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EFFECTS OF REPEATED READING AND TIME-DELAY VOCABULARY ON READING BEHAVIORS OF ADOLESCENTS WITH EMOTIONAL AND BEHAVIORAL DISORDERS

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ABSTRACT

Students with emotional and behavioral disorders demonstrate poor academic achievement, particularly in the area of reading. Inadequate task engagement is one factor that contributes to this poor achievement. Further research is necessary to better understand behavioral mechanisms that establish task engagement in reading so that effective interventions can ultimately combine evidence-based instruction and components specifically targeting engagement for this population. Behavioral momentum theory, which indicates that all behavior is comprised of velocity (i.e., response rate) and mass (i.e., resistance to change) that together establish momentum (i.e., persistence of behavior in a changing environment) offers a theoretical basis for this mechanism. A previous study found that increases in reading fluency decreased latency to initiate subsequent paragraphs–results predicted by behavioral momentum theory–but did not impact reading comprehension. This study examined effects of repeated reading and time-delay vocabulary preteaching interventions on fluency, latency, and comprehension. Results showed that both interventions decreased mean latencies to initiate subsequent paragraphs, an indicator of persistence, and increased mean words correct per minute, an indicator of endurance, though repeated reading resulted in greater mean differences from baseline. Both interventions resulted in mean increases in comprehension scores over baseline, with time-delay vocabulary resulting in larger gains for two of the three participants, while repeated reading resulted in larger gains for the third. Results are discussed in terms of behavioral momentum theory and implications for impacting students' behavioral engagement in academic assignments.

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CHAPTER 1

INTRODUCTION

Students with emotional and behavioral disorders (EBD) demonstrate lower academic achievement relative to ability than students from any other service category in special education (Wagner, 1995). While general academic difficulties of students with EBD are well documented (e.g., Coutinho, 1986; Ruhl & Berlinghoff, 1992; Reid, Gonzalez, Nordness, Trout, & Epstein, 2004; Nelson, Benner, Lane, & Smith, 2004; Lane, Barton-Arwood, Nelson, & Wehby, 2008), adolescents with EBD are particularly at risk for failing to master literacy skills (Gunter & Denny, 1998; Reid et al.). Lane and colleagues (2008) noted that a sample of students with EBD served in self-contained settings demonstrated reading achievement scores below the 25th percentile. This finding corroborated earlier research results (e.g., Greenbaum, et al., 1996; Lane, Wehby, Little, & Cooley, 2005, a, b) demonstrating that students with EBD struggle with reading across their academic careers.

While these academic struggles are pervasive, the Individuals with Disabilities Education Improvement Act (IDEIA, 2004) stipulates that it is primarily these students' behaviors that impede their learning. Studies indicate that students with EBD often choose not to engage in academic tasks (Slate & Saudargas, 1986; Teeple & Skinner, 2004) and take longer to re-initiate academic tasks after interruption than students without disabilities (Slate & Saudargas, 1987). Students with EBD, rather than engaging in academically related behaviors, often demonstrate disruptive and off-task behaviors that subvert teachers' attempts to deliver instruction (Sutherland, Lewis-Palmer, Stichter, & Morgan, 2008).

Ultimately, however, behavioral and academic difficulties appear to maintain a bidirectional relationship in which the two seem to "cause" each other (Morgan, Farkas, Tufis, & Sperling, 2008; Miles & Stipek, 2006). Moreover, academic deficits of students with EBD continue (Anderson, Kutash, & Duchowski, 2001) and worsen over time (Nelson et al., 2004). The simultaneous behavioral and academic problems establish a recurring cycle of failure for students with EBD (Cullinan, Osborne, & Epstein, 2004), which, in turn, assures that students with EBD find limited opportunities for positive reinforcement in school (Sutherland & Singh, 2004). Schools, then, take on aversive qualities for students with EBD (McEvoy & Welker, 2000), increasing the likelihood that these students continue to behave in ways to escape school-related tasks (e.g., academic assignments), thus ensuring that they are not engaged. The outcome of this lack of engagement is evident in data reported in the National Longitudinal Transition Study-2 (as cited in Bradley, Doolittle, & Bartolotta, 2008), indicating that students with EBD have the lowest school completion rate (i.e., 56%) among all disability categories.

Historically, attempts to improve engagement for students with EBD have resulted in patterns of coercion and dominance in teachers' behavior (Farmer, Farmer, & Gut, 1999), as well as classrooms characterized by an explicit focus on control without a corresponding focus on academics (Steinberg & Knitzer, 1992). These factors may result in academically deprived environments that perpetuate continued academic failure of students with EBD (Sutherland & Singh, 2004). In such classrooms, students with EBD tend to receive less academic instruction (Wehby, Symons, Canale, & Go, 1998) and seem unable to access reinforcement for engagement in academic tasks (Shores, Jack, Gunter, Ellis, DeBriere, & Wehby, 1993).

