

The Result of Enhancing the Value of Careful Reading on Reading Achievement in Fourth
Graders

Brittany D. Bly

Submitted in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy
under the Executive Committee
of the Graduate School of Arts and Sciences

COLUMBIA UNIVERSITY

2019

© 2019
Brittany D. Bly
All rights reserved

ABSTRACT

The Result of Establishing Reinforcement Value for Reading on Reading Achievement in Fourth
Graders

Brittany D. Bly

Researchers and educators agree that reading comprehension and interest in reading are strong predictors of future success in academics. I studied the effects of establishing interest for reading (i.e. increased reinforcement value for reading) and reading achievement with 4th grade students. In Experiment I, I tested the correlations between a measure of reinforcement value for reading level (determined by a 20-min, 10s whole interval probe session) and reading achievement tests of 30 fourth-grade students. The reading achievement tests measured passage comprehension, literary comprehension, informational comprehension, and vocabulary. I found significant correlations between reinforcement value for reading and all reading achievement measures. In Experiment II, using a pre- and postintervention design with a multiple probe logic, I tested the effects of establishing a level of interest in reading (CR+ for reading) through a 4-step, peer-collaborative procedure on reading achievement outcomes for 6 fourth grade students. The 4-step procedure included 1) shared reading period, 2) vocabulary task 3) independent reading period, and 4) a comprehension drawing task. The establishment of CR+ for reading in all 6 participants resulted in grade-level increases from 0.8-4.1 in *WJ-IV* passage comprehension, -0.4- 2.3 in *WJ-IV* vocabulary, and 0.2-2.3 in *Gray Silent Reading Tests (GSRT)*. In Experiment III, I conducted a component analysis to test the significance of the independent and shared reading component of the 4-step peer-collaborative procedure. Using a simultaneous treatment design with a built-in crossover, I studied the effects a Collaborative Independent Reading Treatment (CIR) and Collaborative Shared Reading Treatment (CSR) on establishing CR+ for Reading and the overall

effect it had on reading achievement. The 4-step peer-collaborative procedure was the same except students were either exposed to only shared or independent reading and not the other. Participants were yoked into dyads across treatment conditions and completed intervention with a partner in the same treatment condition. Participants in the CIR treatment met CR+ for reading in 1 phase while participants in the CSR treatment did not meet CR+ for reading in 1 phase. The establishment of CR+ for reading in the CIR treatment group resulted in grade-level increases from 1.2 to 3.4 in the *WJ-IV* passage comprehension, 0.4 to 4.5 in the *WJ-IV* vocabulary, and -1.2 to 4.3 in the *GSRT*. Without the establishment of CR+ for reading in the CSR treatment group, grade-level increases for *WJ-IV* passage comprehension was -1 to 2.1, *WJ-IV* vocabulary was -0.9 to 0, and *GSRT* was -0.3 to 1.5). I conducted a crossover treatment where participants in the CSR treatment group underwent the CIR treatment procedure. All 4 participants met acquired CR+ for reading in 1 phase of the intervention and increases were 0.6 to 2.2 for *WJ-IV* passage comprehension, 0.8 to 4.3 for *WJ-IV* vocabulary, and -0.5 to 2.7 for *GSRT*. The CIR treatment procedure was more effective in, not only establishing reinforcement value for reading, but also in increasing reading achievement in a very short amount of time.

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

TABLE OF CONTENTS

| | Page |
|---|------|
| LIST OF TABLES..... | v |
| LIST OF FIGURES..... | vi |
| ACKNOWLEDGEMENTS..... | vii |
| DEDICATION..... | x |
| CHAPTER I: INTRODUCTION..... | 1 |
| CHAPTER II: STUDY I MANUSCRIPT..... | 10 |
| Abstract..... | 10 |
| Introduction..... | 11 |
| Experiment I..... | 15 |
| Method..... | 15 |
| Participants..... | 15 |
| Dependent Variables..... | 16 |
| Interest in Reading (CR+ for reading) | 16 |
| Reading Comprehension..... | 16 |
| Procedures..... | 18 |
| Interobserver Agreement..... | 19 |
| Results | 19 |
| Correlations between CR+ for Reading and dependent measures | 19 |
| Discussion | 19 |
| Experiment II..... | 21 |
| Method..... | 21 |

| | |
|---|----|
| Participants..... | 21 |
| Setting..... | 21 |
| Dependent Variables: Measures of reading achievement..... | 22 |
| Independent Variable: Establishment of Reinforcement for Reading..... | 22 |
| Design..... | 23 |
| Procedure..... | 23 |
| Step 1: Shared Reading..... | 24 |
| Step 2: Vocabulary Task..... | 24 |
| Step 3: Independent Silent Reading..... | 25 |
| Step 4: Comprehension Drawing Task..... | 25 |
| Interobserver Agreement..... | 27 |
| Results..... | 27 |
| Discussion..... | 28 |
| General Discussion..... | 29 |
| References..... | 31 |
| Tables..... | 34 |
| Figures..... | 43 |
| Appendix..... | 47 |
| CHAPTER III: STUDY II MANUSCRIPT..... | 50 |
| Abstract..... | 50 |
| Introduction..... | 51 |
| Method..... | 55 |
| Participants..... | 55 |

| | |
|--|----|
| Setting..... | 56 |
| Dependent Variable: Measures of Reading Achievement..... | 57 |
| Independent Variable: Establishment of conditioned reinforcement value for reading..... | 57 |
| Conditioned Reinforcement for Reading, CR+ for reading..... | 58 |
| Collaborative Independent Reading Treatment, CIR..... | 59 |
| Collaborative Shared Reading Treatment, CIR..... | 60 |
| Crossover Treatment..... | 60 |
| Design..... | 60 |
| Procedure..... | 61 |
| Interobserver Agreement..... | 62 |
| Results..... | 62 |
| Establishment of Conditioned Reinforcement for Reading..... | 62 |
| Reading Achievement Scores..... | 63 |
| Progression through intervention..... | 64 |
| Discussion..... | 64 |
| Limitations and Future Studies..... | 65 |
| Implications..... | 67 |
| References..... | 69 |
| Tables..... | 73 |
| Figures..... | 81 |
| Appendix..... | 90 |
| CHAPTER VI: GENERAL DISCUSSION..... | 94 |

| | |
|---|-----|
| Major Findings..... | 94 |
| Implications..... | 96 |
| Limitations..... | 100 |
| Collaborative Independent Reading: Implications and Future Research | 101 |
| Educational Significance..... | 104 |
| REFERENCES..... | 106 |

LIST OF TABLES

| Table | Page |
|---|------|
| 1. Descriptive statistics of participants at onset of Experiment I..... | 34 |
| 2. Descriptive statistics of continuous variables in Experiment I | 35 |
| 3. Correlations for CR+ for reading and reading achievement in Experiment I..... | 36 |
| 4. Academic and demographic characteristics of participants at onset of Experiment II..... | 37 |
| 5. Materials used in Experiment I and Experiment II..... | 38 |
| 6. Pre- and postintervention grade equivalency scores of participants in Experiment II..... | 39 |
| 7. Interobserver agreement in Experiment I and Experiment II..... | 40 |
| 8. Number and duration of intervention sessions across participants in Experiment II..... | 41 |
| 9. Mean increases in dependent and independent measures..... | 42 |
| 10. Academic and demographic characteristics of participants at onset..... | 73 |
| 11. Materials used..... | 74 |
| 12. Interobserver agreement..... | 75 |
| 13. Duration of sessions and pre- and postintervention reading achievement measures..... | 76 |
| 14. Description of sessions and participants in the crossover treatment condition..... | 77 |
| 15. Pre- and postintervention reading achievement measures of all participants..... | 78 |
| 16. Pre- post intervention and post crossover reading achievement measures of participants in the crossover treatment condition..... | 79 |
| 17. Mean increases in reading achievement and CR+ for reading scores across treatment groups..... | 80 |

LIST OF FIGURES

| Figure | Page |
|---|------|
| 1. Sequence of design in Experiment II..... | 43 |
| 2. Measure of independent variable in Experiment II, measured by the percentage of 10 s whole intervals of reading within each 20-min probe session..... | 44 |
| 3. Intervention data: correct responses emitted in the comprehension drawing task..... | 45 |
| 4. Participants' grade equivalencies on <i>Woodcock-Johnson IV Achievement Tests (WJ-IV)</i> , <i>Gray Silent Reading Test (GSRT)</i> , in preintervention and postintervention probe sessions..... | 46 |
| 5. Sequence of design..... | 81 |
| 6. Sequence of crossover design..... | 82 |
| 7. Session intervention graphs of comprehension drawing component..... | 83 |
| 8. Measures of participant's level of conditioned reinforcement for reading probe session..... | 84 |
| 9. Individual Mean Conditioned Reinforcement for Reading percentages for pre- and postintervention | 85 |
| 10. Mean conditioned reinforcement for reading percentages for pre- and postintervention for treatment groups..... | 86 |
| 11. Pre- and postintervention reading achievement scores for each participant..... | 87 |
| 12. Mean reading achievement increases per participant..... | 88 |
| 13. Mean reading achievement increases per treatment group..... | 89 |

ACKNOWLEDGMENTS

I would like to start by thanking my committee for the hours of editing, feedback, and support I have received over the last year; Dr. Wang, Dr. Dudek, Dr. Brassard, and Dr. Malott: thank you. I would also like to thank Dr. Greer for helping me find my passion and confidence in research. Thank you for your mentorship, your encouragement, and for being a person who puts the student first. I'd also like to thank Dr. Delgado, thank you for your mentorship and support these last five years.

I'd also like to thank my mentors, Allyson, Ally, and Colleen for your patience and kindness during those first few years. Colleen, I literally owe my study to your interest in children's love for reading. Thank you for encouraging me to do the PhD. (Briana Burwell! Without you, I would not have even heard of the program, so thanks for being you.)

I'd also like to thank all of the mentees who went through Camp Bly. Emily, Missy, and Cassy: you were my firsts! Missy and Emily, thank you for walking with me and keeping me laughing when I had no idea what I was doing my first few months. To Yosef, Aparna, and Kristin, thank you! Your continued love for our kids who most people had given up on was so inspiring to me. I cherish that year more than any of you know. And to Daria and Samantha, I could not have done this year without you. Thank you for being so eager to help and learn. You made my last year wonderful and I thank you for that. I learned so much from both of you. Thanks to Ty and Kendra for rounding out the year with me as well. You are both phenomenal teachers who I love and respect.

To the wonderful staff and Alexander Hamilton Elementary, I do not look forward to saying goodbye to you at the end of this year. I have learned from all of you, and most especially my fourth-grade team, Kristen, Raj, Melissa, Elka, Patricia, and Mercy. Thank you for loving me

and taking me under your collective wings. I have never known such a passionate, loving, and inspiring women. You all have left an imprint on me that I will cherish and carry with me for the rest of my life. To Ed Cisneros, thank you for being patient with me and my questions. And lastly, to Sue Nugent for always checking in on me, making sure I had lunch, and just being a calm to my storm.

I'd also like to thank my friends who have been there for me since before starting this journey, Brandon, Laural, Krista, and Tara: your texts, flowers, cards, and check-in texts have meant the world to me. You all believed in me before I believed in myself and I love you for that. To the friends I've met in New York: Jazmin, Hayden, Jake, Tyson, Kate, Jenna, Kyle, Noelle, and Will- you have all become family to me. Thank you for supporting and loving me through this journey. Each of you has loved me and built me up in different and needed ways. Your friendship has meant the world to me these last five years and I cannot possibly express the gratitude I have for your love, kindness, and patience.

To Dr. Frank, I just have to say thank you. I don't know if you will ever see this, but without you and your support, I would not have been able to mentally complete this journey. You helped me realize I am worthy of love, success, and good things in this world.

To my family, (Mom, Dad, Ashleigh, Jonathan, Haley, Taylor, and Stephen), I love you all and am so grateful for you. Without you lot in my corner, where would I be? Remember the day you all drove me to the middle-of-nowhere Idaho and dropped me off for my freshman year in college for our summer vacation? Remember how I didn't know anyone and cried as you all drove away? If it weren't for you all loving me and believing in the strength I didn't know I had, I would not have ever stayed in Idaho and gained confidence in myself. Thank you for loving me

and challenging me in everything I do. I'd like to especially thank Jonathan and Jocelyn for taking care of me here in New York. Thanks for the encouragement and food.

To all of the people in my cohort, I definitely could not have done it without the long hours in (or not in) the library. To Shahad, Lenah, Becca, Jessica, and Katherine, thank you for the kind words and encouragement from the very beginning. To Angela and Lara: going to the Morristown Diner with you every Friday morning was the best decision we made this year. I love you both a lot. Lara: I am glad we were yoked; I literally could not have done this without you.

And lastly, to the students and families I've been blessed to meet: I cannot begin to express how much you have all meant to me. I've learned from you, and been amazed by you. Thank you for leading me to my passion for teaching.

DEDICATION

To Mom and Dad

You taught me that I could do anything and encouraged me to believe that I could.

Chapter I

INTRODUCTION

With regard to conditioned reinforcement for reading content, B. F. Skinner proposed:

It is difficult in the present system to teach a student to read for mere enjoyment. The wrong contingencies are at work. Most schools are proud of what their students are reading: ‘Oh well, but in the tenth grade we teach Dostoevsky.’ They probably do, but how many students are reinforced when reading Dostoevsky at that age and continue to read because they are? It’s a serious question. 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. (Evans, 1968, p. 73)

In behavior analysis, we describe an *engaged reader* as a person for whom reading has a high reinforcement value, such that the content of the text maintains his or her sustained attention (Evans, 1968; Hill-Powell, 2015; Skinner, 1957; Tsai & Greer, 2006). Engaged readers read independently and often, not only because they can, but because they derive reinforcement from reading the content of the text (Bryan, Fawson, & Reutzler, 2003; Guthrie & Wigfield, 1997; Guthrie, Schafer, & Huang 2001; Wigfield et al., 2008). Conversely, non-engaged readers are passive and inactive towards reading and derive little reinforcement from reading (Bryan, et al., 2003; Guthrie & Wigfield, 2000; Hielbert, Wilson, & Trainin, 2010).

As opposed to non-engaged readers, students who engage in high-frequency reading tend to have increased reading achievement scores in comprehension, vocabulary, and fluency (Block, Cleveland, & Reed, 2006; Cumiskey Moore, 2017; Wigfield, et al, 2008; Wu & Samuel, 2005). Furthermore, De Naeghel et al., (2012) emphasized that autonomous motivation for independent

reading increased quality reading and better reading performance as children grew older; that is, the amount of time a child spends independently reading directly predicts reading achievement (Cox & Guthrie, 2001; Guthrie, Wigfield, Metsala, & Cox, 1999).

Despite the extensive literature on reading motivation, reading frequency, and reading achievement, there are surprisingly few studies examining effective interventions to increase frequency and duration of independent reading in students. Even fewer studies evaluate such interventions leading to significant advancement in reading comprehension at the upper elementary level (Al Otaibla, 2018; Wanzek et al., 2017). This leads us to several gaps in the current literature on reading and reading achievement.

One gap in research is the implementation of observational measures of motivation, though many studies implement the use of a questionnaire to determine level of motivation for reading (Cox et al., 2001; De Naeghel et al., 2012; Guthrie et al., 2007; Guthrie et al., 1999). Although many interventions have been developed to improve reading achievement, few target the establishment of interest in or motivation for reading that can be measured directly or experimentally (Tsai & Greer, 2006).

Another gap is a lack of experiments testing the effectiveness of teacher- and peer-collaborative reading interventions to increase motivation for reading and reading achievement. Examples of these interventions include, Sustained Silent Reading (SSR), Guided Repeated Oral Reading (GROR), and Concept-Oriented Reading Instruction (CORI) (Alexander & Murphy, 1998; Baker, Dreher, & Guthrie, 2000; De Naeghel et al., 2012; Cumiskey Moore, 2017; Guthrie et al., 2007; Mckenna & Kear, 1990). Although these interventions include a peer or teacher-collaborative elements, not many have been studied experimentally to identify functional

components that increase reinforcement value, motivation, or gains in achievement (Bryan et al., 2003; Efta, 1984; Kamil 2003; Manning & Manning, 1984; National Reading Panel, 2000).

For example, Bryan et al. (2003) conducted a study implementing the use of a teacher led literary discussion during SSR. The experimenters measured off-task behavior of three students who were not engaged readers during silent reading time. Bryan et al. implemented a reading intervention utilizing book discussion with an adult after 10-min of independent reading. Students' off-task behaviors decreased during and after the intervention. Although this intervention is an important step in the right direction in terms of social interactions paired with reading, it would be impossible to measure whether or not the students were actually reading with only the measurement of off-task behaviors.

Furthermore, Trainin et al., (2015) determined that approximately 20 percent of fourth graders do not engage in reading during silent reading periods and suggest that this is why there are not many studies of the benefits of silent reading (Griffith & Rasinski, 2004; Kim, Wagner, & Foster, 2011; Trainin, Hiebert, & Wilson, 2015). In addition, teachers do not implement independent, silent reading to practice reading because they cannot determine whether the students can read the books they select (Donovan, Smolkin, & Lomax, 2000; Hiebert et al., 2010) However, one way to determine engagement in context is to measure the eye-movement of a student during reading sessions (Brenner & Hiebert, 2010; Samuels, Hiebert, & Rasinski, 2010; Vorstius, Radach, & Lonigan, 2014). It is important that this procedure objectively defines and measures eye-tracking behavior to determine whether a student is engaged in silent reading, thus indicating a reinforcement value of reading.

In our laboratory, Cumiskey Moore (2017) utilized an eye-tracking measurement to determine the level of interest in reading (i.e., reinforcement value for reading) during a 20-min

silent reading session. The purpose of the study was to (a) measure correlations between levels of reinforcement value of reading and reading achievement scores and, (b) study the effects of establishing reinforcement value of reading (CR+ for reading) through a peer-collaborative multicomponent procedure on reading achievement gains. The multicomponent procedure included four steps: (1) a shared reading component, (2) a vocabulary component, (3) an independent reading component, and (4) a comprehensive drawing task. Cumiskey Moore utilized an eye-tracking procedure to measure the level of reinforcement value a student had for reading. If the student read for 80% of the 10 s whole intervals of a 20-min reading session, they had CR+ for reading. The peer-collaborative procedure not only established reinforcement value for reading for all four participants, but also functioned to increase reading achievement scores by 1-2 grade levels (Cumiskey Moore, 2017).

After a thorough examination of current literature on reading motivation, reading achievement and the association between them, several gaps in research emerged. The first gap was that not many studies outside behavior analysis examined operative interventions to establish reinforcement value for reading. Even fewer studies utilized reliable measures to indicate observable increases in actual reading (Bryan et al., 2003; Tsai & Greer, 2006; Vorstius, et al., 2014).

Secondly, even though there were many studies that examined the correlations between motivation and reading achievement, (Guthrie et al., 1997; Guthrie et al., 2007, Guthrie et al., 1999) not many studied the relation between the two. The third gap is a lack in research on effective peer-collaboration interventions to increase motivation and reading achievement. Wigfield and Guthrie (2000) emphasize the importance of using socialization to increasing motivation for reading but did not provide evidence testing interventions utilizing peers to

increase motivation or interest in reading (Wentzel & Wigfield, 1998; Wentzel, 1996; Wigfield, Gladstone & Turci, 2016).

The purpose of the present study is to examine the relation between CR+ for reading and reading achievement in typically developing fourth grade students. In Experiment I, I test the correlations between levels of reinforcement value for reading and measures of reading achievement. In Experiment II, I test the effects of using a peer-collaborative multicomponent procedure to increase reinforcement value for reading while also examining pre- and post-reading achievement measures. In my second paper, I conducted a component analysis of the peer-collaborative, multicomponent procedure to determine the impact of independent or silent reading on (a) reinforcement value for reading (CR+ for reading) and, (b) reading achievement. Both papers add to the growing body of research on reading instruction with the correlation measures for Experiment I ($N=30$), and single-case designs for Experiment II ($n=6$), and Experiment III ($n=8$).

The present studies are significant and crucial to the developing body of research on reading motivation, reading achievement, and reading interventions. By utilizing 10s whole intervals during a 20-min reading session, I used an eye-tracking procedure to measure the CR+ for reading level for students which functioned as the primary measure of reinforcement value during all three experiments. The present papers present significant results that fill in gaps of current research on reading interventions such as: (a) using direct and experimental observations to measure levels of motivation/interest in reading (i.e. CR+ for reading), (b) identifying the impact a peer-collaborative procedure has on establishing CR+ for reading, (c) identifying a functional relation between establishing CR+ for reading and gains in reading achievement, and

(d) identifying which components of the peer-collaborative, multicomponent procedure are necessary for establishing CR+ for reading (e.g., independent or shared reading).

References

- Al Otaibla, S. (2018). I'm not throwing away my shot: What Alexander Hamilton can tell us about standard reading interventions. *Learning Disabilities Research and Practice, 33*, 156-167.
- Alexander, P. A., & Murphy, P. K. (1998). Profiling the differences in students' knowledge, interest and recall: assessing a model of domain learning. *Journal of Educational Psychology, 87*, 559-575.
- Baker, L., Dreher, M. J., & Guthrie, J. T. (2000). Why teachers should promote reading engagement. In L. Baker, M. J., Dreher, & J. T. Guthrie (Eds.), *Engaging young readers; Promoting achievement and motivation* (pp. 1-16). New York: Guilford Press.
- Block, C. C., Cleveland, M. D., & Reed, K. M. (2006). When twenty minutes of literacy instruction is added to the day: Which learning environments increase students' overall achievement, vocabulary, comprehension, fluency, and affective development? *Scholastic classroom books compendium of Research*, (pp. 18-36). New York, NY: Scholastic.
- Brenner D. & Hiebert, E. F. (2010). The impact of professional development on students' opportunity to read. *Revisiting silent reading: New directions for teachers and researchers*, (pp. 198-220). Newark DE: International Reading Association.
- Bryan, G., Fawson, P. C., & Reutzel, D. R. (2003). Sustained silent reading: Exploring the value of literature discussion with three non-engaged readers. *Reading Research and Instruction, 43*, 47-73.
- Cox, K. E., & Guthrie, J. T. (2001). Motivational and cognitive contributions to students' amount of reading. *Contemporary Educational Psychology, 26*, 116-131. doi:10.1006/ceps.1999.1044
- Cumiskey Moore, C. (2017). *The Effects of Conditioned Reinforcement for Reading on Reading Comprehension for 5th Graders*. (Unpublished Doctoral Dissertation, Columbia University). <https://doi.org/10.7916/D8PZ5N30>.
- De Naeghel, J., Keer, H. V., Vansteenkiste, M., & Rosseel, Y. (2012). The relation between elementary students' recreational and academic reading motivation, reading frequency, engagement and comprehension: A self-determination theory perspective. *Journal of Educational Psychology, 104*, 1006-1021. doi: 10.1037/a0027800
- Donovan, C. A., Smolkin, L. B., & Lomax, R. G. (2000). Beyond the independent-level text: Considering the reader-text match in first-graders' self-selections during recreational reading. *Reading Psychology: An International Quarterly, 21*, 309-333.

- Efta, M. (1984). Reading in silence: A chance to read. In A. J. Harris & E. R. Sipay (Eds.), *Reading on reading instruction* (3rd ed., pp. 387-391). New York: Longman.
- Evans, R. I. (1968). *BF Skinner: The man and his ideas*. New York, Dutton.
- Griffith, L. W., Rasinski, T. V. (2004). A focus on fluency: How one teacher incorporated fluency with her reading curriculum. *The Reading Teacher*, 58, 126-137.
- Guthrie J. T., Alao, S., & Rinehart, J. M. (1997). Engagement in reading for young adolescents. *Journal of Adolescent & Adult Literacy*, 40, 438-446.
- Guthrie, J. T., Hoa, A. L.W., Wigfield, A., Tonks, S. M., Humenick, N. M., Littles, E. (2007). Reading motivation and reading comprehension growth in the later elementary years. *Contemporary Educational Psychology*, 32, 282-313.
- Guthrie, J. T., Schafer, W. D., & Huang, C. (2001). Benefits of opportunity to read and balanced instruction on the NAEP. *The Journal of Educational Research*, 94, 145-162. doi:10.1080/002206070109599912
- Guthrie, J. T., Wigfield, A., Metsala, J. L., & Cox, K. E. (1999). Motivational and cognitive predictors of text comprehension and reading amount. *Scientific Studies of Reading*, 3, 231-256.
- Guthrie, J. T., Wigfield, A., & VonSecker, C. (2000). Effects of integrated instruction on motivation and strategy use in reading. *Journal of Educational Psychology*, 92, 331-341.
- Hielbert, E. H., Wilson, K. M., & Trainin, G. (2010). Are students really reading in independent reading contexts? An examination of comprehension-based silent reading rate. *Revisiting silent reading: New directions for teachers and researchers*, (pp. 151-167) Newark, DE: International Reading Association.
- Hill-Powell, J. M. (2015). *The effects of a reading intervention to teach silent reading with comprehension on the speaker-as-own-listener capability among third grade students and comparisons with fluent readers*. (Unpublished doctoral dissertation). Columbia University, New York.
- Kamil, M. L. (2008). How to get recreational reading to increase reading achievement. *Fifty-seventh yearbook of the National Reading Conference*, (pp. 31-40). Oak Creek, WI: National Reading Conference.
- Kim. Y.S., Wagner, R. K., & Foster, E. (2011). Relations among oral reading fluency, silent reading fluency, and reading comprehension: A latent variable study of first-grade readers. *Sci Stud Read*, 15, 338-362. doi: 10.1080/10888438.2010.493964
- Manning, G. L., & Manning, M. (1984). What models of recreational reading make a difference? *Reading World*, 23, 375-380.

