., how the pictures relate to the corresponding sentences) and the structural organization of the behavior and environment (e.g., the details of the text and pictures) (Catania, 1998; Skinner, 1957). The student’s sustained choice of reading material constitutes a measure of reinforcement value or, in more general terms, his or her interest in reading (Skinner, 1945). We are therefore

defining interest in reading as the moment-to-moment selection of the student's attention to reading material and the degree to which the text maintains this attention, such that this sustained behavior is controlled by the embedded reinforcement of the text's content (Greer & Ross, 2008; Greer & Speckman, 2009; Skinner, 1957, 1969).

However, neither looking at books nor reading their content are automatically interesting or reinforcing to young children: rather, they become conditioned as reinforcers when observing book stimuli and early reading responses are experienced in close proximity with consequences that are added by others, such as positive social interaction (Vargas, 2013). Researchers often employ respondent or operant conditioning techniques to increase the reinforcement value of developmentally- and academically-functional stimuli by increasing students' interest in activities or objects that were not previously reinforcing (Greer, 2002). Such procedures comprise stimulus-stimulus pairings, in which a stimulus that does not demonstrate reinforcing characteristics comes to do so through proximate association with a stimulus that is already established as a reinforcer (Pavlov, 1927). For example, several studies have demonstrated the use of contingent social attention to increase students' interest in academic stimuli that were not initially highly preferred (e.g., Buttigieg, 2015; Lee, 2016; O'Rourke, 2006; Tsai & Greer, 2006). From a psychological perspective, the purpose of such conditioning procedures is to shift from extrinsic motivation, or an emphasis on some external reward or recognition that sustains a given behavior, to intrinsic motivation, or emitting a behavior for the sake of interest (Deci & Ryan, 1985; Deci, Vallerand, Pelletier, & Ryan, 1991). Through pairing with some form of social contact—whether direct reinforcement or the observation of peers—such procedures have been used effectively to condition a range of neutral stimuli as reinforcers (Delgado, Greer, Speckman, & Goswami, 2009).

While such pairing procedures are effective in increasing students' interest in a range of stimuli, there are also collateral effects of conditioning new stimuli as reinforcers, including increased rates of acquisition of related skills (Buttigieg, 2015; Delgado et al., 2009; Keohane, Luke, & Greer, 2008; Tsai & Greer, 2006). In the early stages of learning, building reinforcement intrinsic to stimuli that attract observing responses such as listening to voices (Greer, Pistoljevic, Cahill, & Du, 2011) or looking at faces (Maffei, Singer-Dudek, & Keohane, 2014) results in children being able to learn faster and in ways they previously could not. Furthermore, conditioned reinforcement for observing books also serves an academic function, considering that choosing to look at books is associated with reading readiness (Morrow, 1983). Children who look at books frequently and freely are more likely to be exposed to a variety of words, pictures, and concepts, with book stimuli selecting out the attention of these 'voluntary readers' (Buttigieg, 2015). It has also been demonstrated that the establishment of conditioned reinforcement for book stimuli (e.g., print symbols) via stimulus-stimulus pairing procedures with social reinforcers accelerates the rate of learning of learning to read words for preschool-aged students (Buttigieg, 2015; Tsai & Greer, 2006).

As students progress from the early stages of decoding to reading for aesthetic effects or reading to learn, content becomes the reinforcement needed to sustain the reader's interest. To extend the work on conditioned reinforcement for looking at books, researchers have designed instructional consequences such that the content of the text selects out the attention of the student, thus enhancing students' interest in reading. Researchers have previously included collaboration with peers and adults as a critical component of successful interventions for increasing the reading motivation of elementary students, in terms of gaining information and communicating understanding (Cumiskey Moore, 2017; Guthrie, Wigfield, & VonSecker, 2000).

In addition, researchers often include cooperative situations and activity-based reading tasks as components of interventions to increase students' motivation for reading (Nolen & Nicholls, 1994; Pressley, Yokoi, Rankin, Wharton-McDonald, & Mistretta-Hampston, 1997; Turner, 1995). For example, Cumiskey Moore (2017) paired peer social interaction with periods of overt and covert reading to increase the reading interest of fifth-grade students who were above grade-level in reading, utilizing a procedure comprised of opportunities for back-and-forth shared reading between peers. In addition, the procedure involved collaborative activities related to the text for which partners were required to work together to each receive reinforcement (Greer & Ross, 2008; Hamann, Warneken, & Tomasello; 2012; Skinner, 1957). As a result, Cumiskey Moore reported grade-level increases of 0.7 to 3.8 on measures of reading comprehension within a period of a few months with fifth graders, further suggesting that the effects of conditioning procedures extend beyond increasing the reinforcement value of the intended stimuli to gains in related academic skills.

Experiment 1

Given the extensive research on reading motivation, reading amount, and reading comprehension and vocabulary, a goal of the present study was to determine which reading-achievement outcomes are associated with interest in reading amongst second-grade students. Based on previous findings, we hypothesized that there would be significant positive correlations between students' interest in reading and measures of both reading comprehension and vocabulary. We utilized the percentage of whole-interval recording of reading during assigned silent-reading periods as a measure of reading interest, with this observational procedure highly correlated with automatically recorded, continuous measurement in a highly-controlled setting (Greer, 1981; Greer, Dorow, Wachhaus, & White, 1973). Due to the aforementioned limitations

of previous methods of measuring reading interest, an experimental investigation of the correlates of reading interest in the classroom setting can provide a more meaningful account of the factors that casually influence successful acquisition of repertoires underlying reading achievement (Sweet & Snow, 2003; Wigfield et al., 2016).

Method

Participants. We selected 34 second-grade students (52.9% male) with a mean age of 7.8 years ($SD = 0.36$ years) via a convenience sampling procedure across two cohorts of second-grade students in a Title I K-2 public elementary school (Table 1). The classroom utilizes the empirically-supported Comprehensive Application of Behavior Analysis to Schooling (CABAS®) Accelerated Independent Learner (AIL) model of education (www.cabasschools.org), which emphasizes an individualized system of instruction to promote accelerated learning for a wide range of students at varying academic and verbal levels (Greer, 2002; Greer, Keohane, & Healy, 2002; Singer-Dudek, Speckman, & Nuzzolo, 2010). At the start of the study, participants varied in reading level based on their performance on two reading assessments: the *Developmental Reading Assessment, Second Edition*® (DRA2®) (Pearson Education, 2006) and the *i-Ready*® K-12 Adaptive Reading Diagnostic (Curriculum Associates, LLC, 2017) (Table 1).

Measures and materials. As a measure of reading interest, the experimenter individually video-recorded participants during 10-min periods of class-wide silent reading. The experimenter set up a recording device (i.e., iPad, iPhone, video camera, or laptop) on each participant's desk, 1 to 2 ft from the participant. The experimenter positioned the camera in such a way that the participant's eyes were visible for the entirety of the silent-reading session. Prior to the silent-reading probe sessions, the experimenter provided each participant with two to seven books in

the range of his or her reading level. We based the participants' reading levels on his or her performance on the *DRA2*[®] immediately prior to the onset of the study, an assessment with excellent test-retest reliability among early-elementary students (Pearson Education, 2011). In addition, the experimenter covered the books' pictures to control for the presence of picture stimuli, as the presence of pictures moderates comprehension (Mercorella, 2017). We divided each 10-min silent-reading session into 5-s intervals for the purposes of scoring the video recordings (Appendix A).

We utilized a multi-method approach in our assessment of reading achievement, in order to increase the rigor of our research. As measures of reading comprehension, we included the participants' scale scores on the *i-Ready*[®] *K-12 Adaptive Reading Diagnostic* domains of literature comprehension and informational text comprehension (Curriculum Associates, LLC, 2017). This adaptive diagnostic test is a computer-based, multiple-choice assessment that presents students with questions at their developmental level based on the accuracy of their previous responses. Within these *i-Ready* literature comprehension and informational text comprehension subtests, students are presented with various passages with corresponding multiple-choice questions. The *i-Ready*[®] *K-12 Adaptive Reading Diagnostic* is strongly correlated with standardized measures of the *Common Core State Standards* (Curriculum Associates, LLC, 2017; Educational Research Institute of America, 2016a, 2016b), and demonstrates excellent test-retest reliability to diverse populations of second-grade students (National Center on Response to Intervention, 2019).

As additional measures of covert reading comprehension, we included grade-level equivalence scores from Test 4: Passage Comprehension of the *Woodcock-Johnson*[®] *Tests of Achievement*, Fourth Edition (*WJIV*) (Schrank, Mather, & McGrew, 2014) and *Gray Silent*

Reading Tests (GSRT) (Wiederholt & Blalock, 2000). Test 4: Passage Comprehension of the *WJ IV* assesses students' understanding of written text, with the majority of text items requiring the student to vocally identify the missing word in sentences or paragraphs of increasing complexity (e.g., "I like pizza. What do you like to ____?"). The *GSRT* is also an assessment of students' covert reading comprehension, requiring students to read paragraphs of increasing difficulty and answer corresponding multiple-choice questions (e.g., "What goes next in this story?" "Which sentence does not fit in the story?"). Previous studies indicate that these measures have excellent test-retest reliability among second-grade students (McGrew, LaForte, & Schrank, 2014; Wiederholt & Blalock, 2000). The experimenter conducted the *WJ IV* Test 4: Passage Comprehension in a one-to-one setting and the *GSRT* in a class-wide setting, utilizing Form A of both measures.

As measures of vocabulary, we included the participants' scale scores on the *i-Ready*® *K-12 Adaptive Reading Diagnostic* vocabulary (Curriculum Associates, LLC, 2017), which assess students' knowledge of Tier 2 (i.e., high-frequency words used across content areas and contexts) and Tier 3 (i.e., domain-specific vocabulary) vocabulary words in context. We also measured students' grade-level performance on Test 17: Reading Vocabulary of the *WJ IV*, which we conducted in a one-on-one setting (Schrank et al., 2014). This test assesses accuracy in providing synonyms and antonyms to decontextualized words of increasing difficulty. Test-retest reliability for Test 17: Reading Vocabulary of the *WJ IV* was deemed excellent when calculated using a diverse sample of second-grade students (McGrew et al., 2014).

Procedure.

Interest in reading. The sessions to measure reading interest took place during regularly scheduled periods of class-wide silent reading; however, the experimenter video-recorded each

participant separately. Prior to beginning the session, the experimenter instructed the class to read silently at their desks and allowed the participants to select the books they wanted to place on their desks. Throughout the silent-reading period, the experimenter presented behavior-specific approvals for self-management behaviors (e.g., “Great job staying quiet”) across students in the class, at a rate of approximately three approvals per minute.

We defined reading as the participant’s eyes moving across the page of the book from left to right, then returning to the leftmost side of the page after each line. In addition, we considered the participant to be reading if the same pattern of eye movement continued onto the successive page of the book after the participant reached the end of the current page, or if the participant (a) was reading immediately prior to closing a given book, (b) continued to visually attend to the book stimuli while selecting a new book, and (c) selected a new book and began to read (e.g., opening the cover and turning to the first page) within 20 s of closing the previous book (Cumiskey Moore, 2017). The experimenter did not consider the participant to be reading if, at any point within a given interval, he or she stopped engaging in reading, and instead engaged in behaviors such as: (a) uncovering and looking at the covered pictures, (b) interacting with peers, (c) attending to other stimuli, or (d) flipping through the book’s pages without demonstrating eye movements that indicated reading. If the participant engaged in any behavior other than reading during a given 5-s interval, we recorded a minus.

The experimenter recorded participants’ reading using 5-s whole interval recording across 10-min sessions, for a total of 120 intervals per session (Charlesworth & Spiker, 1975). We calculated the participants’ reading interest within each silent-reading session by calculating the percentage of time that each participant engaged in reading across 10 minutes separated into 120 5-s whole intervals. The experimenter video-recorded two silent-reading sessions per

participant and conducted additional sessions if there was not a stable level of responding, which we predefined as a difference of more than 25 intervals of reading between two consecutive sessions for a given participant. The experimenter measured reading interest continuously as mean percentage of intervals of reading across sessions (i.e., interest in reading).

Reading achievement. Participants completed the *i-Ready*® *K-12 Adaptive Reading Diagnostic* (Curriculum Associates, LLC, 2017) in a class-wide setting over the course of one to three 40-min diagnostic periods across consecutive school days. In *WJIV* Test 4: Passage Comprehension, the experimenter instructed the participants to covertly read sentences with a missing word, then respond overtly with the corresponding word (Schrack et al., 2014). In the *GSRT*, the participants read a series of passages of increasing difficulty and answered related multiple-choice questions (Wiederholt & Blalock, 2000). The *i-Ready*® vocabulary subtest was part of the same diagnostic assessment as the *i-Ready*® literature comprehension and informational text comprehension subtests (Curriculum Associates, LLC, 2017). For the *WJIV* Test 17: Reading Vocabulary, the experimenter instructed the participant to read a list of words aloud and provide a synonym or antonym for each word (Schrack et al., 2014).

Interobserver agreement for reading interest. We calculated interobserver agreement (IOA) by dividing the interval-by-interval number of agreements by the total number of agreements plus disagreements between the experimenter and a second observer, and multiplying that number by 100 to find the percentage. We calculated a mean agreement of 99.0% (range, 92.5-100%) for a random sample of 54.2% of sessions for reading interest.

Results

The average interest in reading across participants was 55.2%, with a range of 0 to 99.6% of 5-s whole intervals of reading across silent-reading probe sessions (Figure 1). Table 2 shows

the results of a bivariate Pearson correlation we conducted using SPSS (Version 25; IBM, 2017) to examine the relations between reading interest and the multiple measures of reading achievement. There was a significant positive correlation between reading interest and all measures of reading comprehension, including *WJ IV* Test 4: Passage Comprehension ($r = .41$) and *GSRT* ($r = .44$) at the .05 level and *i-Ready*® literature comprehension ($r = .49$) and *i-Ready*® informational text comprehension ($r = .61$) at the .01 level (Table 2). There was also a significant positive correlation between reading interest and both measures of vocabulary at the .01 level: *WJ IV* Test 17: Reading Vocabulary ($r = .51$) and *i-Ready*® vocabulary ($r = .60$). All measures of reading comprehension were significantly correlated with all measures of vocabulary (Table 2).

Table 3 also shows the results of a multiple regression analysis we conducted in SPSS (Version 25; IBM, 2017) to examine the relationship between several predictor variables and percentage of reading interest. Results indicated that multicollinearity was not a concern in these data. The results of the regression were not significant ($F(8, 24) = 0.67, p = 0.71$). None of the individual predictors were significant in the model.

Discussion

Data from participants in the current study demonstrate that there are significant correlations between reading interest and reading comprehension and vocabulary. The results of the current study with second-grade students support Cumiskey Moore's (2017) findings with fifth graders and suggest a meaningful relation between the extent to which students prefer reading and various measures of reading proficiency. These findings also extend previous work by Stutz et al. (2016), given that we relied on objective behavioral observations instead of retrospective self-report measures to determine "liking of reading."

There are several empirical explanations to support the relation between percentage of intervals engaged in silent reading and reading achievement or, more specifically, to understand why increased reading interest and amount may increase reading comprehension and vocabulary (Pfof, Dörfler, & Artelt, 2013). Considering that students with more highly-developed reading abilities report a higher interest in reading than poorer readers, these students may be more likely to attend to the text during assigned periods of silent reading (Leppänen, Aunola, & Nurmi, 2005; Mol & Bus, 2011). The increased print exposure would then further increase technical reading skills, as well as reading comprehension and vocabulary, thereby further increasing interest in reading (Cunningham, Stanovich, & West, 1994; Kush, Watkins, & Brookhart, 2005; Mol & Bus, 2011; Stanovich, 1986). This hypothesis is further supported by research demonstrating that students who spend more time reading are more likely to learn new word meanings incidentally from the reading context (the input hypothesis; Krashen, 1989); have better comprehension skills; and are better able to integrate new information into existing schemas (Fletcher, Lyon, Fuchs, & Barnes, 2007; Pfof et al., 2013).

The correlation between reading interest and reading achievement may also be attributable to the expansion of students' repertoire of background knowledge with increased amount and breath of reading (Anderson et al., 1988; Cipielewski & Stanovich, 1992; Cunningham & Stanovich, 1991; Stanovich & Cunningham, 1993). Furthermore, the Matthew effect may also serve as an explanation for how increased reading interest drives the development of reading comprehension and other competencies (Stanovich, 1986; Walberg & Tsai, 1983): "Small initial differences in reading achievement or reading-related skills may well increase over time due to the self-reinforcing mechanisms that drive this developmental pattern" (Pfof et al., 2013; p. 90). This Matthew effect model stresses the mutually dependent and

reciprocal causal relation between reading interest and reading achievement, as increased reading supports the development of reading competencies, as well as more efficient reading when reading volume is increased (Pfoest et al., 2013).

Based on previous demonstrations of the reciprocal causal relation between reading interest, reading amount, and the acquisition of reading skills, one may expect the relation between these variables to strengthen as students age (Cunningham et al., 1994; Kush et al., 2005; Mol & Bus, 2011; Stanovich, 1986). Therefore, a potential area of future research may entail an analysis of the association between reading interest and reading achievement across the developmental trajectory. In addition, future studies of reading interest should include daily reading amount as a dependent variable in order to determine if students with a high interest in reading are similarly reading more often outside of assigned periods of silent reading.

Measurement Strengths. Our use of multiple tests of reading comprehension can be considered a strength of this study. That is, since tests of this measure assessed the same domain repertoires (i.e., covert reading comprehension), “their relationship should capture the stability over time of students’ reading comprehension while *not* including measure-specific variance that would typically inflate stability estimates of a single instrument administered at two points in time” (Taylor, Frye, & Maruyama, 1990, p. 357). In addition, our inclusion of both *WJ IV* Test 17: Reading Vocabulary and *i-Ready* vocabulary as measures of vocabulary provides a more comprehensive account of students’ vocabulary abilities, as these measures separately present vocabulary words in contextualized and decontextualized formats, respectively.