Behavioral Engagement

Behavioral engagement, drawing on the idea of active task engagement and classroom participation (see Fredericks, Blumenfeld, & Paris, 2004; National Research Council & Institute of Medicine, 2004, for reviews of the construct of engagement) is clearly linked to overall achievement (e.g., Connell, Spencer, & Aber, 1994; Marks, 2000). Often described as time-on-task, behavioral engagement is a key predictor of academic success (Rosenshine & Berliner, 1978). Effective interventions for students with EBD who tend to avoid academic assignments, then, should incorporate effective instructional strategies, as well as components that account for difficulties with engagement (Sutherland et al., 2008), especially the time-on-task variable that indicates behavioral engagement. This may be critically important during reading instruction, where failure to engage in reading behaviors appears to contribute to weaker reading skills relative to peers over time (Stanovich, 1986). To consistently impact behavioral engagement within reading interventions, however, more research is necessary to develop a complete understanding of the mechanism that establishes behavioral engagement. Behavioral momentum theory (Nevin, 1996; Nevin, Mendall, & Atak, 1983) may offer an explanation of this mechanism.

Behavioral Momentum

Theoretically, behavioral momentum explains why some behaviors persist in the face of environmental disruption, while others cease. Nevin and colleagues (e.g.,1996; Nevin et al., 1983; Nevin & Grace, 2000) have used the analogy of physical momentum to describe this behavioral persistence. Physical momentum is comprised of velocity and mass. Given two objects traveling at the same speed (i.e., velocity), the heavier of the two (i.e., higher level of mass) persists longer when the environment is disrupted in some way, such as when applying the brakes on a vehicle. Similarly, given two objects of the same mass, the one moving at the greater speed persists longer when brakes are applied. Within the behavioral momentum analogy, velocity represents response rate and subsequent reinforcement, while mass represents resistance to change (i.e., behavioral persistence). Much like physical momentum, behavior that possesses a high degree of momentum tends to continue over time. In classrooms, where lack of engagement is a key variable for students with EBD, increasing academic behavior through applications of behavioral momentum may lead to positive outcomes for this group of students.

The high-probability (high-*p*) request sequence is an intervention based on behavioral momentum theory that has been shown to be effective in classrooms. High-*p* sequences typically consist of a series (i.e., 2-5) of brief, more preferred, and easily accomplished tasks immediately before less preferred or more difficult target tasks (Killu, 1999; Lee, 2006). Variations of the high-*p* sequence have been used to increase compliance with requests (e.g., Mace et al., 1988), improve transitions between classroom activities (e.g., Ardoin, Martens, & Wolfe, 1999), maintain task persistence during academic assignments (e.g., Lee, Belfiore, Scheeler, Hua, & Smith, 2004), and increase fluency in reading word lists (Burns, Ardoin, Parker, Hodgson, Lingbeil, & Scholin, 2009). High-*p* sequences increase the rate of responding–and subsequent rate of reinforcement–within a given response class and, thus, increase velocity in order to establish momentum. In academic assignments where engagement may be low for students with EBD (Sutherland et al., 2008), high-*p* sequences may increase overall behavioral engagement. Previous researchers have examined high-*p* sequences in academic settings to increase math problem completion (Hutchinson & Belfiore, 1998) and decrease time between tasks (Belfiore et al., 1997; 2002); however, researchers have not fully examined the effects of high-*p* task completion on reading, a problematic skill for students with EBD. It is possible, then, that increasing behavioral velocity during reading assignments consisting of connected text may establish momentum similar to the above examples, and therefore result in students with EBD persisting in reading behaviors.

In a preliminary study examining increases in velocity on momentum effects during students' reading of connected text, Vostal and Lee (2009) altered text difficulty in a manner consistent with high-*p* sequences. Lowering text readability established more fluent reading and reduced latencies to initiate subsequent paragraphs with greater readability levels, effects related to behavioral momentum. Results demonstrated that high-*p* sequences could be created within texts to increase behavioral velocity. Two key issues arose from Vostal and Lee's study: (a) altering text difficulty in order to increase reading fluency might be of little practical value for teachers because it was too time-consuming to reconstruct reading passages; and (b) even though fluency affected momentum, high-*p* passages did not produce beneficial effects on comprehension, as indicated by answering a factual recall question. While the results presented in Vostal and Lee's study were theoretically significant, a practioner-friendly method is needed to arrange instruction in a manner that capitalizes on behavioral momentum.

Reading Fluency

Repeated reading is one method that has been shown to be effective at increasing students' reading fluency (National Reading Panel [NRP], 2000; Therrien, 2004), which may also take advantage of behavioral momentum. Repeated reading may simultaneously build an important skill for students' reading achievement and may–if it established momentum effects–impact behavioral engagement.