- McKenna, M. C., & Kear, D. J. (1990). Measuring attitude toward reading: A new tool for teachers. *The Reading Teacher, 43*, 626-639. doi: 10.1598/RT.43.8.3
- National Reading Panel. (2000). *Report of the National Reading Panel: Teaching children to read*, Washington, DC: National Institute of Child Health and Human Development.
- Samuels, S. J., Hiebert, E. H. & Rasinski, T. V. (2010). Eye movements make reading possible. *Revisiting silent reading: New directions for teachers and researchers*, (pp. 24-44). Newark, DE: International Reading Association.
- Skinner, B.F. (1957). *Verbal Behavior*. New York, NY.
- Trainin, G., Hiebert, E. A., Wilson, K. M. (2015) A comparison of reading rates, comprehension, and stamina in oral and silent reading of fourth-grade students. *Reading Psychology, 36*, 595-626.
- Tsai, H. & Greer, R. D. (2006). Conditioned preference for books and faster acquisition of textual responses by preschool children. *Journal of Early and Intensive Behavioral Interventions, 3*, 35-60.
- Vorstius, C., Radach, R., & Lonigan, C. J. (2014). Eye movements in developing readers: A comparison of silent and oral sentence reading. *Visual Cognition, 22*, 458-485.
- Wanzek, J., Petscher, Y., Al Otaibla, S., Rivas, B., Jones, F. J., Kent, S., et al. (2017). Effects of a year-long supplemental reading intervention for students with reading difficulties in fourth grade. *Journal of Educational Psychology, 109*, 1108-1119.
- Wentzel, K. R. & Wigfield, A. (1998). Academic and social motivational influences on students' academic performance. *Educational Psychology Review, 10*, 155-175.
- Wentzel, K. R., (1996). Social and academic motivation in middle school concurrent and long-term relations to academic effort. *The Journal of Early Adolescence, 16*, 390-406.
- Wigfield, A, Gladstone, J., & Turci, L. (2016). Beyond cognition: Reading motivation and reading comprehension. *Child Development Perspective, 10*, 190-195.
- Wigfield, A., Guthrie, J. T., Perencevich, K. C., Taboada, A., Klaunda, S. L., McRae, A., & Barbosa, P. (2008). Role of reading engagement in mediating effects of reading instruction on reading outcomes. *Psychology in the Schools, 45*, 432-445.
- Wu, Y. & Samuels, S. J. (2004, May). *How the amount of time spent in independent reading affects reading achievement: A response to the National Reading Panel.*, Reno, NV: Paper presented at the 49th annual convention of the International Reading Association.

Chapter II

STUDY I MANUSCRIPT

Abstract

We conducted 2 experiments to test the relation between reading interest and achievement scores of participants ($n = 30$). In Experiment I, we observed significant positive correlations between reinforcement the value of reading, measured through a 20 min 10 s whole interval eye-tracking probe conditioned reinforcement for reading (CR+ for reading), and reading achievement scores. In Experiment II, we used a pre-and post-intervention design with multiple probe logic to test the effect of the establishment of a high interest in reading or conditioned reinforcement for reading (CR+ for reading) on reading achievement. We paired 6 participants into 3 dyads for the intervention. None of participants had CR+ for reading as measured by eye-movement across a page during a 20-min probe. We implemented a 4-step, peer contingency procedure to enhance the interest in reading content. This procedure included 1) participants reading a novel reciprocally, 2) defining unknown words in passage read, 3) silent reading, 4) selecting and drawing a paragraph from the book. The dependent variables in Experiment II were measures of reading comprehension and vocabulary. Results indicated significant mean increases in grade-levels across all students for the *Woodcock Johnson* comprehension (+1.95) and vocabulary tests (+0.3), as well as the *Gray Silent Reading Tests* (+1.0) in a maximum of 9 pairing sessions.

Keywords: conditioned reinforcement for reading, interest in reading, reading achievement, reading comprehension, vocabulary

The Result of Enhancing the Value of Reading on Reading Achievement in Fourth Graders

Students in the United States underperform in reading comprehension as opposed to students in other countries (U.S. Department of Education, 2017). Sixty-three percent of fourth grade students in the nation performed at or below the *Basic* achievement level of reading (partial mastery of fundamental skills). Only 36 percent performed at or above *Proficient* level (demonstrating competency over challenging subject matter) (U.S. Department of Education, 2017). It is important to identify the components of effective instruction to increase reading achievement in education (Hiebert & Raphael, 1996; Guthrie, Wigfield, & Perencevich, 2004). Reading comprehension becomes significantly more important in the upper elementary grades as the focus of reading shifts from decoding and fluency to text and inference-based comprehension (Sweet & Snow, 2003; Guthrie, et al., 2004). Comprehension consists of unseen, “complex thinking behavior” (Layng, Sota, & Leon, 2011), meaning an individual may accurately and fluently decode a given passage but might not comprehend the text. Layng et al. suggests comprehension is measured by specific changes in referent behaviors that are a function of changes in the text and a knowledge of the vocabulary. Increases in vocabulary are a result of students reading recreationally. If students do not choose to read, they continue to fall behind in vocabulary and reading achievement (Juel, 1988).

Recently, the problem in reading achievement has been a lack of comprehension. The Common Core State Standards (NGA Center & CCSSO, 2010) emphasizes the importance of students analyzing and comprehending complex texts as they progress through grade levels (Spichtig, Hiebert, Vorstius, Pascoe, Pearson & Radach, 2016). This is a challenge for students who are not proficient readers and lack fluency in grade-level texts. It is important for

researchers to identify and target behavioral and cognitive components of reading to increase achievement.

Reading motivation and engagement are two components that play a significant role in developing reading skills and comprehension (McGeown, Duncan, Griffins & Stothard, 2015; Guthrie et al., 2004; Wigfield & Guthrie, 1997). One way a reader demonstrates engagement with a text is by the amount of time spent observing a text (Guthrie et al., 2004; Berliner, 1979; Dolezal, Welsh, Pressley, & Vincent, et al., 2003; Stipek, 2002). The motivation to read increases as a student is attending to the content of a text by visually tracking across printed words. Repeated reading exposes the reader to new vocabulary, resulting in increases in proficiency in reading comprehension (Guthrie et al., 2004).

McGeown et al. (2015) and Wigfield and Guthrie (1997) report that adolescents who demonstrate an interest in reading are motivated to attend to a reading task, and as a result, gain a deeper understanding of the text. This information contributes to the importance of understanding components of reading (e.g., motivation or reinforcement value) that might be missing from the repertoires of a poor reader. Targeting procedures to enhance or establish interest for the content of reading shows promise (McGeown et al., 2015; Guthrie, Wigfield, Metsala, & Cox, 1999; Stipek, 1996). Getting children to engage in and read books is an important component in increasing reading repertoires. Studies in applied behavior analysis have tested interventions to establish interest in first steps of reading (e.g., motivation to decode) (Pereira-Delgado, Greer, Speckman & Goswami, 2009; Tsai & Greer, 2006). But there are few studies outside of behavior analysis devoted to interventions to establish motivation for reading.

Behavior-analytic interventions involving peers have been used to increase interest in different stimuli. In behavior-analytic laboratories, conditioned reinforcement (CR+) or

reinforcement value, is used as a measure of interest or preference. Behavior-analytic interventions have used condition reinforcement for observing and production responses including observing books (Buttigieg, 2015; Tsai & Greer, 2006), engaging in writing (Lee-Moschella, 2016), reading content (Cumiskey Moore, 2017), and mathematics (Maurilus, 2018; O'Rourke, 2006).

The importance of increasing reinforcement value for observing and choosing books has been researched in various studies (Nuzolo-Gomez et al., 2002; Singer-Dudek, Oblak & Greer, 2011; Tsai & Greer, 2006). Tsai and Greer (2006) studied the effect of establishing reinforcement value for observing and choosing books on the rate of learning textual responses to word sets. The intervention included a procedure that conditioned children to choose and continue to look at books over toys. Results from this study indicated that when children demonstrated an interest in books the participants learned to decode single words with three to four times fewer teaching interactions. This is an important early step for providing motivation for learning to decode. Research in the behavior analysis of communicative or verbal behavior has begun to identify a series of motivation steps leading to competent reading and enthusiasm for reading (Greer, Phol, Du, & Lee-Moschella, 2017; Greer, Pistoljevic, Cahill, & Du, 2011; Greer & Ross, 2008; Greer & Speckman, 2009). The final motivational step must be the content of what is being read.

Other than procedures in behavior analysis to establish choosing to look at books and learning simple decoding, there were no experimental studies testing whether the establishment of reading motivation (i.e. CR+ in behavior analysis research) resulted in gains in reading achievement. Research in behavior analysis focusing on the development of verbal behavior and reading instruction led to the development of a peer intervention procedure designed to enhance

or establish CR+ for the content of reading. While the research for establishing preschoolers' interest in looking at and choosing books provides effective instructional tactics for the beginning steps, doing so with third to fifth grade students presents a challenge, because the procedures used with the preschoolers are not practical nor effective for elementary school students.

This problem led to the development of a procedure using peer interactions to establish or enhance fifth grader motivation for reading in our laboratory. The development of the peer procedure then, in turn, allowed for an experiment on the effect of establishing reinforcement value for reading (as measured by duration of eye tracking print in books sustained across repeated 20-min sessions) on tests of reading achievement. In the first of a series of pilot studies, Cumiskey Moore (2017) used the peer intervention procedure to test the relation between the establishment of CR+ for reading and reading achievement. Cumiskey Moore used two standardized assessments to measure reading comprehension, *The Woodcock Johnson III Battery Assessment (WJ-IV)* and the *Gray Silent Reading Tests (GSRT)* (2017). The criterion for the establishment of CR+ for reading was engaging in eye-tracking behavior for 80% of 10-s whole intervals in an independent reading 20-min period (Cumiskey Moore, 2017). The eye-tracking behavior was a measure of the reader's eyes moving across a page from left to right from the top of the page to the bottom of the page (Rayner, Pollatsek, Schotter, 2012). Cumiskey Moore reported the establishment of CR+ for reading resulted in a significant increase in standardized reading comprehension scores over a short period of time. The promising results of that study led to the studies presented herein.

We conducted two studies to examine the relations between student interest in reading and reading comprehension. In the first study, using an N of 30 fourth graders we tested for

correlations between reading achievement and the measures of reading motivation or reinforcement value as described above. In the second study, using a single case experimental design, we tested for the effects of a multicomponent peer-collaborative procedure to establish reinforcement value for reading (CR+ for reading) content. We also tested reading achievement as a second dependent variable once CR+ for reading was established. For this experiment, we recruited six typically developing fourth graders on or slightly below grade level in reading but did not have CR+ for reading as measured by the 20-min CR+ for reading probe.

The first study consisted of a small group analysis of relations between measures of reinforcement value and reading achievement. The second study posed with the following research question: Can a peer-collaborative procedure establish reading as a reinforcer, and if so, will reading achievement scores increase as a result?

Experiment 1

Method

Participants. Participants included 30 students (15 males and 15 females) with a mean age of 10.2 years ($SD = .36$ years). They were recruited participants from a Title I elementary school including grades 3 through 5 located in a suburban city in the northeast United States. The sample consisted of 11 students who demonstrated an interest in reading (i.e. conditioned reinforcement for reading or CR+ for reading) as measured by an eye tracking procedure during a 20-min duration (age $M = 10.24$, $SD = .44$ years) and 19 students who did not demonstrate interest in reading (NCR+ for reading) (age $M = 10.16$ $SD = .26$ years). All students in the CR+ for reading sample had scores at or above 80% on the conditioned reinforcement for reading probe and students in the NCR+ for reading sample scored below 80% on the interest in reading probe. Participants were predominately White (56.7%), whereas 23.3% were Latino, 10% were

African American, 10% were Asian American. The sample included a majority of students who were not eligible for free and reduced lunch services (80%), whereas 20% of students in the sample were eligible for free and reduced lunch services (see Table 1).

Dependent Variables

Interest in Reading (Conditioned Reinforcement for Reading, CR+ for reading). We measured the students' level of CR+ for reading by observing two 20-minute period of silent reading. These were done either in person, or through video recordings. The experimenters instructed the students to pick a novel with no pictures and start reading independently. The experimenter started the timer and observed the participants' eyes for 10-s whole intervals. If the participant's eyes moved across the page from left to right and top to bottom during the entire 10-s interval (indicating reading), the observer marked a plus (+) on their forms for the indicated time. If the participant's eyes were not moving at any point of the whole 10-s interval, the observer marked a minus (-). The observers continued to record whole 10-s intervals for 20 mins for a total of 120 intervals per probe. Upon completion of the probe, the observer calculated the percentage of intervals spent reading as measured by eye-movement across the page. If the participant's eyes moved for 80% or more of the intervals, we considered the participant to have a high interest in reading (or possess reading as a conditioned reinforcer).

Reading Comprehension. We assessed reading achievement scores using three different measures. The *Woodcock Johnson-IV Diagnostic Reading Battery (WJ-IV)* subtests 4, 17a, and 17b measured comprehension and vocabulary. The *Gray Silent Reading Tests (GSRT)* measured comprehension through independent reading. The *i-Ready® Diagnostic Test (iReady)* included three reading achievement measurements: vocabulary, literary comprehension, and informational text comprehension.

Woodcock Johnson-IV Diagnostic Reading Battery. This assessment is a standardized test used to assess students' grade equivalencies through 22 subtests. For the purpose of this study, we administered subtests 4 and 17. Subtest 17 was comprised of two sections while subtest 4 was comprised of one. In both subtests, questions became increasingly more difficult as the student progressed through responding. A series of basal and ceiling scores were used to assess the students' grade-level. The test has been reported to have a median reliability of .91 in the 5-19 age range (Schrank, Mather, & Woodcock, 2004).

Passage Comprehension Subtest 4. Subtest 4 tested passage comprehension and assessed the student's ability to insert a correct word in a blank space in a sentence. The experimenter administered the test using a flipbook with the student stimuli on one side of the booklet and the test administrator stimuli on the other. In this assessment, the student experienced four sentences per page with each sentence increasing in difficulty as the student progressed through the assessment. The experimenter did not deliver prompts, corrections, or reinforcement for incorrect or correct responses through the duration of the probe session. Six consecutive correct responses were required at the onset of the assessment and a ceiling of six consecutive incorrect responses and the end of a page indicated termination of the assessment. Once the participant finished the assessment, the experimenter calculated the raw score that was converted to a grade-equivalency.

Vocabulary Synonyms and Antonyms Subtest 17a and 17b. In subtest 17, we assessed synonym and antonyms. Synonyms were assessed in 17a, and antonyms were assessed in 17b. The test administrator sat across from the student with the text materials in front of the student and the teacher stimuli on the back. After giving a model of a synonym, the student was told to read the word silently and then provide a synonym with a vocal response. Termination of the test

occurred with the student answered 5 consecutive questions incorrectly. Upon termination of the test, the experimenter calculated the grade equivalent associated with the raw score.

Gray Silent Reading Tests. We used the *GSRT* to measure independent reading comprehension grade levels. The *GSRT* is a standardized reading assessment comprised of short reading passages with five multiple-choice responses testing reading comprehension. There were two forms of the test (A and B). The participants completed the assessment using an answer sheet to fill in the correct responses. They completed one story at a time, each story getting progressively more complex. If they emitted fewer than three errors in the story, they continued on to the next story. The participants continued until three or more incorrect responses were emitted for one story. Each story was one paragraph long. Upon completion of the assessment, the experimenter calculated the raw score by adding up the number of correct responses emitted. This raw score was converted to a grade-equivalent score provided by the assessment manual.

i-Ready® Diagnostic. Experimenters used the *i-Ready Diagnostic Test* to measure the reading comprehension scores of the participants in the study. We measured vocabulary, literary comprehension, and informational comprehension scores as a result of an online diagnostic (Curriculum Associates, LLC, 2015).

Procedures. We collected data across all students in-class through observational and diagnostic reported measures. Across two probe sessions, we conducted observational silent-reading probe sessions: some were observed in situ and some were observed later through video recordings. Subtests 4 and 17 of the *Woodcock Johnson-IV Diagnostic Reading Battery (WJ-IV)* (Schrank, Mather, & Woodcock, 2004) were administered across two days by the experimenters. The *Gray Silent Reading Tests (GSRT)* assessment A (Wiederholt & Blalock, 2000) was administered to the students in one session. The *i-Ready® Diagnostic* is an assessment

conducted on a computer across several days in the students' classroom. Data on the outcome of the assessment were gathered through the *i-Ready*® report provided to the teacher (Curriculum Associates, LLC, 2015).

Interobserver agreement for Fidelity of the Independent Variable. We calculated interobserver agreement (IOA) by dividing the number of point-to-point (i.e., 10s interval) agreements by the total number of agreements and disagreements, and multiplied by 100 to gain a percentage. IOA was calculated for 47% of the conditioned reading probe sessions with a mean agreement of 93% across all dyads (range, 70-100%). CR+ for reading probe sessions were conducted both in-situ (60%) and through video recording (40%). We obtained agreement for 100% for implementation of all comprehension assessments with 100% agreement across all dyads.

Results

Using SPSS, we ran bivariate correlations to measure the correlations between the CR+ for reading level and reading achievement scores.

Correlations between conditioned reinforcement value for reading and dependent measures. We found a significant correlation between the level of CR+ for reading and reading achievement test scores as indicated by the *WJ-IV* Vocabulary subtest, *WJ-IV* comprehension subtest, *GSRT*, *iReady* literary comprehension, and *iReady* informational comprehension, literary comprehension, and *iReady* vocabulary measures (see Table 3).

Discussion

The experimental question for Experiment I was, is there a significant correlation between CR+ for reading and Reading Achievement? The findings show the measures of reinforcement value (CR+ for reading) and its relation to reading achievement are consistent

with findings on relations between reading motivation and achievement (Wigfield & Guthrie, 1997). This suggests our eye tracking of moment to moment CR+ value is a valid measure of interest in, and motivation, to read. The data suggests the more a student reads, the higher their reading achievement scores will be as indicated by the positive correlation between conditioned reinforcement value measures and comprehension scores in the *Gray Silent Reading Tests*, *i-Ready* literary comprehension, and *iReady* informational comprehension measures. It is important to note these data are representative of a small sample of students, but the fact the small sample resulted in the relations found suggest the need to determine whether reading achievement increases as a result of rather than a correlate of reinforcement value. This leads us to the question, do comprehension and vocabulary reading achievement scores increase as a function of the establishment of conditioned reinforcement value of for reading? The possibility of answering this question was suggested by a pilot study in our laboratory, conducted by Cumiskey Moore (2017). The peer-intervention used in her experiment did, in fact, establish CR+ for reading for four fifth graders and, in turn, resulted in educationally important increases in reading comprehension and vocabulary measures.

While the group design in our first study suggests potential population relations between reinforcement value for reading and reading comprehension measures, those findings do not demonstrate functional relations nor do they suggest generality to types of individuals. The purpose of Experiment II was to test the establishment of CR+ for reading and, on measures of reading achievement scores with six typically developing fourth-grade students in a single case design experiment. The generality of single case designs is to individuals with characteristics and existing stimulus control but not populations. Thus, we sought to determine whether the

establishment of CR + for reading functions to raise grade level reading achievement with six fourth graders with characteristics we describe herein.

Experiment II

Method

Participants. We selected six fourth-grade students, three females and three males ranging from ages 9-10 years for the study. All participants participated in Experiment I. We classified the participants as typically developing fourth graders who functioned on or slightly below grade level in reading. We used the *Developmental Reading Assessment (DRA)* (Pearson Education, 2006), overall *iReady®* reading diagnostic scores (Curriculum Associates, LLC, 2015) and third grade *PARCC* scores to determine overall reading level. Two participants (33%) were on reading level and four participants (66%) were below reading level. We selected these participants because they did not demonstrate conditioned reinforcement value for reading content (Table 5). We placed the participants into dyads dependent of similar reading levels and starting percentage of intervals spent reading in the conditioned reinforcement for reading probe sessions (Table 5). Prior to starting the intervention, we directed both participants in a dyad to the book room in the school and showed the range of books they could choose from. These books ranged from one level below their reading level, to one level above their reading level as determined by both participants' *DRA* score (Pearson Education, 2006).

Setting. We conducted all sessions in the participants' classroom or within the school setting during regularly scheduled instructional periods. We conducted pre- and post-CR+ for reading probe sessions in a class-wide setting in the classroom. The experimenter conducted all pre- and post-intervention comprehension probe sessions 1:1 in the classroom or in the hallway. Each dyad completed the intervention independently within the classroom or in the hallway. The

classroom teachers conducted regular reading instruction with the rest of the class in small groups within the classroom.

Dependent Variables: Establishment of Conditioned Reinforcement for Reading and Measures of reading achievement. There were two dependent variables in the study. The first dependent variable was the establishment of CR+ for reading which was measured through a 20-min silent reading session. Criterion was 80% of 10s whole intervals spent reading in a 20-min reading period across two consecutive probe sessions. We also used the measures of four reading comprehension tests described in Experiment I, except for the *iReady® Reading Diagnostic* assessment to determine if increases in reading achievement would be observed as a second dependent variable. The participants in Experiment II completed three different assessments to determine grade-equivalent reading comprehension scores through the *Woodcock Johnson IV Diagnostic Reading Battery Test (WJ-IV)*, and the *Gray Silent Reading Tests (GSRT)*.

Independent Variable: Four step peer-collaborative procedure.

There were four steps in the intervention procedure. We placed the participants into dyads based on reading level and CR+ for reading level. The participants completed the multicomponent intervention which included: 1) the shared reading period, 2) a vocabulary task, 3) an independent reading period, and 4) a reading comprehension task. Each time the participants mastered the requirement of a four-step session, the experimenters increased the shared and independent reading periods (e.g., step 1 and step 3) by two minutes. After three increases in the reading time, the participants underwent a 20-min test for CR+ for reading to determine if CR+ for reading was established at 80% of 10s whole intervals spent reading.

Design. The design of the study was a pre- and post-probe intervention design with a multiple probe logic across three dyads. The pre-intervention measures were each participant's reading comprehension scores as measured by the *WJ-IV* and *GSRT*. Prior to starting the intervention to establish CR+ for reading, all participants underwent three CR+ for reading probe sessions to determine eligibility and stability (i.e., the reliability of the measure). CR+ for reading was established when participants read 80% or more of the 10-s whole intervals for 20 min. Dyad 1 entered the intervention upon completion of the initial reading achievement measures and CR+ for reading probe sessions. After meeting criterion of 80% or greater on the CR+ for reading probe sessions, we conducted post intervention comprehension probe sessions on both participants.

Dyad 1 and 3 went through two phases of the intervention before they demonstrated CR+ for reading at or above 80% whereas Dyad 2 went through one phase of the intervention before demonstrating CR+ for Reading at or above 80%. It is also important to note that in the three-month maintenance probe, three of the six participants maintained at least 80% or higher on the CR+ for reading probe sessions (Figures 2 and 3).

Procedure. The procedures for conducting the dependent variable measures of the conditioned reinforcement value of reading probe, reading comprehension, and vocabulary were replicated from Experiment I.

There were four steps in the experimental intervention: 1) collaborative shared reading, 2) selection of novel textual stimuli and deriving meaning (i.e., words that were new to them and what they inferred to be their meaning), 3) collaborative independent reading, and 4) a comprehension drawing task. Prior to starting the intervention, the experimenter determined the average minutes both participants read for a single duration during the pre-intervention

conditioned reinforcement value for reading probe sessions. This was the initial duration of time the participants read during intervention Steps 1 and 3.

Step 1: Shared Reading The participants sat next to each other in a quiet spot either in the classroom or in the hallway. We then directed them to take turns reading paragraphs aloud to each other from the novel they chose until the timer went off. The time was the average number of minutes read by both participants during the pre-intervention conditioned reinforcement for reading probes conducted prior to entering intervention. We also instructed the participants to underline words they did not know in the book with a pencil because they would come back to them in Step 2. Upon completion of the specified duration of time, signaled by a timer, the participants stopped reading and marked with a pencil in their book where they ended. We gave these instructions explicitly to the participants in the first session but they may not have required instruction in subsequent sessions.

Step 2: Vocabulary task. The participants each received a piece of paper with a table on it (Appendix A). We told the participants how to fill in the table. In the first column, we instructed them to write three unknown words they identified in the reading and underline them. In the second column, they wrote the page number of where each word was. In the third column of the table, they were to write a definition for the corresponding word in the first column. After both participants finished writing, they traded papers and read each other's words and definitions. They then either agreed or disagreed with their partner and signified this agreement or disagreement with a plus or minus next to the definition. Correct responding or consequences for incorrect responding were not required before moving on to Step 3 of the intervention. The function of this step was to pair words with peer interaction with the aim that peer interaction with words might increase the reinforcement value of the words.

Step 3: Independent Silent Reading. We separated the participants and instructed them to continue reading independently from where they stopped reading in Step 1. We set the timer to the same time as Step 1, and the participants continued reading until signaled to stop by the timer. Upon completion of their covert reading, the participants marked where they ended in their book. The experimenter marked the number of pages read by each participant and then instructed them to begin Step 4.

Step 4: Comprehensive Drawing Task. The experimenter instructed the participants to choose a paragraph to draw from the pages they read independently. To account for different reading rates, the participants could only choose to draw a scene from the pages the slower reader read. For example, if one reader read from page 25-30, but the other reader read from page 25-29, both participants could only choose to draw a scene from pages 25-29. Once each participant independently, and unbeknownst to their peer, chose a paragraph to draw, each participant highlighted the paragraph in the book and drew the scene on a second graphic organizer provided by the experimenter (*Figure 6*). There was no limit to the amount of time the participants were allowed, however the participants took between 5 and 7 minutes. Once both participants completed their drawings, the experimenter determined which page number and paragraph each drawing was from to verify they were drawn from the correct place and then swapped pictures. Then the experimenter instructed the participants to find the page and paragraph number their partner drew and to write it on the piece of paper. When both finished this part of the intervention, the experimenter and both participants determined if they had correctly identified each other's pictures.

When both correctly identified each other's drawings, they completed this phase of the intervention and were given 10-min of free-time to complete an activity of their choice together.

The participants could choose to go outside, play a game, or take time on the computer together. The next time the intervention was conducted, the duration of time read in Steps 1 and 3 was increased by two minutes.

If one or both participants did not identify the correct page number and paragraph their partner drew, the dyad did not receive access to a 10-min free-time period and were instructed to complete the correction procedure which they agreed upon prior to entering the session. The correction procedure required the participant who incorrectly identified the correct scene, to draw their interpretation of the scene their partner originally drew. When the drawing was completed, their partner checked to see if the participant included all parts of the paragraph and they were instructed to start the intervention in Step 1 again. The time to read in Steps 1 and 3 was set at the same duration and was not increased until both participants correctly identified each other's drawings in Step 4. An interest in reading probe was conducted after three consecutive increases in reading duration. This meant both participants correctly identified each other's drawn scenes at 100% accuracy across three consecutive ascending duration intervals.

We repeated CR+ for reading probes (i.e., 20-min session). If the participant had 80% or greater total intervals spent reading as measured by eye-movement, they were determined to have met the criterion for the intervention and then assessed using the reading achievement test measures (*WJ-IV*, comprehension, and vocabulary, *GSRT*). If the participant did not read for 80% of the intervals, they were placed back into a second phase of the intervention with a 2-min increase in their reading duration in Steps 1 and 3. The whole intervention was repeated until the participants demonstrated an establishment of CR+ for reading at 80% of 120 10-s whole intervals across two independent 20-min probe sessions (Figure 1).

Interobserver agreement for Fidelity of the Independent Variable. We calculated interobserver agreement (IOA) by dividing the number of point-to-point (i.e., 10s interval) agreements by the total number of agreements and disagreements, and multiplied by 100 to gain a percentage. IOA was calculated for 40% of the conditioned reading probe sessions with a mean agreement of 86% across all dyads (range, 80-100%). CR+ for reading probe sessions were conducted both in-situ (65%) and through video recording (35%). We obtained agreement for 100% of the intervention with 100% agreement across all dyads.