With regard to the silent-reading probe procedures for reading interest, we utilized shorter observation intervals than in the pilot study of the CSR procedure to yield more accurate data (Cumiskey Moore, 2017). We also used whole-interval observation procedures, as opposed

to partial-interval recording, in which the observer considers the behavior to be present if it is present at any instance within a given interval. Whole-interval recording underestimates the occurrence of the behavior, thereby providing a more conservative estimate of reading interest (Green, McCoy, Burns, & Smith, 1982). Our silent-reading probe procedures can be considered a reliable measure of reading interest, based on the high degree of agreement amongst independent observers (Kazdin, 1977). In addition, previous research suggests that observations of participants' responses utilizing whole-interval recording is highly correlated with automatically recorded continuous responses under laboratory conditions (Greer, 1981; Greer et al., 1973), further supporting the silent-reading probe procedures as a valid and reliable measure of reading interest. The use of whole-interval observation procedures provides a relatively low-cost and unobtrusive alternative to eye-tracking technology, without compromising the integrity of the data.

Limitations. Although we attempted to control the study environment as much as possible, we note several limitations. First, it is possible that participants' reading interest was confounded by their reactivity to the presence of the camera on their desks, in spite of our attempts to adequately habituate them to the camera prior to the onset of the study. Another limitation is the restriction of measuring students' interest in reading exclusively in the classroom setting during assigned periods of silent reading. Previous studies have found mixed results regarding reading achievement when measuring the relationship between time spent reading at home versus school (Anderson et al., 1988; Greaney, 1980; Heyns, 1978; Taylor et al., 1990; Watkins & Edwards, 1992), and home variables may be different between children in high- and low-interest groups for voluntary reading (Morrow, 1983). Therefore, a limitation of direct observation within the constrained conditions of assigned silent-reading time is that it does

not capture reading amount or interest in other contexts (Wigfield & Guthrie, 1997a). Future researchers should measure reading interest in various settings and educational contexts—for example, whether students with a high interest in reading are more likely to select reading as a preferred activity during periods of leisure time. In addition, researchers should include the simultaneous measurement of reading amount, reading interest, and reading achievement, considering that reading amount predicts reading achievement, and that reading amount is also predicted by reading motivation for elementary students (Cox & Guthrie, 2001; Guthrie et al., 1999; Wigfield & Guthrie, 1997b).

Implications. Given that the stimuli that select a student’s attention are considered to be a function of what he or she has learned, education should be focused on the development of teaching procedures to expand students’ repertoires of conditioned reinforcers, and in turn shift their interest to more academic behaviors (Greer, 2002). The results of the current study demonstrate that there is a significant relation between students’ reading interest and reading achievement. However, the question remains as to whether establishing a high interest in reading will lead to successive gains in related repertoires. Therefore, the purpose of the second experiment in the current study was to determine if the procedures utilized in a pilot study on the use of collaborative reading activities would function to increase second-grade students’ interest in reading and, in turn, result in gains in reading achievement (Cumiskey Moore, 2017)..

Experiment 2

In the second experiment, we replicated and extended Cumiskey Moore’s (2017) pilot study conducted with older-elementary students by testing the effect of the establishment of a high interest in reading in second-grade students on the outcome measures examined in Experiment 1. More specifically, we intended to answer the following research question: What is

the effect of the establishment of a high interest in reading on second-grade students' reading comprehension and vocabulary? Based on the previous literature, we considered the participant to have a high interest in reading if he or she read for an average of at least 80% of the 5-s whole intervals across silent-reading sessions, such that his or her interest was consistently selected out by the text (Buttigieg, 2015; Cumiskey Moore, 2017; Nuzzolo-Gomez, Leonard, Ortiz, Rivera, & Greer, 2002). We hypothesized that increasing second-grade students' reading interest to the point of establishing a high interest in reading would result in gains in these students' reading achievement.

Given that our study sample was comprised of younger students than the participants in Cumiskey Moore's study, we employed a collaborative shared reading (CSR) procedure with an adult as opposed to a peer; that is, we paired the reciprocal reading and related activities with attention and collaboration from a teacher, as opposed to a classmate. We postulated that younger students would be reinforced to a greater degree by adults, based on reactivity in the students' interest in reading in the presence of a teacher as well as prior research on the acquisition of adult attention as a reinforcer for various behaviors in early childhood (Greer & Du, 2015; Schmelzkopf, Greer, Singer-Dudek, & Du, 2017; Tomasello & Bates, 2001). To our knowledge, this is the first study to apply a CSR intervention with a teacher, as opposed to a peer, to establish a high interest in reading among early-elementary students.

Method

Participants. We recruited all participants ($n = 7$) from Experiment 1 who (a) did not meet the criterion for a high interest in reading, (b) were students in the classroom the first year of the study, and (c) had the lowest interest in reading relative to the other participants in the classroom (Table 4). We included these participants because they had the necessary prerequisite

repertoires at the onset of the study to participate, including relevant verbal-developmental milestones (Greer & Ross, 2008).

Design. We conducted a combined preintervention and postintervention single-case design with multiple probe logic to test the effect of the establishment of a high interest in reading via a CSR intervention on reading comprehension and vocabulary for second-grade students. We utilized multiple-probe logic to control for maturation and history by initiating the onset of intervention for selected participants as others remained in baseline or control conditions. This can be likened to a wait-list control design applied at the level of the case, as opposed to the group. Once the effect of the intervention was present in the first dyad or triad of participants, we entered the next set of participants while the remaining participants continued in the baseline or control condition, therefore utilizing a between participants single-case design (Figure 2). We entered participants into the intervention in dyads or triads to increase the number of students who contact the intervention within the timeframe of the study. There was no change in the participants' typical instructional environment outside of the context of the intervention.

Dependent measures and procedure. We utilized identical measures as in Experiment 1 for the dependent variables of reading comprehension and vocabulary, with the primary procedural difference being the experimenters' utilization of Form B of the *GSRT* Standard Test Book. In addition, we excluded the *i-Ready*[®] comprehension and vocabulary measures; the *i-Ready*[®] Reading Diagnostic was a school-wide assessment that could only be administered at mandated periods during the school year, such that we could not collect data on these measures both immediately before and after the intervention. We utilized the data from Experiment 1 as baseline and conducted the same procedures again (a) directly before entering the participants into the intervention and (b) immediately after all participants in the dyad or triad met criterion

for a high interest in reading. As a secondary dependent variable, we measured participants' progress through the intervention partly as a function of the number of sessions required to meet criterion for a given phase; the number of phases required to meet criterion for a high interest in reading; and the duration of each session of the intervention.

Collaborative shared reading (CSR) procedure for increasing reading interest. The experimenter assigned participants to dyads or triads based on their average percentage of reinforcement value of reading in the initial preintervention unsequenced assessment (i.e., probe sessions), entering participants with the lowest reinforcement value of reading into the intervention first, and then assigning the remaining dyads or triads in a stepwise fashion. Prior to each session of the intervention, the teacher presented the participant with a choice of five to eight books; all of the pictures in the books were covered, and the books were within one to two levels of the participant's reading placement based on the *DRA2*[®]. After selecting two to three books (depending on the length of the assigned reading interval), the participant completed all four steps of the CSR procedure with the teacher (Figure 3).

Step 1: Reciprocal overt reading. The participant and teacher first engaged in reciprocal overt reading, such that they rotated reading pages aloud for a given duration of time; that is, one participant read one page aloud, the other participant read the next page aloud, and so forth. Depending on the level of the text, each page had between one to three sentences or paragraphs. The experimenter assigned the duration of the reciprocal reading period based on the average amount of time the participant read silently in the probe sessions immediately prior to entering the intervention, which was dependent on the average number of intervals in which the participant engaged in observable reading. The experimenter converted the average number of 5-s whole intervals of observable reading to a corresponding number of minutes, rounded to the

nearest whole minute. If any participant read less than that average amount of time the teacher automatically entered into him or her into the intervention with a reading duration of 2-min.

Step 2: Vocabulary task. Following the reciprocal reading period, the teacher provided each participant with a vocabulary worksheet; the participant was required to write three words from the reciprocal reading period that he or she found interesting or confusing (Appendix B). The teacher also wrote three words from the reading period that he or she thought would be novel for the participant on a separate copy of the vocabulary worksheet. Next, the teacher and participant exchanged worksheets and wrote what they suggested to be the meaning of, and a synonym for, each of the words identified by their partner. After both the participant and teacher completed the vocabulary worksheet, they once again switched their worksheets and discussed each other's responses—that is, each partner vocally explained why he or she considered each response correct or incorrect. The teacher delivered reinforcement in the form of vocal praise contingent upon the participant's completion of the task, as opposed to the accuracy of the participant's responding.

Step 3: Silent reading. The teacher then instructed the participant to read silently for the same duration of time as the reciprocal-reading period, and provided behavior-specific praise (e.g., "I like the way you are keeping your eyes on the book") at a rate of one to three approvals per minute during the period of silent reading. The teacher did not sit at the same table as the participant during this portion of the intervention.

Step 4: Mental-imagery task. After the designated silent-reading time, the teacher and participant independently completed the mental-imagery worksheet, which required the participant to indicate a specific scene from the pages read during the preceding silent-reading period and then draw a picture of that scene (Appendix C). The teacher also completed a copy of

the mental-imagery worksheet. Once the participant and teacher folded their respective worksheets along the dotted horizontal line (such that the partner would be able to see the picture drawn, but not the written description of the targeted scene), they switched papers and responded to the written antecedent on the back of the worksheet (“I think this drawing is from page number _____, when the author writes _____”). The teacher and participant then switched worksheets once again and indicated whether the partner had correctly guessed the targeted scene. If both the teacher and the participant guessed their partners’ scene correctly on the mental-imagery worksheet, the participant earned the previously agreed-upon consequence (e.g., tally towards having lunch with the teacher); if the teacher or participant responded incorrectly, the partner (i.e., teacher or participant) who guessed incorrectly drew his or her own version of the scene after being told the correct response.

The criterion for each designated duration of reading required that both the teacher and participant correctly identifying the scene drawn by his or her partner. Upon meeting criterion for a session of a given reciprocal and silent reading duration, the teacher increased the duration of reciprocal and silent reading by 2 min. Once the participant had met criterion for three increases in reading durations (e.g., 2 min, 4 min, 6 min), the experimenter conducted two probe sessions for reading interest, and conducted additional probe sessions until a stable level of responding was reached if the difference in responding between two consecutive probe sessions was greater than 25 intervals.

The experimenter considered the participants to have a high interest in reading if they read for at least 80% of the 5-s whole intervals across sessions in a given probe period. If the participant met criterion for a high interest in reading, the experimenter conducted the postintervention probe procedures for reading comprehension and vocabulary. If the participant

did not meet criterion for a high interest in reading, the teacher entered him or her into another phase of the intervention, with the duration of reciprocal and silent reading continuing to increase by intervals of 2 min. The experimenter repeated these procedures after each phase of the intervention.

The experimenter continued to conduct the silent-reading probe procedures for any participants in a given dyad or triad who met criterion for a high interest in reading before the remaining participant(s) in that dyad or triad. If participants who exited the intervention prior to their peers did not maintain a high interest in reading, the teacher entered these participants into the next phase of the intervention. Once all participants in a given dyad or triad met criterion for a high interest in reading, the experimenter conducted the postintervention probe procedures for reading comprehension and vocabulary, while simultaneously conducting a second set of preintervention probe procedures for the next dyad or triad before entering them into the CSR procedure.

Interobserver agreement. Utilizing the same procedures as in Experiment 1, we calculated a mean agreement of 99.2% (range, 92.5-100%) for 55.7% of preintervention probe sessions for reading interest; 99.3% (range, 95.8-100%) for 100% of postintervention probe sessions for reading interest; and 95.8% (range, 86.9-99.2%) for 50.0% of follow-up probe sessions for reading interest.

Results

Table 5 shows changes in participants' interest in reading as a measure of the implementation of the independent variable. None of the participants demonstrated the criterion for a high interest in reading (i.e., an average of 80% of 5-s whole intervals across 10-min probe sessions) prior to entering the intervention (Table 5; Figure 4). Only one participant (Participant

10) demonstrated a decrease in reading interest after meeting criterion for the first phase of intervention. The majority of participants demonstrated an ascending or stable trend as they progressed through and exited the intervention, as well as in the one- to three-month follow-up probe sessions. All participants demonstrated an average reading interest of at least 80% of 5-s whole intervals in the follow-up probe sessions (Table 5; Figure 4).

Table 6 shows grade-level increases across measures of reading achievement between probe sessions immediately prior to and following the CSR intervention. The majority of participants demonstrated increases on *WJ IV* Test 4: Passage Comprehension ($n = 6$) and the *GSRT* ($n = 4$) (Table 6; Figure 5) following the establishment of a high interest in reading. For the six participants who demonstrated increases on *WJ IV* Test 4: Passage Comprehension, the range of grade-level increases was 0.1 to 0.8 (Table 7). The range of grade-level increases for the four participants who demonstrated gains on the *GSRT* was 0.8 to 2.2 (Table 7). Based only on the amount of time that elapsed between the preintervention and postintervention probe periods (approximately 0.2 grade levels for Dyad 1, 0.1 grade levels for Dyad 2, 0.1 grade levels for Triad 3), the majority of participants demonstrated grade-level increases beyond the amount expected on *WJ IV* Test 4: Passage Comprehension ($n = 5$) and the *GSRT* ($n = 4$); that is, the participants' change in grade level (the difference between the preintervention and postintervention grade-level equivalent on these measures) exceeded the amount of time that had passed (in grade levels) between the two probe periods (Table 6). All participants also demonstrated increases on *WJ IV* Test 17: Reading Vocabulary, with a range of 0.4 to 0.9 grade-level increases (Table 6; Figure 5). All participants demonstrated grade-level increases beyond the amount expected based solely on elapsed time between the preintervention and postintervention probe periods for the *WJ IV* Test 17: Reading Vocabulary.

Table 7 shows the number and duration of intervention sessions in each phase of the CSR procedure across participants. The majority of participants entered the intervention with a target duration of 2 min, although there was variability in terms of number of phases required to meet criterion for a high interest in reading (Table 7). Participants 3, 4, and 6 required one phase of the intervention; Participants 1, 8, and 10 required two phases of the intervention; and Participant 9 required three phases of the intervention to meet criterion for a high interest in reading. It was necessary for the students to complete at least three sessions to exit a given phase, as criterion was three increases in reading durations. In this study, it took no more than three sessions for the majority of participants to meet criterion for a given phase, with Participant 10 being the only participant to require an additional session to meet criterion in any phase. The range of intervention-session length across Dyad 1, Dyad 2, and Triad 3 was 15.55 to 52.02 min. The range of total session durations per participant was 68:49 to 314:10 min (Table 7).

Discussion

The results of this study suggest that a CSR procedure may be effective in increasing early-elementary students' interest in reading. Among the participants in this study, seven demonstrated educationally important increases in conditioned reinforcement for reading following the CSR procedure, with grade-level increases from 0.1 to 2.2 with a maximum of 9 intervention sessions totaling 314 min. We identified variable gains across participants between their preintervention and postintervention reading comprehension and vocabulary scores, supporting the significant reading-achievement increases Cumiskey Moore (2017) reported with fifth-grade students. The relative stability of the participants' reading interest during baseline assessment increases the internal validity of the results, as it suggests that the intervention was responsible for increases in the participants' interest in reading. In addition, changes in the

participants' reading comprehension and vocabulary from the immediate preintervention to postintervention assessments imply that the increases in reading achievement were attributable to the establishment of a high interest in reading, since the majority of participants did not demonstrate an increase in interest in reading from the initial preconditioning probe sessions to the probe sessions immediately prior to entering the intervention. The results of this study therefore suggest that a CSR procedure with a teacher is effective for promoting the academic achievement of second-grade students, with the establishment of a high interest in reading resulting in gains in students' reading comprehension and vocabulary.

Limitations and suggestions for future research. A limitation of this study is that we did not include a second group of participants paired with peers that would have allowed for the comparison of the CSR procedure with a teacher to Cumiskey Moore's (2017) procedure utilizing peers. Although the teacher-pairing CSR procedure was effective in establishing a high interest in reading, the use of peers in the CSR procedure would potentially maximize the number of students who are able to acquire conditioned reinforcement for reading while minimizing the need for teacher assistance within a classroom setting. Moreover, a direct comparison of the two types of conditioning procedures might also elucidate children's shift in preference from adults to peers in terms of efficacy in establishing a high interest in reading.

Another limitation of the current study is the use of Form A of the *WJ-IV* in both the preintervention and postintervention probe sessions, as the use of multiple forms would have better controlled for changes in the participants' comprehension and vocabulary as a function of repeated testing. However, the overall stability of the participants' performance on this measure across preintervention probe sessions within the delayed design suggests that their postintervention results were not inflated as a function of repeated exposure to the same test

items. An additional limitation of measurement was the lack of multiple measures of vocabulary, as the experimenter was required to exclude the *i-Ready* subtest measures to adhere to the school district's predetermined diagnostic testing periods. Future studies of the CSR procedure should therefore consider including a second measure of vocabulary in order to provide a more complete profile of students' contextualized and decontextualized vocabulary abilities.

In the current study, participants were permitted to refer back to the text during the mental imagery task before drawing their targeted scene or when guessing their partner's scene. As a result, it is possible that participants might have guessed correctly without actually reading during the silent-reading period. Future iterations of this design might consider prohibiting reference to determine whether the words will more strongly select out their attention. In terms of the vocabulary task, a limitation of the study was the lack of a direct contingency linking the participants' correct responding to access to a back-up reinforcer. Within the framework of behavior analysis, the meaning of a word is characterized by its function (e.g., effect on the listener), which is directly related to the effect of using that word as a speaker or responding to that word as a listener (Catania, 1998; Greer & Ross, 2008; Skinner, 1957). Considering that the meaning of a word changes based on reinforcement or punishment from a particular verbal community, the vocabulary component of the conditioning procedure should be consequated if the child is to acquire an expanded vocabulary (Skinner, 1957). The conditioning procedure in the current study failed to embed such contingencies in the vocabulary task, as access to back-up reinforcement was not contingent upon the accuracy of the participant's responding (Cumiskey Moore, 2017). Therefore, a modified procedure in which the percentage of correct responding determines the reinforcement received may be more effective in promoting vocabulary development.