In terms of reading behaviors, the velocity component of behavioral momentum is best exemplified by reading fluency (Vostal & Lee, 2009), where fluent reading demonstrates a high response rate. Typically, reading fluency is measured as words correct per minute (WCPM; Therrien, 2004), and is primarily an issue of decoding that represents skills beyond mere word recognition (National Reading Panel [NRP], 2000). The combination of decoding speed and accuracy provides a parsimonious, observable measure of general reading proficiency (Archer, Gleason, & Vachon, 2003; Kostewicz, 2008).

Samuels (1979) defined repeated reading as an intervention in which students reread short, meaningful passages several times. Therrien's (2004) meta-analysis found that the assisted form of repeated reading in which an adult delivered corrective feedback was most effective, and that if the intervention was simply designed to impact fluency on a single passage, a set number of readings (i.e., 3 or 4) was sufficient to demonstrate fluency effects. Therrien's guideline was based, in part, on the work of O'Shea, Sindelar, & O'Shea (1987), who compared the effects of one, three, and seven readings of passages across students in a repeated measures design, and found that larger increases in oral reading fluency occurred between the first and third readings than between the third and seventh readings. Unfortunately, some evidence indicates that fluency is necessary but insufficient to increase reading comprehension to a meaningful degree for many adolescents (Wexler, Vaughn, Edmonds, & Reutebuch, 2008). For these students, vocabulary instruction may be a critical factor for increased comprehension.

Reading Comprehension through Vocabulary

While Vostal and Lee (2009) found that high-*p* sequences embedded in connected text did not produce positive effects on comprehension, preteachng vocabulary should produce these positive effects. The NRP (2000) found that vocabulary instruction was an essential component of reading comprehension instruction. While it has been suggested that vocabulary preteaching could increase reading fluency (Beck, Burns, & Lau, 2009), this suggestion is not supported by results from the NRP (2000). It is unclear whether vocabulary preteaching can impact reading behaviors in such a way as to establish momentum effects on indicators of behavioral engagement in the same way that, theoretically, reading fluency should. According to results from the NRP, preteaching vocabulary before reading facilitates both vocabulary acquisition and comprehension. And while the NRP ultimately found support for both explicit vocabulary instruction and indirect vocabulary learning, they were clear: "There is a need for direct instruction of vocabulary items required for a specific text" (p. 4-4).

Constant time-delay (CTD) is one method of direct instruction that has been shown to be effective for teaching vocabulary (e.g., Hughes & Fredrick, 2006; Schuster, Stevens, & Doak, 1990; Wannarka, 2009). It is a prompting procedure in which the teacher systematically models the correct response until the student produces that response in the presence of the target stimulus without prompting. Typically, initial presentation of the target stimulus (e.g., vocabulary word) is followed immediately by the controlling prompt (e.g., definition); subsequent presentations of the stimulus are followed by a "wait time" or constant time-delay (e.g., 3 or 5 s) during which the student provides the correct response. If the student does not respond correctly, the teacher provides the controlling prompt

(Wannarka). These procedures produce near-errorless learning, while establishing frequent opportunities for students to respond (Hughes & Fredrick).

The use of CTD for vocabulary instruction has been shown to be effective for students with disabilities (Jitendra, Edwards, Sack, & Jacobson, 2004). Schuster, Stevens, and Doak (1990) used CTD to teach new vocabulary to three students with LD in six trials per day, and students mastered words by the third day. McDonnell, Johnson, Polychronis, and Risen (2002) used CTD to teach vocabulary words to two students with moderate cognitive impairments. Both students mastered words in an average of fewer than four trials per word. Hughes and Frederick (2006) and Wannarka (2009) each used peer tutoring in an implementation of CTD. These studies showed that peers could effectively deliver CTD (Hughes & Frederick) and that students mastered the vocabulary instructed by a peer, as well as the vocabulary they instructed (Wannarka). None of these studies of CTD vocabulary instruction specifically measured effects on comprehension or behavioral engagement.

Purpose

The primary purpose of this study was to investigate the behavioral mechanism that underlies behavioral engagement during reading for students with EBD. Behavioral momentum theory explains the persistence of behaviors in changing environments (i.e., those with more or less available reinforcement). This theoretical framework has been used to examine indicators of behavioral engagement in math (e.g., Belfiore et al., 1997; 2002; Lee et al., 2004) and writing (Lee & Lapse, 2003). Recently, it has been used as the theoretical framework to examine indicators of reading persistence (Vostal & Lee, 2009). In reading connected text, behavioral momentum theory suggests that increased velocity (i.e., reading fluency) should establish momentum in reading behaviors. Additionally, though fluency may establish momentum, it may be insufficient to increase reading comprehension, while improved vocabulary knowledge resulting from preteaching could increase comprehension. Therefore, procedures in this study compared two pre-reading interventions: one designed to increase fluency and one designed to increase comprehension.

Specifically, the research questions guiding this study are as follows:

1) Does repeated reading and/or time-delay vocabulary preteaching reduce latency to initiate subsequent paragraphs, thus establishing momentum effects on indicators of behavioral engagement?