Results

Conditioned Reinforcement for reading as measured by the 20-min probe was established for all six participants as a result of the intervention, with all participants meeting criterion of 80 percent or greater on post-intervention CR+ for reading probes. We conducted CR+ for reading probe sessions for each dyad initially and again just prior to entering the intervention. All three dyads remained at initial reinforcement value measures prior to entering the intervention (Figure 2).

To compensate for the time passing between the pre- and postintervention reading achievement assessments, we included a projected level of expected increase to account for the time spent in intervention for all participants. We used the expected grade-equivalency number to calculate differences in grade equivalency scores measured in the post intervention reading achievement tests. The range of grade level increase for the reading were from 0.4 to 2.1 grade levels for the *WJ-IV* passage comprehension subtest, a range increase of -0.6 to 1.1 grade levels for *WJ-IV* vocabulary subtest a range increase of -0.4 to 2.3 grade equivalency levels for the *GSRT* (Table 9 for individual Participant Dependent Variable measures). All participants completed the intervention between 120 min to 236 min. All participants increased beyond

expected grade levels on the *WJ-IV* passage comprehension subtest, three participants increased in *WJ-IV* vocabulary subtest, and four participants increased past expected results for the *GSRT* (Figure 3).

Discussion

The data suggests the multicomponent peer-collaborative procedure functioned to establish reading as a reinforcer for all six participants. We also observed reading achievement gains in postintervention assessments. Thus, advances in reading achievement were a possible function of the peer- collaborative intervention for these participants. In other words, the findings suggest the establishment of CR+ for reading functions to increase reading comprehension scores for students like the ones we studied. Most significant were the *WJ-IV* Passage Comprehension subtest and the *GSRT* with increases of a mean of 1.8 grade levels or 1 grade level respectively in less than 120 to 236 min. These findings are similar to the results of Cumiskey Moore's (2017) pilot study where increases in reading comprehension test scores occurred as a result of the establishment of CR+ for reading, with the participants increasing 1.2 grade levels (0.8 to 1.6) for *WJ-IV* passage comprehension, 1.3 grade levels (1.1-1.7) for *WJ-IV* vocabulary, and 2.3 grade levels (0.7-3.8) for the *GSRT*.

It is of interest to note that Dyads 1 and 3 had greater increases in reading comprehension scores in the *WJ-IV* Passage Comprehension subtest and in the *GSRT*. This may be due to longer exposure to the intervention, that is, both dyads spent more time in the pairing procedure (M= 248 min) thus enhancing CR+ for reading content. Dyad 1 spent 260 min in the intervention, Dyad 2 spent 120 min in intervention, and Dyad 3 spent 236 min in intervention (Table 8).

General Discussion

The results of Experiment I demonstrated positive significant correlations CR+ for reading and reading comprehension scores. In Experiment II, we asked the question: Can a peer-collaborative procedure establish reading as a reinforcer, and if so, will their comprehension scores increase as a result? As a result of the intervention, all participants acquired CR+ for reading. We observed a significant increase in reading comprehension scores in Experiment II possibly as a result of establishing conditioned reinforcement for reading. These findings replicated Cumiskey Moore's (2017) pilot study even with students who were not initially on grade level prior to starting the intervention, where significant increases in comprehension were observed over a short period of time. However, the latency between the pre-intervention probe sessions and the onset of the intervention is a significant confound, and calls for a replication that controls for this limitation. Specifically, the pre-intervention probe sessions for reading achievement were conducted for each dyad at the same time between 24-39 days before the participants entered the intervention. Future studies should conduct the pre-intervention probe sessions just prior to implementing the intervention to control for other variables (i.e. reading lessons, instruction, maturation). To account for this limitation, we added a projected increase score to the graphs to visually demonstrate the significant increase in scores.

We can attribute another limitation to the eye-tracking procedure. While this measure is difficult to calibrate the agreement was 86% across CR+ for reading sessions. Video recordings are a better solution, but can be difficult if the participant is out of frame or covers their face with the book. Eye-tracking measures using computers might be a future instrument to measure conditioned reinforcement for reading. There has been an increase in research devoted to the use of reading e-books (Huang & Liang, 2014). Interactive E-books Learning System (IELS) are

systems used to collect students' reading rate profiles with an ability to accurately track reading better than using printed books (2015).

Future studies should include a functional analysis between CR+ for reinforcement and reading achievement to determine if increases in achievement are a direct result of acquiring CR+ for reading. Future studies should include a component analysis, identifying which part or parts of the procedure are critical to the effectiveness of the intervention as the intervention done herein includes elements of both independent and shared reading, a vocabulary task, and a comprehension drawing task. Because the implications of this study are potentially important given the present level of reading comprehension in the United States, there is pressing need for further research. The results suggest the need to further test: (a) for the replicability of the procedure, (b) the generality of the of the procedure to other individuals who differ from those we tested, and (c) component analyses of which components are most necessary.

References

- Berliner, D. C. (1979). Tempus educare. In P. L. Peterson & H. J. Walber (Eds.), *Research on teaching* (pp. 120-135). Berkley, CA: McCutchan.
- Cumiskey Moore, C. (2017). *The Effects of Conditioned Reinforcement for Reading on Reading Comprehension for 5th Graders*. (Unpublished Doctoral Dissertation, Columbia University). <https://doi.org/10.7916/D8PZ5N30>.
- Dolezal, S. E., Welsh, L. M., Pressley, M., & Vincent, M. M. (2003). How nine third-grade teachers motivate student academic engagement. *Elementary School Journal, 103*, 239-267.
- Greer, R. D., Pistoljevic, N., Cahill, C., & Du, L. (2011). Effects of conditioning voices as reinforcers for listener responses on rate of learning, awareness, and preferences for listening to stories in preschoolers with autism. *The Analysis of Verbal Behavior, 27*, 103-124.
- Greer, R.D., Pohl, P., Du, L. & Lee-Moschella, J. (2017). The separate development of children's listener and speaker behavior and the intercept as behavioral metamorphosis. *Journal of Behavioral and Brain Science, 7*, 674-704.
- Greer, R. D., & Ross, D. E. (2008). *Verbal behavior analysis: Inducing and expanding complex communication in children with severe language delays*. Boston: Allyn & Bacon.
- Greer, R. D., & Speckman, J. (2009). The integration of speaker and listener responses: A theory of verbal behavior development. *The Psychological Record, 59*, 448-499.
- Guthrie, J. T., Wigfield, A., & Perencevich, K. C. (Eds.). (2004). *Motivating reading comprehension: Concept-Oriented Reading Instruction*. Mahwah, NJ: Erlbaum.
- Guthrie, J. T., Wigfield, A., Metsala, J. L., & Cox, K. E. (1999). Motivational and cognitive predictors of text comprehension and reading amount. *Scientific Studies of Reading, 3*, 231-256.
- Heibert, E. H., & Raphael, T. E. (1996). Psychological perspectives on literacy and extensions to educational practice. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 550-602). New York: Simon & Schuster/Macmillan.
- Huang, Y-M., & Liang, T-H. (2014). A technique for tracking the reading rate to identify the e-book reading behaviors and comprehension outcomes of elementary school students. *British Journal of Educational Technology, 46*, 351-372.
- Juel, C. (1988). Learning to read and write: a longitudinal study of 54 children from first through fourth grades. *Journal of Educational Psychology, 80*, 437-447.

- Lang, T.V., Sota, M. & Leon, M. (2011). Thinking through text comprehension I: foundation and guiding relations. *The Behavior Analyst Today*, 12, 3-11.
- Lee-Moschella, J. (2016). *The effect of a social condition on the establishment of direct and indirect conditioned reinforcement for writing by second graders*. (Unpublished doctoral dissertation). Columbia University, New York.
- Maurilus, E. (2018). The effect of the establishment of reinforcement value for math on rate of learning for pre-kindergarten students. (Unpublished Doctoral Dissertation, Columbia University).
- McGeown, S.P, Duncan, L.G, Griffiths, Y. N., & Stothard, S.E. (2015) Exploring the relationship between adolescent's reading skills, reading motivation and reading habits, *Reading and Writing*, 28, 545-569.
- Nuzzolo-Gomez, R., Leonard, M., Rivera, C. M. & Greer, R. D. (2002). Teaching children with Autism to prefer books or toys over stereotypy or passivity. *Journal of Positive Behavior Interventions*, 4, 80-87.
- O'Rourke, C. A. (2006). *Conditioning math as a reinforcer for performance and learning as a function of observation*. (Unpublished doctoral dissertation). Columbia University, New York.
- Pereira-Delgado, J.A., Greer, R.D., Speckman, J., & Goswami, A. (2009). Effects of conditioning reinforcement for print stimuli on match-to-sample responding in preschoolers. *The Journal of Speech-Language Pathology and Applied Behavior Analysis*, 3.2/3.3, 199-216.
- Pearson Education (2006). *Developmental Reading Assessment, Second Edition*[®] (DRA-2[®]). New York, NY.
- Rayner, K., Pollatsek, A. & Schotter, E.R. (2012). Reading: Word identification and eye movements. In A. Healy (Ed.) *Handbook of Psychology, Volume 4: Experimental Psychology*, (pp. 548-577). Hoboken: Wiley.
- Schrank, F. A., Mather, N., & McGrew, K. S. (2014). Woodcock-Johnson IV tests of achievement. *Rolling Meadows, IL: Riverside*.
- Singer-Dudek, J., Oblak, M., & Greer, R. D. (2011). Establishing books as conditioned reinforcers for preschool children as a function of an observational intervention. *Journal of Applied Behavior Analysis*, 44, 421-434.
- Sweet, A. P., & Snow, C. E. (2003). *Rethinking reading comprehension*. New York: Guilford Press.

- Spichtig, A.N., Hiebert, E.H, Vorstius, C., Pascoe, J.P., Pearson, P.D., Radach, R. (2016). The decline of comprehension-based silent reading efficiency in the United States: a comparison of current data with performance in 1960. *Reading Research Quarterly*, 51, 239-259.
- Stipek, D. (1996). Motivation and instruction. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology* (pp. 309-332).
- Tsai, H. & Greer, R.D. (2006). Conditioned preference for books and faster acquisition of textual responses by preschool children. *Journal of Early and Intensive Behavioral Interventions*, 3, 35-60.
- U.S. Department of Education. (2017). *National Reading Performance Report*. Institute of Education Sciences, National Center for Education Statistics. Retrieved from https://nces.ed.gov/programs/coe/pdf/coe_cnb.pdf.
- Woodcock, R.W., Mather, N. & Schrank, F.A. (2004). Woodcock Johnson IV® Diagnostic Reading Battery (WJ IV® DRB) 4th ed. Rolling Meadows, IL, USA: The Riverside Publishing Company.
- Wigfield, A., & Guthrie, J. T. (1997). Relations of children's motivation for reading to the amount and breadth of their reading. *Journal of Educational Psychology*, 89, 420-432.

Table 1

Descriptive statistics for participants in Experiment I (N = 30)

| Characteristic | Frequency | Percent |
|---------------------------------|-----------|---------|
| Gender | | |
| Male | 15 | 50 |
| Female | 15 | 50 |
| Free/Reduced Lunch ^a | | |
| Yes | 6 | 20 |
| No | 24 | 20 |
| CR+ for Reading ^b | | |
| Yes | 11 | 36.7 |
| No | 19 | 63.3 |
| Ethnicity | | |
| Caucasian | 17 | 56.7 |
| Hispanic | 7 | 23.3 |
| African American | 3 | 10 |
| Asian American | 3 | 10 |
| IEP | | |
| Yes | 5 | 16.7 |
| No | 25 | 83.3 |

Note. CR+ = Conditioned Reinforcement.

^a Free and Reduced lunch status refers to low-income students whose families qualify for state assistance in paying for lunch and breakfast of the student

^b CR+ for Reading was determined by the conditioned reading probe where the student was observed for a duration of 20 minutes. Every 10-s, the observer either marked a “+” or a “-” indicating the participant’s eyes were tracking across the page from left to right or they weren’t. If the participant read for 80% of the intervals, they were considered to have conditioned reinforcement for reading.

Table 2

Descriptive statistics for continuous variables in Experiment I (N = 30)

| Variable | Range | Mean | Std. Deviation |
|---|-----------------|--------|----------------|
| Percentage of intervals reading out of 20 minutes | 3% - 100% | 57.3% | .33 |
| GE Comprehension WCJ | 1.6 - 8.6 | 3.6 | 1.48 |
| GE Vocabulary WCJ | 2.2 - 12.9 | 5.6 | 2.86 |
| Gray Silent Reading Tests | 1.00 - 10.80 | 4.07 | 2.50 |
| iReady ^a Literary Comp | 425.00 - 647.00 | 559.10 | 54.67 |
| iReady Informational Comp | 368.00 - 651.00 | 544.10 | 71.40 |
| iReady Vocabulary | 411.00 - 634.00 | 547.43 | 49.51 |
| Age of the student | 9.70 - 10.80 | 10.21 | .36 |

Note. GE = Grade Equivalency; WCJ = Woodcock Johnson Battery Assessment

^a the iReady Diagnostic is an online assessment delivered three times a year to measure student growth across mathematics and reading. Each score is made up of several subtests, literary comprehension, informational comprehension, and vocabulary are components of the reading assessment that measure reading comprehension.

Table 3

Pearson Correlation data between Reading Comprehension and CR+ for Reading in Experiment I (N =30).

| Reading Achievement | CR+ for reading | |
|---------------------|---------------------|--------------------|
| | Pearson Correlation | Significance Level |
| GE WCJ-Vocab | .382* | .037 |
| GE WCJ-Comp | .489** | .006 |
| GSRT | .723** | .000 |
| iReady Lit Comp | .495** | .005 |
| iReady Info Comp | .419* | .021 |
| iReady Vocab | .458* | .011 |

Note. ** p-value < 0.01 * p-value < 0.05; GE = Grade Equivalence; WCJ = Woodcock Johnson Battery Assessment; GSRT = Gray Silent Reading Tests

Table 4

Information about Participants in Experiment II including age, gender, ethnicity, Free/Reduced Lunch, Academic Cusps, and Developmental Reading Assessment (DRA) levels.

| Dyad | Participant | Age (in years) | Gender | Ethnicity | Free/Reduced Lunch | DRA^a Level | CR+ Value^b in pre- intervention probe | Overall^c Fall iReady Reading diagnostic | 3rd Grade ELA PARCC^d score |
|-------------|--------------------|-------------------------------|---------------|------------------|-------------------------------|----------------------------------|---|---|---|
| 1 | AM | 9 | F | Caucasian | No | 34 | 9% | 532 | 723 |
| | KN | 10 | F | Caucasian | Yes | 38 | 18% | 582 | 781 |
| 2 | JK | 9 | M | Caucasian | No | 28 | 14% | 536 | 749 |
| | JS | 10 | M | Hispanic | Yes | 30 | 26% | 530 | 731 |
| 3 | SF | 9 | M | Caucasian | No | 34 | 46% | 571 | 736 |
| | LW | 9 | F | Caucasian | No | 28 | 30% | 515 | 748 |

Note. DRA = Developmental Reading Assessment. CR+ Value = percentage of 120 10-s intervals spent reading as measured by the CR+ for reading probe.

^a The Developmental Reading Assessment is used to assess students' reading level. Upon entrance to the intervention, all participants completed the assessment to determine their reading levels. On-grade level upon entry to the study was between 34 and 38. Everything below 34 was below reading level; hence, Participant JK, JS, and LW were reading below grade level upon starting the pre-intervention measures.

^b Participants were placed in dyads based on their DRA level and CR+ pre-intervention probe sessions (in percentage).

^c iReady Reading diagnostic indicated whether students were on, <1 grade level below or >2 grade levels below. Participants KN and SF were on grade level, AM, JK, JS, and LW were all less than 1 grade level below in reading.

^d PARCC scores were standardized test assessments given at the end of 3rd grade. Scores are scaled into 1 (650-699) Did not meet grade standards, 2 (700-724) Partially met, 3 (725-749) Approached, 4 (750-809) Met, and 5 (810-850) Exceeded. Participants KN met, Participants JK, JS, SF, and LW partially approached meeting, and Participant AM partially met the standards for 3rd grade English Language Art

Table 5

Materials needed for intervention and probe sessions for Experiment II.

| Procedure | Materials |
|--|--|
| Conditioned Reinforcement for Reading Probe | Data sheet, timer, book |
| <i>Woodcock Johnson® Assessment</i> | Assessment booklet, data sheet for teacher |
| <i>Gray Silent Reading Tests</i> | Assessment booklet A and B, answer sheet, answer key, grade equivalency conversion chart |
| <i>Peer-yoked Contingency Intervention</i> | Two copies of same book (chosen by students), timer, intervention worksheet |

Table 6

Pre-intervention and Post-intervention grade equivalent scores for all participants in Experiment II.

| Participant | WJ-IV Comprehension (GE) | | WJ-IV Vocabulary (GE) | | Gray Silent Reading Tests (GE) | |
|-------------|-------------------------------|------------|-----------------------|------------|--------------------------------|------------|
| | Preintervention Probe session | Post-Probe | Pre-Probe | Post-Probe | Pre-Probe | Post-Probe |
| AM | 2.8 | 6.9 | 5.8 | 7 | 1.2 | 3 |
| KN | 3.9 | 4.9 | 4.8 | 4.8 | 3.2 | 5.5 |
| JK | 3.5 | 4.3 | 4 | 4.4 | 3 | 3.2 |
| JS | 2.1 | 3.9 | 2.9 | 3.1 | 2.8 | 2.5 |
| SF | 3.9 | 6.2 | 4.4 | 4.8 | 3.5 | 3.8 |
| LW | 2.6 | 4.3 | 4.4 | 4.3 | 3.0 | 5.5 |

Note. WCJ Comprehension = Woodcock Johnson Battery Assessment; GE = Grade Equivalency

Table 7

Percentage of Interobserver Agreement for the Conditioned Reinforcement for Reading probe, Woodcock Johnson® IV Test, Gray Silent Reading Tests for Experiment I and 2.

| Probe Type | Percent of Trials With IOA | Percent Agreement |
|--|-----------------------------------|--------------------------|
| Conditioned Reinforcement for Reading probe (Eye Tracking Measure) | 40% | 84% |
| Peer-yoked Contingency Procedure | 100% | 100% |
| <i>Woodcock Johnson-IV</i> ® | 60% | 100% |
| <i>Gray Silent Reading Tests</i> | 100% | 100% |

Table 8

Number of School days between the Pre-Probe and entry into the intervention, Number of school days required to complete the intervention, and Total number of school days between the pre-probe and post-probe measure across all participants for Experiment II.

| Participant | Pre-Test measures | School Days between pre-test measures and Entering Intervention | Min to complete intervention | ^a Total Days between Pre- to Post-test | ^b Expected GE scores | ^c Post-Test Measures | ^d Difference in GE from expected GE scores |
|-------------|--|---|------------------------------|---|--|--|---|
| AM | WJ-IV Comp: 2.8 WJ-IV Vocab: 5.8 GSRT: 1.2 | 24 | 260 | 35 | WJ-IV Comp: 2.9 WJ-IV Vocab: 5.9 GSRT: 1.3 | WJ-IV Comp: 6.9 WJ-IV Vocab: 7 GSRT: 3 | WJ-IV Comp: +4. WJ-IV Vocab: +1.1 GSRT: +1.7 |
| KN | WJ-IV Comp: 2.9 WJ-IV Vocab: 4.8 GSRT: 3.2 | 24 | 260 | 35 | WJ-IV Comp: 3.0 WJ-IV Vocab: 4.9 GSRT: 3.3 | WJ-IV Comp: 4.9 WJ-IV Vocab: 4.8 GSRT: 5.5 | WJ-IV Comp: +1.9 WJ-IV Vocab: -0.1 GSRT: +2.2 |
| JK | WJ-IV Comp: 3.5 WJ-IV Vocab: 4 GSRT: 3.0 | 30 | 120 | 35 | WJ-IV Comp: 3.6 WJ-IV Vocab: 4.1 GSRT: 3.1 | WJ-IV Comp: 4.3 WJ-IV Vocab: 4.4 GSRT: 3.2 | WJ-IV Comp: +.7 WJ-IV Vocab: +.3 GSRT: +0.1 |
| JS | WJ-IV Comp: 2.1 WJ-IV Vocab: 2.9 GSRT: 2.8 | 30 | 120 | 35 | WJ-IV Comp: 2.2 WJ-IV Vocab: 3.0 GSRT: 2.9 | WJ-IV Comp: 3.9 WJ-IV Vocab: 3.1 GSRT: 2.5 | WJ-IV Comp: +1.7 WJ-IV Vocab: +0.1 GSRT: -0.4 |
| SF | WJ-IV Comp: 3.9 WJ-IV Vocab: 4.4 GSRT: 3.5 | 39 | 236 | 49 | WJ-IV Comp: 3.1 WJ-IV Vocab: 4.6 GSRT: 3.7 | WJ-IV Comp: 6.2 WJ-IV Vocab: 4.8 GSRT: 3.8 | WJ-IV Comp: +2.1 WJ-IV Vocab: +0.2 GSRT: +0.1 |
| LW | WJ-IV Comp: 2.8 WJ-IV Vocab: 5.3 GSRT: 3.0 | 39 | 236 | 49 | WJ-IV Comp: 3.1 WJ-IV Vocab: 5.5 GSRT: 3.2 | WJ-IV Comp: 4.3 WJ-IV Vocab: 4 GSRT: 5.5 | WJ-IV Comp: +1.3 WJ-IV Vocab: -0.6 GSRT: +2.3 |

Note. WJ-IV Comp = Woodcock Johnson Battery Assessment IV Subtest 4 (Passage Comprehension); WJ-IV Vocab = Woodcock Johnson Battery Assessment IV, Subtest 17a & 17b (Vocabulary); GSRT = Gray Silent Reading Tests; GE = Grade Equivalent

^a Days between pre-test measures and post-test measures. ^b Every 30 days of school, the students were expected to make an increase of .1 grade levels. These GE are projected scores based on the days between pre-test measures and post-test measures. ^c Post-test measures were conducted upon completion of the conditioned reinforcement value for reading intervention at 80% of the intervals spent reading. ^d These are the adjusted gains in GE when the projected GE was calculated.

Table 9

Mean increases in Reading Achievement scores for WJ-IV comprehension and vocabulary, GSRT. Mean increases in CR+ for reading were also calculated.

| Measure | Mean Increase | Range |
|---|---------------|------------|
| WCJ Passage Comprehension | 1.95 | 0.8 - 4.1 |
| WCJ Vocabulary | 0.3 | -0.4 - 2.3 |
| Gray Silent Reading Test | 1.0 | 0.2 - 2.3 |
| Percentage of intervals with eye-movement | 58% | 44% - 71% |

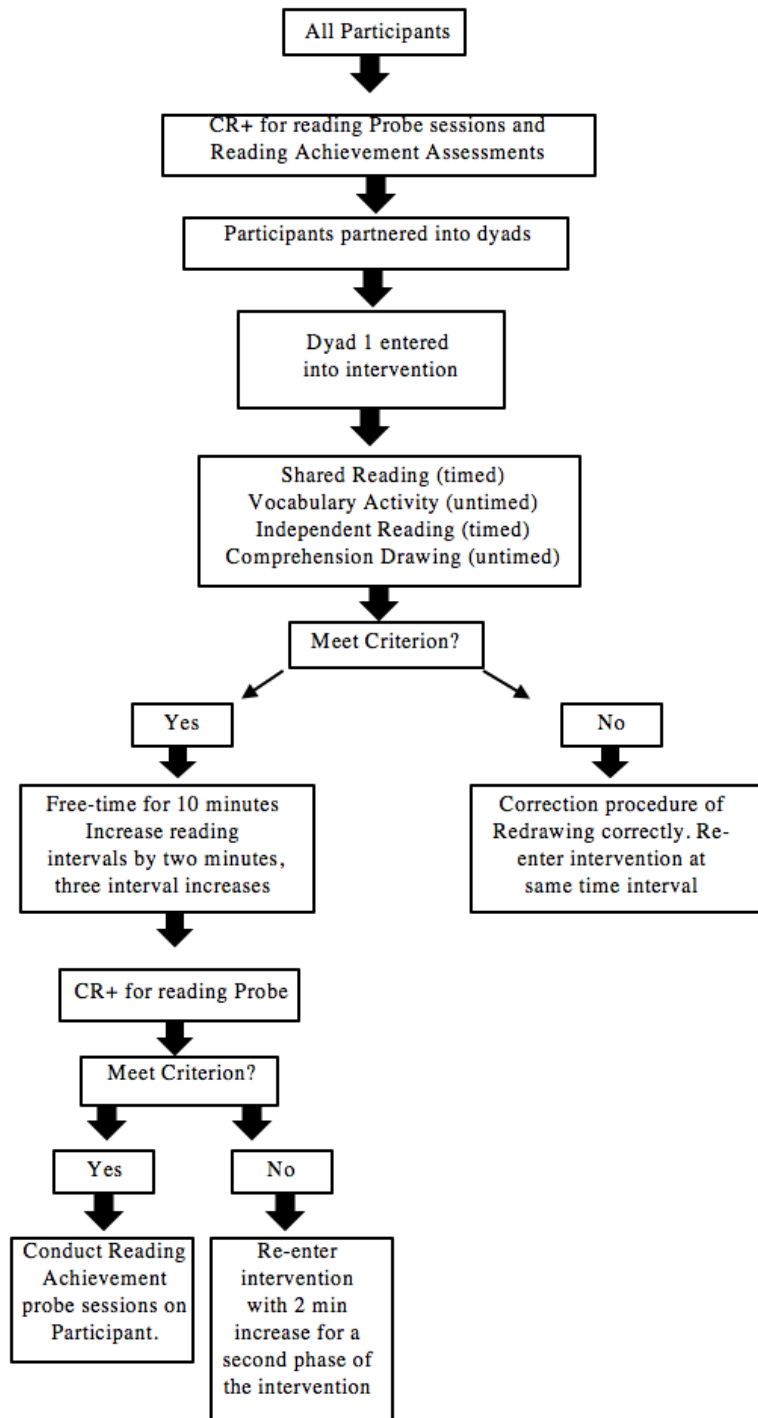


Figure 1: This is a representation of the progression of the entire experiment. This flow chart represents the participation selection and pairing procedure, pre-intervention measures, intervention steps, and post-intervention procedures.