Implications. The purpose of education in the context of the application of behavior analysis to schooling is for students to come under new environmental control, so that stimuli that did not previously affect their behavior are now controlled by the causes of the behavior and its consequence (Greer, 1983, 2002). From this disciplinary perspective, expert teaching must include arranging instructional consequences such that the reading and comprehension of text select out the attention of the student, thus making reading reinforcing in and of itself (Vargas, 2013). Based on the results of the current experiment, the teacher-pairing CSR procedure adapted from Cumiskey Moore (2017) can be considered a systematic method for establishing a high interest in reading for the sample of second-grade students, with the acquisition of this intrinsic reinforcer promoting successive gains in a variety of advanced reading repertoires as students' covert reading comes under stimulus control.

Conclusions and Future Directions

The results of this study suggest that there is educational significance to establishing a high interest in reading via a CSR procedure with a teacher. Furthermore, the majority of participants who engaged in the intervention demonstrated increases in reading comprehension and vocabulary as a function of the establishment of a high interest in reading, with significant relations between reading interest and these measures of reading achievement. Although the CSR procedure with a teacher was effective in establishing a high interest in reading, the question remains as to whether a peer CSR procedure could be utilized with students in early elementary grades, which may significantly decrease average time required to enact the intervention (Cumiskey Moore 2017).

A study comparing a CSR procedure with a teacher versus a peer could also provide insight into whether children are more reinforced by adults or peers, as well as at what age

preference shifts from one group to the other. In addition, future research should include a third group of students who undergo teaching as usual, without the addition of a CSR procedure with a teacher or a peer. This design would permit the experimenter to attribute gains in the experimental group to teacher or peer contingencies, although the delay in our design partially addressed this concern. Furthermore, future studies might investigate the application of the current protocol to a broader population of participants. Considering that students referred for in-school psychology services commonly demonstrate deficits in reading skills, such research could address the need for procedures that expand academic literacy (Freeland, Skinner, Jackson, McDaniel, & Smith, 2000).

With the knowledge that a student's reading level in third grade is a significant predictor of his or her future educational performance, researchers and early-elementary educators alike must apply the best instructional practices and interventions to increase students' reading readiness (Lesnick, Goerge, Smithgall, & Gwynne, 2010; Pfof, Dörfler, & Artelt, 2010). There is a statistically significant correlation between reading performance in the third and eighth grades, with children who are reading on or above grade-level by third grade more likely to enroll in and graduate from college, and students reading below grade-level more likely to drop out of high school as compared to their peers (Lesnick et al., 2010). Future research and practice must therefore consider the most efficient and effective means of increasing various reading repertoires for a myriad of students who do not demonstrate a high interest in reading. As B.F. Skinner suggested, "We shouldn't teach great books; we should teach a love of reading. Knowing the contents of a few words of literature is a trivial achievement. Being inclined to go on reading is a great achievement" (Evans, 1968, p. 73).

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Table 1. Demographic Characteristics of Participants at Onset of Experiment 1

Measure	<i>Mean (SD)</i>	<i>n (%)</i>
Age (years)	7.8 (.36)	
Sex		
Male		18 (52.9)
Female		16 (47.1)
Year of study		
First year		14 (41.2)
Second year		20 (58.8)
IEP or 504		10 (29.4)
Eligible for free/reduced lunch		8 (23.5)
English as a second language		8 (23.5)
Race/ethnicity		
Asian		1 (2.9)
Black		4 (11.8)
Hispanic/Latino		9 (26.5)
White		19 (55.0)
Other		1 (2.9)
<i>DRA2</i> [®] grade-level benchmark for second grade		
Below grade level		10 (29.4)
On grade level		12 (35.3)
Above grade level		12 (35.3)
<i>i-Ready Reading</i> grade-level benchmark for second grade		
Greater than one grade-level below		0 (0)
Less than one grade-level below		10 (29.4)
On or above grade level		24 (70.6)

Note. All demographic information gathered from school's database, with free/reduced lunch based on the local familial income criterion.

Table 2. Correlations for Reading Interest and Reading Comprehension and Vocabulary in Experiment 1

	Interest in Reading	<i>WJIV</i> Test 4: Passage Comp.	<i>GSRT</i>	<i>i-Ready</i> ® Lit. Comp.	<i>i-Ready</i> ® Info. Comp	<i>WJIV</i> Test 17: Reading Vocab.	<i>i-Ready</i> ® Vocab.
Interest in Reading	—						
<i>WJIV</i> Test 4: Passage Comp.	.41*	—					
<i>GSRT</i>	.44*	.37*	—				
<i>i-Ready</i> ® Literature Comp.	.49**	.56**	.49**	—			
<i>i-Ready</i> ® Info. Comp.	.61**	.65**	.53**	.84**	—		
<i>WJIV</i> Test 17: Reading Vocab.	.51**	.82**	.51**	.60**	.64**	—	
<i>i-Ready</i> ® Vocab.	.60**	.71**	.58**	.65**	.65**	.82**	—

* $p < .05$ ** $p < .01$

Table 3. Regression Results for Reading Interest and Predictor Variables in Experiment 1

Variable	<i>B</i>	<i>SE B</i>	<i>t</i>	<i>p</i>
(Constant)	-69.66	118.42	-0.59	0.56
Age	11.17	14.79	0.76	0.46
Sex	-3.35	15.71	-0.21	0.83
IEP or 504	-12.98	14.45	-0.90	0.38
Eligible for free/reduced lunch	6.52	19.15	0.34	0.74
English as a second language	11.83	19.04	0.62	0.54
Race/ethnicity	2.98	7.97	0.37	0.71
<i>DRA2</i> [®] grade-level benchmark for second grade	9.13	10.46	0.87	0.39
<i>i-Ready Reading</i> grade-level benchmark for second grade	7.56	18.24	0.41	0.68

Table 4. Demographic Characteristics of Participants at Onset of Experiment 2

Intervention Group	Participant	Age (years)	Sex	Race/Ethnicity	Free/Reduced Lunch Status	English as a Second Language	Grade-Level Equivalent for <i>i-Ready</i> ® Reading ^a	DRA® Grade-Level Benchmark ^b
Dyad 1	4	8.3	F	White	Not Eligible	No	Early 2	On Level
	8	8	M	White	Not Eligible	No	Grade 1	Below Level
Dyad 2	1	7.4	M	Asian	Not Eligible	No	Grade 1	On Level
	10	8.2	F	Hispanic	Eligible	Yes	Grade 1	Below Level
Triad 3	3	7.8	F	Black	Not Eligible	No	Grade 1	Below Level
	6	7.8	M	Black	Not Eligible	No	Late 2	Above Level
	9	7.9	M	Hispanic	Eligible	No	Grade 1	Below Level

^aBased on the participants' overall scores on the *i-Ready*® *K-12 Adaptive Reading Diagnostic* immediately prior to the onset of the study. The diagnostic assesses phonological awareness, phonics, high-frequency words, vocabulary, and comprehension of literature and informational text. Students who scored in the second-grade range were considered to be on grade level. ^bBased on the participants' scores on the *Developmental Reading Assessment, Second Edition*® (*DRA2*®) immediately prior to the onset of the study. The *DRA2*® assesses reading fluency and comprehension, and provides an overview of the children's competencies in reading accuracy and story retelling.

Table 5. Participants' Average Interest in Reading Per Probe Period in Experiment 2

Group	Participant	Initial Average Percentage of Intervals of Reading	Average Percentage of Intervals of Reading Prior to Intervention	Post-Phase 1 Average Percentage of Intervals of Reading	Post-Phase 2 Average Percentage of Intervals of Reading	Post-Phase 2 Average Percentage of Intervals of Reading	Follow-up Average Percentage of Intervals of Reading (range, 1-3 months)
Dyad 1	4	0.9	NA	87.5	90.9	NA	84.2
	8	1.7	NA	70.8	88.0	NA	83.8
Dyad 2	1	2.5	22.1	53.4	87.1	NA	87.9
	10	40.9	15.0	7.5	85.0	NA	82.5
Triad 3	3	42.1	37.1	82.5	81.7	89.6	91.3
	6	45.0	56.3	89.2	95.8	94.6	92.1
	9	45.4	22.9	67.9	70.0	91.3	90.4

Note. Based on the average percentage of 5-s whole intervals of observable reading across two or three 10-min silent-reading sessions per probe period.

Table 6. Grade-Level Increase in Comprehension and Vocabulary Between Probe Sessions Immediately Prior to and Following Intervention in Experiment 2

Measure	Participant						
	Dyad 1 (Elapsed Time: 0.2 grade levels)		Dyad 2 (Elapsed Time: 0.1 grade levels)		Triad 3 (Elapsed Time: 0.1 grade levels)		
	4	8	1	10	3	6	9
<i>WJ IV</i> Test 4: Passage Comprehension	0.1	0.8 *	1.4 *	0.5 *	0.6 *	0.2 *	---
<i>GSRT</i>	1.0 *	2.2 *	---	---	---	1.8 *	0.8 *
<i>WJ IV</i> Test 17: Reading Vocabulary	0.6 *	0.4 *	0.6 *	0.4 *	0.7 *	0.9 *	0.7 *

Note. --- denotes that the participant did not demonstrate an increase on that measure.

* denotes that the participant demonstrated a grade-level increase beyond the amount expected based solely on elapsed time between probe periods.

Table 7. Number and Duration of Intervention Sessions in Each Phase Across Participants in Experiment 2

Group	Participant	Initial Target Duration (min)	Duration of Sessions, Phase 1 (min)	Duration of Sessions, Phase 2 (min)	Duration of Sessions, Phase 3 (min)	Total Duration of Sessions
Dyad 1	4	2	1. 16:57 2. 22:13 3. 29:39	NA	NA	68:49 min ≈ 1.1 hr
	8	2	1. 17:09 2. 26:15 3. 28:57	1. 32:20 2. 37:59 3. 40:38	NA	183:18 min ≈ 3.1 hr
Dyad 2	1	2	1. 15:55 2. 21:28 3. 29:19	1. 30:54 2. 37:06 3. 38:33	NA	173:15 min ≈ 2.9 hr
	10	2	1. 19:17 2. 26:09 3. 28:02	1. 33:58 2. 40:19 3. 36:47 4. 39:39	NA	224:11 min ≈ 3.7 hr
Triad 3	3	4	1. 23:47 2. 27:59 3. 33:26	NA	NA	85:12 min ≈ 1.4 hr
	6	6	1. 30:33 2. 35:03 3. 35:39	NA	NA	101:15 min ≈ 1.7 hr
	9	2	1. 16:52 2. 20:37 3. 26:50	1. 33:18 2. 33:01 3. 38:26	1. 43:57 2. 49:07 3. 52:02	314:10 min ≈ 5.2 hr

Figure 1. Average percentage of 5-s whole intervals of reading across participants in Experiment 1. We defined observable reading as the participant’s eyes moving across the page of the book from left to right, and the returning to the leftmost side of the page after each line. In addition, we considered the participant to be reading if the same eye-tracking behavior continued onto the successive page of the book after the participant reached the end of the current page (Cumiskey Moore, 2017).

Figure 2. Sequence of design in Experiment 2. We utilized a combined preintervention and postintervention single-case design with multiple probe logic to test the effect of the establishment of a high interest in reading via a CSR intervention on participants' reading comprehension and vocabulary.

Figure 3. Sequence of the teacher-pairing collaborative shared reading (CSR) procedure for establishing a high interest in reading in Experiment 2. Criterion for each increase in reading duration was based on the participant's response on the mental-imagery worksheet (i.e., both the intervention agent and participant correctly guessing the scene drawn by his or her partner). Once the participant had met criterion for three 2-min increases in session durations, the experimenter conducted the probe procedures for reading interest. If the participant met criterion for a high interest in reading (i.e., read for an average of at least 80% of the 5-s whole intervals across probe sessions), the experimenter conducted the postintervention probe procedures for reading comprehension and vocabulary. If the participant did not meet criterion for a high interest in reading, the experimenter entered him or her into another phase of the intervention, with the duration of reciprocal and silent reading continuing to increase by intervals of 2 min.

Figure 4. Implementation of the independent variable in Experiment 2, measured by the percentage of 5-s whole intervals of reading within each 10 min probe session. All participants demonstrated an ascending or stable trend in reading interest as they progressed through and exited the intervention, as well as in the one- to three-month follow-up probe sessions.

Figure 5. Participants' grade equivalences on *Woodcock-Johnson*[®] Tests of Achievement, Fourth Edition (*WJ IV*) Test 4: Passage Comprehension, *Gray Silent Reading Test* (*GSRT*), and *WJ IV* Test 17: Reading Vocabulary in the preintervention and postintervention probe sessions for Experiment 2.

Appendix A Data Sheet for Silent-Reading Probe Procedures for Reading Interest

Date:

Observer:

IOA:

Whole Interval R+ Reading

Student:	
0:05	
0:10	
0:15	
0:20	
0:25	
0:30	
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Appendix B Vocabulary Worksheet

Name_____

Date_____

During or after the period in which you and your teacher take turns reading aloud, please write down three words that you find interesting or confusing and the page numbers for each of those words. When you switch worksheets with your teacher, write down what you think each of your teacher's word means and a possible synonym for each word (a word that means the same thing):

1.	Page	What could it mean?	What's a word that might mean the same thing?	+/-
2.	Page	What could it mean?	What's a word that might mean the same thing?	
3.	Page	What could it mean?	What's a word that might mean the same thing?	

Appendix C
Mental-Imagery Worksheet

Name _____

Date _____

Book Title: _____

Starting Page: _____

Pages Read: _____

Reinforcer: _____

Draw a picture of your favorite scene. Please look back in the book for specific details, and be sure to include as many details as possible.

This drawing is from page number _____, when the author writes _____

_____.

Partner's Response:

I think this drawing is from page number _____, when the author writes _____
_____.

Did your partner guess the correct scene? (circle one) *yes* *no*

If not, have your partner read your favorite scene again and draw his or her own detailed version of the scene:

A large, empty rectangular box with a thin black border, intended for a student to draw a detailed version of a scene.

Chapter II

The Effect of the Establishment of Conditioned Reinforcement for Reading Content on Second-Graders' Reading Achievement

Abstract

There remains a gap in the current literature as to how to reliably measure and increase students' "voluntary reading," based on research suggesting a relation between reading amount and reading achievement. We tested the effect of the establishment of conditioned reinforcement for reading via a collaborative shared reading conditioning procedure on 8 second-grade students with and without learning disabilities and developmental disorders. This conditioning procedure is comprised of opportunities for reciprocal reading and collaboration on comprehension and vocabulary tasks related to the reading content, such that partners (teacher-participant or participant-participant) were required to work together. We utilized a combined small- n experimental-control simultaneous treatment design with a single-case multiple-probe design nested within each small group, in order to compare within- and between-group differences for participants in the collaborative shared reading procedure with a teacher or peer. All participants for whom conditioned reinforcement for reading was established ($n = 7$) demonstrated gains in reading achievement after a maximum of nine sessions (412 min), with grade-level increases between 0.2 and 2.5 on measures of reading comprehension and 0.3 to 3.1 on measures of vocabulary. The students in the teacher-yoked condition ($n = 3$) demonstrated more significant gains in their average increases in achievement.

Keywords: conditioned reinforcement, conditioned seeing, derived relational-responding, reading comprehension, reinforcement value, vocabulary

The Effect of the Establishment of Conditioned Reinforcement for Reading Content on Second-Graders' Reading Achievement

The National Reading Panel (NRP; 2000) proposed that, “there are few beliefs more widely held than that teachers should encourage students to engage in ‘voluntary reading’ and, that if they did this successfully, better reading achievement would result” (p. 27). This push for increased voluntary reading is supported by extensive research demonstrating positive relations between reading motivation; self-reported reading amount; and reading achievement for elementary and middle school students (Becker, McElvany, & Kortenbruck, 2010; Guthrie & Wigfield, 2000; Stutz, Schaffner, & Schiefele, 2016; Wigfield, Gladstone, & Turci, 2016). For example, there is a positive relation between reading amount and reading achievement, in terms of both comprehension and vocabulary (Heyns, 1978). Children who read in their leisure time perform better on measures of reading achievement when controlling for cognitive abilities (Cipielewski & Stanovich, 1992), with reading amount outside of school as the best predictor of reading achievement in elementary school (Anderson, Wilson, & Fielding, 1988). There is also a significant positive relation between intrinsic reading motivation among elementary school students and later reading achievement (Becker et al., 2010; Gottfried, Fleming, & Gottfried, 2001; Wang & Guthrie, 2004).

Although instructional reading programs often cite improvements in voluntary reading as a major goal, a significant percentage of students do not spend their leisure time reading for pleasure or information. For example, Ysseldyke and Algozzine (1983) found that among second-, third-, and fourth-grade students, participants spent an average of about 8 min per day engaged in silent reading in school. Similarly, Kurth and Kurth

(1987) reported that students in first, third, and fifth grades engaged in silent reading for approximately 10 min during a reading period of 60 min, suggesting that it is not enough to simply allocate more time for silent reading in the classroom if students are to become “voluntary readers” (Bryan, Fawson, & Reutzel, 2003; Carver & Leibert, 1995; Pearson & Fielding, 1991; Stahl, 2004). However, there remains a gap in the current literature as to how to reliably measure and increase students’ voluntary reading, with much of the present research on voluntary reading relying on ad hoc instruments and non-operational constructs (Stutz et al. 2016; Wigfield et al., 2016).