2) Does repeated reading and/or time-delay vocabulary preteaching increase reading fluency, thus establishing reading endurance as an indicator of behavioral engagement?

3) Does repeated reading and/or time-delay vocabulary preteaching increase comprehension?

4) How much time do repeated reading and time-delay vocabulary preteaching take to implement?

5) Does repeated reading or time-delay vocabulary demonstrate greater social validity for pre-reading intervention, as demonstrated by participant preference at the end of the study?

CHAPTER 2

REVIEW OF LITERATURE

This chapter presents a narrative literature review on the concepts that form the foundation of the present study. Initially, the review focuses on time-on-task as part of the meta-construct of engagement and roles for behavior analysts in this research domain. Next, the review focuses on rate building as a means of increasing fluency and endurance in academics as a means of increasing behavioral engagement. Then, the review focuses on applications of behavioral momentum in academics, which may be related to behavioral endurance. After these conceptual examinations, the review focuses on the two interventions employed in the current study, repeated reading and constant time-delay. Finally, the research questions guiding the present study are reiterated.

Behavioral Engagement

In schools, students' time-on-task is closely aligned with academic achievement (Rosenshine & Berliner, 1978; Brophy & Good, 1986). Furthermore, when students are successfully engaged in appropriately challenging academic assignments, time-on-task fosters the most learning (Hughes & Archer, in press). This form of time-on-task is often referred to as Academic Learning Time (ALT; Fisher, et al., 1980; Gettinger, 1986) and incorporates both the observable behaviors associated with learning (e.g., completing tasks; Gettinger & Seibert, 2002) and students’ "investment" in learning (Spanjers, Burns, & Wagner, 2008). This investment is related to level of success and incorporates outcomes of behaviors; for example, amount of text read and level of comprehension could be considered indicators of investment in reading (Appleton, Christenson, Kim, & Reschly, 2006).

Together, observable behaviors and quality of investment in learning represent the broader construct of *engagement*. Students' engagement in school has attracted research focus as a means of increasing academic achievement and reducing school dropout (Fredericks, Blumenfeld, & Paris, 2004; National Research Council & Institute of Medicine, 2004). Because it is multifaceted, Fredericks et al. suggest that engagement is best understood as a meta-construct comprised of three components. First, *behavioral engagement* draws on the idea of active participation. It includes a variety of student behaviors such as following teachers' directions, demonstrating persistence during assignment completion, and contributing to class discussions. Second, *cognitive engagement* draws on issues of self-regulation in learning. One aspect of cognitive engagement includes students' values for mastery in academic situations, and is related to motivation to learn. Another aspect includes the application of learning strategies, and is more overtly related to cognition. Third, *emotional engagement* draws on positive attitudes toward learning and students' sense of belonging in school. It includes interests in school and teachers, as well as feelings of happiness while at school. Researchers continue to identify alterable variables that affect all components of engagement as targets for interventions (Christenson, Sinclair, Lehr, & Godber, 2001). Nevertheless, many studies demonstrate a clear link between behavioral engagement and overall academic achievement (e.g., Connell, Spencer, & Aber, 1994; Marks, 2000).

Because it is grounded in observable behaviors, behavioral engagement establishes an important link between the engagement meta-construct and the field of Applied Behavior Analysis (ABA). Behavior analysts focus on reliable relations between objectively defined behaviors, technologically reliable interventions, and behavioral improvements (Cooper, Heron, & Heward, 2007). Ultimately, the power of the meta-construct of engagement lies in researchers' capacity to wrestle with patterns of interactions among the three components of engagement (i.e., behavioral, cognitive, emotional) in schools (Appleton, Christenson, & Furlong, 2008). But, as Appleton and colleagues note, separate lines of research into each component fosters "a fine level of specificity of conceptualization and nuanced measurement" (p.381). Therefore, additional research into each separate component, conducted by researchers grounded in their own scientific paradigms, can eventually move the study of engagement into a fully-integrated line of inquiry built on the best each scientific paradigm concerned with education has to offer.

In fact, the study of aspects of behavioral engagement has been central to behavior analysts' work in schools. The history of work with token economies (e.g., Allyon & Azrin, 1968), the Good Behavior Game (e.g., Barrish, Saunders, & Wolf, 1969), functional behavioral assessment (e.g., O'Neil, Horner, Albin, Sprague, Storey, & Newton, 1997), and group contingencies (e.g., Litrow & Pumroy, 1975) illustrate some of the ways behavior analytic approaches have centered on increasing students' behavioral engagement in educational contexts. Ultimately, interventions associated with these approaches rely on teachers' structuring the application of consequences for individuals or groups to reinforce behaviors associated with task engagement (e.g., asking questions, completing assignments). The evidence-base for interventions stemming form these approaches is strong (for reviews, see Akin-Little, Little, Bray, & Kahle, 2009). Nevertheless, while delivering consequences for appropriate task-focused behaviors is effective, it can also be problematic in classrooms where students may engage in target responses so infrequently that it is not possible to achieve the reinforcement necessary to maintain behavioral engagement (Lee, 2006). An important component of successful consequence-based procedures, then, would be to increase the rate of academic behaviors so that reinforcers can be delivered consistently. In this area as well, behavior analysts have undertaken research specifically designed to examine procedures for and effects of increasing the rate of academic behaviors that may have implications for the study of engagement in schools.