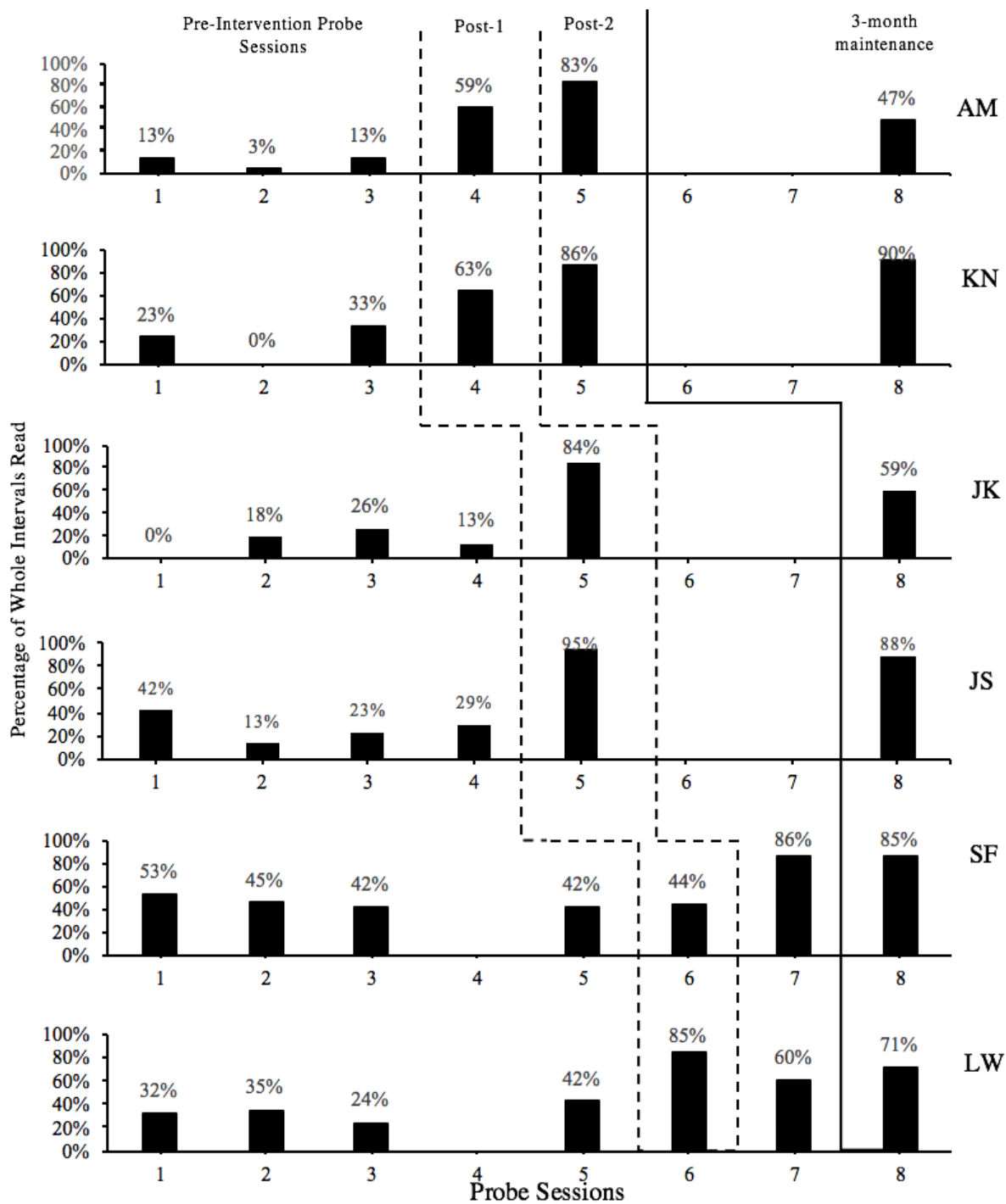


Figure 2: Twenty-min, 10-s whole interval Conditioned Reinforcement for Reading probe sessions were conducted for all 6 participants in Experiment II. Three pre-intervention probe sessions were conducted initially to determine a baseline. A fourth pre-intervention probe was conducted prior to entrance into the intervention. A post-intervention probe was conducted after the participants met 100% accuracy across three ascending phases in intervention. If the participants did not meet 80% of intervals with eye-tracking behavior across a 20-min, 10-s whole intervals, then they were entered back into the intervention.

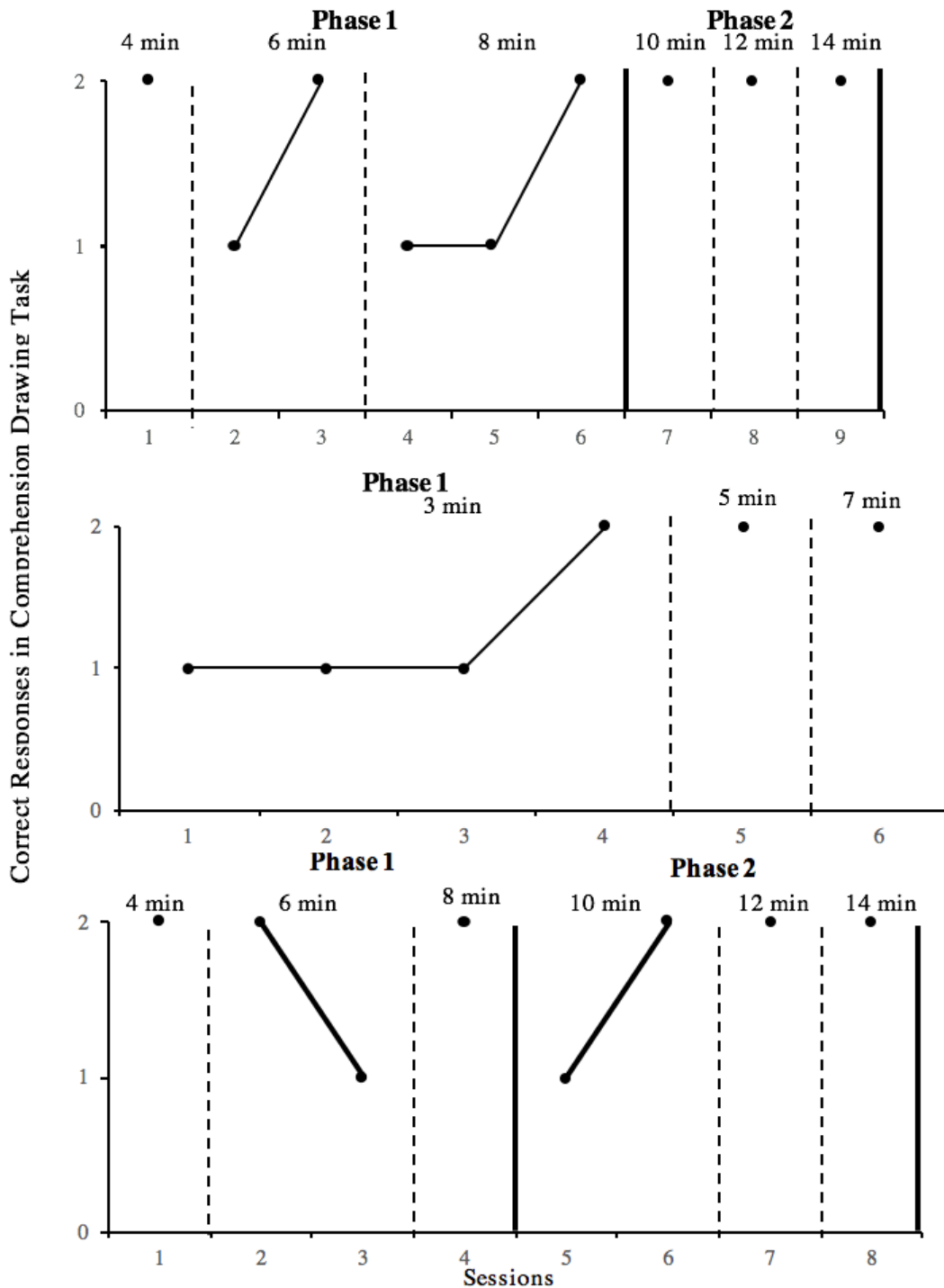


Figure 3: Intervention data for Dyad’s 1, 2, and 3 for Experiment II. The data represent Step 4 in the intervention data. The data represent the number of correctly identified paragraphs drawn in a session between the two participants in the dyad. Criterion was set at 100% accuracy across 3 ascending dyads. The solid black phase change line represents the implementation of a Conditioned Reinforcement for Reading probe. The dotted phase-change line represents increase in duration of reading time.

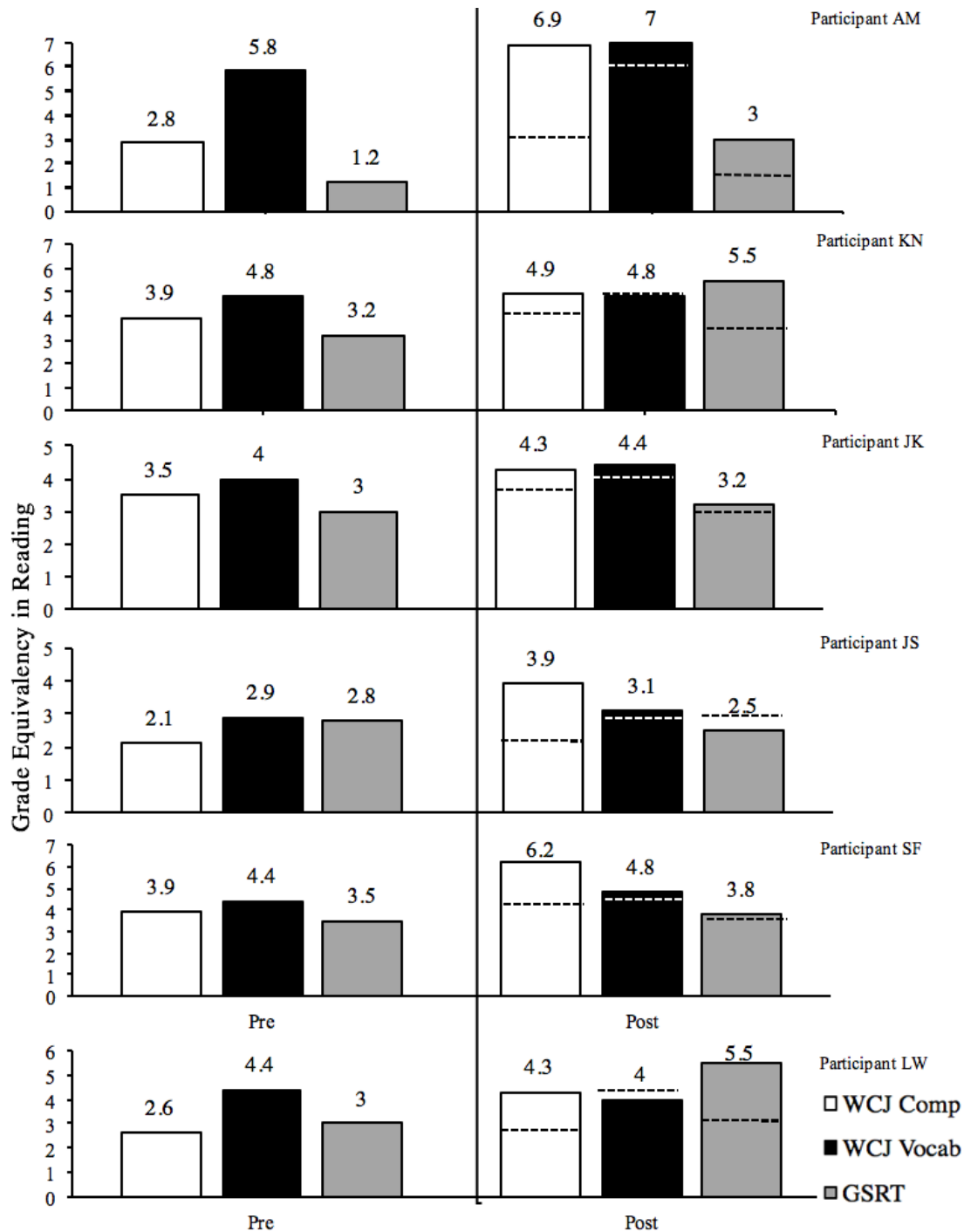


Figure 3: Pre- and post-intervention Standardized Reading Comprehension probe sessions for Experiment II. The graphs represent the grade-equivalent levels for all 6 participants. The white bar represents the Woodcock Johnson IV Diagnostic Reading Battery passage comprehension session, the black bar represents The Woodcock Johnson IV Diagnostic Reading Battery passage for vocabulary. The grey bar represents the Gray Silent Reading Tests. All data are represented in grade-level equivalencies. The dotted lines on the post-intervention graph represents the projected grade equivalent the student should be upon taking the assessment accounting for duration of time passed between pre- and post-intervention tests.

Appendix A

Book Title: _____

Chapter: _____

Pages Read: _____

Draw a picture of your favorite scene. Please look back in the text of specific details. Be sure to include as many details as possible.



Friend's Response:

I think this drawing is from page number _____ and paragraph number _____.

Is this correct or incorrect? _____

Appendix B

Name: _____

Date: _____

Pick three words you find interesting:

| | | |
|----|--------|---------------------|
| 1. | Page # | What could it mean? |
| 2. | Page # | What could it mean? |
| 3. | Page # | What could it mean? |

Appendix C

Whole Interval R+ Reading

| Student: | | Date: | | | | | | | |
|-----------------|--|--------------|--|-------|--|-------|--|-------|--|
| 0:10 | | 4:10 | | 8:10 | | 12:10 | | 16:10 | |
| 0:20 | | 4:20 | | 8:20 | | 12:20 | | 16:20 | |
| 0:30 | | 4:30 | | 8:30 | | 12:30 | | 16:30 | |
| 0:40 | | 4:40 | | 8:40 | | 12:40 | | 16:40 | |
| 0:50 | | 4:50 | | 8:50 | | 12:50 | | 16:50 | |
| 1:00 | | 5:00 | | 9:00 | | 13:00 | | 17:00 | |
| 1:10 | | 5:10 | | 9:10 | | 13:10 | | 17:10 | |
| 1:20 | | 5:20 | | 9:20 | | 13:20 | | 17:20 | |
| 1:30 | | 5:30 | | 9:30 | | 13:30 | | 17:30 | |
| 1:40 | | 5:40 | | 9:40 | | 13:40 | | 17:40 | |
| 1:50 | | 5:50 | | 9:50 | | 13:50 | | 17:50 | |
| 2:00 | | 6:00 | | 10:00 | | 14:00 | | 18:00 | |
| 2:10 | | 6:10 | | 10:10 | | 14:10 | | 18:10 | |
| 2:20 | | 6:20 | | 10:20 | | 14:20 | | 18:20 | |
| 2:30 | | 6:30 | | 10:30 | | 14:30 | | 18:30 | |
| 2:40 | | 6:40 | | 10:40 | | 14:40 | | 18:40 | |
| 2:50 | | 6:50 | | 10:50 | | 14:50 | | 18:50 | |
| 3:00 | | 7:00 | | 11:00 | | 15:00 | | 19:00 | |
| 3:10 | | 7:10 | | 11:10 | | 15:10 | | 19:10 | |
| 3:20 | | 7:20 | | 11:20 | | 15:20 | | 19:20 | |
| 3:30 | | 7:30 | | 11:30 | | 15:30 | | 19:30 | |
| 3:40 | | 7:40 | | 11:40 | | 15:40 | | 19:40 | |
| 3:50 | | 7:50 | | 11:50 | | 15:50 | | 19:50 | |
| 4:00 | | 8:00 | | 12:00 | | 16:00 | | 20:00 | |

Chapter III

STUDY II MANUSCRIPT

Abstract

We conducted a component analysis on a reading intervention used to condition reinforcement for reading (CR+ for reading) in 8 fourth-grade students. Using pre- and post-intervention measures in a simultaneous crossover treatment design, we examined the effect of the establishment of CR+ for reading on reading achievement through two treatments: Collaborative Independent Reading (CIR) or Collaborative Shared Reading (CSR). We matched participants in dyads across treatment conditions. Intervention for both groups was a 4-step, peer-contingency procedure including: (1) reading a novel either independently or shared, (2) a vocabulary activity, (3) continuation of reading either independently or shared and (4) a comprehension drawing task. We conducted post-intervention probe sessions to measure the reading achievement of both participants once one participant in the across-group dyad met the criterion of 80% for CR+ for reading across 2 consecutive 20 min probe sessions. All participants who went through the CIR group acquired CR+ for reading while the students in the CSR group did not. Participants in the CIR group made greater increases in academic achievement ($M = WJ-IV$ comp: +2, $WJ-IV$ vocab: +2.3, $GSRT$: +2.0 grade levels) than participants in CSR group whose reading assessment increases were not as significant ($M = WJ-IV$ comp: +0.5, $WJ-IV$ vocab: -0.2, $GSRT$: +0.6 grade levels). The participants in the CSR group then went through the CIR treatment and all participants acquired CR+ for reading and made significant increases academically in all three assessments.

Keywords: conditioned reinforcement for reading, interest in reading, reading achievement, reading comprehension, vocabulary

A Comparison of the Effect of Collaborative Shared Reading vs. Collaborative Independent Reading on the Reading Achievement of Fourth Grade Students

Recent reports show 63 percent of fourth graders in the United States tested at or below the *Basic* achievement level of reading. In other words, more than half of our fourth-grade students have obtained only partial mastery of fundamental reading skills (U.S. Department of Education, 2017). Furthermore, the country's ranking dropped from fifth in the world in 2011 to 13th in 2016 (U.S. Department of Education, 2017). Results from the Progress in International Reading Literacy Study (PIRLS) indicated that fourth-grade students in the United States ranked 15th out of the 58 countries participating (Warner-Griffin, Liu, Tadler, Herget, & Dalton, 2017). Educators and scientists alike have researched and implemented interventions to help increase reading achievement within the United States for struggling learners, students with and without learning disabilities, and students with or at risk of behavioral disorders (Benner, Nelson, Ralston, & Mooney, 2010; Foorman & Torgesen, 2002).

A strong argument for reading motivation as an indicator in reading achievement exists amongst educators and scientists studying and developing reading interventions (Baker & Wigfield, 1990; McKenna & Kear, 1990; Sweet, Guthrie & Ng, 1998; Wigfield & Guthrie, 1997a). A large body of research has been dedicated to studying the effects of motivation for reading on reading achievement. There is strong correlational evidence suggesting the amount of time a student spends reading predicts reading achievement and general knowledge (Cox & Guthrie, 2001; Guthrie, Wigfield, Metsala, & Cox, 1999; Kim, Wagner, & Foster, 2011;). De Naeghel, Keer, Vanteenkiste, and Rosseel (2012) discussed the relationships existing among reading motivation, reading behavior, and reading performance. Their research demonstrated that if a student is motivated to read, the behavior of reading increases. As the frequency of reading

increases, reading achievement is likely to increase as a result. Wigfield and Guthrie (1997a) state breadth and depth of reading, as well as frequency of reading, correlate significantly with reading achievement. Moreover, motivation in reading predicts students' growth in comprehension over time (Guthrie, McCrae, and Klauda, 2007).

Although many studies identifying the strong correlation between reading motivation and reading achievement, few studies have implemented interventions specifically designed to increase motivation for reading (Guthrie, McCrae, & Klauda, 2007; Wigfield et al., 2008;). The *Concept-Oriented Reading Instruction* (CORI) is an example of a multi-component intervention linking reading fiction and non-fiction books to science activities (Guthrie, Wigfield, and Vonsecker, 2000) and is intended to target motivational processes to increase motivation for reading. These motivational processes are self-efficacy and mastery of goals, perceived autonomy, and collaborative work using peers to facilitate learning (Guthrie et al., 2007a). This multi-component intervention improves reading strategy use, motivation for reading, and achievement (Guthrie et al., 2007a; Guthrie et al., 2007b; Klauda, & Guthrie, 2008).

Interventions aimed at increasing reading motivation should focus on enhancing autonomous reasons for reading (De Naeghel et al., 2012). Autonomous reading motivation leads to greater qualitative reading and therefore greater reading performance (De Naeghel et al., 2012). To become an autonomous reader, a person must acquire interest in reading, as interest is a motivational construct that has been described as a personal investment with a stimulus (Alexander & Murphy, 1998). To develop an interest in reading, a person must find a reinforcement value in what is being read (Bly & Greer, 2019; Gentilini & Greer, 2019; Cumiskey Moore, 2017). Conditioned reinforcement for a stimulus increases the likelihood that an individual will interact with that stimulus in the future (Greer, 1983; Skinner, 1969; Skinner,

1953). Therefore, to become an autonomous reader, a person must acquire conditioned reinforcement (CR+) for reading.

Using the Comprehensive Application of Behavior Analysis to Schooling® (CABAS®) model (Singer-Dudek, Speckman, & Nuzzolo, 2010) and principles of behavior analysis, we have developed a peer-collaborative reading intervention in our laboratory to increase reinforcement value for reading (CR+ for reading). Cumiskey Moore (2017) used a peer-collaborative multicomponent intervention procedure with four fifth-grade students to test the effects of increased level of CR+ for reading on reading achievement outcomes for students who were above grade level for reading. The multicomponent procedure of the intervention included: 1) an oral reading period (i.e. the participants traded reading paragraphs aloud) 2) a collaborative vocabulary activity 3) a silent reading period (i.e. the participants read from the same book silently), 4) a comprehension drawing task. In all three of the studies, the participants engaged in both silent and oral reading. Gentilini and Greer (2019) tested the same multicomponent reading procedure using a teacher-student collaboration with second grade students. Findings of Bly and Greer (2019) extended the results of Cumiskey Moore by using fourth grade students who were on or slightly below reading level for reading. We implemented the same multicomponent procedure to increase reinforcement value for reading as measured by a 20-min reading probe sessions; we measured eye-tracking for 10-s whole intervals. All three studies indicated the establishment of CR+ for reading also increased reading comprehension scores significantly across grade levels in a short amount of time.

A large body of research has been dedicated to identifying the importance and impact of silent and oral reading on reading comprehension (Fuchs, Fuchs, Hosp, & Jenkins, 2001; Jenkins, & Jewell, 1993; Prior & Welling, 2001; Schimmel & Ness, 1997). Within this literature,

three hypotheses have been established: 1) comprehension performances are similar in the two modes, 2) comprehension is greater in oral reading, or 3) comprehension is greater in silent reading (Trainin, Hiebert, & Wilson, 2015; Schimmel & Ness, 2017; Prior et al., 2011; Prior & Welling, 2001). Some researchers have found students who engage in oral reading have higher comprehension scores than silent readers and this mode seems to benefit poor readers (Schimmel & Ness, 2017; Fuchs, et al., 2001), while others show a positive impact of silent reading as the focus of the student tends to be less on decoding aloud and more on comprehension (Schimmel & Ness, 2017; Trainin et al., 2005; Chall, Jacobs, & Baldwin, 1990). Many researchers agree that comprehension ability, in either mode of reading, depends on the level of the reader (Kim et. al., 2011; Prior, et al., 2011; Prior & Welling, 2001).

Juel and Holmes (1981) extend this logic by saying poor readers have poor comprehension in both modes while strong readers have strong comprehension in both modes. In addition to these conflicting views regarding comprehension and modes of reading, there is evidence to suggest the importance and benefit for students receiving instruction in guided silent reading in addition to oral reading, to develop reading fluency and comprehension (Kuhn et al., 2006; Reutzel, Fawson, & Smith, 2008; Vadasy & Sanders, 2008). Even though the relations between silent and oral reading on comprehension have been studied extensively, few, if any have examined the effect of increasing reinforcement for reading through silent (independent) or oral (shared) components and the impact it has on reading achievement. Even fewer studies have examined the impact of a peer collaborative intervention using silent and oral modes of reading. In our first study (Bly & Greer, 2019) we combined silent and oral reading components with a peer collaborative intervention. Because the procedure was a peer collaborative procedure, we used the terms independent instead of silent, and shared instead of oral.

We extended the findings of Cumiskey Moore's pilot study (2017) and tested the effects of establishing conditioned reinforcement for reading (CR+ for reading) on reading achievement scores. Six participants, on or slightly below reading level, were paired into treatment dyads. A four step, peer-yoked contingency intervention was used to establish CR+ for reading at 80% of 120, 10s whole intervals. We found that participants who acquired CR+ for reading at 80% or greater through this intervention also increased in reading achievement scores as measured by the *Woodcock Johnson-IV Diagnostic Reading Battery (WJ-IV)* subtests 4, 17a, and 17b (Schrank, Mather, & Woodcock, 2004), and the *Gray Silent Reading Tests* (Wiederholt, & Blalock, 2000).

The purpose of the present study was to correct the limitations in Experiment II of Bly and Greer (2019) and to conduct a component analysis on the independent and shared reading components of the original intervention used to increase reinforcement value for reading. We controlled for extraneous variables by using a simultaneous treatment crossover design with pre- and postintervention measures. To further replicate and extend the findings, we used participants who were similar to those used in Cumiskey Moore's pilot study (2017). We selected participants who were on or above grade level for reading. The research questions of the experiment were as followed: 1) When conditioned reinforcement for reading is established, are increases in reading comprehension observed? 2) What impact does the independent reading vs shared reading component of the original intervention have on conditioning reading as a reinforcer? 3) What is the overall effect of both components on reading achievement?

Method

Participants. Participants included eight students (seven males) with a mean age of 9.3 years ($SD = .32$ years). We recruited the participants from a fourth-grade elementary school

classroom. This Title I school included grades three through five and was in a suburban city in the northeast United States. We selected these participants for the experiment because a preference for reading or conditioned reinforcement value for reading (CR+ for reading) was not demonstrated across two to three 20-min reading probe sessions at 80% or higher of 10 s whole intervals read. All eight participants were in fourth grade and functioned on or above-grade level in reading based on the *Developmental Reading Assessment, Second Edition*[®] (DRA-2[®]; Pearson Education, 2006) We paired each participant with a partner who had similar academic reading levels and CR+ for reading levels. We then randomly assigned the pair to one of two reading groups. In the first group, the participants received the Collaborative Independent Reading (CIR) treatment. In the second group, the participants received the Collaborative Shared Reading (CSR) treatment. Within these treatment conditions, each participant was paired with a different partner who had similar reading scores and CR+ for reading levels to complete the reading intervention. The experimenters stopped reading instruction within the classroom with the eight participants until the intervention was completed (Table 1; Figure 1).

Setting. We conducted all intervention sessions in the classroom within the school setting during regularly scheduled instructional reading periods. All pre- and post-intervention assessments were conducted in a class-wide setting within the classroom. We conducted pre- and post-intervention comprehension probe sessions 1:1 within the classroom in a quiet corner of the room during independent working time within the classroom schedule. We conducted all intervention sessions with each participant or dyad independently within the classroom. Teachers conducted regular instruction with the rest of the class in small groups within the classroom but did not conduct regular reading instruction with any of the participants through the duration of the experiment. The experimenters supervised or recorded each intervention session to ensure no

interruptions or disruptions were experienced and the sessions were completed with fidelity by the participants.