Whereas voluntary reading may be associated with constructs of reading ‘interest’ or ‘motivation’ from some psychological perspectives, other theoretical models—such as the theory of verbal-behavior development—frame the moment-to-moment selection of the student’s attention to the text in terms of one’s reinforcement value of reading (Greer, 1983; Greer & Ross, 2008; Greer & Speckman, 2009; Moore, 2008; Skinner, 1987). We operationally define reinforcement value for reading content as the percentage of assigned silent-reading periods during which an individual’s attention is selected out by textual stimuli, or in which the student emits observing responses to textual stimuli (Cumiskey Moore, 2017; Greer & Ross, 2008; Greer & Speckman, 2009). Considering the empirical support for the contribution of reading amount and motivation to expansion of reading repertoires, the study of reinforcement value of reading can inform both theory and practice in terms of the establishment of conditioned reinforcement for reading as a means of enhancing literacy achievement for early elementary students.

Verbal behavior research on conditioned reinforcement for reading is precipitated by studies of children’s conditioned reinforcement for the observation of various stimuli,

with faster and more immediate learning as one effect of such increased reinforcement value (e.g., Du, Broto, & Greer, 2015; Greer & Han, 2015; Greer, Pistoljevic, Cahill, & Du, 2011; Maffei, Singer-Dudek, & Keohone, 2014). For example, previous research has demonstrated the establishment of conditioned reinforcement for the observation of book stimuli via stimulus-stimulus pairing procedures, as well as accelerated rates of learning of textual responses to words for preschool-aged students as a collateral effect of increased reinforcement for looking at books (Buttigieg, 2015; Tsai & Greer, 2006). To expand upon conditioned reinforcement for observing book stimuli with older students in an educational setting, teachers as strategic scientists can arrange instructional consequences such that the content of the text selects out the attention of the student, thus increasing the reinforcement value of reading content for the purposes of promoting reading achievement (Greer, 2002; Vargas, 2013).

One method for establishing conditioned reinforcement for reading content is a collaborative shared reading (CSR) procedure (Cumiskey Moore, 2007; Gentilini & Greer, 2019). This conditioning procedure is comprised of opportunities for reciprocal reading and collaboration on comprehension and vocabulary tasks related to the reading content, such that partners are required to work together in order to receive access to a shared activity or event, selected by the participants. Research evaluating this intervention with second-grade students demonstrated grade-level increases from 0.1 to 2.2 grades on various measures of reading achievement in less than nine sessions (Gentilini & Greer, 2019). Moreover, the results of this research suggest that students with conditioned reinforcement for reading score higher on reading achievement assessments, on average, compared to peers without this reinforcer in repertoire

(Cumiskey Moore, 2017; Gentilini & Greer, 2019). However, given the intensive amounts of one-on-one teacher time required by this intervention (range, 15:55 to 52:02 min per session; Gentilini & Greer, 2019), there is the need for an empirical investigation of the effectiveness of the CSR procedure with peer dyads amongst early elementary students, as has been demonstrated with fifth-grade students (Cumiskey Moore, 2017).

The purpose of the current study was to test the effect of the establishment of conditioned reinforcement for reading via a CSR conditioning procedure on second-grade students with and without learning disabilities and developmental disorders. More specifically, we tested the effect of increases in the reinforcement value of reading on various repertoires of reading with understanding—defined from the behavioral perspective as the way in which one listens to oneself when one reads and, in turn, hears, sees, and derives meaning from the story (Greer & Ross, 2008). We included standardized measures of comprehension and vocabulary as dependent variables, as well as the behavioral constructs of conditioned seeing (i.e., one's ability to 'see' and assign meaning to a text as demonstrated by drawing responses) and derived-relational responding (i.e., one's accuracy in assigning meaning to unfamiliar words) (Hayes, Barnes-Holmes, & Roche, 2001; Skinner, 1953, 1957). The CSR procedure involved similar steps as previous implementations of this intervention (Cumiskey Moore, 2017; Gentilini & Greer, 2019), including: (1) reciprocal overt reading between partners, (2) a collaborative vocabulary task, (3) silent reading, and (4) a collaborative comprehension task. However, this version of the procedure differed in that we incorporated both participants' performance on both the vocabulary and comprehension tasks in the intervention criterion, as opposed to making the criterion contingent only upon the

comprehension component as in previous studies (Cumiskey Moore, 2017; Gentilini & Greer, 2019). Furthermore, we modified the book stimuli used during the intervention to include nonsense words, in order to provide students with increased opportunities to derive the meaning of unknown words embedded in contextualized texts (Cumiskey Moore, 2017; Gentilini & Greer, 2019). We also sought to increase participants' attention to the text during the silent-reading step of the intervention by precluding them from referring back to the text during the comprehension task, which differed from previous versions of the CSR procedure (Cumiskey Moore, 2017; Gentilini & Greer, 2019).

The goal of this study was to compare a modified peer-yoked and teacher-yoked CSR procedure on students' gains in reading achievement. Through this research, we intended to identify factors that may influence the development of higher-order repertoires of reading, and to develop an understanding of the relative reinforcing effectiveness of peers versus adults for students like those included in this study. We also sought to fill the gap in the existing literature on the effect of the establishment of conditioned reinforcement for reading via a CSR procedure with a teacher versus a peer on the reading-achievement gains of students in early elementary school.

Method

Participants

We identified eight participants who did not meet our predefined criterion for the presence of conditioned reinforcement for reading in repertoire in the baseline silent-reading probe sessions; that is, they did not read for an average of at least 75% of 5-s whole intervals across two or three silent-reading periods (Table 1). These participants had the necessary prerequisite repertoires at the onset of the study to participate in the

CSR intervention, including relevant verbal-developmental cusps and capabilities (Greer & Ross, 2008).

The participants were second-grade students (37.5% male) in a general education classroom of 19 students with a mean age of 8.0 years ($SD = 0.4$ years) at the onset of the study (Table 1). The classroom was situated within a Title I K-2 public elementary school located in a suburb outside of a major metropolitan area in the northeast United States that utilizes the Comprehensive Application of Behavior Analysis to Schooling (CABAS®) Accelerated Independent Learner (AIL) model of education (www.cabasschools.org). This model employs empirically-supported methods of pedagogy, curricula, and classroom management techniques based on the principles of applied behavior analysis for all instruction and classroom management (Singer-Dudek, Speckman, & Nuzzolo, 2010).

Participants 4 and 6 were eligible for free/reduced lunch based on the local familial income criterion, and Participants 4, 6, and 8 spoke English as a second language. Four participants had an independent diagnosis or educational classification (Table 1). We utilized their overall scores from the *i-Ready® K-12 Adaptive Reading Diagnostic* to categorize the participants as on, below, or above grade level, which includes the domains of phonological awareness, phonics, high-frequency words, literature comprehension, informational text comprehension, and vocabulary (Curriculum Associates, LLC, 2017). Participants were all on or below grade level (Table 1).

Measures and Materials

As a measure of reinforcement value of reading, we individually video-recorded participants during 10-min periods of class-wide silent reading utilizing 5-s whole

interval recording, for a total of 120 intervals per session (Charlesworth & Spiker, 1975; Gentilini & Greer, 2019). Previous research has demonstrated that observations of participants' responses utilizing whole-interval recording is highly correlated with automatically recorded continuous responses under laboratory conditions (Greer, 1981; Greer, Dorow, Wachhaus, & White, 1973). Prior to every silent-reading session, we provided each participant with two to seven books within the range of his or her reading level, based on the participant's performance on the *Developmental Reading Assessment, Second Edition*[®] (*DRA2*[®]; Pearson Education, 2006)—a highly valid and reliable measure of reading achievement in elementary aged students (Pearson Education, 2011)—immediately prior to the onset of the study. We covered the pictures in all books to control for the presence of picture stimuli, as the presence of pictures moderates comprehension (Mercorella, 2017). We placed a recording device (i.e., iPhone, laptop) on the participant's desk, such that it was 1 to 2 ft from the participant and the participant's eyes were visible for the entirety of the silent-reading session. We utilized a data sheet divided into 5-s intervals across 10 min for the purposes of scoring the video recordings (Appendix A).

As measures of covert reading comprehension, we included the participants' grade-level equivalencies on Test 4: Passage Comprehension of the *Woodcock-Johnson*[®] *Tests of Achievement*, Fourth Edition (*WJ IV*) (Schrank, Mather, & McGrew, 2014) and the *Gray Silent Reading Tests (GSRT)* (Wiederholt & Blalock, 2000). The majority of items in Test 4: Passage Comprehension of the *WJ IV* require the student to vocally identify the missing word in sentences or paragraphs of increasing difficulty (e.g., “The drums were pounding in the distance. We could _____ them.”), in order to assess

students' covert reading comprehension. The *GSRT* is also an assessment of students' understanding of written text, and requires students to read paragraphs of increasing complexity and answer corresponding multiple-choice questions (e.g., "What is the best name for this story?"). Both of these measures are widely accepted as valid assessments of reading comprehension, given their excellent test-retest reliability among diverse populations of second-grade students (McGrew, LaForte, & Schrank, 2014; Wiederholt & Blalock, 2000). We utilized Form A of both assessments in the preintervention probe sessions and Form B in the postintervention sessions. We administered *WJ IV* Test 4: Passage Comprehension with participants in a one-to-one setting and conducted the *GSRT* in small groups of three to six participants.

As another category of comprehension, we included conditioned seeing (i.e., comprehension drawing): an attempt to measure the conditioned reflex of "seeing" what is being described in a text in the absence of a visual stimulus, which Skinner (1953, 1957) described as a private event. We therefore measured conditioned seeing as the participants' percentage of accuracy in response to a comprehension drawing task, in which they were required to read, comprehend, and then visualize a given series of sentences. We presented a series of five sentences via a presentation on a laptop in small-groups of two to five participants. Each sentence included one nonsense word: the reading difficulty of the sentence was based on lists of first- and second-grade high-frequency words and the average reading level of the participants. We created two sets of stimuli, and randomly assigned the participants to engage with one of two sets. We counterbalanced the presentation of stimuli sets, such that we presented the Set A stimuli in the postintervention probe session to participants who responded to Set B stimuli in the

preintervention session, and vice versa. Following completion of the three sets of stimuli, we scored the participants' responses using the corresponding scoring sheet for each set (see Appendices B and C).

As a measure of the vocabulary knowledge the participants had in repertoire, we utilized Test 17: Reading Vocabulary of the *WJ IV* (Schrack et al., 2014). Previous research indicates that this measure has excellent test-retest reliability among diverse groups of second-grade students (McGrew et al., 2014). To measure participants' accuracy in deriving the meaning of unknown words in context—referred to in other theoretical models as *inference comprehension*—we conducted a derived-relational responding task. The participants were assigned to the same groups of stimuli as in the comprehension-drawing task (i.e., Group A stimuli in the preintervention probe sessions and Group B stimuli in the postintervention sessions, or vice versa), and we utilized the same scoring sheet as the comprehension-drawing task (Appendices B and C).

We conducted a stimulus preference assessment at the onset of the study to measure participants' preferences for adults versus peers (Northup, George, Jones, Broussard, & Vollmer, 1996). We presented each participant with the written instruction “Please write down the name of a teacher or classmate in our class with whom you’d like to...” followed by one of five designated activities: have lunch, sit at snack, have a tic-tac-toe tournament, play Connect 4®, or color. We counterbalanced the order with which ‘teacher’ or ‘classmate’ was presented in the sentence and we randomly assigned the participants into one of two groups, such that one group received ‘teacher’ as the first choice presented in the sentence and one group received a sentence with ‘classmate’ as the first choice.

We implemented the CSR procedure with a teacher or a peer to establish conditioned reinforcement for reading as the independent variable. The teacher provided the participants with written steps of the procedure and a trade-in menu that corresponded to various positions on a game board, which remained available to the participants throughout all intervention sessions (see Appendices D and E). In addition, the experimenter provided the participants with a game board, which had a character that students moved around the board contingent upon correct responding in various intervention tasks. By displaying their performance through the use of a game board, the participants could visually monitor their progress towards the reinforcer.

At the start of each session of the CSR intervention with a teacher or peer, the teacher provided one to three books within one to two levels of the participants' reading level, depending on the length of the assigned reading interval. If the participants in a peer-yoked dyad were at different reading levels, the teacher presented books within the higher range of the participant with the lower reading level (i.e., one to two levels above this participant's reading level). The picture stimuli in each book were covered, and there was one contextualized nonsense word approximately every 10 sentences (Appendix F). The teacher also presented each participant with the vocabulary worksheets for the given books (Appendix G), as well as with the answer keys for those worksheets and a paper to cover the answers on the key until needed (see Appendix H). Lastly, the teacher gave each participant a copy of the comprehension worksheet (Appendices I and J). For purposes of recording treatment fidelity, a second observer utilized a fidelity checklist with the steps of the intervention (Appendix K). There was a column on the checklist for

the second observer to record whether the teacher prompted the participants for each component of the CSR procedure with a peer.

Design

We utilized a combined small-*n* experimental-control simultaneous treatment design with a single-case multiple-probe design nested within each small group, in order to compare within- and between-group differences (Dugard, File, & Todman, 2012; Greer, Stolfi, & Pistoljevic, 2007). The two groups differed in that one group completed the CSR procedure utilizing a teacher-yoked contingency, and one group completed the CSR utilizing a peer-yoked contingency. We therefore tested the effects of the establishment of conditioned reinforcement for reading via a CSR conditioning procedure with a teacher versus a peer on participants' gains in reading comprehension and vocabulary. We delayed the design by entering the next set of dyads into the intervention only once the effect of the intervention was present in the first set of dyads (Figure 1). In addition, we conducted the probe procedures for reinforcement value of reading for each of the participants at the onset of the study; directly before entering the participants into the intervention; and after any participant entered into the intervention met criterion for a phase of the CSR procedure. We also conducted the reading achievement assessments at the onset of the study, and again (a) directly before entering the participants into the intervention (for Dyads 3 and 4) and (b) immediately after all participants entered into the intervention at a given time met criterion for conditioned reinforcement for reading. There was no change in the participants' typical instructional environment outside of the intervention.

We entered participants into the intervention based on their reinforcement value of reading in baseline conditions, beginning with the participants with the reinforcement value closest to criterion levels. We paired participants in dyads based on their arithmetic average (i.e., mean) reinforcement value of reading, such that the average preintervention reinforcement value of the dyad in the teacher condition was closely matched to that of the dyad collaborating in the peer condition (i.e., within 15%). We also assigned participants to dyads based on their grade-equivalent placement on the *i-Ready*® *K-12 Adaptive Reading Diagnostic* (e.g., ‘Mid 2’), so that the dyad in the teacher CSR condition was matched in grade-level overall reading abilities to the dyad simultaneously in the peer CSR condition, and vice versa. We then randomly assigned the dyads to the teacher or peer CSR condition.

Procedure

Reinforcement value of reading. At the start of each session, the teacher instructed all students in the class to read silently at their desks. The teacher provided behavior-specific praise for self-management behavior (e.g., staying in one’s seat) at a rate of approximately three approvals per min across students in the class.

We considered the participant to be reading if his or her eyes were moving across the page of the book from left to right, and then returning to the leftmost side of the page. Reading also constituted continuing the same pattern of eye movement onto the successive page of the book after reaching the end of the current page. If a participant selected a new book, we scored his or her behavior as reading if he or she emitted observing responses for reading immediately prior to closing a given book; continued to visually attend to the book stimuli while selecting a new book; and turned to the first

page of a new book within 20 s of closing the previous book. We did not consider the participant to be reading if at any point within a given 5-s interval the participant was not engaging in these behaviors.

We calculated the participants' reinforcement value of reading within each silent-reading session as a percentage of intervals in which each participant read, across a total of 120 intervals. We video-recorded two silent-reading sessions per participant and conducted additional sessions if there was not a stable level of responding (i.e., difference in reading of more than 25 intervals between two consecutive sessions for a given participant). We then calculated the average reinforcement value for reading across two or three sessions per participant depending on the demonstration of stability of responding, such that reinforcement value was the average percentage of 5-s whole intervals of reading across silent-reading sessions within a particular probe period (i.e., baseline, preintervention, each postintervention set). In addition to recording reinforcement value of reading as a continuous measure, we also measured the categorical variable of whether conditioned reinforcement for reading was in repertoire for each of the participants. We considered the participants to have conditioned reinforcement for reading in repertoire if they read for at least 75% of the 5-s whole intervals across sessions, as previous research on conditioned reinforcement for observing books or textual stimuli has identified the criterion for conditioned reinforcement as either 70% or 80% (Buttigieg, 2015; Cumiskey Moore, 2017; Gentilini & Greer, 2019; Nuzzolo-Gomez, Leonard, Ortiz, Rivera, & Greer, 2002; Tsai & Greer, 2006).

Reading comprehension.

Covert reading comprehension. In *WJ IV* Test 4: Passage Comprehension, we required the participants to read sentences with a missing word covertly, then respond overtly with a word to complete the sentence (Schrank et al., 2014). In the *GSRT*, the participants covertly read a series of passages and answered corresponding multiple-choice questions (Wiederholt & Blalock, 2000).

Comprehension drawing. For each sentence in the comprehension-drawing task, we vocally instructed the participant to silently read the text presented on the computer. After 30 s, we removed the sentence from the computer screen and instructed the participants to draw a picture representing the content of the entire sentence (Cumiskey Moore, 2017). We repeated this process until we had presented all five of the target sentences, and replicated these procedures with two more groups of five stimuli each, for a total of 15 sentences presented to each participant (Cumiskey Moore, 2017).

For each of the sentences, we scored whether the participant included each of the five major components of the sentence, as listed on the scoring sheet (e.g., the components ‘pilot,’ ‘flying,’ ‘dark,’ ‘clouds,’ and ‘plane’ in the sentence “The pilot flew the **tig** through the dark clouds”). We then calculated each participant’s percentage of accuracy in the comprehension-drawing task by (1) summing the total number of components drawn correctly across the three sets of stimuli within a given group; (2) dividing by the total number of components (i.e., 75 total possible correct responses); and (3) multiplying by 100.