Increasing the Rate of Academic Behaviors

Within ABA, a focus on increasing the rate of academic behaviors has been most closely aligned with Precision Teaching (PT; Binder, 1996; Doughty, Chase, & O'Sheilds, 2004). This focus has led to the discovery of the importance of *fluency*, the fluid combination of accuracy plus speed that characterizes competent performance (Binder). Free-operant responding (i.e., behaviors that may be emitted at any time), rather than discrete trial responding (i.e. behaviors whose rate is controlled by the presentation of opportunities to respond), is fundamental to the demonstration of fluency and the free-operant measurement system employed by precision teachers (Johnson & Layng, 1996). Moreover, precision teachers' instructional focus ensures fluency of component responses before building fluency for composite responses (Johnson & Layng). Once individuals attain certain degrees of fluency, empirically validated outcomes in retention, endurance, and application occur (Kubina & Morrison, 2000). While retention (i.e., mastery over time of educational content) and application (i.e., integration of component behaviors into composite skills) are educationally critical outcomes of fluency, endurance is most germane to behavioral engagement. *Endurance* is the fluent performance of a behavior over prolonged amounts of time (Kubina & Morrison) and increases the likelihood that students maintain task engagement in the face of disruption (Binder). This resistance to response disruption is referred to as *stability* and is a feature of the overall "endurance effect" (Binder, 2004). Specifically, stability suggests that behavior performed at fluency more effectively resists competing stimulus control in the environment.

Precision teaching endurance. In PT studies that have examined endurance, short-duration rate building activities have positive effects on response endurance during longer sessions. For example, Whalen, Willis, and Sweeney (1993) compared 1 min and 4 min timed practice sessions during subtraction of mixed fraction problems for a high school student identified as behavior disordered. Authors reported that fluency during the longer sessions improved to a level near the shorter sessions throughout the study. The implication, then, was that continued practice to fluency at the short-duration sessions encouraged endurance of comparable levels of fluency during the long-duration session.

Similar results were presented by Kim, Carr, and Templeton (2001), who instructed three English-speaking university students in previously unknown Hindi characters. Participants originally acquired the 25 characters to a fluency criterion (i.e., 90-100 words per minute) during 1 min sessions where they said the English translation while looking at the Hindi character on a flashcard. Stability was measured by adding a distracting stimulus (i.e., two individuals orally performing a similar phonics task, thus simulating a typical classroom setting). Results showed a deceleration in correct responding for one participant and an acceleration of errors for a second, while the third participant maintained fluent levels. In the next phase of this study, endurance was measured by changing to 20 min sessions, and results indicated that all participants maintained the 90-100 words per minute fluency criterion during the longer sessions. A final phase of this study continued the 20 min sessions, but added the distracting stimulus again. Results during the final sessions with distraction indicated that all three participants maintained fluent responding. Authors noted that endurance results were positive in their study, suggesting the short-duration fluent responding corresponded with subsequent longer-duration fluent responding, but that stability results were inconclusive. There was not a clear pattern in the impact of fluent responding on all three participants' resistance to distraction across all phases of the study.

In a third PT study on endurance, McDowell and Keenan (2001) taught letter sound identification to an elementary student diagnosed with Attention Deficit/Hyperactivity Disorder (ADHD). Using a 7-phase reversal design, they shifted from 10 min baseline sessions to 1 min intervention sessions and measured endurance of responding in the return to baseline as well as endurance of on-task behaviors. Results showed that acceleration in correct responses during the short-duration intervention phases corresponded with immediate improvement in on-task behaviors to 100% of intervals. Once the participant reached a fluency criterion of 60-80 sounds per minute, his fluent responding endured during reversal to the long-duration baseline sessions, and his on-task behaviors endured at 100% of intervals.

In sum, PT studies targeting endurance described above show that achieving fluency during short-duration sessions leads to the endurance of that fluency during longer sessions. There is some evidence that this endurance leads to increased behavioral engagement as measured through intervals on-task (i.e., McDowell and Keenan, 2001), though inconclusive evidence that it directly leads to resistance to competing stimuli (i.e., Kim et al., 2001). Overall, these studies support the conceptual and anecdotal evidence about the impact of fluency on endurance and behavioral engagement (e.g., Binder, Houghton, & Van Eyck, 1990; Binder, 1996; Johnson & Laying, 1992).