Dependent Variable: Measures of reading achievement. The dependent variables of this study were the measures of three reading comprehension assessments, which were the same measures used the study conducted by Bly and Greer (2019). The participants completed three different assessments prior to and following intervention to determine grade-equivalent reading comprehension scores through the *Woodcock Johnson IV Diagnostic Reading Battery Test (WJ-IV)*, and the *Gray Silent Reading Tests (GSRT)*. We used Form A of both the *WJ-IV* and *GSRT* in the preintervention assessments and Form B of both the *WJ-IV* and *GSRT* in the postintervention assessments. For the participants who underwent a crossover of treatment, we utilized Form A for the second postintervention measure.

Independent Variable: Establishment of conditioned reinforcement value for reading. The independent variable was the establishment of conditioned reinforcement for reading (CR+ for reading). We conducted the intervention to condition reading as a reinforcer with the same multicomponent procedure outlined in Experiment II conducted by Bly and Greer (2019). However, the participants were exposed to one of two treatments in the procedure separating the components of the intervention: independent or shared reading (i.e. the CIR treatment or the CSR treatment). The experimenters referred to both treatments as “The Reading Game” with the participants. Each participant in the experiment was yoked (Davies Lackey, 2005) with a participant in the opposite treatment. For example, Participant JC completed the CIR intervention with Participant F, but was yoked with Participant R who was in the CSR intervention completing intervention with Participant C. Whichever participant in the dyad met criterion for CR+ for reading first stopped intervention for both participants. The experimenter

then conducted postintervention reading achievement tests with both participants in the dyad (Figure 1). If the participant did not meet criterion for CR+ for reading (80% of 10s whole intervals read during two 20-min probe sessions), they underwent a crossover treatment of the other treatment condition. Once CR+ for reading was established, we conducted a second round of postintervention reading achievement measures.

Conditioned Reinforcement for Reading, CR+ for reading. CR+ for reading probe sessions were conducted in the classroom during a silent reading period. The teachers instructed the students to pick a novel to read. The students were only allowed to read literary novels (e.g., no graphic novels, picture books, or non-fiction picture books). The novels could have pictures in them, but could not be picture-based. The participants were either observed in situ or using a video camera. The experimenters started a stopwatch and observed the students' eyes move across the page from left to right and then back to the far left of the page to measure reading. Every 10s the experimenter indicated if the student was reading by marking a plus if the student's eyes tracked across the page for the entire 10s. If the students' eyes were not tracking at any point during the 10s intervals, the experimenter indicated this by marking a minus on the data sheet. At the end of the 20-min reading period, the experimenter calculated the percentage of intervals spent reading by adding the total intervals spent reading and dividing that number by the total number of intervals (120). If the participant read for 80% or more of the intervals, we considered them to have CR+ for reading. This criterion of between 70%-80% has been the standard for conditioned reinforcement for books, textual stimuli, and other stimuli (Cumiskey Moore, 2017; Bly & Greer, 2019; Gentilini & Greer, 2019; Nuzzolo-Gomez, Lenard, Ortiz, Rivera, & Greer, 2002; Tsai & Greer, 2006).

Collaborative Independent Reading Treatment, CIR. In the CIR treatment, the steps of the procedure were as follow: 1) the partnered participants independently read from the same novel for the average time both participants spent reading during the CR+ for reading probe, 2) upon completion of the independent reading time, the participants chose three novel words from the pages read and defined the words on a piece of paper. The participants then traded papers to determine accuracy of each other's definitions. This section was not consequence or timed but took, on average 5 minutes to complete. 3) The participants started the timer for the same number of minutes read in Step 1 and read independently starting where the slower reader left off. 4) Upon completion of the second independent reading time, the participants chose a scene to draw from the pages they both read. Once they were finished drawing, the participants traded papers, closed their books, and identified the scene that was drawn by their partner. If both participants identified the correct scene drawn by their partner, they were given 10 minutes of free-time in the classroom and the next time they entered the intervention, the time interval for Steps 1 and 3 was increased by two minutes. If one or both participants identified an incorrect scene from the drawing, the participant who drew the picture had to re-draw the picture or add more to the drawing until the partner guessed the correct scene. The participants did not receive free-time and repeated the intervention at the same time interval until both participants identified the correct drawing. After three increases in time, the participants underwent a 20-min CR+ for reading probe session. If the participants increased to at least 80% of intervals read, a second probe was conducted to determine stability in responding. If fewer than 80% of intervals spent reading was observed, the participants re-entered intervention with the time intervals for Steps 1 and 3 increasing by 2-min. When a participant met criterion of 80% of intervals spent reading across two consecutive CR+ for reading probe sessions, the participant and the paired participant

in the other treatment condition, the experimenter assessed dependent measures to determine if an increase in reading achievement was made (Figure 1).

Collaborative Shared Reading Treatment, CIR. The steps for intervention were identical to CSR treatment except for Step 1 and Step 3. Instead of the participants reading independently, they engaged in shared reading, which was identified as partners in the intervention reading aloud from the same book, while trading paragraphs to read. All other components and procedures were the same as the CIR treatment in terms of criterion and probe measures (Figure 1).

Crossover Treatment. The participants who did not meet criterion for CR+ for reading through the CSR treatment underwent a crossover condition. That is, all participants in the CSR treatment were exposed to the CIR treatment after initial postintervention assessments were conducted. We conducted post assessment reading achievement measures once participants met criterion for CR+ for reading at 80% of 10 s whole intervals read across two 20-min probe sessions (Figure 2).

Design. The design of the experiment was a simultaneous treatment with a crossover design (Browning, 1967; Tinmouth & Hebert, 2007) with pre- and postintervention test measures. All participants underwent preintervention reading achievement assessments at the same time and started intervention simultaneously. Whichever participant in a dyad acquired CR+ for reading first stopped intervention for the other participant. The experimenters then conducted postintervention reading assessments for both participants to measure the reading achievement outcomes. The classroom teachers served as the experimenters and the assistants in the classroom served as a second observers. The participants who did not meet criterion for CR+ for reading through the CSR treatment underwent a crossover condition. That is, all participants

in the CSR treatment were exposed to the CIR treatment after initial postintervention assessments were conducted. We conducted post assessment reading achievement measures once participants met criterion for CR+ for reading at 80% of 10 s whole intervals read across two 20-min probe sessions (Figure 2). The crossover occurred for Participants, R, C, J, and E.

Procedure. At the beginning of the experiment, the experimenters conducted CR+ for reading probe sessions for each participant. The experimenter conducted CR+ for reading probe sessions in the classroom either in situ or through video recording during a designated silent reading period. The participants selected a book and the experimenter instructed the class to read silently. We conducted the two to three CR+ for reading probe sessions to establish a steady state of responding for each participant in the study. All participants in the study did not have CR+ for reading as they all had fewer than 80% on the CR+ for reading probe sessions prior to entering the intervention.

Each participant simultaneously underwent the intervention in the treatment as outlined above. All participants were yoked into a dyad with a participant in the opposite treatment condition and were also grouped with a participant within their treatment condition. As an intervention group met criterion for the intervention (three, 2-min time increases) a CR+ for reading probe session was conducted. If one partner in the reading intervention treatment group met criterion, but the other did not, we conducted the postintervention reading achievement tests for the participant who met but did not give the postintervention reading assessments to the participant in the reading intervention until either they, or their partner in the opposite treatment condition met. In other words, participants underwent postintervention reading achievement tests only when they or their yoked partner in the opposite treatment condition met criterion for CR+ for reading. If CR+ for reading of 80% across two consecutive probe sessions was acquired by

one of the participants in the across treatment yoked dyad but not the other, the experimenter stopped intervention for both participants and conducted postintervention tests (*WJ-IV* and *GSRT*).

We conducted a crossover treatment condition for participants who did not acquire CR+ for reading through the CSR treatment condition. Upon acquiring CR+ for reading at 80% or higher across two consecutive reading probes, we conducted a second session of postintervention tests using Forms B for *WJ-IV* and *GSRT* (Figure 1).

Interobserver agreement. We calculated interobserver agreement by dividing the number of point-to-point agreements by the total number of agreements and disagreements, and multiplying the quotient by 100. We obtained 100% agreement for 100% of all reading achievement assessments include *WJ-IV* subtests 4 and 17a, and 17b, and *GSRT*. We obtained agreement for 100% of the CIR and CSR interventions with 100% agreement across all dyads. IOA was calculated for 62% of the CR+ for reading probe sessions with a mean agreement of 86% across all dyads (62%-100%). CR+ for reading probe sessions were conducted both in-situ (26%) and through video recording (72%) (Table 3).

Results

Establishment of Conditioned Reinforcement for Reading. Prior to entering the intervention, none of the participants had conditioned reinforcement for reading (an average of 80% of 10-s whole intervals across 20-min probe sessions). CR+ for reading was established with Participant JC and F in the CIR treatment, but their respective partners, R and C did not acquire CR+ for reading across two phases of the intervention. Similarly, Participants T and D, also of the CIR treatment met criterion for CR+ for reading but their yoked partners, Participants J, and E of the CSR treatment, did not meet criterion for CR+ for reading (Figure 4). Both

treatment groups started with a similar mean across all participants (i.e. CIR was 39% and CSR was 40%). The CIR treatment group increased to a mean of 86% (18 to 58%) postintervention and CSR treatment group increased to a mean of 60% (47 to 71%) postintervention (Figure 5).

When we conducted the crossover treatment on Participants R, C, J, and E in the CSR treatment group, we saw a mean increase of 27% (17 to 41%) in CR+ for reading after only one phase. The participants in the crossover treatment increased from a mean of 60% (in the post CSR treatment probe sessions to a mean of 87% (84 to 88%) in the CIR treatment post probe sessions (Figure 5; Figure 6).

Reading Achievement Scores. Table 6 shows that Participant JC, F, T, and J had greater increases in reading achievement postintervention scores than their partners, R, C, J, and E. The participants who acquired CR+ for reading through the CIR intervention had greater increases in postintervention reading achievement scores. The participants who did not acquire CR+ for reading through the CSR treatment had lower overall increases, with Participants C decreasing in *WJ-IV* comp and vocabulary (Figure 7). A mean increase in grade equivalency for *WJ-IV* comp for participants in the CIR treatment was 2.0 (1.2 to 3.2) grade levels as opposed to participants in the CSR intervention where a mean increase of 0.5 (-1.0 to 2.1) grade levels was observed. A mean increase for *WJ-IV* vocabulary was 2.3 (0.4 to 45.) grade levels in the CIR treatment, and a decrease of 0.2 (-0.9 to 0) for participants in the CSR treatment. A mean increase for *GSRT* was 2.0 (-1.2 to 4.3) grade levels for participants in the CIR treatment and +0.6 (-0.3 to 1.2) grade levels for participants in the CSR treatment (Table 9; Figure 8).

Table 7 shows that participants who underwent the crossover treatment also had increases postintervention. We calculated these increases by subtracting the initial preintervention grade equivalency score from the final post crossover grade level equivalency score. For the *WJ-IV*

comprehension we observed a mean increase of 1.0 (0.6 to 2.2) grade levels. For the *WJ-IV* vocabulary, we observed a mean increase of 2.3 (0.8 to 4.3) grade levels. For the *GSRT*, we observed a mean increase of 0.5 (-0.5 to 2.7) grade levels (Figure 8; Figure 9).

Progression through intervention. Table 4 shows participants in the CIR treatment group all required only one phase of the intervention to acquire CR+ for reading. In seven sessions and with a total of 162 min Participants JC and F met CR+ for reading. Participants T and D spent 4 sessions and 96 min in the intervention before meeting CR+ for reading criterion. In the CSR treatment, Participants R and C had 9 sessions and a total of 274 min in the intervention and did not meet CR+ for reading criterion. Similarly, Participants J and E underwent 5 sessions and spent 118 min in the intervention and did not meet criterion for CR+ for reading (Figure 3).

Discussion

The experimental questions guiding this study were: 1) Could the results of Bly & Greer (2019) be replicated with students on grade level for reading when the limitations of the experimental design are corrected? 2) What impact does the independent reading vs shared reading component of the original intervention have conditioning reading as a reinforcer? 3) What is the overall effect of either component on reading achievement?

The results of this study replicate the findings of Bly and Greer (2019), Gentilini and Greer (2019) and Cumiskey Moore's pilot study (2017) indicating the establishment of CR+ for reading is effective in increasing reading achievement scores for fourth grade students. Upon correcting the limitation of the dependent variables in the study conducted by Bly and Greer, we continued to observe significant increases in grade equivalencies for all four participants who acquired CR+ for reading (Figure 7).

The results suggest that when participants were only exposed to the independent reading component of the original intervention, it was more effective at increasing reinforcement value for reading than the shared reading component (Bly & Greer, 2019; Gentilini & Greer, 2019; Cumiskey Moore, 2017). In addition, all four participants in the CIR intervention increased in CR+ for reading at or above 80% criterion in only one phase of the intervention. Although some increases were observed in CR+ for reading level for three participants in the CSR treatment, none of the participants reached the criterion level of 80% after only one phase of the intervention. Additionally, Participants R and C completed two phases of the CIR intervention and minimal increases in CR+ for reading were observed. This suggests that even when participants had more exposure to the CSR treatment, they did not increase CR+ for reading probe sessions. It also suggests the CIR treatment condition was faster at conditioning reading as a reinforcer.

Furthermore, all four participants in the CIR treatment condition had significant increases in reading achievement overall. The only exception was Participant F who decreased 1.2 for the *GSRT*. Mean increases in reading achievement were significantly higher for participants in the CIR treatment. Mean increases in reading achievement were significantly lower for participants in the CSR treatment. These results suggest the silent reading is an important component of the intervention to increase not only CR+ for reading, but also reading achievement scores.

Limitations and Future Studies. It is important to note several limitations for this study. The first limitation is the CR+ for the reading probe and was discussed as a limitation in other studies using the same procedure (Bly & Greer, 2019; Gentilini & Greer, 2019; Cumiskey Moore, 2017). It is difficult to observe eye-movement while also controlling for observer effect. The participants may have read more, or not read due to the experimenter watching in person.

The use of a video camera decreases the observer effect but is not always accurate if a participant moves out of frame or puts their head down when reading. Future studies should implement a better way of measuring eye movement. If cameras are strategically placed, these limitations are eliminated. One way this could be done is by using a webcam. The participant could select an eBook from an online library and the participant would read while the camera is recording.

Another limitation occurred due to the nature of conducting research within a public elementary school setting. We had 3 different snow days interrupting the progression of the intervention. Several of the participants were out for different reasons due to illness, vacation, and injury. Participant JC sustained a concussion outside of school hours and missed a week of school. We continued conducting sessions with Participant R and C instead of waiting for JC to return to school. This resulted in increased pairing sessions for Participants R and C. Likewise, Participant E was out for a week due to a cheer competition. These are difficult variables to control for and may impact elements of the study.

Another limitation of the study is that we did not control for the number of sessions each participant completed. Due to the correction procedure of the intervention, it was difficult for each participant to receive the same number of intervention sessions at the same time interval. That is why we waited for participants to meet criterion of the phase (i.e. three increases in 2-min intervals) before conducting CR+ for reading. We did conduct all CR+ for reading probe sessions at the same time within the classroom.

Future studies should focus on a component analysis of the collaborative features of the intervention. In the present study, the only components manipulated were the independent and reading components. A future study might compare the CIR treatment with either vocabulary or

comprehension drawing task. There are many future studies that can be conducted to test the different components of the intervention and the effects these components have on the outcomes.

Future studies should focus on testing the intervention with struggling readers. Gentilini and Greer (2019) observed increases in reading achievement and reinforcement value for reading with struggling readers in second grade; future research should identify if the current procedure has the same effects on older, struggling learner students. Researchers suggest struggling readers benefit from oral mode of reading to improve comprehension.

Implications. We found that independent reading is important for increasing not only reinforcement for reading, but also reading achievement. We demonstrated this through a simultaneous treatment design where students were exposed to one of two treatments: Collaborative Silent Reading or Collaborative Shared Reading. Such reading interventions using components of peer-collaboration and silent reading should be implemented in classrooms nationwide. All participants met criterion of CR+ for reading in only one phase of the intervention. When we conducted a crossover on the participants who did not meet CR+ for reading after the CSR treatment, they too met criterion of CR+ for reading in only one phase. This very simple, and very concise intervention could greatly benefit students and educators alike.

Another implication is the importance for independent silent reading time in schools. Trainin et al (2015) emphasize the importance of silent reading during reading instruction. Students who engage in silent reading read at a faster pace and therefore contact a higher number of words. Because of this, more comprehension occurs. Although fewer words may be comprehended during silent reading measures (55% as opposed to 59%), more words are read (3,060 as opposed to 2,149 in oral reading) during a 20-min reading period (McCallum et al.,

2004). Because we know CR+ for reading and reading achievement can be increased through a peer collaborative reading intervention, considering these implications is critical when developing new curricula and interventions for children.

References

- Alexander, P. A., & Murphy, P. K. (1998). Profiling the differences in students' knowledge, interest and recall: assessing a model of domain learning. *Journal of Educational Psychology, 87*, 559-575.
- Baker, L., & Wigfield, A. (1990). Dimensions of children's motivation for reading and their relations to reading activity and reading achievement. *Reading Research Quarterly, 34*, 452-477.
- Benner, G. J., Nelson, J. R., Ralston, N. C., Mooney, P. (2010). A meta-analysis of the effects of reading instruction on the reading skills of students with or at risk of behavioral disorders. *Behavioral Disorders, 35*, 86-102.
- Bly, B. D., & Greer, R. D. (2019). *The result of enhancing the value of reading on reading achievement in fourth graders*. Manuscript in preparation.
- Browning, R. M., (1967). A same-subject design for simultaneous comparison of three reinforcement contingencies. *Behaviour Research & Therapy, 5*, 237-243.
- Chall, J. S., Jacobs, V. A., & Baldwin, L. E. (1990). *The reading crisis: Why poor children fall behind*. Cambridge, MA: Harvard University Press.
- Cox, K. E., & Guthrie, J. T. (2001). Motivational and cognitive contributions to students' amount of reading. *Contemporary Educational Psychology, 26*, 116-131. doi:10.1006/ceps.1999.1044
- Cumiskey Moore, C. (2017). *The effects of conditioned reinforcement for reading on reading comprehension for 5th graders*. (Unpublished doctoral dissertation). Columbia University, New York.
- De Naeghel, J., Keer, H. V., Vansteenkiste, M., & Rosseel, Y. (2012). The relation between elementary students' recreational and academic reading motivation, reading frequency, engagement and comprehension: A self-determination theory perspective. *Journal of Educational Psychology, 104*, 1006-1021. doi: 10.1037/a0027800
- Foorman, B. R., & Torgesen, J. (2002). Critical elements of classroom and small-group instruction promote reading success in all children. *Learning Disabilities Research & Practice, 16*, 183-258.
- Fuchs, L. S., Fuchs, D., Hosp, M. K., & Jenkins, J. R. (2001). Oral reading fluency as an indicator of reading competence: A theoretical, empirical, and historical analysis. *Scientific Studies of Reading, 5*, 239-256.
- Gentilini, L. M., & Greer, R. D. (2019). *Establishment of a high interest in reading and effects on reading achievement for early-elementary students*. Manuscript in preparation.

- Guthrie, J. T., Wigfield, A., Metsala, J. L., Cox, K. E. (1999). Motivational and cognitive predictors of text comprehension and reading amount. *Scientific Studies of Reading, 3*, 231-256. doi: 10.1207/s1532799xssr0303_3
- Guthrie, J. T., Wigfield, A., & Vonsecker, C. (2000). Effects of integrated instruction on motivation and strategy use in reading. *Journal of Educational Psychology, 92* (2), 331-341.
- Guthrie, J. T., McCrae, A., & Klauda, S. L. (2007a). Contributions of concept-oriented reading instruction to knowledge about interventions for motivations in reading. *Educational Psychologist, 42*, 237-250.
- Guthrie, J. T., Hoa, A. L.W., Wigfield, A., Tonks, S. M., Humenick, N. M., Littles, E. (2007b). Reading motivation and reading comprehension growth in the later elementary years. *Contemporary Educational Psychology, 32*, 282-313.
- Greer, R. D. (1983). Contingencies of the science and technology of teaching and pre behavioristic research practices in education. *Educational Researcher, 12*(1), 3-9.
- Jenkins, J. R., & Jewell, M. (1993). Examining the validity of two measures for formative teaching: Reading aloud and maze. *Exceptional Children, 59*, 421-432.
- Kim, Y.S., Wagner, R. K., & Foster, E. (2011). Relations among oral reading fluency, silent reading fluency, and reading comprehension: A latent variable study of first-grade readers. *Sci Stud Read, 15*, 338-362. doi: 10.1080/10888438.2010.493964
- Klauda S. L., Guthrie, J. T. (2008). Relationships of three components of reading fluency to reading comprehension. *Journal of Educational Psychology, 100*, 310-321.
- Kuhn, M. R., Schwanenflugel, P.J., Morris, R. D., Morrow, L. M., Woo, D. G., Meisinger, E. B., Sevcik, R. A., Bradley, B. A., Stahl, S. A. (2006). Teaching children to be fluent and automatic readers. *Journal of Literacy Research, 38*, 357-387.
- McCallum, R. S., Sharp, S., Bell, S. M., & George, T. (2004). Silent versus oral reading comprehension and efficiency. *Psychology in the schools, 41*, 241-246.
- McKenna, M. C., & Kear, D. J. (1990). Measuring attitude toward reading: A new tool for teachers. *The Reading Teacher, 43*, 626-639. doi: 10.1598/RT.43.8.3
- Nuzzolo-Gomez, R., Leonard, M., Rivera, C. M. & Greer, R. D. (2002). Teaching children with Autism to prefer books or toys over stereotypy or passivity. *Journal of Positive Behavior Interventions, 4*, 80-87.
- Pearson Education (2006). *Developmental Reading Assessment, Second Edition*[®] (DRA-2[®]). New York, NY.

- Prior, S. M., Fenwick, K. D., Saunders, K. S., Ouellette, R., O'Quinn, C., & Harvey, S. (2011). Comprehension after oral and silent reading: Does grade level matter? *Literary Research and Instruction, 50*, 183-194.
- Prior, S. M., & Welling, K. A. (2001). "Read in your head": A Vygotskian analysis of the transition from oral to silent reading. *Reading Psychology, 22*, 1-15.
- Reutzel, D. R., Fawson, P. C., Smith, J. A. (2008). Reconsidering silent sustain reading (SSR): An exploratory study of scaffolded silent reading (ScRC). *Journal of Educational Research, 102*, 37-50.
- Schimmel, N., & Ness, M. (2017). The effects of oral and silent reading on reading comprehension. *Reading Psychology, 38*, 390-416. doi: 10.1080/02702711.2016.1278416
- Schrank, F. A., Mather, N., & McGrew, K. S. (2014). Woodcock-Johnson IV tests of achievement. *Rolling Meadows, IL: Riverside*.
- Singer-Dudek, J., Speckman, J., & Nuzzolo, R. (2010). A comparative analysis of the CABAS® model of education at the Fred S. Keller School: A twenty-year review. *The Behavior Analyst Today, 11*, 253-264. <http://dx.doi.org/10.1037/h0100705>
- Skinner B.F. (1969). *Contingencies of reinforcement: A theoretical analysis*. New York: Appleton-Century-Crofts.
- Skinner, B. F. (1953). *Science and human behavior*. New York, NY: Macmillan.
- Sweet, A. P., Guthrie, J. T., & Ng, M. (1998). Teacher perceptions and student reading motivation. *Journal of Educational Psychology, 90*, 210-224.
- Tinmouth, A., & Hebert, P. (2007). Intervention trials: an overview of design alternatives, *Transfusion, 47*, 565-567.
- Trainin, G., Hiebert, E. A., Wilson, K. M. (2015) A comparison of reading rates, comprehension, and stamina in oral and silent reading of fourth-grade students. *Reading Psychology, 36*, 595-626.
- Tsai, H. & Greer, R. D. (2006). Conditioned preference for books and faster acquisition of textual responses by preschool children. *Journal of Early and Intensive Behavioral Interventions, 3*, 35-60.
- U.S. Department of Education. (2017). *National Reading Performance Report*. Institute of Education Sciences, National Center for Education Statistics. Retrieved from https://nces.ed.gov/programs/coe/pdf/coe_cnb.pdf.
- Vadasy, P. F., Sasnders, E. A. (2008). Repeated reading intervention: Outcomes and interactions

- with readers' skills and classroom instruction. *Journal of Educational Psychology*, *100*, 272-290.
- Warner-Griffin, C., Liu, H., Tadler, C., Herget, D., & Dalton, B. (2017). *Reading achievement of U.S. fourth-grade students in an international context: First look at the progress in international reading literacy study (PIRLS) 2016 and ePIRLS 2016*. (NCES 2018-017). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved March 18, 2017 from <https://nces.ed.gov/pubsearch>.
- Wiederholt, J. L., & Blalock, G. (2000). *GSRT: Gray Silent Reading Tests*. Pro-Ed.
- Wigfield, A., & Guthrie, J. T. (1997a). Motivation for reading: individual, home, textual, and classroom perspective. *Educational Psychologist*, *32*, 57-135.
- Wigfield A., & Guthrie, J. T. (1997b). Relations of children's motivation for reading to the amount and breadth of their reading. *Journal of Educational Psychology*, *89*, 420-432.
- Wigfield, A., Guthrie, J. T., Perencevich, K. C., Taboada, A., Klauda, S. L., McRae, A., & Barbosa, P. (2008). Role of reading engagement in mediating effects of reading instruction on reading outcomes. *Psychology in the Schools*, *45*, 432-445.

Table 1

Information about Participants including age, gender, ethnicity, Academic Cusps, and Developmental Reading Assessment (DRA) levels.

| Dyad | Participant | Age (in years) | Gender | Experimental Treatment Condition | Ethnicity | Free/Reduced Lunch | DRA ^a Level | Mean CR+ Value ^b in pre-probe sessions | Classification ^c |
|------|-------------|----------------|--------|----------------------------------|------------------|--------------------|------------------------|---|-----------------------------|
| 1 | JC | 9 | M | CIR ^d | Caucasian | No | 40 | 64% | no |
| | R | 10 | M | CSR ^e | Caucasian | No | 40 | 65% | no |
| 2 | F | 10 | M | CIR | Asian | No | 40 | 28% | IEP: ADHD |
| | C | 10 | M | CSR | Caucasian | No | 40 | 51% | IEP: ADHD |
| 3 | T | 9 | M | CIR | African American | No | 40 | 29% | no |
| | J | 10 | M | CSR | Caucasian | No | 40 | 7% | IEP: Speech |
| 4 | D | 9 | M | CIR | Caucasian | No | 40 | 38% | no |
| | E | 9 | F | CSR | Caucasian | No | 40 | 38% | no |

Note. DRA = Developmental Reading Assessment; CR+ Value = percentage of 120 10-s intervals spent reading as measured by the CR+ for reading probe; CIR = Collaborative Independent Reading; CSR = Collaborative Shared Reading; IEP = Independent Education Plan; ADHD = Attention Deficit Hyperactivity Disorder

^a The Developmental Reading Assessment is used to assess participants' reading level. Upon entrance to the intervention, all participants completed the assessment to determine their reading levels. All participants entered the study reading on grade-level.