Vocabulary.

Vocabulary knowledge. For Test 17: Reading Vocabulary of the *WJ IV*, we instructed the participant to overtly read a list of words in a one-on-one setting, and emit either a synonym or antonym for each word (Schrack et al., 2014).

Derived-relational responding. We conducted the derived-relational responding task in unison with the comprehension drawing measure (Hayes et al., 2001). That is, after requiring the participants to draw the picture of each sentence in the comprehension-drawing task, we instructed them to turn their pictures face down and write the meaning of the nonsense word. We repeated this process until all five of the target sentences in a given group had been presented and replicated these procedures with all three groups of five stimuli in a given set (Cumiskey Moore, 2017). We calculated the participants' percentage of accurate derived-relational responding by dividing the total number of meanings derived correctly by a total of 15 possible correct responses (i.e., one nonsense word per sentence, with fifteen sentences in each stimulus set) and multiplied by 100.

Preference assessment for teachers versus peers. After presenting the participant with each of the five choices and having them write their preference (i.e., the name of a specific teacher or peer), the participant engaged in the designated activity with the individual he or she selected within the preference assessment. After presenting the assessment for all five activities to each participant, we calculated the participant's preference for adults versus peer by dividing the number of choices in a given category (adult or peer) by the total number of choices and multiplying by 100 to find the percentage of preference for adults versus peers.

Collaborative Shared Reading (CSR) Conditioning Procedure

CSR with a peer. Prior to the onset of the intervention, the teacher vocally explained the steps of the procedure while demonstrating a model of each step (Figure 2). The teacher provided prompting on the steps of the intervention for the first session of the intervention for each dyad. The teacher did not sit at the table with the dyad in successive sessions, and only intervened to provide vocal prompts for purposes of procedural fidelity or to answer questions.

Step 1: Reciprocal overt reading. The participants first rotated reading pages of the selected text aloud for a specified duration of time, as a form of reciprocal overt reading. The duration of reading was dependent on the average number of intervals between participants in which they engaged in reading during preintervention probe sessions immediately prior to entering the intervention, with a minimum starting duration of 2 min. We converted the average number of 5-s whole intervals of reading between participants in the preintervention sessions to a corresponding number of minutes, rounded to the nearest whole minute.

Step 2: Vocabulary task. At the end of the reciprocal reading period, the participants looked back at the text and wrote on the vocabulary worksheet what they suggested to be a synonym for each of the nonsense words they encountered during the reading period. Once the participants had written a response adjacent to a given nonsense word, the partners discussed their answers. They decided on one response in the case of a discrepancy, which they then wrote on their worksheets. After discussing the given nonsense word, the participants checked their response against an answer key that included the verb, noun, adjective, or adverb that was originally included in the text, as well as synonyms for those words. If the participants' response accurately matched the

response on the answer key, the participants advanced their character one space on the game board. If their answer did not match the answer key, the participants did not advance their character on the game board; in this case, the participants went back to the nonsense word in the text and one participant read the sentence aloud with the correct synonym from the answer key, replacing the nonsense word. Participants rotated reading the corrected sentence aloud for each incorrect response.

Step 3: Silent reading. Once the participants completed and consequated all nonsense words encountered during the reciprocal reading period, the participants read silently for the same duration of time as in the reciprocal-reading period. The participants read one at a time, continuing to read the leveled books with covered pictures and nonsense words.

Step 4: Comprehension task. After the designated time for the covert reading period, the participants began a comprehension task which involved (1) selecting a scene from the pages read during the silent-reading, (2) writing the context of that scene on the comprehension worksheet, and (3) drawing a picture of that scene. At the onset of the task, the participants used the book to determine where both partners had stopped reading, as they were only to draw a scene that both partners had encountered during the silent-reading period. However, the participants were not permitted to refer back to the text during the task itself. Once the participants completed their respective worksheets and folded them along the dotted horizontal line (so that their targeted written sentence was hidden), they switched papers and responded in writing to the antecedent printed on the back of the worksheet (“What scene did your partner draw? What happened right before this scene?”) without referring back to the book. The participants then switched

worksheets again and indicated whether the partner had correctly indicated the targeted scene. If both participants correctly guessed their partners' scene, the participants advanced their character three spots on the game board. If either or both of the participants guessed incorrectly, the participant(s) who guessed incorrectly drew their own version of the scene after being told the correct response and did not advance on the game board. Following the completion of the comprehension worksheet, the participants utilized the provided trade-in menu and jointly selected a reinforcer based on their progress on the game board; that is, the number of spots the partners advanced on the game board corresponded to various activities or events. Before each period of trading in, the participants moved their character back to the initial placement on the game board, such that they could not accumulate previously-earned reinforcement across sessions.

Criterion for each session of a given duration of reading was at least 80% accuracy in the vocabulary task and both participants correctly guessing the scene drawn by his or her partner in the comprehension task (i.e., 100% accuracy). Upon meeting criterion, we increased the duration of reciprocal and silent reading by 2 min until the participants met criterion for three consecutive increases in reading durations (e.g., 2 min, 4 min, 6 min). Once any of the participants met criterion for a phase of the intervention, we conducted the probe procedures for the reinforcement value of reading with all participants entered into the intervention at that time, with two or three silent-reading sessions per set (e.g., Post-Probe Set 1). We began the postintervention probe procedures for the reading-achievement measures if all of the participants entered in the intervention at a given time met criterion for conditioned reinforcement for reading (i.e., an average of at least 75% of the 5-s whole intervals across probe sessions). If none, or only some, of

the participants met criterion for conditioned reinforcement for reading, all participants continued in the intervention until any of participants met criterion for a given phase of the intervention—at which point we repeated the probe procedures for reinforcement value of reading.

CSR with a teacher. The four steps of the CSR conditioning procedure with a teacher were nearly identical to those in the CSR procedure with a peer. The teacher and participant engaged in reciprocal reading (Step 1), followed by the vocabulary task in which the participant completed the vocabulary worksheet (Step 2). The teacher and participant discussed each nonsense word after the participant had written down a response, and checked the answer key after deciding on one response. If the participant had written down an incorrect response, he or she reread the sentence from the text, substituting the correct response for the nonsense word. The participant began the silent-reading period after the completion of the vocabulary task (Step 3), and the teacher and participant then both completed and exchanged the comprehension worksheet and consequated each other's responses (Step 4). The rules for the game board were the same as in the peer condition (i.e., move up one spot for each correct response on the vocabulary worksheet, and move up three spots if both partners correctly guessed each other's scene in the comprehension task), as was the trade-in menu.

Interobserver Agreement and Treatment Fidelity

We calculated interobserver agreement (IOA) by dividing the number of agreements by the total number of agreements plus disagreements between the experimenter and an independent second observer, and multiplying that number by 100 to find the percentage. The experimenter calculated an agreement of 99.3% (range, 96.7-

100%) for a random sample of 62.5% of preintervention probe sessions and an agreement of 97.7% (range, 95.8-100%) for a random sample of 31.7% of postintervention probe sessions for reinforcement value of reading. In addition, we calculated 99.2% (range, 97.3-100%) IOA across 100% of preintervention comprehension drawing probe sessions and 98.2% (range, 96.0-100%) IOA across 100% of postintervention probe sessions for comprehension drawing. For derived-relational responding, we calculated 100% IOA across 100% of preintervention and postintervention probe sessions.

In addition, we calculated the treatment fidelity of the teacher's or peer's implementation of CSR procedure by dividing the number of point-by-point components accurately implemented within each video-recorded or in-person session of the intervention by the total number of components included on the fidelity checklist, and multiplying that number by 100 to find the percentage (see Appendix J). In the teacher-yoked CSR procedure, the second independent observer reported 91.2% (range, 73.6-100%) treatment fidelity by the teacher for 37.5% of sessions for Participant 1; 92.5% (range, 77.4-100%) fidelity for 37.5% of sessions for Participant 2; 100% fidelity for 55.6% of sessions for Participant 5; and 100% fidelity for 33.3% of sessions for Participant 6. In the peer-yoked CSR procedure, the second independent observer reported 92.8% (range, 85.0-100%) treatment fidelity for 37.5% of sessions for Participants 3 and 4 (Dyad 2), and 83.5% (range, 72.7-100%) fidelity for 44.4% of sessions for Participants 7 and 8 (Dyad 4). Of the intervention components in the peer CSR condition, the teacher prompted 23.7% (range, 7.7-38.5%) of the components for Dyad 2 and 25.0% (15.4-38.5%) of the components for Dyad 4.

Results

Reinforcement Value of Reading

Table 2 shows changes in participants' reinforcement value of reading throughout the course of the study, with comparable gains in reinforcement value across the teacher and peer conditions for participants who met criterion for conditioned reinforcement. None of the participants demonstrated the criterion for conditioned reinforcement for reading (i.e., an average of 75% of 5-s whole intervals across 10-min probe sessions) prior to entering the intervention (Table 2; Figure 3). Reinforcement value of reading remained relatively stable from the baseline probe sessions to the probe sessions immediately prior to the onset of the intervention for all participants, with a mean change of 11.8% (range, 1.6-22.1%) in reinforcement value between probe periods in the absence of the CSR intervention (Table 2).

The majority of participants increased in reinforcement value for reading as they progressed through the intervention, and seven of the participants acquired conditioned reinforcement for reading by the conclusion of the intervention (excluding Participant 5, who decreased in reinforcement value throughout the intervention) (Table 2; Figure 3). In the teacher condition, Participants 2 and 6 met criterion in the first set of postintervention probe sessions and Participant 1 met criterion for conditioned reinforcement for reading in the second set of postintervention probe sessions (Table 2; Figure 3). In the peer condition, Participant 3 met criterion for conditioned reinforcement in the first set of postintervention probe sessions; Participants 4 and 7 met criterion after the second set of postintervention probe sessions; and Participant 8 met criterion following the third set of postintervention probe sessions (Table 2; Figure 3). Table 3 shows the average increase in reinforcement value from the probe sessions immediately prior to the onset of the

intervention to the probe sessions immediately following the conclusion of the intervention for all participants who met criterion for conditioned reinforcement for reading by the conclusion of the study (i.e., excluding Participant 5). Participants in the teacher condition increased an average of 29.4% (range, 12.0-57.5%) in reinforcement value, and participants in the peer condition increased an average of 31.9% (range, 13.7-54.1%) (Table 3).

Reading Achievement

Tables 4 and 5 show grade-level increases in measures of reading comprehension and vocabulary between probe sessions immediately prior to and following the intervention. Of the participants who met criterion for conditioned reinforcement for reading (i.e., excluding Participant 5), all participants increased beyond the amount expected based solely on elapsed time between probe periods for Test 4: Passage Comprehension of the *WJ IV* (Table 4; Figure 4). The average increase on *WJ IV* Test 4: Passage Comprehension for participants who acquired conditioned reinforcement for reading was 1.5 grade levels (range, 0.6-2.5 grade levels) for those in the teacher condition and 0.6 (range, 0.2-1.2 grade levels) for those in the peer condition (Table 3; Figure 5). For the *GSRT*, Participants 1 and 6 in the teacher condition and Participants 3 and 7 in the peer condition increased beyond the expected amount based on elapsed time between probe periods (Table 4; Figure 4). In the teacher condition, the average increase on the *GSRT* was 0.7 grade levels (range, 0-1.5 grade levels) when rounding any decreases in scores to 0 (i.e., Participant 2 in the teacher-yoked condition and Participant 4 in the peer condition). In the peer condition, the average increase on the *GSRT* was 0.5 grade levels (range, 0-1.5 grade levels) (Table 3; Figure 5). All participants who met

criterion for conditioned reinforcement for reading demonstrated increases on the measure of comprehension drawing (Table 5; Figure 6), with an average increase of 19.1% (range, 4.0-36.0%) in the teacher condition and 8.3% (range, 5.3-9.3%) in the peer condition (Table 3; Figure 7).

All participants who met criterion for conditioned reinforcement for reading also demonstrated increases beyond the expected amount based on elapsed time between probe periods on *WJ IV* Test 17: Reading Vocabulary (Table 4; Figure 4). On average, participants in the teacher condition increased 1.3 grade levels (range, 0.3-3.1 grade levels), and participants in the peer condition increased 0.7 grade levels (range, 0.3-1.0 grade levels) on this measure of vocabulary (Table 3; Figure 5). Of the participants who met criterion for conditioned reinforcement for reading, Participants 2 and 6 in the teacher condition and Participants 4 and 8 in the peer condition demonstrated increases in derived-relational responding (Table 5; Figure 6). The average increase on this measure was 17.8% (range, 0-40.0%) in the teacher condition and 18.4% (range, 0-53.4%) in the peer condition when rounding any decreases in scores to 0 (i.e., Participant 1 in the teacher condition and Participants 3 and 7 in the peer condition for derived relational responding) (Table 3; Figure 7).

Participant 5 (teacher condition) did not meet criterion for conditioned reinforcement for reading and did not demonstrate gains on any standardized measure of reading comprehension or vocabulary, including *WJ IV* Test 4: Passage Comprehension, the *GSRT*, and *WJ IV* Test 17: Reading Vocabulary (Table 4; Figure 4). Participant 5 increased in both comprehension drawing and derived-relational responding from the assessments immediately prior to and following the intervention (Table 5; Figure 6).

Progression Through the Intervention

Table 6 shows the number and duration of intervention sessions across participants in the teacher and peer CSR conditions. The range of session durations for the participants in the CSR intervention with a teacher is 11:32 to 58:32 min, with a mean total duration of 291:51 min (range, 209:36-356:10 min) across all sessions for participants who exited the intervention (Table 6). The range of session durations for the participants in the CSR intervention with a peer is 27:12 to 76:44 min, with a mean total duration of 361:02 min (range, 311:36-412:16 min) across all sessions for participants who exited the intervention (Table 6). By the conclusion of the intervention, Participants 1 and 6 met criterion for two phases of the intervention, Participant 5 met criterion for one phase of the intervention, and Participant 2 did not meet criterion for any phases of the intervention in the teacher CSR condition (Figures 8 and 9). For the peer CSR procedure, Dyad 4 (Participants 7 and 8) met criterion for one phase of the intervention, and Dyad 2 (Participants 3 and 4) did not meet criterion for any phases of the intervention by the conclusion of the study (Figures 8 and 9).

Preference Assessment

Table 7 shows participants relative preference for teachers versus peers in the stimulus preference assessment at the onset of the study. All participants assigned to the teacher condition (i.e., Participants 1, 2, 5, and 6) demonstrated a stronger relative preference for peers prior to the onset of the study. For those assigned to the peer condition, Participants 3 and 4 demonstrated a stronger relative preference for peers, and Participants 7 and 8 demonstrated a stronger relative preference for teachers (Table 7).

Discussion

The results of this study suggest that the establishment of conditioned reinforcement for reading via a CSR procedure with a teacher or peer is effective in increasing the reading achievement of second-grade students. We anecdotally note that participants entered in both of the CSR conditions mandated for more sessions of the intervention. It is likely that the intervention increased the participants' purpose of reading—that is, to acquire information and derive meaning from the text that can be used effectively for some aesthetic or technical function. The steps within the CSR procedure increased the participants' stimulus control for observing, in part by incorporating tasks that required a high degree of attention to the text in order to contact the pertinent content.

Whereas previous research has tested the effects of similar collaborative, content-based activities on the reading comprehension and vocabulary of fifth-grade students (Cumiskey Moore, 2017), this study fills a gap in the current literature in that it is the first empirical investigation of a CSR procedure with peers applied to second-grade students. In addition, it differs from previous applications of the CSR procedure (Cumiskey Moore, 2017; Gentilini & Greer, 2019), as it includes students with and without disabilities. Seven of the participants acquired conditioned reinforcement for reading through the CSR intervention with a teacher ($n = 3$) or a peer ($n = 4$), including participants whose preintervention preference for teachers versus peers did not align with their assigned condition (i.e., teacher-yoked or peer-yoked).

Participant 5 was the only participant to consistently decrease in reinforcement value of reading throughout the intervention, and did not demonstrate conditioned reinforcement for reading by the conclusion of the study. Moreover, Participant 5 did not

demonstrate increases on the majority of measures of reading achievement. This participant entered the intervention with relatively low overall reading comprehension and vocabulary scores compared to the other participants, as well as with the lowest relative reading level based on her performance on the *DRA2*[®]. It is possible that students who are below a certain grade-level equivalency in reading do not benefit from the CSR procedure, further suggesting that skill and will are not mutually exclusive in the development of reading achievement (Watkins & Coffey, 2004). In addition, we anecdotally noted that Participant 5 required frequent reminders to read silently, as opposed to aloud, during periods of both silent reading and reading-achievement assessments. It is possible that Participant 5 had not yet acquired the ability to read and comprehend text covertly, and may therefore require more direct training in this speaker-as-own listener capability before acquiring conditioned reinforcement for content contacted through silent reading (Greer & Keohane, 2005; Greer & Ross, 2008; Hill-Powell, 2015). An increased sample size may provide greater generality of the procedure to students with various academic profiles and verbal-behavior developmental cusps and capabilities in repertoire. Furthermore, future studies may test the effect of the peer-yoked CSR procedure on the reinforcement value of reading and reading achievement for Participant 5 and students with similar profiles, as this may provide insight into whether one condition is more effective for students with or without certain verbal-developmental milestones (Greer & Ross, 2008).

The results of this study also demonstrate more educationally significant gains in reading achievement for participants in the teacher condition who met criterion for conditioned reinforcement for reading, as opposed to those in the peer condition. Despite

demonstrating comparable average increases in reinforcement value of reading from the probe sessions immediately prior to and following the intervention, participants in the teacher condition who acquired conditioned reinforcement for reading increased to a greater degree than participants in the peer condition on the majority of dependent measures. The largest differences between conditions were participants' gains on *WJ IV* Test 4: Passage Comprehension and Test 17: Reading Vocabulary. However, all participants for whom conditioned reinforcement for reading was established demonstrated gains on at least some measures of reading comprehension and vocabulary after only nine sessions at most, totaling a maximum of 412 min (6.9 hr) across sessions per participant or dyad.