Evoking endurance. While the PT literature includes studies examining the endurance effects of teaching students to increase response rate, other behavior analytic investigations have examined similar effects stemming from task modifications. For example, Montarello and Martens (2005) used an endurance measure to demonstrate effects of the interspersal procedure on four elementary students' math assignment achievement. Interspersing a few brief, more preferred problems into academic assignments targeting difficult, less preferred problems had been shown to increase preference for assignment completion (e.g., Cates & Skinner, 2000). Using a multielement alternating treatments design, Montarello and Martens found that interspersal and interspersal plus token reinforcers both increased all participants' digits correct per minute, and that these mean increases endured throughout the 10 min sessions. Results imply that increasing response rate through inserting easier problems not only increases the degree of fluency students demonstrate during problem completion (i.e., they were able to complete more digits correct per minute), but that this increase in fluency endures across each minute of sessions. That is, students continued to perform at similarly fluent levels in the final minute of sessions as they performed during the initial minute of sessions. While this study did not teach in short-duration sessions and then measure endurance in long-duration sessions–as was typical of PT studies–the underlying outcome of endurance remains the same: participants maintained fluent responding as measured through response rate per minute across sessions of long duration.

Fluent responding across sessions seems that it should be fundamental to measures of behavioral engagement. Students demonstrating endurance are simultaneously successful and on-task. When students maintain accurate academic responding at appropriate rates–

when they demonstrate endurance–they show the clearest signs of behavioral engagement that can help to maintain the optimal learning environment suggested by Academic Learning Time (Fisher et al., 1980). Endurance, then, should be a basis for understanding behavioral engagement.

Endurance and Momentum

Recently, the outcome of endurance has been equated with behavioral momentum (Porritt, Van Wagner, & Poling, 2009). Theoretically, behavioral momentum explains why some behaviors persist in the face of environmental disruption, while others cease, and seems overtly tied to the stability component of endurance. Nevin and colleagues (e.g., Nevin, 1992; 1993; Nevin, Mandell, & Atak, 1983; Nevin & Grace, 2000) have used the analogy of physical momentum to describe this behavioral persistence. Physical momentum is comprised of velocity and mass. Given two objects traveling at the same speed (i.e., velocity), the heavier of the two (i.e., higher level of mass) persists longer when the environment is disrupted in some way, such as when applying the brakes on a vehicle. Similarly, given two objects of the same mass, the one moving at the greater speed persists longer when the brakes are applied. In behavioral momentum, rate of responding is analogous to velocity, while resistance to change (i.e., persistence of behavior) is analogous to mass. Behavior that possesses a high level of momentum tends to persist over time in the face of environmental disruptions.

In a literature review and commentary, Doughty, Chase, and Shields (2004) suggested that the reported benefits of fluency (e.g., endurance) in studies of rate building, such as those presented in the PT literature, are confounded by reinforcement rate. Therefore, the authors argue, some results may be better explained as applications of behavioral momentum. Doughty and colleagues cite research into behavioral momentum (e.g., Nevin, 1979) indicating that reinforcement rate, not response rate, best predicts resistance to disruption, and that when reinforcement rate is controlled across differing response rates, the behavior with the lower response rate persists to a greater degree over time. Thus, any increase in endurance found through studies of rate building may be the result of increased reinforcement rate, and not the increased response rate, per se.

In order to make their claim, Doughty et al. (2004) cite only the basic literature in behavioral momentum. Traditionally basic researchers have focused on the mass component of momentum (i.e., resistance to change; Lee, 2005). In the typical experimental arrangement assessing behavioral mass, responding is reinforced under multiple schedules of reinforcement. The environment is then disrupted in some way and behavioral persistence during the disruption is documented. In a series of basic experiments Nevin and others (e.g., Nevin, Smith, & Roberts, 1987; Grace, McLean, & Nevin, 2003) found that persistence was a function of the total amount of reinforcement–both contingent and noncontingent–delivered for a given behavior. That is, stimulus conditions associated with higher levels of reinforcement produce greater persistence. This basic research was later replicated with humans using computer-based formats (e.g., Dube, McIlvane, Mazzitelli, & McNamera, 2003). By citing only the basic research, Doughty et al. ignore the body of literature that suggests that response rate and reinforcement rate are linked in applied tasks.

In order to develop interventions based on behavioral momentum, applied researchers have taken advantage of the linkage between response and reinforcement rates. Interventions based on behavioral momentum increase response rate (i.e., velocity in the behavioral momentum metaphor) in order to establish momentum effects on behavior (Lee, 2005). The process of building response rate is directly related to reinforcement rate during training through a basic operant paradigm (Nevin, Mendall, & Atak, 1983; Nevin & Grace, 2000). Thus, when a reinforcing consequence follows each behavior emitted, those behaviors are likely to continue. As those behaviors are emitted at faster rates, the access to contingent reinforcers necessarily increases. So, even when a reinforcement *schedule* remains constant, when behaviors increase in rate, the reinforcement *rate* increases.