^b Participants were placed in dyads based on their DRA level and CR+ preintervention probe sessions (in percentage).

^c iReady Reading diagnostic indicated whether participants were on, <1 grade level below or >2 grade levels below. All participants were on grade level prior to entering the study.

^d Collaborative Independent Reading was the treatment condition where participants read independently while collaborating on comprehensive tasks.

^e Collaborative Shared Reading was the treatment condition where participants engaged in shared reading while collaborating on comprehensive

Table 2

Materials needed for intervention and probe sessions.

| Procedure | Materials |
|---|--|
| Conditioned Reinforcement for Reading Probe | Data sheet, timer, book |
| Woodcock Johnson® Assessment | Assessment booklet, data sheet for experimenter |
| Gray Silent Reading Tests | Assessment booklet A and B, answer sheet, answer key, grade equivalency conversion chart |
| Peer-yoked Contingency Intervention | Two copies of same book (chosen by participants), timer, intervention worksheet |

Table 3

Percentage of Interobserver Agreement for the Conditioned Reinforcement for Reading probe, Woodcock Johnson® IV Assessment, Gray Silent Reading Tests.

| Probe Type | Percent of Trials With IOA | Percent Agreement |
|---|---------------------------------------|--------------------------|
| Conditioned Reinforcement for Reading probe (eye-movement measure) | 62% | 87% |
| Probe sessions Conducted in situ (48%) | 38% | 85% |
| Probe sessions Conducted through Video (67%) | 72% | 88% |
| Collaborative Reading Procedures | 100% | 100% |
| Reading Achievement Assessments | 100% | 100% |

Table 4

Number of sessions, total minutes spent in treatment, for all participants. Pre- and postintervention measures are also displayed in this table as well as differences in grade equivalency scores after we conducted postintervention probe sessions on all participants.

| Participant | Treatment Condition | Group | Met CR+ for reading | Total Number of Sessions | Total Time (min) Spent in Treatment | Pre-Test measures | ^a Post Test Measures | ^b Difference in GE |
|-------------|---------------------|-------|---------------------|--------------------------|-------------------------------------|--|---|---|
| JC | CIR* | 1 | Yes | 7 | 162 | WJ-IV Comp: 3.9 WJ-IV Vocab: 2.6 GSRT: 3.5 | WJ-IV Comp: 6.3 WJ-IV Vocab: 4.8 GSRT: 7.8 | WJ-IV Comp: +2.4 WJ-IV Vocab: +2.2 GSRT: +4.3 |
| R | CSR* | 2 | No | 9 | 274 | WJ-IV Comp: 4.9 WJ-IV Vocab: 7.7 GSRT: 4.0 | WJ-IV Comp: 7.0 WJ-IV Vocab: 7.7 GSRT: 5.2 | WJ-IV Comp: +2.1 WJ-IV Vocab: +0 GSRT: +1.2 |
| F | CIR | 1 | Yes | 7 | 162 | WJ-IV Comp: 3.9 WJ-IV Vocab: 6.4 GSRT: 8.2 | WJ-IV Comp: 5.1 WJ-IV Vocab: 10.9 GSRT: 7.0 | WJ-IV Comp: +1.2 WJ-IV Vocab: +4.5 GSRT: -1.2 |
| C | CSR | 2 | No | 9 | 274 | WJ-IV Comp: 5.5 WJ-IV Vocab: 8.6 GSRT: 4.0 | WJ-IV Comp: 4.5 WJ-IV Vocab: 7.7 GSRT: 5.5 | WJ-IV Comp: -1.0 WJ-IV Vocab: -0.9 GSRT: +1.5 |
| T | CIR | 3 | Yes | 4 | 96 | WJ-IV Comp: 3.9 WJ-IV Vocab: 4.0 GSRT: 3.5 | WJ-IV Comp: 5.1 WJ-IV Vocab: 5.8 GSRT: 5.5 | WJ-IV Comp: +1.2 WJ-IV Vocab: +1.8 GSRT: +2.0 |
| J | CSR | 4 | No | 5 | 118 | WJ-IV Comp: 4.3 WJ-IV Vocab: 5.3 GSRT: 3.5 | WJ-IV Comp: 4.8 WJ-IV Vocab: 5.1 GSRT: 3.5 | WJ-IV Comp: +0.5 WJ-IV Vocab: -0.2 GSRT: +0 |
| D | CIR | 3 | Yes | 4 | 96 | WJ-IV Comp: 2.5 WJ-IV Vocab: 4.0 GSRT: 5.2 | WJ-IV Comp: 5.7 WJ-IV Vocab: 4.4 GSRT: 8.2 | WJ-IV Comp: +3.2 WJ-IV Vocab: +0.4 GSRT: +3.0 |
| E | CSR | 4 | No | 5 | 118 | WJ-IV Comp: 4.3 WJ-IV Vocab: 2.9 GSRT: 4.8 | WJ-IV Comp: 4.5 WJ-IV Vocab: 3.4 GSRT: 4.5 | WJ-IV Comp: +0.2 WJ-IV Vocab: +0.5 GSRT: -0.3 |

Note. WJ-IV Comp = Woodcock Johnson Battery Assessment IV Subtest 4 (Passage Comprehension); WJ-IV Vocab = Woodcock Johnson Battery Assessment IV, Subtest 17a & 17b (Vocabulary); GSRT = Gray Silent Reading Tests. GE = Grade Equivalent; CIR = Collaborative Independent Reading; CSR = Collaborative Shared Reading.

^a Posttest measures were conducted upon completion of the conditioned reinforcement value for reading intervention at 80% of the intervals spent reading two consecutive times. ^b Difference in GE were calculated by subtracting pretest measures from posttest measures. Pre- and Post measures were conducted with forms A and B for both WJ-IV and GSRT.

Table 5

Crossover treatment sessions for Participants R, C, J, and E, total minutes spent in treatment. Pre- and both Post-test measures are reported in this table. Differences in grade equivalency are reported as difference between second post-test measure and pre-test measure.

| Participant | Met CR+ for reading | Number of Sessions in Crossover Treatment | Total Number of Sessions in Intervention | Min Spent in Crossover Treatment | Total min spent in Intervention | Pre-intervention GE | ^a Post CSR Treatment GE | Post CIR Treatment GE | ^b Difference in Grade Equivalency between Post CIR and Pre-CSR |
|-------------|---------------------|---|--|----------------------------------|---------------------------------|--|--|---|---|
| R | Yes | 4 | 13 | 110 | 384 | WJ-IV Comp: 4.9 WJ-IV Vocab: 7.7 GSRT: 4.0 | WJ-IV Comp: 7.0 WJ-IV Vocab: 7.7 GSRT: 5.2 | WJ-IV Comp: 5.5 WJ-IV Vocab: 8.5 GSRT: 3.5 | WJ-IV Comp: +0.6 WJ-IV Vocab: +0.8 GSRT: -0.5 |
| C | Yes | 4 | 13 | 110 | 384 | WJ-IV Comp: 5.5 WJ-IV Vocab: 8.6 GSRT: 4.0 | WJ-IV Comp: 4.5 WJ-IV Vocab: 7.7 GSRT: 5.5 | WJ-IV Comp: 7.7 WJ-IV Vocab: 12.9 GSRT: 3.5 | WJ-IV Comp: +2.2 WJ-IV Vocab: +4.3 GSRT: -0.5 |
| J | Yes | 4 | 9 | 110 | 228 | WJ-IV Comp: 4.3 WJ-IV Vocab: 5.3 GSRT: 3.5 | WJ-IV Comp: 4.8 WJ-IV Vocab: 5.1 GSRT: 3.5 | WJ-IV Comp: 4.9 WJ-IV Vocab: 8.6 GSRT: 6.2 | WJ-IV Comp: +0.6 WJ-IV Vocab: +3.3 GSRT: +2.7 |
| E | Yes | 4 | 9 | 110 | 228 | WJ-IV Comp: 4.3 WJ-IV Vocab: 2.9 GSRT: 4.8 | WJ-IV Comp: 4.5 WJ-IV Vocab: 3.4 GSRT: 4.5 | WJ-IV Comp: 4.9 WJ-IV Vocab: 3.7 GSRT: 5.2 | WJ-IV Comp: +0.6 WJ-IV Vocab: +0.8 GSRT: +0.4 |

77

Note. WJ-IV Comp = Woodcock Johnson Battery Assessment IV Subtest 4 (Passage Comprehension); WJ-IV Vocab = Woodcock Johnson Battery Assessment IV, Subtest 17a & 17b (Vocabulary); GSRT = Gray Silent Reading Tests. GE = Grade Equivalent; CIR = Collaborative Independent Reading; CSR = Collaborative Shared Reading.

^a Posttest measures were conducted upon completion of the conditioned reinforcement value for reading intervention at 80% of the intervals spent reading two consecutive times. ^b Difference in GE were calculated by subtracting pretest measures from posttest measures. Pre- and Post measures were conducted with forms A and B for both WJ-IV and GSRT.

Table 6

*Preintervention and Postintervention
grade equivalent scores for all*

participants.

| Participant | Treatment Condition | WJ-IV Comprehension (GE) ^a | | WJ-IV Vocabulary (GE) | | GSRT (GE) ^b | |
|-------------|---------------------|---------------------------------------|------------|-----------------------|------------|------------------------|------------|
| | | Pre-Probe | Post-Probe | Pre-Probe | Post-Probe | Pre-Probe | Post-Probe |
| JC | CIR* | 3.9 | 6.3 | 2.6 | 4.8 | 3.5 | 7.8 |
| R | CSR* | 4.9 | 7.0 | 7.7 | 7.7 | 4.0 | 5.2 |
| F | CIR | 3.9 | 5.1 | 6.4 | 10.9 | 8.2 | 7.0 |
| C | CSR | 5.5 | 4.5 | 8.6 | 7.7 | 4.0 | 5.5 |
| T | CIR | 3.9 | 5.1 | 4.0 | 5.8 | 3.5 | 5.5 |
| J | CSR | 4.3 | 4.8 | 5.3 | 5.1 | 3.5 | 3.5 |
| D | CIR | 2.5 | 5.7 | 4.0 | 4.4 | 5.2 | 8.2 |
| E | CSR | 4.3 | 4.5 | 2.9 | 3.4 | 4.8 | 4.5 |

Note. WJ-IV Comprehension = Woodcock Johnson Battery Assessment; GSRT = Gray Silent Reading Tests; GE = Grade Equivalency; CIR = Collaborative Independent Reading; CSR = Collaborative Shared Reading

^a WJ-IV pre- and post assessment was delivered using form A and form B.

^b GSRT pre- and post assessment was delivered using form A and form B.

Table 7

*Preintervention and Postintervention
grade equivalent scores for all*

participants.

| Participant | WJ-IV Comprehension (GE) ^a | | | WJ-IV Vocabulary (GE) | | | GSRT (GE) ^b | | |
|-------------|---------------------------------------|-------------|--------------------------|-----------------------|-------------|-------------|------------------------|-------------|-------------|
| | Pre | Post CSR | Post CIR ^c | Pre | Post CSR | Post CIR | Pre | Post CSR | Post CIR |
| R | 4.9 | 7.0 | 5.5 | 7.7 | 7.7 | 8.5 | 4.0 | 5.2 | 3.5 |
| C | 5.5 | 4.5 | 7.7 | 8.6 | 7.7 | 12.9 | 4.0 | 5.5 | 3.5 |
| J | 4.3 | 4.8 | 4.9 | 5.3 | 5.1 | 8.6 | 3.5 | 3.5 | 6.2 |
| E | 4.3 | 4.5 | 4.9 | 2.9 | 3.4 | 3.7 | 4.8 | 4.5 | 5.2 |

Note. WJ-IV Comprehension = Woodcock Johnson Battery Assessment; GSRT = Gray Silent Reading Tests; GE = Grade Equivalency; CIR = Collaborative Independent Reading; CSR = Collaborative Shared Reading

^a WJ-IV pre- and post assessment was delivered using form A and form B.

^b GSRT pre- and post assessment was delivered using form A and form B.

^c WJ-IV and GSRT was delivered using Form A.

Table 8

Mean increases in reading achievement scores for WJ-IV passage comprehension and vocabulary, and GSRT for all treatment groups. We calculated the mean increases of crossover from pre-intervention to final postintervention assessments.

| Measure | Mean GE Increase of CIR | Range | Mean GE Increase of CSR | Range | Mean GE* Increase of Crossover | Range |
|------------------------------------|--------------------------------|--------------|--------------------------------|--------------|---------------------------------------|--------------|
| <i>WJ-IV</i> passage comprehension | 2.0 | 1.2 – 2.4 | 0.5 | -1 – 2.1 | 1.0 | 0.6 -2.2 |
| <i>WJ-IV</i> vocabulary | 2.3 | 0.4 – 4.5 | -0.2 | -0.9 – 0.5 | 2.3 | 0.8 – 4.3 |
| <i>GSRT</i> | 2.02 | -1.2 – 4.3 | 0.6 | -0.3 – 1.5 | 0.5 | -0.5 – 2.7 |
| CR+ for Reading | 47% | 18 – 58% | 19% | -3 – 40% | 46% | 21 – 81% |

Note. We calculated the mean increases of the crossover treatment by subtracting the pre-intervention measures from the post-crossover measures.

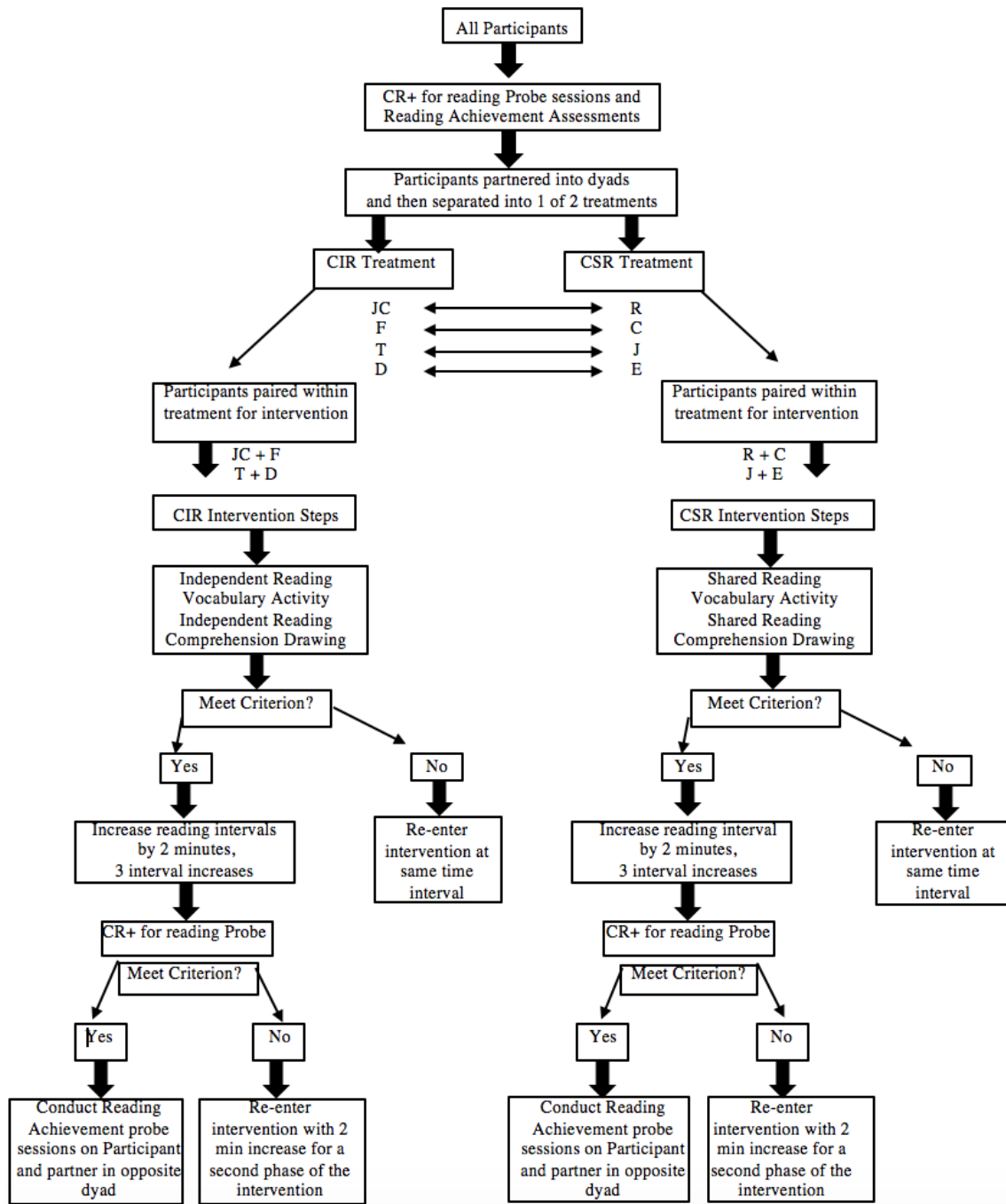


Figure 1: Progression of entire procedure across all treatment conditions and participants before crossover condition. Criterion to acquire CR+ for reading was 80% or greater across two consecutive sessions.

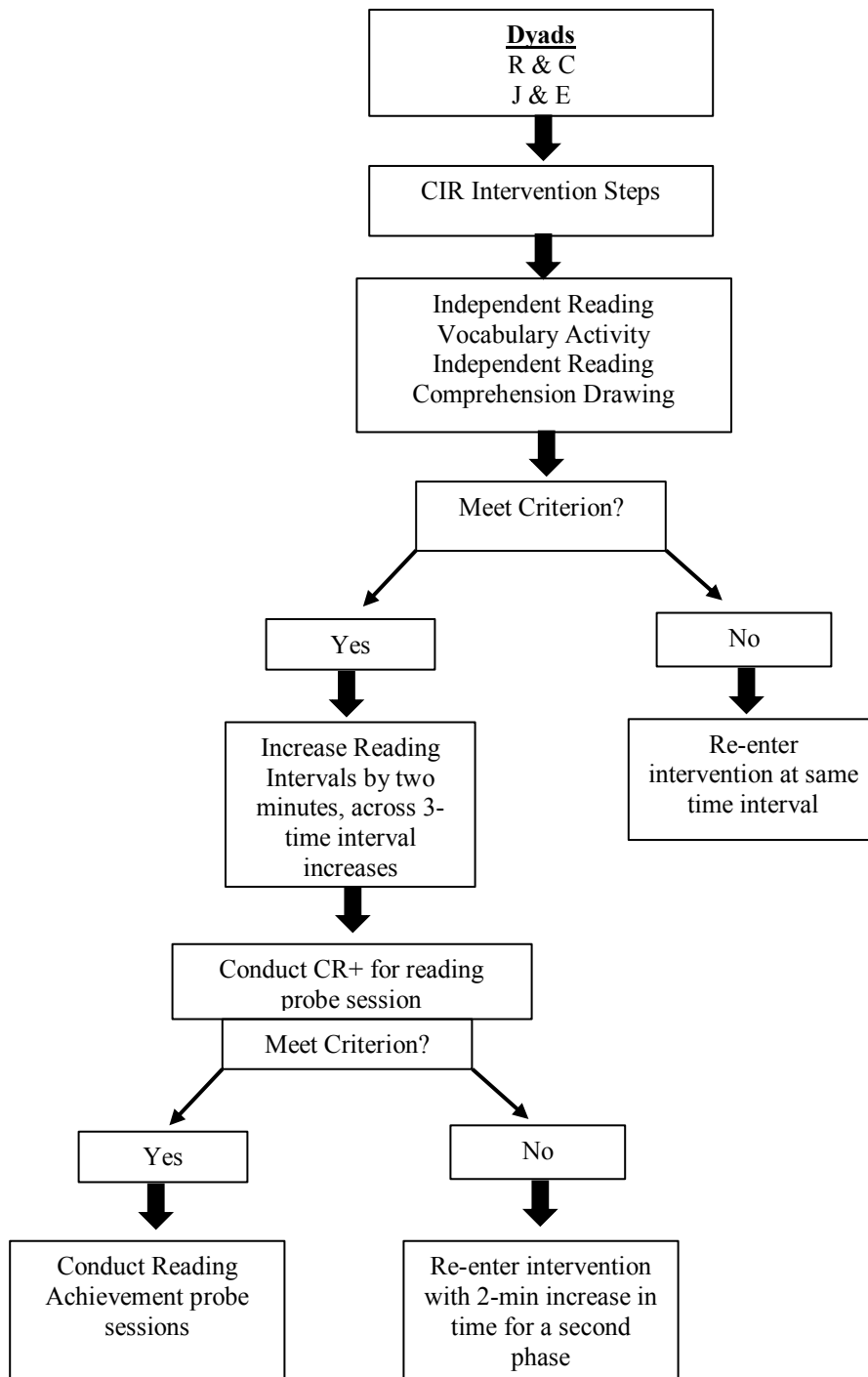


Figure 2: Crossover treatment procedure for Participants R, C, J, and E. We implemented this procedure after CR+ for reading was not established in the CSR treatment.

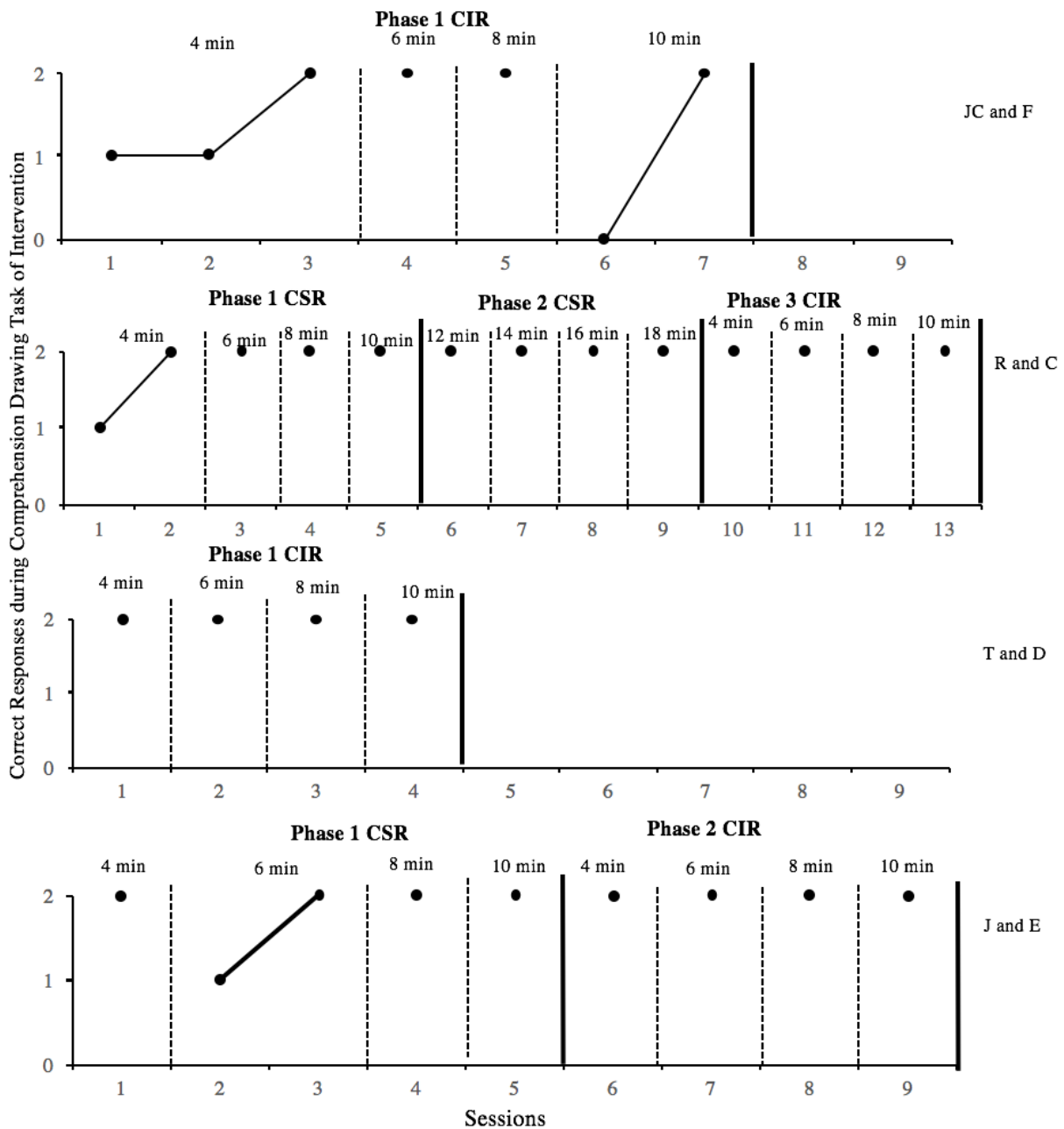


Figure 3: Intervention graphs for all participants. Each participant was paired in both a dyad to compare acquisition of conditioned reinforcement and reading achievement scores. Participants JC and F were paired respectively with Participants R and C. Participants T and D were paired with Participants J and E. The above graphs represent the 4th step of the intervention procedure where the participants drew a scene from the story they read. Three consecutive increases in 2 min of time indicated criterion met for the phase of the intervention. The solid black line represents a CR+ for reading probe whereas dotted lines represent the increase in time interval for the intervention.