The majority of participants did not increase significantly in their reinforcement value of reading or reading achievement when assessed at multiple times prior to the onset of the intervention. Although there are some participants whose preintervention reading-achievement increases may warrant additional examination, it is likely that these increases are at least partially attributable to repeated exposure to a given form or set of stimuli (e.g., Form A of the *GSRT*). The delayed design is strength of this study, as it controls for threats to internal validity such as maturation and instructional history and suggests that the participants would not otherwise have demonstrated such significant increases in reinforcement value or reading achievement without the addition of the CSR intervention. We utilized a multi-method approach in our assessment of covert reading comprehension (i.e., *WJ IV* Test 4: Passage Comprehension, *GSRT*, and comprehension drawing) and vocabulary (i.e., vocabulary knowledge and derived-relational responding) to increase the rigor of our research.

Limitations and Suggestions for Future Research

Considering the time-intensive nature of the teacher-yoked CSR procedure, the overall effectiveness and relative efficacy of the peer-yoked CSR procedure increases the applicability of this intervention in the classroom setting, although a teacher procedure may result in greater gains in reading achievement. Future studies should include a social validity questionnaire to be completed by the students' general classroom teachers, reading specialists, and paraprofessionals. Such measures would indicate whether these individuals consider the CSR procedure with a teacher or peer to be a feasible method of implementation to increase students' reinforcement value of reading. In addition, future studies should continue to measure the treatment fidelity of a CSR intervention with a peer with a larger sample of students, as the question remains as to whether this procedure can be implemented with a high degree of fidelity by early-elementary students without the need for teacher mediation. A limitation of the current study is that the teacher prompted the participants when she observed them incorrectly implementing a given step of the procedure, therefore making it difficult to obtain a valid measure of treatment fidelity for a CSR procedure completed by a peer dyad with total independence. Future research should focus on identifying tactics to enhance the viability of the peer procedure (e.g., more intensive preintervention training), in terms of both increasing treatment fidelity and decreasing the need for instructional guidance from adults. In addition, a limitation of this study is that only one book stimulus was available per dyad, such that partners in the peer condition had to complete the silent-reading step of the CSR intervention at separate times, as opposed to concurrently at separate tables. It is therefore difficult to reliably compare the duration of the teacher and peer conditions, as the

availability of additional intervention stimuli would have likely decreased the total duration of the peer-yoked CSR procedure.

Another limitation of the current study is that the criterion for what constitutes an ideal percentage of reading intervals for the nominal category of conditioned reinforcement for reading has not been identified. Although the criterion was based on existing verbal-behavior developmental research on conditioned reinforcement for observing books or textual stimuli (e.g., Buttigieg, 2015; Cumiskey Moore, 2017; Nuzzolo-Gomez et al., 2002; Tsai & Greer, 2006), there remains the possibility that an alternative criterion may have yielded different gains in reading achievement, as the criteria in these studies were all arbitrarily established based on the experimenters' estimates. Experimenters should consider conducting a parametric analysis to evaluate the criterion for conditioned reinforcement for reading that is optimal in its effect on reading achievement (Fuller & Fienup, 2017). Future studies can also test alternate mastery criteria for the intervention, in terms of how different criteria affect participants' acquisition of conditioned reinforcement for reading, and successive gains in reading comprehension and vocabulary. Such data can potentially lend themselves to increasing the efficiency of the intervention, in turn increasing the feasibility of the procedure in a classroom setting. An additional suggestion for future research is to conduct maintenance probe sessions for reinforcement value of reading to determine whether the effects of the CSR procedure are maintained over time, or whether the intervention must be periodically reinstated in order for textual stimulus to maintain stimulus control. A parametric analysis involving the criterion of both the intervention and the establishment of conditioned reinforcement for reading may also provide insight into which

intervention conditions best maintain or increase a students' reinforcement value of reading over time.

It is possible, and even likely, that there are idiosyncratic differences in the reinforcement value of adults and peers for children at different grade levels that confer variations across individuals in the effectiveness of a teacher-yoked versus peer-yoked CSR procedure for establishing conditioned reinforcement. We therefore conducted a preference assessment prior to the onset of the intervention to possibly explain such variations in the effectiveness of the conditions. Participants in the teacher condition who preferred peers acquired conditioned reinforcement, and vice versa, suggesting that students can accrue benefits in reading achievement from the CSR procedure, regardless of whether their relative preference for teachers versus peers aligns with their assigned condition. However, stimulus preference assessments do not evaluate a stimulus's reinforcing effects (Piazza, Fisher, Hagopian, Bowman, & Toole, 1996). It may therefore be advantageous to develop a method for testing the potency of adults and peers as reinforcers for certain social-interaction behaviors for each participant prior to implementing conditioning procedures. For example, the experimenter can consider comparing participants' rate of correct responding when receiving vocal praise from a teacher versus a peer during the completion of a performance task, or the participants' rate of learning when contacting instruction delivered by a teacher versus instruction presented through a peer-tutoring tactic when procedures are held constant.

It may also be effective to combine aspects of a teacher-yoked and peer-yoked procedure within one intervention, as both the type and variation of reinforcers have an effect on the degree to which the target behavior is increased (Becraft & Rolider, 2015;

Milo, Mace, & Nevin, 2010). For instance, the derived-relational responding task might include a peer-yoked contingency game board, and the comprehension component of the intervention might incorporate reinforcement from an adult by requiring the participants to complete the task together and then exchange their drawing with the teacher to guess the scene. Another suggestion for future research is to allow students to choose for themselves whether they would prefer working with a teacher or peer, particularly for students who initially demonstrate a high interest in partaking in the pairing procedure (Patall, 2013). Although there are mixed results regarding the effect of choice on motivation and performance outcomes (e.g., Moller, Deci, & Ryan, 2006; Patall, Cooper, & Robinson, 2008; Patall, Cooper, & Wynn, 2010; Reeve, Nix, & Hamm, 2003), students who demonstrate a higher interest in a task are more likely to reap the motivational benefits of choice (Patall, 2013). It is therefore possible that providing the students the opportunity to choose their partner may increase the effectiveness and efficiency of the pairing procedure.

Another limitation present in this study includes the potential for participants' reactivity to the presence of the recording device during the silent-reading probe procedures. We utilized recording devices, as opposed to real-time data collection by the experimenter, to decrease the possibility of instructional control as a confounding variable.

Furthermore, experimenters in future studies using this procedure should consider including the vocabulary and comprehension components of the intervention after both the overt and covert silent-reading periods, such that both collaborative activities become paired with both types of reading. In the current CSR procedure, the vocabulary task

followed the overt reading and the comprehension task followed the covert reading period, which may affect the degree to which participants demonstrate increases on reading achievement measures—which require only covert reading. Lastly, the question remains as to whether comprehension drawing and derived-relational responding are valid and reliable measures of reading achievement. Future studies should utilize a multi-method approach to capture the construct of conditioned seeing, as well as derived-relational responding, as consistency between measures may increase the content validity. Experimenters should also consider presenting sentences of differing levels of complexity in the comprehension drawing and derived-relational responding measures, based on students' overall reading abilities at the onset of the study. This change could have potentially eliminated the ceiling effect demonstrated by Participants 1, 3, and 6 in the derived-relational responding task, and could allow for more meaningful comparisons of improvements in students' accuracy on these measures.

Implications

Considering that a wide range of studies report reading amount as a positive predictor of reading competence and growth (Anderson et al., 1988; Cipielewski & Stanovich, 1992; Cunningham & Stanovich, 1997; Taylor, Frye, & Maruyama, 1990), the results of this study suggest that a peer-yoked CSR procedure is both an efficient and effective method by which to promote the development of higher-order repertoires of reading. Educators of early elementary-school students should therefore consider this procedure as a systematic method for establishing conditioned reinforcement for reading—with the acquisition of this reinforcer promoting successive gains in a variety of advanced

reading repertoires as students' covert reading behavior comes under stimulus control.

As B.F. Skinner proposed:

By scheduling reading material so that the student is reinforced at the right time, we can “hook” him so that he will go on reading more and more difficult things and continue to read throughout his life. We shouldn't teach great books; we should teach a love of reading. Knowing the contents of a few words of literature is a trivial achievement. Being inclined to go on reading is a great achievement.
(Evans, 1968, p. 73)

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Table 1. Demographic Characteristics of Participants at Onset

Intervention Condition	Intervention Group	Participant	Age (years)	Sex	Race/Ethnicity	Free/Reduced Lunch Status	English as a Second Language	Diagnosis/Educational Classification	Grade-Level Equivalent for <i>i-Ready</i> ® Reading ^a	Scholastic® Guided Reading Program Level ^b
Teacher CSR	Dyad 1	1	8.4	M	Black	Not Eligible	No	Attention-Deficit/Hyperactivity Disorder	Mid 2	L
		2	8.3	M	White	Not Eligible	No	Autism Spectrum Disorder	Grade 1	K
Peer CSR	Dyad 2	3	7.7	M	White	Not Eligible	No	N/A	Mid 2	L
		4	7.7	F	Hispanic	Eligible	Yes	N/A	Early 2	L
Teacher CSR	Dyad 3	5	7.4	F	White	Not Eligible	No	Other Health Impaired	Grade 1	I
		6	8.2	F	Hispanic	Eligible	Yes	N/A	Early 2	L
Peer CSR	Dyad 4	7	8.2	F	Other	Not Eligible	No	N/A	Grade 1	L
		8	7.9	F	White	Not Eligible	Yes	Communication Impaired	Early 2	L

Note. All demographic information gathered from school's database, with free/reduced lunch based on the local familial income criterion.

^aBased on the participants' overall scores on the *i-Ready*® *K-12 Adaptive Reading Diagnostic* immediately prior to the onset of the study. ^bBased on the participants' performance on the *Developmental Reading Assessment, Second Edition*® (*DRA2*®) immediately prior to the onset of the study.

Table 2. Participants' Average Reinforcement Value of Reading Per Probe Period

Intervention Condition	Intervention Group	Participant	Baseline Probe Average	Probe Average Immediately Prior to Intervention	Post-Probe Set 1 Average	Post-Probe Set 2 Average	Post-Probe Set 3 Average
Teacher CSR	Dyad 1	1	70.5	58.8	58.0	77.5	N/A
		2	55.8	63.4	75.0	75.4	N/A
Peer CSR	Dyad 2	3	69.6	68.0	78.8	81.7	N/A
		4	46.7	68.8	68.8	86.3	N/A
Teacher CSR	Dyad 3	5	35.9	17.1	26.3	25.8	20.0
		6	38.4	22.1	77.5	67.6	79.6
Peer CSR	Dyad 4	7	28.8	20.5	52.5	82.9	78.8
		8	37.1	45.4	74.2	73.8	87.5

Note. Based on the average percentage of 5-s whole intervals of observable reading across two or three 10-min silent-reading sessions per probe period (i.e., baseline, preintervention, each postintervention set). We defined conditioned reinforcement for reading as an average of at least 75% of 5-s whole intervals of reading across 10-min probe sessions in a given probe period.

Table 3. Average Increase Across Measures of Reading Achievement for Participants in Teacher Versus Peer Condition Between Probe Sessions Immediately Prior to and Following Intervention

Measure	CSR Condition	
	Teacher Condition (<i>n</i> = 3)	Peer Condition (<i>n</i> = 4)
Reinforcement Value of Reading	29.4% (range, 12.0-57.5%)	31.9% (range, 13.7-54.1%)
<i>WJIV</i> Test 4: Passage Comprehension	1.5 grade levels (range, 0.6-2.5 grade levels)	0.6 grade levels (range, 0.2-1.2 grade levels)
<i>GSRT</i>	0.7 grade levels (range, 0-1.5 grade levels)	0.5 grade levels (range, 0-1.5 grade levels)
Comprehension Drawing	19.1% (range, 4.0-36.0%)	8.3% (range, 5.3-9.3%)
<i>WJIV</i> Test 17: Reading Vocabulary	1.3 grade levels (0.3-3.1 grade levels)	0.7 grade levels (0.3-1.0 grade levels)
Derived-Relational Responding	17.8% (range, 0-40.0%)	18.4% (range, 0-53.4%)

Note. Only includes participants who met criterion for conditioned reinforcement for reading by the conclusion of the study (i.e., excluding Participant 5). We rounded any decreases to 0.

Table 4. Grade-Level Increase in Comprehension and Vocabulary Between Probe Sessions Immediately Prior to and Following Intervention

Measure	Participant							
	Dyad 1 (Teacher Condition)		Dyad 2 (Peer Condition)		Dyad 3 (Teacher Condition)		Dyad 4 (Peer Condition)	
	1	2	3	4	5	6	7	8
<i>WJIV</i> Test 4: Passage Comprehension	2.5 *	1.4 *	0.2 *	0.4 *	---	0.6 *	1.2 *	0.4 *
<i>GSRT</i>	0.5 *	---	1.5 *	---	---	1.5 *	0.5 *	---
<i>WJIV</i> Test 17: Reading Vocabulary	3.1 *	0.5 *	0.8 *	1.0 *	---	0.3 *	0.5 *	0.3 *

Note. --- denotes that the participant did not demonstrate an increase on that measure.

* denotes that the participant demonstrated a grade-level increase beyond the amount expected based solely on elapsed time between probe periods (i.e., approximately 1 month or 0.1 grade levels).

Table 5. Percentage Increase in Comprehension Drawing and Derived-Relational Responding Between Probe Sessions Immediately Prior to and Following Intervention

Measure	Participant							
	Dyad 1 (Teacher Condition)		Dyad 2 (Peer Condition)		Dyad 3 (Teacher Condition)		Dyad 4 (Peer Condition)	
	1	2	3	4	5	6	7	8
Comprehension Drawing	4.0	36.0	9.3	5.3	42.7	17.3	12.0	6.6
Derived-Relational Responding	---	40.0	---	20.0	20.0	13.3	---	53.4

Note. --- denotes that the participant did not demonstrate an increase on that measure.

Table 6. Number and Duration of Intervention Sessions Across Participants

Intervention Condition	Intervention Group	Participant(s)	Initial Target Duration (min)	Duration of Sessions, Phase 1 (min)	Duration of Sessions, Phase 2 (min)	Total Duration of Sessions
Teacher CSR	Dyad 1	1	6	1. 35:21 2. 42:18 3. 40:55 4. 39:44	1. 51:08 2. 37:50 3. 50:22 4. 58:32	356:10 min ≈ 5.9 hr
		2	6	1. 29:14 2. 30:27 3. 36:19 4. 26:08 5. 41:47 6. 42:06 7. 38:46 8. 43:47	N/A	288:34 min ≈ 4.8 hr
Peer CSR	Dyad 2	3 and 4	7	1. 41:18 2. 54:19 3. 43:29 4. 53:04 5. 46:51 6. 39:10 7. 57:21 8. 76:44	N/A	412:16 min ≈ 6.9 hr
Teacher CSR	Dyad 3	5	2	1. 19:15 2. 14:06 3. 24:02 4. 21:39 5. 22:03 6. 21:50 7. 27:08 8. 28:04	1. 31: 29	209:36 min ≈ 3.5 hr
		6	2	1. 11:32 2. 23:51 3. 31:56 4. 34:23 5. 31:52	1. 36:19 2. 42:07 3. 48:57 4. 52:08	313:05 min ≈ 5.2 hr
Peer CSR	Dyad 4	7 and 8	3	1. 35:16 2. 36:15 3. 32:05 4. 29:18 5. 27:12 6. 38:27 7. 29:02 8. 39:30 9. 44:31	N/A	311:36 min ≈ 5.2 hr

Table 7. Percentage of Relative Preference in a Stimulus Preference Assessment at Onset of Study

Participant	Relative Preference for Teachers	Relative Preference for Peers
1	0%	100%
2	0%	100%
3	0%	100%
4	20%	80%
5	20%	80%
6	40%	60%
7	100%	0%
8	100%	0%

Figure 1. Sequence of the design to test the effect of the establishment of conditioned reinforcement for reading via a collaborative shared reading (CSR) intervention with a teacher or peer on participants' reading achievement. We utilized a small-*n* experimental-control simultaneous treatment design, with a single-case multiple-probe delayed design nested within each small group (Dugard et al., 2012; Greer, Stolfi, & Pistoljevic, 2007).

Figure 2. Sequence of the collaborative shared reading (CSR) conditioning procedure with a peer or teacher for establishing conditioned reinforcement for reading. The duration of the overt and covert reading periods were dependent on the average number of intervals in which the participant(s) engaged in observable reading behavior across preintervention probe sessions immediately prior to entering the intervention. Criterion for each session of a given duration of reading was at least 80% accuracy in the derived-relational responding tasks and 100% accuracy in the comprehension task. Once the participants met criterion for a given duration of overt and covert reading, the experimenter increased the duration of the reading periods by 2 min; once the participant had met criterion for three 2-min increases in session durations, the experimenter conducted the probe procedures for the reinforcement value of reading with all participants entered into the intervention at that time.

Figure 3. Implementation of the independent variable, as measured by the percentage of 5-s whole intervals of reading within each 10 min probe session, or reinforcement value of reading. We defined conditioned reinforcement for reading as an average of at least 75% intervals of reading across probe sessions within a given probe period.

Figure 4. Participants' grade equivalences on *Woodcock-Johnson® Tests of Achievement*, Fourth Edition (*WJ IV*) Test 4: Passage Comprehension, *Gray Silent Reading Test (GSRT)*, and *WJ IV* Test 17: Reading Vocabulary in the preintervention and postintervention probe sessions.