Response Rate and High-Probability Sequences

The specific interventions stemming from behavioral momentum are referred to as high-probability (high-*p*) request sequences (Killu, 1999; Lee, 2005). Within any response class, such as compliance, there are behaviors that are likely to occur (i.e., high-*p*) and behaviors that are unlikely to occur (i.e., low-*p*). When given a series of low-*p* requests the level of responding and subsequent reinforcement is often below that needed to maintain a target behavior. However, when a series of brief requests, the completion of which has been reinforced in the past, is administered prior to a task with a low probability of completion, the density of reinforcement for the response class as a whole increases. This results in an increase in responding for the entire response class (Lee, 2006).

In a study examining the high-*p* procedure, Mace and colleagues (1988) worked with adults with developmental disabilities. They preceded requests with a low probability of compliance (e.g., "put your lunch box away") with a series of three or four high-*p* requests (e.g., "give me five," "give me a hug," "show me your notebook"). Results showed that high-*p* requests increased compliance to subsequent low-*p* requests. Similar effects were found by other researchers across populations (participants with severe mental retardation – Harchick & Putzier, 1990; a student with autism – Banda & Kubina, 2006; children with EBD – Davis

& Reichle, 1996; general education students – Ardoin, Martens, & Wolfe, 1999), types of requests (self-care – Mace & Belfiore, 1990; communication – Davis, Brady, Hamilton, McEvoy, & Williams, 1994; transition to activities – Wehby & Hollohan, 2000) and interveners (classroom teachers – Ardoin, et al., 1999; parents – Ducharme & Worling, 1994; peers – Davis & Reichle, 1996).

All of these studies increased response rate through rapidly requested tasks (i.e., 3 to 5 s apart; Killu, 1999; Lee, 2005) and increased reinforcement rate though researcher-provided positive reinforcement in the form of praise statements (e.g., "good job"). Moreover, the researcher delivered the requests in a controlled operant (i.e., discrete trial format). That is, participants did not have the opportunity to comply with requests in a self-paced manner; they could only comply once the request was made, and then another request would be made shortly thereafter. The absence of free operant responding in many applied studies of high-*p* sequences, in part, has lead to some controversy over whether these studies actually demonstrate behavioral momentum (e.g., Plaud & Gaither, 1996), though the relation between behavioral momentum and high-*p* interventions is widely accepted (Lee, 2005; 2006; Nevin, 1996; 2005).

One class of high-*p* interventions, though, does take advantage of free operant responding. Characterized as affecting transitions within tasks (Lee, 2006), these high-*p* sequences are embedded in academic assignments and do not involve interveners presenting the high-*p* requests in separate discrete trials. And, interveners do not follow completion of each high-*p* task by individual praise statements designed to increase reinforcement rate. Rather, these applications of high-*p* sequences allow the participants to control their own responding as they move from one task to the next within the assignment, and any reinforcement rate increases are assumed to be connected to participants' reinforcement history for assignment completion.

The increase in reinforcement rate produced through these applications of high-*p* sequences is described by the discrete task completion hypothesis (DTCH; Skinner, 2002). The DTCH suggests that each completed task in a sequence can serve as a conditioned reinforcer. That is, when students have a learning history where task completion has been reinforced, those students experience each completed task within a larger task as a conditioned reinforcer, much like the steps of a task analysis. The conditioned reinforcer may be construed as a positive reinforcer (i.e. the presentation of a completed step toward completing the total assignment, which in turn is consequated with some other positive reinforcer) or negative reinforcer (i.e., a step closer to escaping task demands). Regardless, the completion of each task signals delivery of reinforcement. Moreover, these completed tasks also serve as conditioned stimuli, leading to a greater probability that students complete the next problem in a series.

The DTCH suggests the possibility that an inextricable link between response rate and reinforcement rate may be advantageous in applied academic environments. Rather than the confound Doughty et al. (2004) claim, the link is one that offers insight into the use of rate building and the development of persistence. Similar to benefits of reactivity from self-monitoring in self-management interventions (Mace & Kratochwill, 1988), the fact that response rate and reinforcement rate may be inseparable in building academic fluency supports the use of rate building procedures in schools. If response rate building increases access to reinforcers, which in turn establishes that response as resistant to disruption, the applied benefits to behavioral engagement outweigh concerns over confounds in the theoretical design. While attempts to separate the seemingly inextricable link between response and reinforcement rate are important, they may require basic studies involving species other than humans (e.g., Porritt et al., 2009).

In applied academic assignments, any inextricability between response rate and reinforcement rate might be considered a constant. Certainly, studies of high-*p* sequences in academics using free operant responding acknowledge that the response rate increases likely lead to reinforcement rate increases (e.g., Belfiore et al., 1997). Rather than a confound, this seemingly inextricable connection explains the effectiveness of high-*p* sequences.