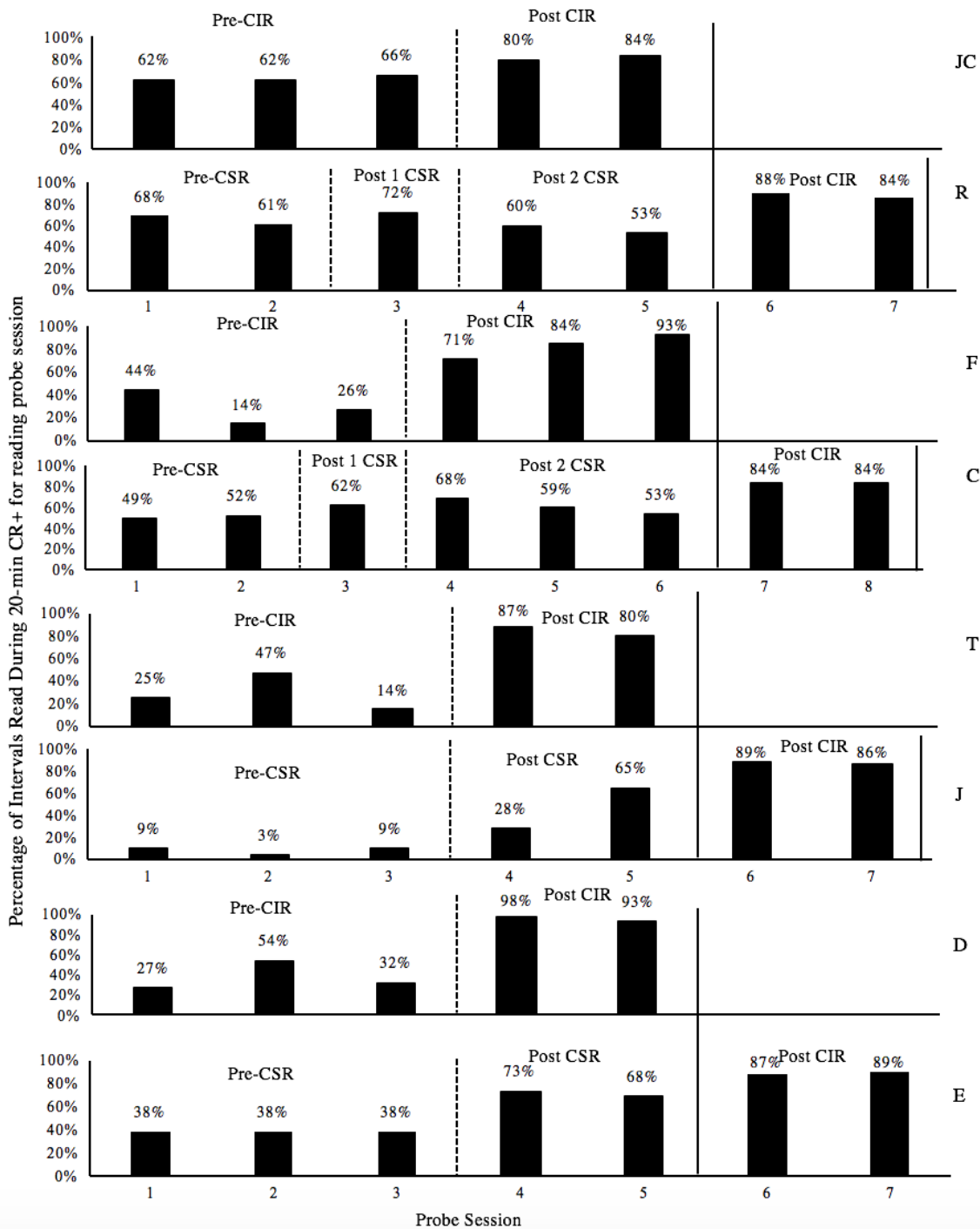


Figure 4: Pre-intervention and postintervention CR+ for reading probe sessions for all dyads. Each participant was paired with another participant in the opposite treatment condition. Each participant underwent the Collaborative Independent Reading (CIR) treatment or the Collaborative Shared Reading (CSR) treatment. Once one participant in the dyad met criterion for CR+ for reading, intervention stopped for both participants and post reading achievement tests were conducted.

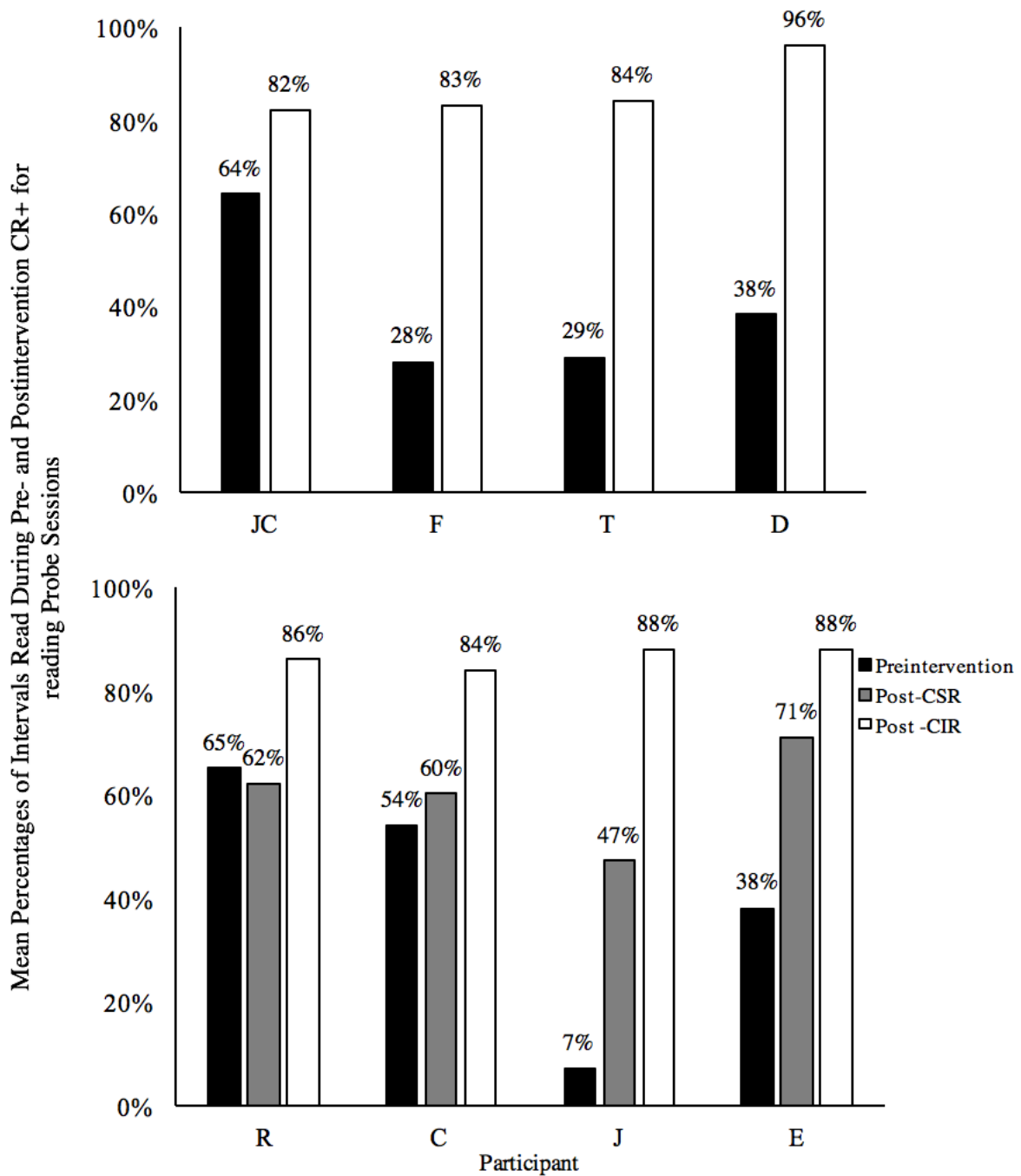


Figure 5: Mean pre- and postintervention percentages for CR+ for reading probe sessions for all participants. Participant JC and R were Dyad 1, F and C were Dyad 2, T and J were Dyad 3 and D and E were Dyad 4. All participants in CSR treatment met CR+ for reading criterion of 80%.

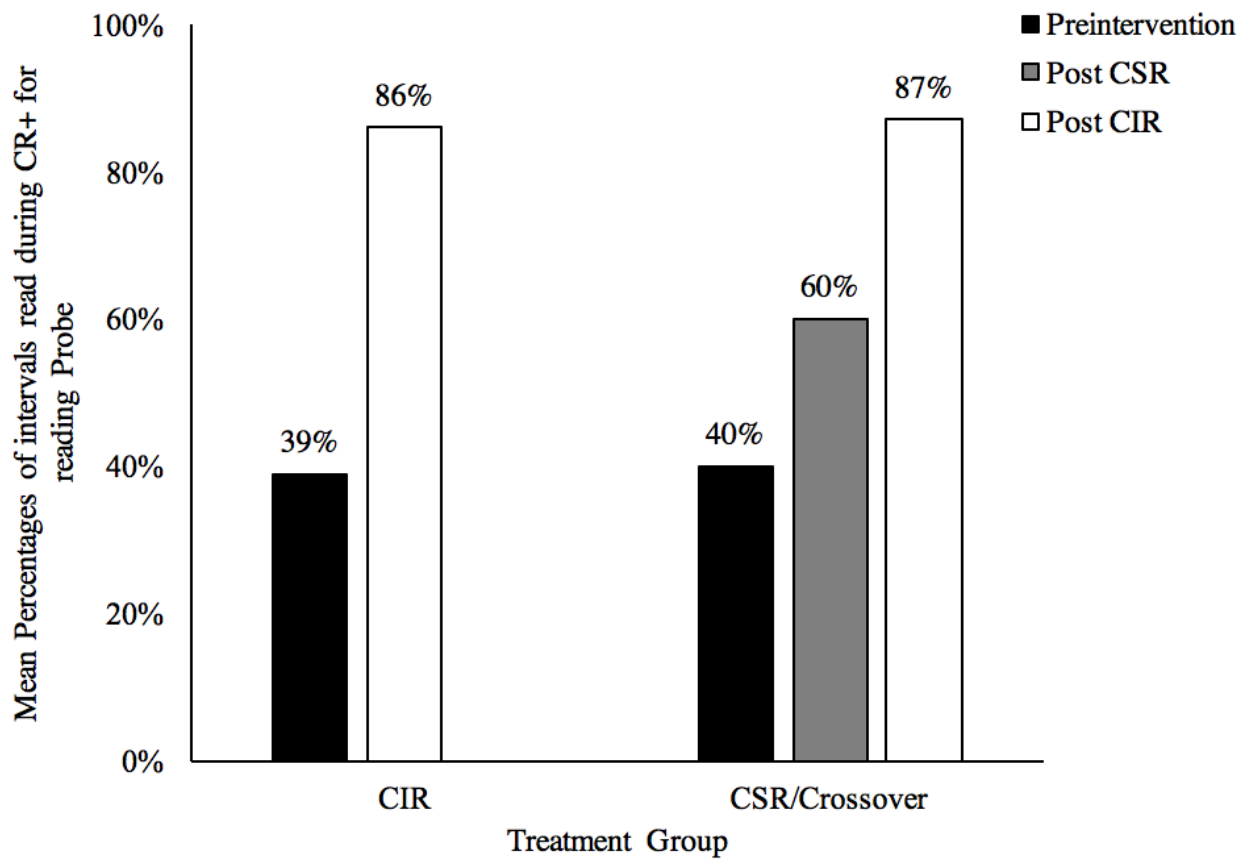


Figure 6: Mean preintervention and postintervention CR+ for reading probe sessions measured as a percentage of 10 s intervals in 20 minute sessions across all treatment conditions for all participants. Mean was calculated by adding all pre-CR+ for reading probe sessions for each participant and dividing that number by four. The mean post CR+ for reading probe was calculated the same way.

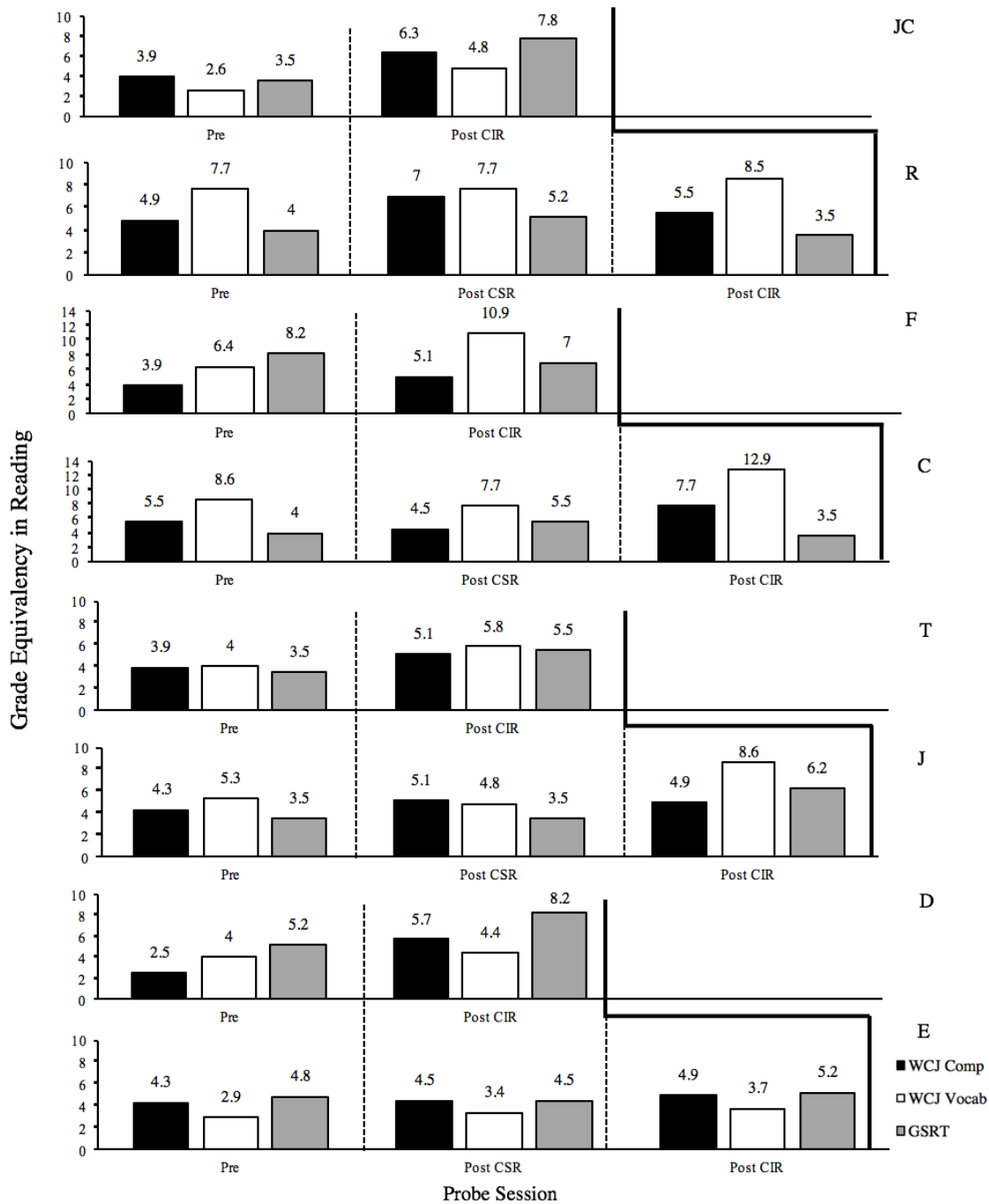


Figure 7: Preintervention and postintervention reading achievement grade equivalencies for all participants. We assessed each participant prior to entering intervention and again upon one participant in the dyad met CR+ for reading. We also conducted a crossover treatment where participants in CSR treatment went through the CIR treatment.

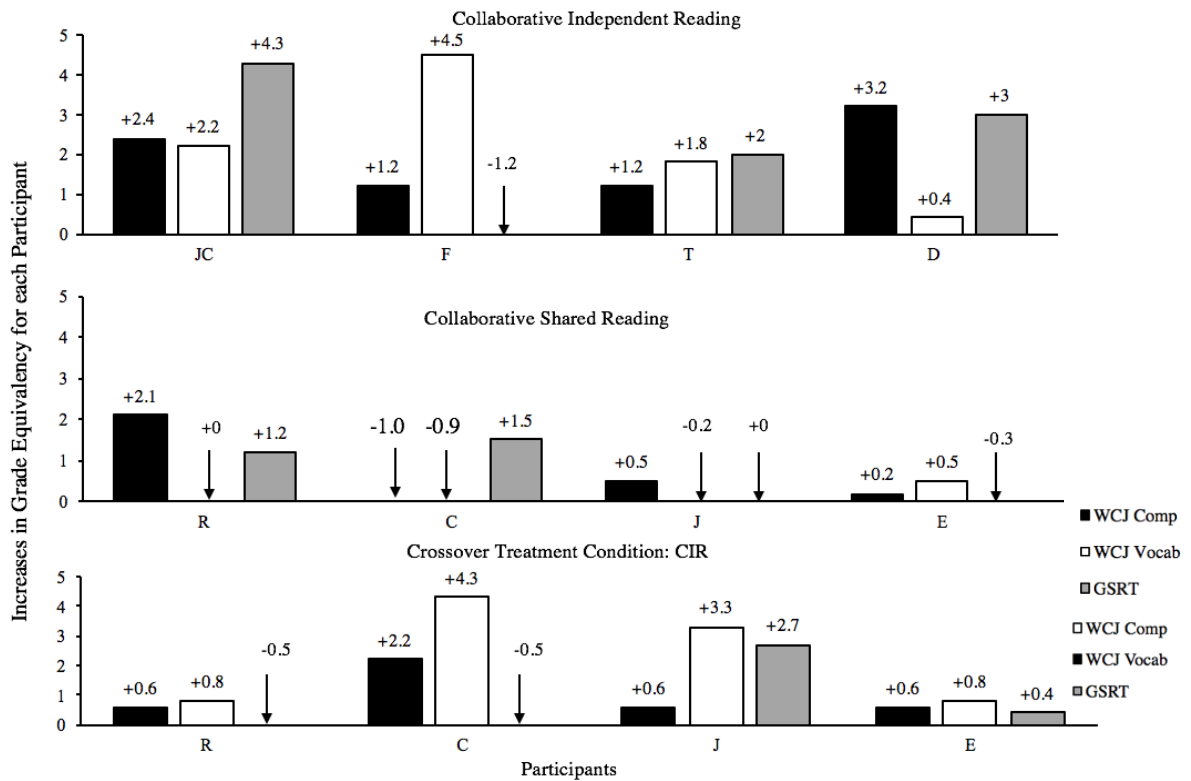


Figure 8: Mean increases in grade equivalency for each participant. Participants JC and R were yoked into Dyad 1, F and C were Dyad 2, T and J were Dyad 3, D and E were Dyad 4. All participants in CIR treatment met CR+ for reading criterion of 80% first. GE are also reported for Participants R, C, J, and E who went through a crossover treatment condition of CIR.

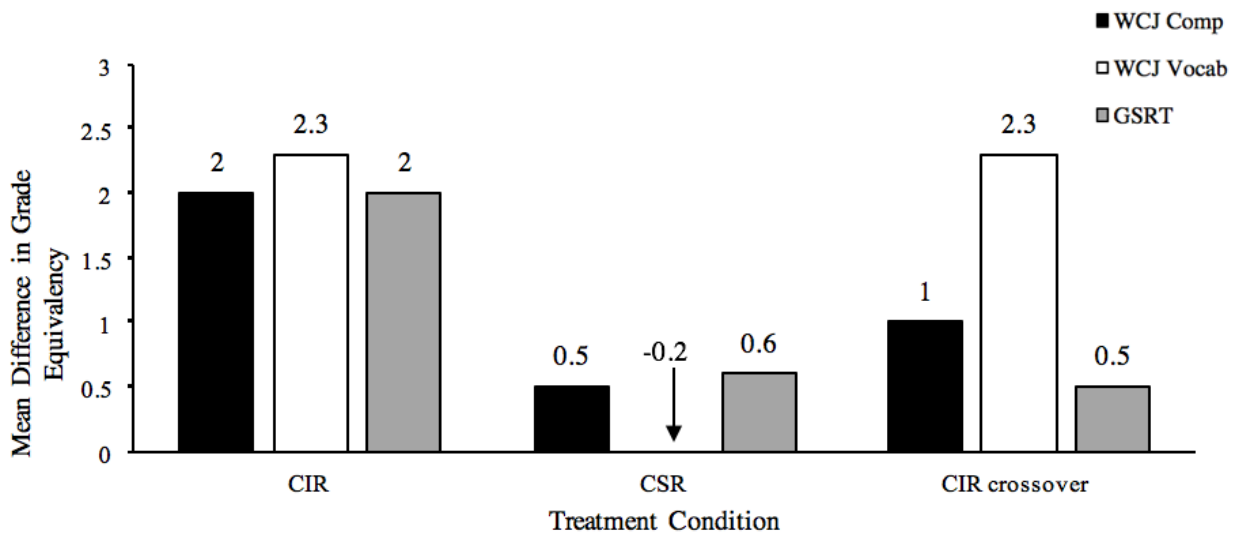


Figure 9: Mean reading achievement increases per group after intervention. A mean was determined by adding all preintervention reading achievement scores of all participant in each treatment condition and dividing that number by 4 (number of participants in either treatment) and subtracting that number by the mean postintervention reading achievement scores. The mean score of postintervention measures was determined the same way but with the postintervention reading achievement measures. Increase was calculated by subtracting the preintervention mean scores from the postintervention mean scores.

Appendix A

Comprehension Drawing Task

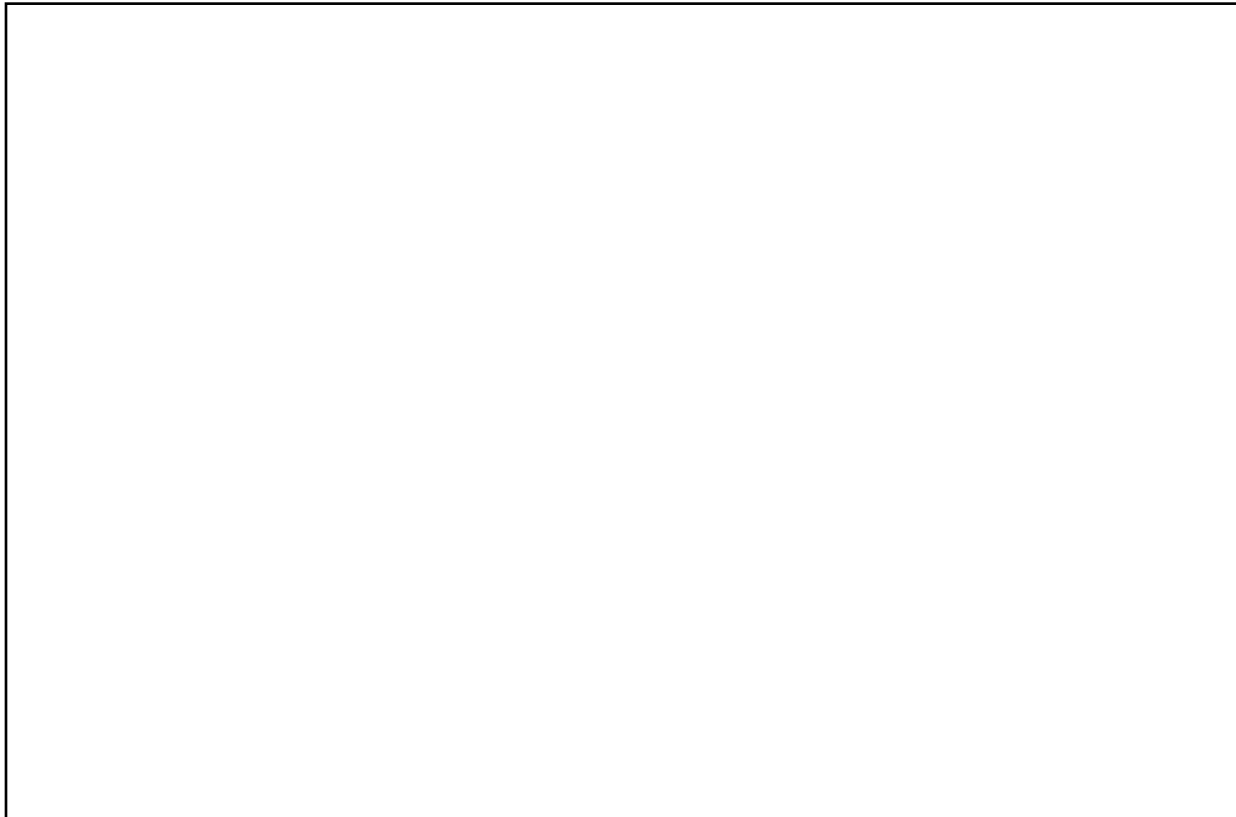
Student Sheet

Book Title: _____

Chapter: _____

Pages Read: _____

Draw a picture of your favorite scene. Please look back in the text of specific details. Be sure to include as many details as possible.



Friend's Response:

Describe what scene this is from the book:

| |
|--|
| |
| |
| |
| |

Is this correct or incorrect? _____

Appendix B

Vocabulary Task Student Sheet

Pick three words you find interesting from the pages you read. Be sure to write the page number you found the word, and define what you think it means. when you are finished, be sure to trade papers with your partner and discuss if you agree with their definition. Mark a check if you agree and a minus if you disagree.

| Word | Page Number | What do you think it means? |
|------|-------------|-----------------------------|
| | | |
| | | |
| | | |

Appendix C

Data Sheet for CR+ for Reading

Probe Procedure

Whole Interval R+ Reading

| Student: | | Date: | | | | | | | |
|-----------------|--|--------------|--|-------|--|-------|--|-------|--|
| 0:10 | | 4:10 | | 8:10 | | 12:10 | | 16:10 | |
| 0:20 | | 4:20 | | 8:20 | | 12:20 | | 16:20 | |
| 0:30 | | 4:30 | | 8:30 | | 12:30 | | 16:30 | |
| 0:40 | | 4:40 | | 8:40 | | 12:40 | | 16:40 | |
| 0:50 | | 4:50 | | 8:50 | | 12:50 | | 16:50 | |
| 1:00 | | 5:00 | | 9:00 | | 13:00 | | 17:00 | |
| 1:10 | | 5:10 | | 9:10 | | 13:10 | | 17:10 | |
| 1:20 | | 5:20 | | 9:20 | | 13:20 | | 17:20 | |
| 1:30 | | 5:30 | | 9:30 | | 13:30 | | 17:30 | |
| 1:40 | | 5:40 | | 9:40 | | 13:40 | | 17:40 | |
| 1:50 | | 5:50 | | 9:50 | | 13:50 | | 17:50 | |
| 2:00 | | 6:00 | | 10:00 | | 14:00 | | 18:00 | |
| 2:10 | | 6:10 | | 10:10 | | 14:10 | | 18:10 | |
| 2:20 | | 6:20 | | 10:20 | | 14:20 | | 18:20 | |
| 2:30 | | 6:30 | | 10:30 | | 14:30 | | 18:30 | |
| 2:40 | | 6:40 | | 10:40 | | 14:40 | | 18:40 | |
| 2:50 | | 6:50 | | 10:50 | | 14:50 | | 18:50 | |
| 3:00 | | 7:00 | | 11:00 | | 15:00 | | 19:00 | |
| 3:10 | | 7:10 | | 11:10 | | 15:10 | | 19:10 | |
| 3:20 | | 7:20 | | 11:20 | | 15:20 | | 19:20 | |
| 3:30 | | 7:30 | | 11:30 | | 15:30 | | 19:30 | |
| 3:40 | | 7:40 | | 11:40 | | 15:40 | | 19:40 | |
| 3:50 | | 7:50 | | 11:50 | | 15:50 | | 19:50 | |
| 4:00 | | 8:00 | | 12:00 | | 16:00 | | 20:00 | |

Appendix D

Sample of Correct Responses in the Vocabulary Task and the Comprehension Drawing Task

Number: +/-

Pick three words you find interesting from the pages you read

| Word | Page Number | What do you think it means? |
|-----------|-------------|-----------------------------|
| Kotbschka | 70 | A type of name. |
| Devine | 68 | Beautiful, good-looking |
| Minuscule | 70 | A type of wire. |

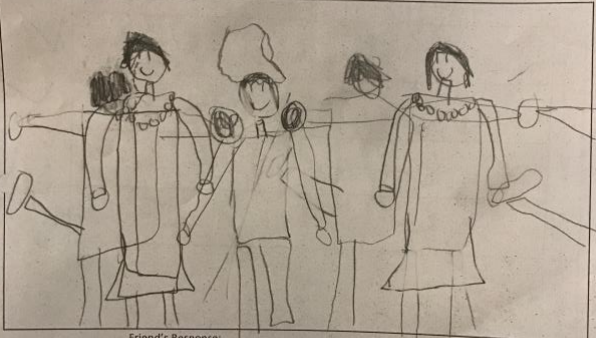
Number: +/-

Book Title: Wah K Threth h Dava Time Interval: 8 min

Chapter: _____ Number: #1

Pages Read: _____

Draw a picture of your favorite scene. Please look back in the text of specific details. Be sure to include as many details as possible.