Figure 5. Average grade-level increase on *Woodcock-Johnson*[®] *Tests of Achievement*, Fourth Edition (*WJ IV*) Test 4: Passage Comprehension, *Gray Silent Reading Test (GSRT)*, and *WJ IV* Test 17: Reading Vocabulary between probe sessions immediately prior to and following the collaborative shared reading (CSR) for participants who met criterion for conditioned reinforcement for reading in the teacher or peer condition. The error bars represent the range of increases for students in each condition, with any decreases in score rounded to 0 and comparable numbers of participants who decreased across conditions (i.e., Participant 2 in the teacher-yoked condition and Participant 4 in the peer condition for the *GSRT*).

Figure 6. Participants' percentage of accuracy in the comprehension drawing and derived-relational responding preintervention and postintervention probe sessions.

Figure 7. Average increase in percentage of accuracy on the comprehension drawing and derived-relational responding tasks between probe sessions immediately prior to and following the intervention for participants who met criterion for conditioned reinforcement for reading in the teacher or peer condition. The error bars represent the range of increases for students in each condition, with any decreases in score rounded to 0 and comparable numbers of participants who decreased across conditions (i.e., Participant 1 in the teacher condition and Participants 3 and 7 in the peer condition for derived-relational responding).

Figure 8. Progression through the intervention for participants in Dyads 1 and 2. Criterion for each session of a given duration of reading was at least 80% accuracy in the vocabulary task and 100% accuracy in the comprehension task. Criterion for a given phase of the intervention was three consecutive increases in reading durations (e.g., 2 min, 4 min, 6 min).

Figure 9. Progression through the intervention for participants in Dyads 3 and 4.

Appendix A Data Sheet for Reinforcement Value of Reading Probe Procedures

Date:

Observer:

IOA:

Whole Interval R+ Reading

Student:	
0:05	
0:10	
0:15	
0:20	
0:25	
0:30	
0:35	
0:40	
0:45	
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9:35	
9:40	
9:45	
9:50	
9:55	
10:00	

Appendix B
Scoring Sheet for Conditioned Seeing and Derived-Relational Responding, Set A

Student:
Scorer:

Date of Assessment:
IOA:

Probe 1:

1. The mom heard the **gux** ring, so she picked it up and said “hello.”

mom	ringing	picking up	saying “hello”	<i>phone</i>	DR: + / –
					Total: /5

2. The pilot flew the **tig** through the dark clouds.

pilot	flying	dark	clouds	<i>plane</i>	DR: + / –
					Total: /5

3. After putting on her scarf, the child put her **mif** on her head and played in the snow.

scarf	child	playing	snow	<i>hat</i>	DR: + / –
					Total: /5

4. The girl put her pole in the water and caught a **nik** on the hook.

girl	pole	water	hook	<i>fish</i>	DR: + / –
					Total: /5

5. Once the **yuts** fell off the tree, the boy made a pile to jump into.

tree	boy	pile	jumping	<i>leaves</i>	DR: + / –
					Total: /5

Probe 2:

1. It was raining, so the man opened his **sid** when he was walking his dog.

raining	man	opened	walking dog	<i>umbrella</i>	DR: + / –
					Total: /5

2. The tip of the student’s **saf** broke, so she was upset that she could not write.

tip	student	broke	upset	<i>pencil</i>	DR: + / –
					Total: /5

3. The boy closed his eyes as he blew out the **lan** on his birthday cake.

boy	closed eyes	blowing	birthday cake	<i>candles</i>	DR: + / –
					Total: /5

4. The lady used the switch to turn off the bright **pid** when she got into bed.

lady	switch	turning off	bed	<i>lights</i>	DR: + / –
					Total: /5

5. The princess tried to put the **fif** on her foot, but she cried when her toes wouldn't fit.

princess	trying to put on	crying	toes not fitting	<i>shoe</i>	DR: + / –
					Total: /5

Probe 3:

1. The students turned towards the **poc** and put their hands on their chest when they said the pledge.

students	facing flag	hands on chest	saying pledge	<i>flag</i>	DR: + / –
					Total: /5

2. The cat cried when the man stepped on its long **vut**.

cat	crying	man	stepping	<i>long tail</i>	DR: + / –
					Total: /5

3. The kid was happy when his grandma took the training wheels off his **jem**.

kid	happy	grandma	taking off training wheels	<i>bike</i>	DR: + / –
					Total: /5

4. The grandpa used the flash on his **yaf** to take a photo of his dog at night.

grandpa	flash	photo of dog	night	<i>camera/phone</i>	DR: + / –
					Total: /5

5. The lady surfed in the ocean's big **hurs** when she went to the beach.

lady	surfing	ocean	beach	<i>big waves</i>	DR: + / –
					Total: /5

Total Components Correct: /75

Total Derived Relations Correct: /15

Percentage of Conditioned Seeing:

Percentage of Derived Relations:

Appendix C
Scoring Sheet for Conditioned Seeing and Derived-Relational Responding, Set B

Student:

Date of Assessment:

Scorer:

IOA:

Probe 1:

1. The boy wore **buy** on his face to protect his eyes from the sun at the beach.

boy	on face	sun	beach	<i>sunglasses</i>	DR: + / –
					Total: /5

2. The sweaty girl filled her **yax** with water at the water fountain.

sweaty	girl	filling	water fountain	<i>bottle</i>	DR: + / –
					Total: /5

3. The nurse gave the crying girl a **kew** for her cut.

nurse	crying	girl	cut	<i>bandage</i>	DR: + / –
					Total: /5

4. The woman jumped and cheered when she scored a **sut** in soccer.

woman	jumping	cheering	soccer	<i>goal</i>	DR: + / –
					Total: /5

5. The angry **fup** barked as he ran after a cat.

angry	barking	running	cat	<i>dog</i>	DR: + / –
					Total: /5

Probe 2:

1. The farmer collected three white **bews** from the chicken cage.

farmer	collecting	three	chicken cage	<i>eggs</i>	DR: + / –
					Total: /5

2. The jolly chef put the round cake in the **vix** to bake.

jolly	chef	round	putting in cake	<i>oven</i>	DR: + / –
					Total: /5

3. The dad got his shoe wet when he stepped in a **fer** on a rainy day.

dad	wet shoe	stepping	rainy day	<i>puddle</i>	DR: + / –
					Total: /5

4. The cowboy rode his gray **rov** fast enough to catch the angry robber.

cowboy	riding	gray	angry robber	<i>horse</i>	DR: + / –
					Total: /5

5. The fireman sprayed **ger** from the hose to put out the fire.

fireman	spraying	hose	fire	<i>water</i>	DR: + / –
					Total: /5

Probe 3:

1. When principal called the student's mom on the **tud**, the student laid on the floor and screamed.

principal	student	laying	screaming	<i>calling on phone</i>	DR: + / –
					Total: /5

2. The singer was scared to perform on the huge **caf** in front of so many people.

singer	scared	huge	many people	<i>stage</i>	DR: + / –
					Total: /5

3. The **ser** happily hopped around the park looking for carrots.

happy	hopping	park	carrots	<i>bunny</i>	DR: + / –
					Total: /5

4. When the teacher pointed to Friday on the **waz**, the girl started smiling.

teacher	pointing to Friday	girl	smiling	<i>calendar</i>	DR: + / –
					Total: /5

5. The baby looked outside her **lig** and saw a dancing snowman.

baby	looking outside	dancing	snowman	<i>window</i>	DR: + / –
					Total: /5

Total Components Correct: /75

Total Derived Relations Correct: /15

Percentage of Conditioned Seeing:

Percentage of Derived Relations:

‘Reading Robot’ Quick Guide

Step 1: Take Turns Reading Aloud

- Take turns reading out loud with your partner; switch readers after each page
- Don’t forget to set the timer!

Step 2: Guess the Word

- On Worksheet #1, find the page number you started on and write down a word that means the same as each silly word
- Don’t talk to your partner until you have both written down a word
- Talk to your partner and come up with one answer you both agree on
- Write down your final answer
- Check the answer key
 - Correct: move your robot up one spot and write a plus (+)
 - Incorrect: take turns with your partner reading the sentence with the correct answer and write down a minus (–)
- Keep going until you get to the last page that you read
- Remember–you *should* use the book!

Step 3: Silent Reading

- One partner reads silently and then gives the book to the other partner when the timer goes off
- Don’t forget to set the timer and use your “start” and “stop” Post-it notes

Step 4: Sentence Drawing

- Check the book to see where your partner stopped reading, but then do not use the book
- Pick something that happened in the book during silent reading
- On Worksheet #2, write about the scene and draw a picture of it
- Fold your worksheet on the dotted line and switch with your partner
- Guess your partner’s scene by writing your answer on the back of their worksheet
- Check each other’s work
 - Correct: move your robot up three spots
 - Incorrect: if your partner guessed incorrectly, tell them the correct scene, and have them draw the scene on the back of your worksheet

Step 5: Trade-in Time!

- Raise your hand as soon as you’re finished!

Appendix E
Trade-in Menu for CSR Procedure

Trade-in Menu

5 Spots or less: 20 points

6 Spots: 5 minutes of free trade-in or 30 points

8 Spots: 10 minutes of free trade-in or 5 extra minutes of recess

10 Spots: 15 minutes of free trade-in or 10 minutes of free trade-in with a guest

12 Spots: 20 minutes of free trade-in or 15 minutes of free trade-in with a guest

14 Spots: 5 extra minutes of snack time for the whole class or 10 minutes of free trade-in with two guests

16 Spots: 5 extra minutes of recess for the whole class or 15 minutes of free trade-in with two guests

18 Spots: lunch in the classroom with one friend or 20 minutes of free trade-in with a guest

20 Spots: 10 extra minutes of recess for the whole class or lunch in the classroom with two guests

25 Spots or More: lunch in the classroom with four guests or 20 minutes of free trade-in with three guests

30 Spots or More: lunch in the classroom with six guests or 20 minutes of free trade-in with five guests

Appendix F
Sample Book Used in the CSR Procedure

Appendix G
Sample Vocabulary Worksheet

Worksheet #1: Flat Stanley Goes Camping (J)

Page	Word	Guess	Final Answer	+/-
10	sut			
13	kizzing			
14	pob			
19	sotted			
21	vid			
23	zatted			
25	demmed			
27	lix			
31	wegged			

Appendix H
Sample Vocabulary Worksheet Answer Key

Answer Key: Flat Stanley Goes Camping (J)

p. 10: sut = sick; tired; bored

p. 13: kizzing = camping

p. 14: pob = drive; trip; time

p. 19: sotted = peered; looked

p. 21: vid = tail

p. 23: zatted = landed

p. 25: demmed = spotted; saw; heard

p. 27: lix = river; water

p. 31: wegged = saved; helped

Appendix I
Comprehension Worksheet

Name _____

Date _____

Book Title: _____

Worksheet #2

Draw a picture of a scene that you read during silent reading, without looking back at the book:

What was happening in your scene? What happened right before this scene?:

Partner's Response:

What scene did your partner draw? What happened right before this scene?:

Did your partner guess the correct scene? (circle one) *yes* *no*

If not, have your partner read your scene again and draw his or her own detailed version of the scene:

Appendix J Sample Intervention Set-up

Appendix K
Checklist Used by Second Observer for Scoring Treatment Fidelity
Treatment Fidelity Checklist

Participant(s)/Session:

Observer:

Intervention Step:	Component:	Treatment Fidelity:	Teacher Prompting:
Step 1: Reciprocal Overt Reading Rotating Between Partners	Set timer for designated reciprocal reading time	Yes or No (circle one)	Yes or No (circle one)
	Take turns reading aloud until timer goes off	Yes or No (circle one)	Yes or No (circle one)
Step 2: Completion and Consequence of Vocabulary Worksheet	Separately define each word from the reciprocal overt reading period	Implemented Correctly (<i>tally</i>): Total Opportunities (<i>tally</i>):	Yes or No (circle one)
	Converse with partner and decide on final response for each word	Implemented Correctly (<i>tally</i>): Total Opportunities (<i>tally</i>):	Yes or No (circle one)
	Check each answer against key: For each incorrect response, read the targeted sentence with the correct response in place of the nonsense word (should alternate between partners in peer condition, such that one partner does the correction procedure for the first incorrect word, the other partner does the correction procedure for the next incorrect word, and so on) For each correct response, move the character up on the game board by one spot (either after each response or at the end of the vocabulary task)	Implemented Correctly (<i>tally</i>): Total Opportunities (<i>tally</i>):	Yes or No (circle one)

Step 3: Silent (Covert) Reading by the Participants	Set timer for designed reading time	Yes or No (circle one)	Yes or No (circle one)
	Each partner reads silently until timer goes off, beginning where they left off at the end of reading period in Step 1	Yes or No (circle one)	Yes or No (circle one)
Step 4: Completion and Consequence of Comprehension Task	For peer condition only: participants determine what page they each ended at	Yes or No (circle one)	Yes or No (circle one)
	Separately draw a scene from within silent reading period without using book	Yes or No (circle one)	Yes or No (circle one)
	Write a description of scene on front of the worksheet	Yes or No (circle one)	Yes or No (circle one)
	Exchange worksheets and write a description of partner's scene	Yes or No (circle one)	Yes or No (circle one)
	Exchange worksheets again and circle if partner guessed correctly or incorrectly	Yes or No (circle one)	Yes or No (circle one)
	If either participant guessed incorrectly, partner who guessed wrong draws the scene after being told correct answer	Yes or No (circle one)	Yes or No (circle one)
		Total Components Correct: Total Opportunities: Percentage of Treatment Fidelity:	Total Prompted Components: Percentage of Teacher Prompting:

Chapter III

GENERAL DISCUSSION

“Verbal behavioral development refers to children’s *experientially* acquired capabilities to learn and be taught new relations, to learn multiple responses and multiple stimulus control from a single experience, to learn at a faster pace, and to learn in ways they could not prior to the attainment of verbal developmental capabilities” (Greer & Speckman, 2009, p. 450). A child learns and matures as a result of ontogenetic and phylogenetic changes and certain sets of experiences or instruction. Development is therefore determined by the relationships between the sensory apparatuses as they develop and the experiences that effect—and are affected by—these developmental changes (Greer, 2019; Greer & Keohane, 2005; Greer & Ross, 2008). The theory of verbal-behavior development suggests that if experience or instruction builds new conditioned reinforcers, new behaviors will emerge, as behavior is often under control of a given postcedent stimulus (Greer & Ross, 2008; Greer & Speckman, 2009). The acquisition of new conditioned reinforcers expands one’s environment, as stimuli that previously had no effect on behavior now consistently select out that behavior (Greer, 2002, 2019).

The expansion of a student’s community of reinforcers through the acquisition of conditioned reinforcement for a variety of stimuli is one of the most important educational objectives, as it leads to a changed and expanded environment for the student (Bushel & Baer, 1994; Greer, 2002, 2019; Schneider, 2012; Singer-Dudek, Oblak, & Greer, 2011). The results of this study contribute to the existing body of behavior-analytic research on the collateral effects of the acquisition of new reinforcers, as increases in students’ reinforcement value of reading content resulted in gains in their reading comprehension and vocabulary. The targeted reinforcement within these experiments was the stimulus control for the observation of the

textual stimuli, such that the observing response for sustained contact with the text can be considered an operant (Dinsmoor, 1983; Holland, 1958). The consequence of observing the textual stimuli selected out the participants' continued looking once conditioned reinforcement was acquired, in turn further selecting and strengthening the behavior. The change in the reinforcement value of reading (as demonstrated by increased intervals of movement of the eyes with the text) was the result of accrual of new stimulus control, with the stimulus control of reading becoming a function of conditioned reinforcement for the content of the text.

Major Findings

Considering the multifaceted and multidimensional cognitive processes or complex stimulus control underlying reading, educational researchers often focus on the form, function, and interrelations between interacting individual and environmental variables that contribute to the complex development of reading literacy (Pfof, Dörfler, & Artelt, 2013). The collective results of these experiments suggest that one such explanatory variable from the perspective of behavioral science is the reinforcement value of reading, which can be increased via procedures involving shared experiences between students and their teachers or peers, as these experiences relate to the content of a given text. The results of these studies suggest that the CSR procedure reliably establishes reading content as a conditioned reinforcer with early-elementary students, including children with developmental disorders or learning disabilities, like those included in the current experiments.

In Experiment 1, we demonstrated that reinforcement value of reading (i.e., percentage of whole intervals of reading) was significantly correlated with various measures of reading comprehension and vocabulary ($n = 34$). In Experiment 2, we demonstrated the effect of the establishment of conditioned reinforcement for reading in a CSR procedure with a teacher on the

reading achievement of early-elementary students ($n = 7$). The purpose of Experiment 3 was to compare a modified teacher-yoked CSR procedure with a peer-yoked version of the intervention on the emergence of conditioned reinforcement for reading and related gains in reading achievement by early-elementary students ($n = 8$). The students in the teacher-yoked condition demonstrated more significant gains in their average increases in reading comprehension and vocabulary, although all participants who acquired conditioned reinforcement for reading ($n = 7$) increased on multiple measures of reading achievement.

We utilized the (a) *Woodcock-Johnson[®] Tests of Achievement*, Fourth Edition (*WJ IV*) (Schrank, Mather, & McGrew, 2014), (b) *Gray Silent Reading Tests (GSRT)* (Wiederholt, & Blalock, 2000), and (c) *WJ IV* Test 17: Reading Vocabulary as measures of reading comprehension and vocabulary in all three experiments. We can therefore broadly compare the average increase in reinforcement value from the probe sessions immediately prior to and following the intervention for participants in each of the three conditions: the original CSR procedure with a teacher (Experiment 2), the modified CSR procedure with a teacher (Experiment 3), and the modified CSR procedure with a peer (Experiment 3) (Appendices A and B). The modified procedure in Experiment 3 differed in its criterion for a given phase of the intervention, as the vocabulary and comprehension (i.e., mental-imagery) worksheets were both consequated. In addition, the modified procedure included more direct training in derived-relational responding, as participants had the opportunity to practice deriving the meaning of an increased number of words within each session, and checked their responses against an answer key. Lastly, we prohibited the participants from referring to the text when completing the comprehension task, with the intention of increasing participants' attention to the text during the corresponding silent-reading period.

Participants in the original teacher-pairing CSR procedure (Experiment 2) demonstrated the greatest average increase in reinforcement value, with a mean increase of 67.2% (range, 38.8-90.0%). This can be compared to average increases of 29.4% (range, 12.0-57.5%) in the modified teacher-yoked CSR procedure (excluding Participant 5), and 31.9% (13.7-54.1%) in the modified peer-yoked CSR procedure in Experiment 3. These results might be attributable to the lower average preintervention reinforcement value of reading of participants in Experiment 2, such that they required greater gains in reinforcement value to meet criterion for conditioned reinforcement for reading. However, despite producing more drastic changes in reinforcement value, the original CSR procedure did not produce the greatest gains in reading comprehension amongst participant who acquired conditioned reinforcement for reading (i.e., excluding Participant 5 in Experiment 3, and when any decreases in scores were rounded to 0).

On *WJ IV* Test 4: Passage Comprehension, participants in the modified teacher-yoked CSR procedure ($M = 1.5$ grade levels; range, 0.6-2.5 grade levels) increased to a greater degree than participants in the original teacher-pairing CSR procedure ($M = 0.5$ grade levels; range, 0-1.4 grade levels) or peer-yoked CSR procedure ($M = 0.6$ grade levels; range, 0.2-1.2 grade levels). We found similar results for Test 14: Reading Vocabulary of the *WJ IV*. Participants in the modified teacher-yoked condition demonstrated the greatest gains ($M = 1.3$ grade levels; range, 0.3-3.1 grade levels), relative to the original teacher-pairing CSR procedure ($M = 0.6$ grade levels; range, 0.4-0.9 grade levels) or the modified peer-yoked CSR procedure ($M = 0.7$ grade levels; range, 0.3-1.0 grade levels). This trend was not demonstrated for the *GSRT*, for which participants in the original teacher-pairing CSR procedure demonstrated the greatest gains ($M = 0.8$ grade levels, range, 0-2.2 grade levels). However, the average gains were relatively similar to those demonstrated by the participants in the modified teacher-yoked CSR procedure

($M = 0.7$ grade levels, range, 0-1.5 grade levels) and the modified peer-yoked CSR procedure ($M = 0.5$ grade levels, range, 0-1.5 grade levels). Furthermore, the original teacher-pairing CSR procedure was most efficient in terms of average total time of completion ($M = 164:19$ min; range, 68:49-314:10 min), compared to the modified teacher-yoked CSR procedure ($M = 291:51$ min; range, 209:36-356:10 min) or the modified peer-yoked CSR procedure ($M = 361:02$ min; range, 311:36-412:16 min).

Based on this comparison of the dependent variables included in both Experiments 2 and 3, the modified teacher-yoked CSR procedure resulted in greatest relative average gains in reading achievement, although an increased sample size is needed to increase the reliability of these group differences. We hypothesize that this is a result of the increased number of pairings compared to the original teacher-pairing CSR procedure, in part due to the more stringent intervention criterion. In addition, the greater average gains in the modified teacher-yoked CSR procedure can be attributed to the more direct training in, and consequence of, the vocabulary and comprehension in each of these intervention tasks, as compared to the original intervention. Although the modified teacher-yoked intervention was the most effective in terms of average increases in reading achievement, the modified CSR procedure with a peer required the least amount of teacher mediation, and may therefore be most applicable in a classroom setting.

Future Research

In addition to increasing the sample size included in the group analyses, future research should test the validity and reliability of more efficient ways of measuring reinforcement value of reading, in terms of teacher time and resources. Although the effectiveness of the peer-yoked CSR procedure decreases the need for involvement by a teacher, the process of scoring each 5-s interval within multiple 10-min probe sessions per participant was time intensive. For example,

research can consider testing the effect of conjugate reinforcement apparatuses such as those utilized to measure reinforcement value of visual and auditory stimuli (Cotter & Spradlin, 1971; Lovitt, 1968; Morgan & Lindsley, 1966), as this technique may allow for the direct and absolute measures of observing responses in a more efficient way. However, the argument can be made for this intervention to be incorporated into reading curriculums, which would permit the degree of teacher involvement necessitated by the procedure. That is, the measurement and development of reinforcement value could replace typical reading instruction for students who do not have conditioned reinforcement for reading in repertoire, supported in part by the significant gains in reading achievement demonstrated within these experiments.

Experimenters can also conduct research on the verbal-behavior developmental cusps and capabilities and the existing stimulus control required for entering the intervention to establish conditioned reinforcement for reading via the CSR procedure. For example, selecting individuals with and without certain prerequisite stimulus control may indicate what prior stimulus control needs to be established prior to the intervention based on individual characteristics. A larger and more varied sample would also allow for estimates of the intervention conditions under which participants of particular profiles acquire conditioned reinforcement, such that teachers can strategically apply this information when implanting the intervention in a classroom setting. The inclusion of an increased and more diverse sample can also allow researchers to determine whether the CSR procedure is applicable beyond early-elementary students who share the characteristics of the participants in the current studies. The combination of both group and single-case designs with an increased sample of students would allow for the development of more tailored interventions, as well as increased generality to both populations and individuals.

In addition to testing the generality of the results to students of various characteristics, experimenters should also consider studying the generalizability of the results to other contexts and genres of text. If “voluntary reading” is defined as the student choosing to read and the duration of reading in his or her leisure time (i.e., the moment-to-moment selection of an individual’s observing responses to textual stimuli), future research should explore whether children spend more time reading throughout the school day as a function of the acquisition of conditioned reinforcement for reading during periods of assigned silent-reading. For example, researchers can measure what percentage of time students spend on various tasks when presented with a range of academic stimuli (e.g., books, math-fact worksheets, writing prompts). In addition, future studies can measure amount of time spent reading during allocated periods of free time, considering that the stimuli that select out a student’s attention are considered to be a function of the reinforcers he or she has in repertoire (Greer & Speckman, 2009). Researchers can also conduct reinforcer assessments by measuring the effect of different stimuli (including opportunities for reading) on students’ rates of responding on a performance or learning task. Measuring the relative reinforcing effectiveness of reading compared to other academic and non-academic stimuli—as well as measuring student’s reading during leisure time—can provide insight into whether conditioned reinforcement for reading content during allocated silent-reading periods generalizes to student’s overall reading amount throughout the school day.

Experimenters can also test the effect of the CSR procedure in the classroom on students’ reading amount at home. Previous research exists on the correlation between the time spent reading at home and school and students’ reading achievement (Greaney, 1980; Heyns, 1978). For example, Anderson, Wilson, and Fielding (1988) demonstrated that the amount of time spent recreationally reading outside of school was the best predictor of reading comprehension,

vocabulary, and reading rate for fourth-grade students. Increased reading amount at home following the acquisition of conditioned reinforcement for reading via the CSR procedure conducted in the school setting would suggest that reinforcement value is not dependent on the context in which it is established.

In addition, the question remains as to whether students' continued reinforcement for reading literature generalizes to other types of text, as we primarily utilized fiction text during the pairing procedure. The natural reinforcers for reading differ based on the content and function of the text, with aesthetic consequences for genres such as poetry and instrumental consequences in scientific or technical reading (Greer, 2002, 2019). Although several studies support the positive contribution of reading interest on the development of reading achievement, such studies often fail to address the question of whether various forms of reading materials are differentially beneficial, as different types of text may present diverse demands on the reader (Pfoest et al., 2013). Based on the data from the 2002 *Programme for International Student Assessment* (PISA), Kirsch et al. (2002) categorized students based on the diversity of their preferred types of reading materials. They found that the least diversified readers performed the lowest on the PISA reading proficiency scale, and that diversified readers of long and complex texts demonstrated the highest reading achievement score (Kirsch et al., 2002). It is critical that researchers understand recreational-reading factors that lead to the greatest gains in reading comprehension and vocabulary development, as this knowledge will allow them to design more effective interventions and instructional tactics for the promotion of "voluntary reading." If future research demonstrates that the establishment of conditioned reinforcement for literature generalizes to other genres of literature for the participants like those in these studies, such results would underscore the applicability of the CSR procedure to other reading experiences.

In addition to testing the effects of the establishment of conditioned reinforcement for reading via the CSR procedure across contexts and genres of texts, future studies should include reading amount as a dependent variable. An empirical investigation of the relation between reinforcement value of reading and overall reading amount across contexts—whether it be reading outside of assigned silent-reading periods or outside of the classroom altogether—may also provide support for a cumulative advantage of establishing new reinforcers. A wide range of studies has reported reading amount as a positive predictor of reading competence and growth (e.g., Anderson et al., 1988; Cipielewski & Stanovich, 1992; Cunningham & Stanovich, 1997; Taylor, Frye, & Maruyama, 1990). However, few studies have empirically assessed the mediating role of reading amount in the relation between reading interest and reading achievement, with inconsistent findings (Becker, McElvany, & Kortenbruck, 2010; McElvany, Kortenbruck, & Becker, 2008; Schaffner, Schiefele, & Ulferts, 2013; Wang & Guthrie, 2004), and with a gap in the literature for students in early elementary school. We hypothesize that increased reinforcement for reading will have a causal effect on reading amount, as the content of the text reinforces the continuation of reading once a student acquires conditioned reinforcement for reading.

We also hypothesize that students who acquire conditioned reinforcement for reading content will continue to demonstrate exponential gains in reading achievement as a function of increased reading amount. Increased reading amount increases an individual's catalog of background knowledge (i.e., a history of more learned stimulus control), which then facilitates text comprehension (i.e., more derived relations) (Kintsch & Rawson, 2005; Pfoest et al., 2013; Purcell-Gates, Duke, & Martineau, 2007). Additionally, more frequent reading may increase the automaticity of decoding skills or use of reading strategies, which also aids reading

comprehension (Perfetti, Landi, & Oakhill, 2005; Pfoet et al., 2013). Furthermore, a reader's ability to infer word meaning from context (i.e., derived relational responding) is significantly influenced by his skill level, such that students who spend more time reading may be more likely to learn new word meanings incidentally from context (Ford-Connors & Paratore, 2015; Pfoet et al., 2013). Greater exposure to reading content may also increase a student's self-concept and self-efficacy in terms of his or her beliefs about reading, considering that individuals who believe they have the aptitude to read a certain text are more likely to persist in reading challenging text (Guthrie & Wigfield, 2000; Pfoet et al., 2013; Schunk, 2003). Therefore, one may expect gains in reading achievement to accumulate even after conditioned reinforcement for reading is acquired.

From a verbal-behavior perspective, it is possible that comprehension and vocabulary gains in the current study arose as a result of the expansion of bidirectional Naming (BiN): the developmental phenomena identified in the behavior analysis literature as the experiential source for learning word-meanings incidentally, such that the individual can learn words as a listener or reader and then use them as a speaker or writer, or vice versa (Greer, Corwin, & Buttigieg, 2011; Greer & Du, 2015; Greer & Longano, 2010; Greer, Pohl, Du, & Moschella, 2017; Longano & Greer, 2015; Morgan, 2018). If a student attends to the content of what he or she is reading, it is likely that the context and content of the text occasions the conditions for BiN to emerge. The possibility exists that the content of the text produces name-learning experiences in which the individual observes and responds to the textual stimulus. These repeated exposures then allow the reader to acquire new vocabulary words, and promote increases in comprehension as the content selects out the individual's continued reading behavior (Greer et al., 2005; Longano & Greer, 2015). Future studies should consider one's degree of BiN for symbolic stimuli as a

dependent variable, as this can reveal whether conditioned reinforcement for reading content results in the emergence of this verbal-behavior developmental capability.

Educational Significance

The development of reading competence is prerequisite to the acquisition of a wide range of academic skills (Duke & Martin, 2008; Foorman & Connor, 2011). Educators and researchers alike must develop an understanding of the factors that affect reading achievement and the instructional practices that support such components, including reading interest or reinforcement value of reading. The National Reading Panel (NRP; 2000) stressed the “need for rigorous experimental research on the impact of programs that encourage reading on different populations of students at varying ages and reading levels using several different reading outcomes” (p. 4). A goal of the current study was to elucidate reading practices in the classroom setting that casually influence successful acquisition of more advanced reading repertoires.

Whereas the initial emphasis in early literacy instruction is on the basic acquisition of the alphabetic system and word-recognition skills (e.g., letter-sound correspondences, vowel-constant blends), the “essence of reading” is often thought to entail text comprehension and other complex aspects of reading such as vocabulary knowledge (Becker et al., 2010; Durkin, 1993). The CSR procedures evaluated in this study should be incorporated as a critical facet of literacy instruction, based on the collateral effects of the acquisition of conditioned reinforcement for reading on higher-order reading repertoires such as reading comprehension and vocabulary. More specifically, teachers should implement the CSR procedure for students without conditioned reinforcement for reading content in the early elementary years, as interventions for below grade-level readers after third grade are rarely as effective as those in earlier grades (Annie E. Casey Foundation; Hernandez, 2012). It is also important for teachers to implement

procedures for increasing students' interest in reading beginning in early grades, considering that reading motivation declines across the developmental trajectory beginning in elementary school (Chapman & Tunmer, 1997; Guthrie & Davis, 2003; Guthrie & Wigfield, 2000; Unrau & Schlackman, 2006; Wigfield et al., 1997). The collective results of the three experiments suggest that by reliably identifying a student's early interest in reading—or lack thereof—teachers can effectively intervene in early elementary school, in part by increasing the reinforcement value of reading.

Contributions to the Field

There are few studies from within and outside the field of applied behavior analysis devoted to developing and testing interventions to establish conditioned reinforcement for reading content amongst early-elementary students. This study was successful in filling the gap in the existing literature on the effect of the establishment of conditioned reinforcement for reading via a CSR procedure on the reading-achievement gains of students in early elementary school. Specifically, we extended previous research by testing the effect of a teacher-yoked version of the procedure. In addition, we included younger participants than in previous studies of the CSR procedures (Cumiskey Moore, 2017), based on the consequences of reading proficiency in third grade on future educational and professional success (Annie E. Casey Foundation; Hernandez, 2012; Miles & Stipek, 2006). We also included students with and without developmental disorders and learning disabilities to increase the generality of the findings to students with similar profiles, considering the prevalence of students who receive special education services (U.S. Department of Education, 2018).

Moreover, we sought to use more valid measures than previously utilized to assess reinforcement value of reading, measuring reading interest in degrees of reinforcement value as

opposed to utilizing rating scales or other self-report measures. Although the educational literature is replete with studies of reading interest and its relation to reading achievement, the majority of previous studies fail to offer explicit definitions of such motivational variables (Conradi, Jang, & McKenna, 2014; Petscher, 2010). We therefore suggested a more operational definition of ‘interest’ through our use of observational interval recording. We equated the construct of reading interest to the participants’ reinforcement value, such that the “motivation” becomes embedded in content stimuli because of the child’s acquisition of that stimuli as a conditioned reinforcer via his or her instructional history (Greer, 2002, 2019). It was our resolve to convey our findings in such a way that they can be applied and advanced by researchers and practitioners in the fields of both behavior analysis and education. We strived to provide a trans-disciplinary account of conditioned reinforcement for reading content (i.e., a high interest in reading) and its effects on reading achievement, with the educationally-significant goals of increasing students’ reading achievement and reinforcing sustained reading and, in turn, reinforcing continued learning.

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Appendix A
Average-Increase Across Conditions (Table 1)

Table 1. Average Increase Across Measures of Reading Achievement Probe Sessions Immediately Prior to and Following Intervention for Participants in Experiments 2 and 3

Measure	CSR Condition		
	Original Teacher-Pairing CSR Procedure (Experiment 2, $n = 7$)	Modified Teacher-Yoked CSR Procedure (Experiment 2, $n = 3$)	Modified Peer-Yoked CSR Procedure (Experiment 2, $n = 4$)
Reinforcement Value of Reading	67.2% (range, 38.8-90.0%)	29.4% (range, 12.0-57.5%)	31.9% (range, 13.7-54.1%)
<i>WJIV</i> Test 4: Passage Comprehension	0.5 grade levels (range, 0-1.4 grade levels)	1.5 grade levels (range, 0.6-2.5 grade levels)	0.6 grade levels (range, 0.2-1.2 grade levels)
<i>GSRT</i>	0.8 grade levels, (range, 0-2.2 grade levels).	0.7 grade levels (range, 0-1.5 grade levels)	0.5 grade levels (range, 0-1.5 grade levels)
<i>WJIV</i> Test 17: Reading Vocabulary	0.6 grade levels (range, 0.4-0.9 grade levels)	1.3 grade levels (0.3-3.1 grade levels)	0.7 grade levels (0.3-1.0 grade levels)

Note. Only includes participants who met criterion for conditioned reinforcement for reading by the conclusion of the study (i.e., excluding Participant 5 in Experiment 3). We rounded any decreases to 0, with comparable numbers of participants who decreased across conditions (i.e., Participant 2 in the modified teacher-yoked condition and Participant 4 in the peer condition for the *GSRT*).

Appendix B
Average-Increase Across Conditions (Figure 1)

Figure 1. Average grade-level increase on *Woodcock-Johnson*[®] *Tests of Achievement*, Fourth Edition (*WJ IV*) Test 4: Passage Comprehension, *Gray Silent Reading Test (GSRT)*, and *WJ IV* Test 17: Reading Vocabulary between probe sessions immediately prior to and following the collaborative shared reading (CSR) intervention for participants who met criterion for conditioned reinforcement for reading in Experiments 2 and 3. The error bars represent the range of increases for students in each condition (original teacher-pairing CSR procedure, modified teacher-yoked CSR procedure, and modified peer-yoked CSR procedure), with any decreases in score rounded to 0 (i.e., Participant 2 in the modified teacher-yoked condition and Participant 4 in the peer condition for the *GSRT*).