Friend's Response:

Describe what scene this is from the book:

When Salama (the main character) is lost in the parking lot and sees the inders dancing

Is this correct or incorrect? yes

Chapter IV:

GENERAL DISCUSSION

To continue the quote from Skinner in Chapter I, “We shouldn’t teach great books; we should teach a love of reading. Knowing the contents of a few works of literature is a trivial achievement. Being inclined to go on reading is a great achievement” (Evans, 1968 p. 73). It is of great importance that we, as educators and scientist alike, understand the foundations that a great reader is built upon. Motivation, interest, and reinforcement value are three different terms used to describe what Skinner called, a love of reading.

Major Findings

I propose, that this current body of research establishes a love of reading in a way that has not been done before. In Experiment I, I asked: What correlations exist between reinforcement value of reading and reading achievement? I found that significant positive correlations existed in all standardized reading assessments used and the level of reinforcement value as measured by 10s whole intervals in a 20-min reading probe session (Bly & Greer, 2019). Students who have a high reinforcement value for reading had higher comprehension scores on reading achievement scores measuring reading comprehension.

In Experiment II, I asked if a peer-collaborative, multicomponent reading intervention could establish reading as a reinforcer in participants without CR+ for reading. I also examined if this established reinforcement value for reading would have an effect on reading achievement in postintervention measures. I used a peer collaborative, multicomponent reading intervention with six participants functioning on or below reading level. The multicomponent procedure included: (1) a shared reading period, (2) a collaborative vocabulary task (3) an independent reading

period, and (4) collaborative comprehension drawing task. All participants in the intervention acquired CR+ for reading through the peer-collaborative, multicomponent intervention. I also observed significant increases in grade level across all participants in both reading comprehension and vocabulary (1.7 grade levels for *WJ-IV* passage comprehension, 0.3 grade levels for *WJ-IV* vocabulary, and 1.1 grade levels for *GSRT*).

In Experiment III, I asked, (a) can the results of Experiment II be replicated with a individuals with different academic profiles? (b) What impact does the independent reading vs shared reading component of the original multicomponent intervention have on conditioning reading as a reinforcer? (c) What is the overall effect of either component on reading achievement? To answer these questions, I conducted a component analysis on the multicomponent peer-collaborative procedure using two treatments: The Collaborative Independent Reading Treatment (CIR) and the Collaborative Shared Reading Treatment (CSR). I used a simultaneous treatment design with a crossover to test the effects of establishing conditioned reinforcement for reading on reading achievement using the two different treatments. Because none of the participants in the CSR treatment acquired CR+ for reading after one phase of the intervention, I conducted a crossover procedure where they went through the CIR treatment. All participants who went through the CIR treatment, including the participants in the crossover, only required one phase of the intervention with a mean pairing time of 120 min total with a range of 96 to 162-min to complete one phase.

The participants in the initial CIR treatment group increased in reading level 2.0 grade levels for *WJ-IV* passage comprehension, 2.3 grade levels for *WJ-IV* vocabulary, and 2.0 grade levels for *GSRT*. The participants in the CSR treatment increased a mean of only 0.5 grade levels in *WJ-IV* passage comprehension, decreased 0.2 grade levels in *WJ-IV* vocabulary, and increased

0.6 grade levels for the *GSRT*. After going through the CIR treatment, the participants made significant gains in achievement for the *WJ-IV* assessments. For *WJ-IV* passage comprehension, the participants increased by a mean of 1 grade level, For the *WJ-IV* vocabulary, the participants increased by a mean of 2.3 grade levels. The participants only increased by a mean of 0.5 grade levels in the *GSRT*.

Implications

We can make several definitive claims about the results of Experiments 2 and 3 and how they address gaps in research. First, the peer collaborative multicomponent intervention was effective in conditioning reinforcement value for reading for all participants in Experiments 2, and 3, but only when the intervention had the independent reading component. In Experiment II, using the original peer collaborative multicomponent intervention, four participants in Experiment II acquired CR+ for reading after two phases of the intervention and two participants only acquired CR+ for reading after one phase. In Experiment III, all participants acquired CR+ for reading after one phase of the CIR intervention.

Second, the collaborative independent reading (CIR) treatment procedure established CR+ for reading faster than the shared reading condition (CSR) and the original procedure. Participants in CIR treatment and crossover treatment acquired CR+ for reading in a mean of 120 min (96-162), whereas Participants in Experiment II acquired CR+ for reinforcement in a mean of 206 min (120-260). It is of interest to note, that two participants in the CSR treatment went through two phases of the intervention (274 min) and did not acquire CR+ for reinforcement until they went through one phase of CIR (110 min).

Third, in Experiment III, the CIR treatment produced higher gains in reading achievement than the CSR treatment and original treatment used in Experiment II. Although the

participants in Experiment II acquired CR+ for reinforcement, they had lower gains in academics than those in Experiment III who also acquired CR+ for reinforcement. This suggests that although the acquisition of CR+ for reading increases reading achievement, CR+ for reading acquired through CIR produced significantly higher increases in achievement.

Fourth, vocabulary gains were significantly higher for participants who went through the CIR treatment than participants in the CSR treatment or Experiment II. Participants in Experiment III had mean gains of 2.3 grade levels with a range of 0.4 to 4.5 in vocabulary after going through the CIR treatment whereas the participants in Experiment II only had mean gains of 0.3 grade levels with a range of -0.4 to 1.2. Similarly, participants who initially underwent the CSR treatment had a mean decrease in vocabulary of 0.2 grade levels with a range of -0.9 to 0.5. This supports the evidence that not only was the independent reading component more effective in conditioning reading as a reinforcer, but also in increasing vocabulary levels.

Fifth, the independent reading treatment resulted in greater increases in reading comprehension measures than the shared reading treatment as well as the original procedure. The participants in the CIR treatment of Experiment III had mean gains of 2.0 grade levels for both the *WJ-IV* passage comprehension and the *GSRT* whereas the participants in the CSR treatment only had an increase of 0.5 grade levels and 0.6 grade levels for *WJ-IV* passage comprehension and *GSRT* respectively. The participants in Experiment II had increases of 1.7 grade levels for *WJ-IV* for passage comprehension and 1.1 for *GSRT*.

Implications of peer-collaboration procedure

Bryan, Fawson, and Reutzell, (2003) found that little research has been dedicated to combining social interactions and verbal feedback to increasing both the reinforcement and effectiveness of independent reading. Bryan et al, also determined that students who participate

in conversation about what they read were more engaged readers. Guthrie et al., (2007) determined collaboration and social interactions in reading increased motivation to complete reading activities and were associated with students' reading grades and test scores (Baker & Wigfield, 1990; Sweet, Guthrie, & Wigfield, 1998) The results from Experiments 2 and 3 indicate that the peer-collaborative multicomponent procedure was functional in establishing CR+ for reading. This is a pioneer study as the intervention can be used to increase the reinforcement value of reading for both students who undergo the procedure. Anecdotally, participants in both Experiments 1 and 2, requested reading time after undergoing the intervention procedure and engaged in conversation about the literature with either their peers or teachers.

The results of all experiments indicate a *conditioning* of reinforcement value for reading through a peer-collaborative procedure. Within behavior analysis, peer-collaborative procedures used to condition stimuli as reinforcers are called *peer-yoked contingencies*. A peer-yoked contingency (Davies-Lackey, 2005; Greer & Ross, 2008; Rothstein, & Gautreaux, 2007; Stolfi, 2005) implies a social collaboration of both people working towards an end goal; one cannot contact reinforcement without the other. It is a tactic used within interventions as a means of conditioning stimuli as reinforcement by establishing a motivating operation to respond correctly (Greer & Ross, 2008). In the case of the multicomponent reading intervention procedure, participants worked towards earning 10 min of free time together functioned to condition reading content as a reinforcer. An important shift in stimulus control occurred when the reinforcement of earning free time shifts to the reinforcement of reading content, that is, a transformation of reinforcement stimuli is established (Greer & Ross, 2008; Sidman, 1971).

Peer-yoked contingencies have been used across various interventions in our laboratory to condition specific learning repertoires. These repertoires include: conditioned reinforcement for social listener reinforcement (Davies-Lackey, 2005; Sterkin, 2012; Stolfi, 2005), conditioned reinforcement for reading content, (Cumiskey Moore, 2017), conditioned reinforcement for mathematics, (Maurilus, 2018; O'Rourke, 2006), and the use of functional math algorithms, (Weber, 2016).

Conditioned reinforcement and reading

The importance of establishing conditioned reinforcement for observing and choosing books has been researched in various studies (Nuzolo-Gomez, Leonard, Rivera, & Greer, 2002; Greer & Ross, 2008; Singer-Dudek, Oblak & Greer, 2011). Tsai & Greer (2006) studied the effect of establishing a conditioned reinforcement for observing and choosing books on the rate of learning textual responses to word sets. Results from this study indicated participants required fewer learn units to meet criterion on textual responding after going through a stimulus-stimulus pairing procedure to condition books as a reinforcer (Tsai & Greer, 2006). Buttigieg (2015) also found that conditioning procedures for books could increase learning responses significantly in preschoolers.

Pereira-Delgado, Greer, Speckman, & Goswami (2009) tested the effects of conditioning reinforcement for print stimuli on match-to-match sample responding in preschoolers. This experiment conditioned reinforcement value for print stimuli with a stimulus-stimulus pairing procedure. Greer and Han (2015) also tested the establishment of conditioned reinforcement for observing 2D print on the emergence of match-to-sample repertoires. Mercorella (2017) established conditioned seeing responses through a peer-yoked narrative procedure. Bidirectional

Naming (BiN) and conditioned seeing responses were positively correlated with the student reading level and comprehension.

The current study adds to the existing body of research on conditioned reinforcement and peer-yoked contingencies. It also adds to the research conducted in our laboratory on the importance of establishing books, text, pictures, and now, content as reinforcers for students. The importance of establishing reading as a reinforcer is evident in the academic outcomes observed.

The behavior analytic 20 min eye-tracking procedure used in all three studies provides a framework to measure increases in reinforcement value for reading and should be implemented by educators and researchers alike. Educational researchers strengthen the argument that motivation for reading impacts academic achievement by adding this scientific procedure as a measure of motivation. The intervention also emphasizes the important pairing of instrumental reinforcement (i.e. receiving a reward for close reading) and hedonic reinforcement, (i.e. the reading for pleasure during post intervention CR+ for reading probes).

Limitations

As described in both experiments, there were several limitations to the studies. Most can be attributed to the nature of conducting research in a classroom. In Experiment I, the sample size is only 30 students which may prove to be a limitation. All participants were also recruited from the same classroom. However, it should be noted that several studies have conducted analyses across different grade levels and found similar correlations (Cumiskey Moore, 2018, Gentilini & Greer, 2019). Another limitation is that in Experiment II, we only conducted one post-intervention CR+ for reading probe session for participants to determine stability of responding across participants. This is why, in Experiment III, criterion for CR+ for reading was 80% or greater across two consecutive 20 min reading sessions.

Limitations in Experiment III can be attributed to several participants being absent from school during the duration of the intervention. Participant JC sustained a concussion and was absent for a week; Participant T was ill for a week, and Participant E was at a cheer competition for a week. These, combined with school cancelation due to weather disrupted the flow of the implementation of the intervention procedures. Participants R and C were yoked with participants JC and F. When Participant JC was out for the head injury, we made the decision to continue Participants R and C in the CSR treatment. They met criterion for the intervention and we conducted a CR+ for reading probe. When both participants did not meet criterion of 80% in the probe session, we made the decision to re-enter them into a second phase of the intervention. When Participant JC returned, Participants R and C completed Phase 2 of the CSR treatment at the same time Participants JC and F finished Phase 1 of the CIR treatment. We conducted a post-probe CR+ for reading session on all four participants. This may be viewed as a limitation since the yoked participants in the study did not receive the same number of phases in the intervention.

Collaborative Independent Reading: Implications and future research

By examining the results of Experiment III, it is evident that collaborative independent reading impacts vocabulary and reading comprehension with students on and above reading level in fourth grade. The participants in this study increased in reading level significantly over a short period of time due to the collaborative independent reading procedure, even more so than those who were in the shared reading treatment. If there is evidence supporting the importance of independent silent reading, why do so few studies focus on increasing independent reading within classrooms?

Furthermore, a majority of reading instructional time is spent oral reading even though oral reading does not necessarily increase reading comprehension over silent reading (Brenner &

Hiebert, 2010; Trainin, Hiebert, & Wilson, 2015; Guthrie, Schafer, & Huang, 2001). Students who engage in silent reading typically read at a faster pace and therefore contact a higher number of words thus acquiring greater comprehension. McCallum, Sharp, Bell, and George (2004) reported that although approximately 55% of words were comprehended in silent reading as opposed to 59% of words in oral reading, 911 more words were read in a 20-min reading period for independent readers than oral readers (Schimmel & Ness, 2017). This may account for the greater increases in reading achievement for the participants in the Collaborative Independent Reading treatment in Experiment III.

To further emphasize this, Donovan, Smolkin, and Lomax (2000), reported that many classroom teachers were hesitant to implement silent reading practices within the classroom because they could not assure that struggling students could read the books they selected and were actually engaging in reading (Hiebert, Wilson, & Trainin, 2010). Furthermore, students achieving in the bottom quartile of their classes differed significantly when they read silently in an unguided structure (Hiebert et al., 2010; Trainin, Wilson, Hiebert, Erickson, & Laughridge, 2007). Bryan et al., (2003) reported that without structured guidance and accountability, struggling readers failed to read. However, recent studies on independent silent reading reported that when the challenge level of the texts and the tasks of reading independently and silently were scaffolded and guided by the teacher, third-grade struggling readers could engage in the text successfully (Kamil, 2008; Kuhn et al, 2006; Reutzel, Fawson, & Smith, 2008; Vadasy & Sanders, 2008).

From our laboratory, Hill-Powell (2015) identified a relationship between silent reading and comprehension by implementing a peer-yoked contingency procedure with third-grade students. Participants had to independently read the same passage and correctly answer

comprehension questions in order to move up on a game board. Hill-Powell found that as independent reading skills developed, readers improved speed of reading and accuracy while also maintaining comprehension. Hill-Powell also compared adult silent reading versus aloud reading on comprehension and found that adults reading silently yielded greater comprehension than those reading aloud. This study was important because it demonstrated how to remedy deficits in fluency and comprehension between silent and oral reading.

The Collaborative Independent Reading intervention is a carefully scaffolded and guided intervention (i.e., behavioral principle of successive approximation) that uses scientific measures to increase students': (a) time spent reading, (b) reinforcement value of reading, (c) and reading achievement. Future studies should focus on implementing this procedure with students who are struggling readers to determine effectiveness of the procedure. Will similar outcomes be observed if the procedure is applied to struggling learners? That is a question that must be answered.

Future studies should conduct a parametric analysis as well as a further component analyses to determine effectiveness of the collaborative multi-components of the intervention. To what level are the vocabulary and drawing component of the intervention important in impacting results? Future studies should examine these components either separately or between treatment groups.

Future studies should also identify differences in age levels for different components of the intervention. These studies were functional in increasing the value of reading content through the peer collaborative contingency intervention with fourth and fifth grade students. It was also functional with second grade students (Gentilini & Greer, 2019), however the procedure in

second grade was more effective when conducted with a teacher. Parametric and component analyses focused on addressing these questions should be conducted and implemented.

Educational Significance

Fuchs, Fuchs, and Malone (2017), provide seven dimensions to improve the intensity of reading interventions in schools. I believe the educational significance of implementing the Collaborative Independent Reading (CIR) treatment meets each dimension proposed by Fuchs et al.

The first dimension is *strength* and suggests findings are derived from randomized control or experimental studies or from single case design studies. The CIR procedure was assessed in a single case experimental design study and provided functional results. The second dimension is *dosage* and refers to how often the intervention is implemented to small group sizes. The CIR procedure allowed students to receive intervention intensely until conditioned reinforcement for reading was acquired in a short period of time. The third dimension is *alignment* and refers to targeting appropriate reading skills and current reading levels by using small homogeneous groups. In the CIR procedure, all participants were matched on reading level, reading fluency, and level of reinforcement value for reading. The fourth dimension is *attention to transfer* and emphasizes importance of implementing intervention at all reading levels. Future studies of CIR should focus on transferring the procedure to students who are below reading level. The fifth dimension is *comprehensiveness*, meaning interventions should include modeling and immediate corrective feedback with cumulative review and practice. In the CIR procedure, participants received corrective feedback on the comprehension drawing task. The sixth dimension is *behavior supports*, and refers to training and encouraging self-regulation,

engagement, and motivation for task completion. The CIR procedure includes initial training of the procedure, but encourages autonomy and self-regulation for completing the task. In fact, in the CIR procedure, I anecdotally observed independence and motivation to complete the procedure by all participants after one session. The last dimension is *individualization*, and refers to the importance of using data to monitor student performance so ongoing adjustments to interventions can be made. In the CIR procedure, the experimenters monitored completion of sessions and made decisions based on participant behavior progression through the intervention.

This study is groundbreaking in not only the field of behavior analysis, but also of educational research. With national reports suggesting the decrease in American children's performance on reading achievement (National Center for Educational Statistics, 2016; National Reading Panel, 2000), implications and the educational significance of this study should not be ignored. The foundation of increasing reading achievement lies in the hands of researchers and educators alike. It is our responsibility to spark the love of reading that ignites the fire of life-long learning.

References

- Baker, L., & Wigfield, A. (1990). Dimensions of children's motivation for reading and their relations to reading activity and reading achievement. *Reading Research Quarterly, 34*, 452-477.
- Bly, B. D., & Greer, R. D. (2019). *The result of enhancing the value of reading on reading achievement in fourth graders*. Manuscript in preparation.
- Brenner D. & Hiebert, E. F. (2010). The impact of professional development on students' opportunity to read. *Revisiting silent reading: New directions for teachers and researchers*, (pp. 198-220). Newark DE: International Reading Association.
- Bryan, G., Fawson, P. C., & Reutzel, D. R. (2003). Sustained silent reading: Exploring the value of literature discussion with three non-engaged readers. *Reading Research and Instruction, 43*, 47-73.
- Buttigieg, S. F. (2015). The effects of the establishment of conditioned reinforcement for observing books on rate of acquisition of textual responses with two- to four-year-old participants. (Unpublished doctoral dissertation). Teachers College Columbia University, New York, NY.
- Cumiskey Moore, C. (2017). *The Effects of Conditioned Reinforcement for Reading on Reading Comprehension for 5th Graders*. (Unpublished Doctoral Dissertation, Columbia University). <https://doi.org/10.7916/D8PZ5N30>.
- Davies-Lackey, A. J. (2005). Yoked peer contingences and the acquisition of observational learning repertoires in young children with autism. (Doctoral Dissertation, 2005, Columbia University). Abstract from: UMI Proquest Digital Dissertations [on-line]. Dissertations Abstracts Item: AAT 3159730.
- Donovan, C. A., Smolkin, L. B., & Lomax, R. G. (2000). Beyond the independent-level text: Considering the reader-text match in first-graders' self-selections during recreational reading. *Reading Psychology: An International Quarterly, 21*, 309-333.
- Evans, R. I. (1968). *BF Skinner: The man and his ideas*. New York, Dutton.
- Fuchs, L. S., Fuchs, D., Hosp, M. K., & Jenkins, J. R. (2001). Oral reading fluency as an indicator of reading competence: A theoretical, empirical, and historical analysis. *Scientific Studies of Reading, 5*, 239-256.
- Gentilini, L. M., & Greer, R. D. (2019). *Establishment of a high interest in reading and effects on reading achievement for early-elementary students*. Manuscript submitted.

- Greer, R. D., & Han, H. S.-A. (2015). Establishment of conditioned reinforcement for visual observing and the emergence of generalized visual-identity matching. *Behavioral Development Bulletin*, 20 227-252.
- Greer, R. D., & Ross, D. E. (2008). *Verbal behavior analysis: Inducing and expanding complex communication in children with severe language delays*. Boston: Allyn & Bacon.
- Guthrie, J. T., Hoa, A. L.W., Wigfield, A., Tonks, S. M., Humenick, N. M., Littles, E. (2007). Reading motivation and reading comprehension growth in the later elementary years. *Contemporary Educational Psychology*, 32, 282-313.
- Guthrie, J. T., Schafer, W. D., & Huang, C. (2001). Benefits of opportunity to read and balanced instruction on the NAEP. *The Journal of Educational Research*, 94, 145-162. doi:10.1080/002206070109599912
- Hielbert, E. H., Wilson, K. M., & Trainin, G. (2010). Are students really reading in independent reading contexts? An examination of comprehension-based silent reading rate. *Revisiting silent reading: New directions for teachers and researchers*, (pp. 151-167) Newark, DE: International Reading Association.
- Hill-Powell, J. M. (2015). *The effects of a reading intervention to teach silent reading with comprehension on the speaker-as-own-listener capability among third grade students and comparisons with fluent readers*. (Unpublished doctoral dissertation). Columbia University, New York.
- Kamil, M. L. (2008). How to get recreational reading to increase reading achievement. *Fifty-seventh yearbook of the National Reading Conference*, (pp. 31-40). Oak Creek, WI: National Reading Conference.
- Kuhn, M. R., Schwanenflugel, P.J., Morris, R. D., Morrow, L. M., Woo, D. G., Meisinger, E. B., Sevcik, R. A., Bradley, B. A., Stahl, S. A. (2006). Teaching children to be fluent and automatic readers. *Journal of Literacy Research*, 38, 357-387.
- McCallum, R. S., Sharp, S., Bell, S. M., & George, T. (2004). Silent versus oral reading comprehension and efficiency. *Psychology in the schools*, 41, 241-246.
- Maurilus, E. (2018). The effect of the establishment of reinforcement value for math on rate of learning for pre-kindergarten students. (Unpublished Doctoral Dissertation, Columbia University).
- Mercorella, K. A. (2017). *The Effects of Sequencing and Producing Narrative Components of a Story on Reading Comprehension*. (Unpublished Doctoral Dissertation, Columbia University). <https://doi.org/10.7916/D8GF15WZ>

- Nuzzolo-Gomez, R., Leonard, M., Rivera, C. M. & Greer, R. D. (2002). Teaching children with Autism to prefer books or toys over stereotypy or passivity. *Journal of Positive Behavior Interventions, 4*, 80-87.
- O'Rourke, C. A. (2006). Conditioning math as a reinforcer for performance and learning as a function of observation. (Doctoral Dissertation, Columbia University). Dissertations Abstracts Item: AAT 3213574.
- Pereira-Delgado, J. A., Greer, R. D., Speckman, J., & Goswami, A. (2009). Effects of conditioning reinforcement for print stimuli on match-to-sample responding in preschoolers. *The Journal of Speech-Language Pathology and Applied Behavior Analysis, 3.2/3.3*, 199-216.
- Reutzel, D. R., Fawson, P. C., Smith, J. A. (2008). Reconsidering silent sustain reading (SSR): An exploratory study of scaffolded silent reading (ScRC). *Journal of Educational Research, 102*, 37-50.
- Rothstein, M., & Gautreaux, G. (2007). The effects of peer-yoked contingencies on observation learning and the collateral emergence of naming. *Journal of Early Intensive Behavioral Interventions, 4*, 453-470.
- Schimmel, N., & Ness, M. (2017). The effects of oral and silent reading on reading comprehension. *Reading Psychology, 38*, 390-416. doi: 10.1080/02702711.2016.1278416
- Sidman, M. (1971). Reading and auditory-visual equivalences. *Journal of Speech and Hearing Research, 14*, 5-13.
- Singer-Dudek, J., Oblak, M., & Greer, R. D. (2011). Establishing books as conditioned reinforcers for preschool children as a function of an observational intervention. *Journal of Applied Behavior Analysis, 44*, 421-434.
- Sterkin, V. L. (2012). The effects of social listener reinforcement protocol on the audience control of stereotypy and social operants for students with developmental delays. (Unpublished Doctoral Dissertation). Columbia University, NY.
- Stolfi, L. (2005). *The effects of yoked contingencies on the acquisition of observational learning by preschoolers*. (Doctoral Dissertation, Columbia University). Abstracted from: UMI Proquest Digital Dissertations [on-line]. Dissertations Abstracts Item: AAT 3174899.
- Sweet, A. P., Guthrie, J. T., & Ng, M. (1998). Teacher perceptions and student reading motivation. *Journal of Educational Psychology, 90*, 210-224.

- Trainin, G., Wilson, K. M., Hiebert, E., Erickson, J., & Laughridge, V. (2007, April). An examination of silent reading rates and comprehension: Tasks, proficiency levels, and length of text. Poster presented at the annual meeting of the American Educational Research Association, Chicago, IL.
- Tsai, H. & Greer, R. D. (2006). Conditioned preference for books and faster acquisition of textual responses by preschool children. *Journal of Early and Intensive Behavioral Interventions*, 3, 35-60.
- Trainin, G., Hiebert, E. A., Wilson, K. M. (2015) A comparison of reading rates, comprehension, and stamina in oral and silent reading of fourth-grade students. *Reading Psychology*, 36, 595-626.
- Vadasy, P. F., Sasnders, E. A. (2008). Repeated reading intervention: Outcomes and interactions with readers' skills and classroom instruction. *Journal of Educational Psychology*, 100, 272-290.
- Weber, J. D. (2016). The effects of mastery of editing peers' written math algorithms on producing effective problem solving algorithms. (Unpublished Doctoral Dissertation) Columbia University, NY.