High-*p* Studies of Free Operant Academic Responding

Initial studies examining high-*p* sequences in academics focused on mathematics (e.g., Belfiore et al., 1997; 2002). One reason for this may be related to Skinner's (2002) explanation that effects stemming from the DTCH may be most apparent in academic assignments comprised of discrete tasks such as math. Math high-*p* studies established the dependent variable of latency to initiate low-*p* tasks after high-*p* sequences as a measure of momentum in free operant academic responding. Later studies examining high-*p* sequences in language arts (Lee & Lapse, 2003; Joseph & Nist, 2008) have employed other measures, but continued to employ assignments comprised of discrete tasks, functionally similar to math problems (i.e., the participants clearly see the completion of each discrete task). Recently, high-*p* sequences have been incorporated into reading connected text (Vostal & Lee, 2009), representing a shift into a continuous, rather than discrete, task.

Math. The first study to apply high-p sequences to free operant academic responding was Belfiore, Lee, Vargas, and Skinner (1997). In this study, researchers preceded non-preferred, low-*p* math problems with a series of three high-*p* problems (e.g., 4 x 4 = ___, 5 x

8 = ___, 3 x 9 = ___, 587 x 639 = ___) during independent work for two students enrolled at an alternative school for students with behavioral challenges. Results showed that the latency to initiate the low-*p* problems was reduced in the high-*p* condition. Belfiore, Lee, Scheeler, and Klein (2002) replicated the high-*p* sequence from Belfiore et al. (1997) and, given that academic responding was aversive, compared it to a possible negative reinforcement contingency (i.e., discarding every other problem prompt). Participants were two elementary students with high incidence disabilities (i.e., one identified with emotional disturbance, one with learning disabilities). Results indicated that the high-*p* sequence by itself (i.e., without the escape contingency) was effective in decreasing latency to initiate low-*p* problems.

Lee, Belfiore, Scheeler, Hua, and Smith (2004) compared high-*p* math sequences to traditional low-*p* sequences plus token reinforcers. Working with four elementary students receiving special education services for learning disabilities and behavioral support, the authors reported that high-*p* sequences alone had a greater effect on persistence than traditional low-*p* sequences with added reinforcers. This finding offered support to the contention that increasing response rate established a simultaneous increase in reinforcement rate to a greater degree than applying a consequence-based intervention external to the academic assignment. Similarly, Lee, Belfiore, Ferko, Hua, Carranza, and Hildebrand (2006), working with two students identified with learning disabilities, examined effects of high-*p* sequences and high-*p* sequences with token reinforcers on two separate measures of momentum: (a) the traditional high-*p* latency measure (i.e., high-*p* sequence into a low-*p* task), and (b) an exploratory post low-*p* latency measure (i.e., low-*p* task into the subsequent high-*p* sequence). Results demonstrated that momentum generated by high-*p* sequences was expended as participants completed low-*p* tasks and then was reliably regenerated in the next high-*p* sequence–whether token reinforcers were delivered after completion of the low-*p* task or not. This indicated that momentum effects generated by high-*p* sequences were separate from that which could be explained by the Premack principle and were tied to the link between response rate increases and corresponding reinforcement rate increases.

Together, the math studies demonstrate that applications of high-*p* sequences reliably result in reduced latencies to initiate low-*p* tasks during free operant responding. This reduced latency serves as an index of persistence (Belfiore et al., 1997; 2002) when considered over extended assignments. When students transition within assignments more efficiently, they demonstrate more behavioral engagement.

Language arts. High-*p* sequences have been applied to language arts tasks as well, but these studies have employed different measures than the latency measure prevalent in math studies. For example, Lee and Laspe (2003) implemented a high-*p* sequence during a journal-writing task for four elementary students receiving special education services and examined cumulative words written. When participants stopped writing during fixed-duration journaling sessions, researchers instructed them to write a series of three discrete words that typically occasioned compliance and then continue journaling. They found that the high-*p* sequence was more efficient than verbal prompts alone and produced more persistent writing behaviors across sessions.

In another language arts study, Joseph and Nist (2006) examined high-*p* sequences in the acquisition of unknown sight words–by measuring cumulative words read–as well as instructional efficiency (i.e., ratio of unknown to known words read per unit of time). Three elementary students in general education placements were presented high-*p* sequences of sight words (i.e., known word, known word, known word, unknown word), interspersal of sight words (i.e., three known words after every third unknown word), and traditional drill of sight words (i.e., six unknown words only). While high-*p* sequences resulted in the greatest number of words read by participants, the efficiency measure indicated that traditional drill facilitated the highest cumulative learning rate (i.e., participants learned the unknown words the fastest). These results supported results in Lee, Stansbery, Kubina, and Wannarka (2005), who examined the use of high-*p* sequences during math acquisition, showing high-*p* sequences could be effectively incorporated into explicit instruction, but that doing so increased the amount of time that instruction took.

Burns et al. (2009) applied behavioral momentum to reading word lists through establishing the entire list of 100 grade-appropriate words as a low-*p* task. Researchers presented an additional 20 below grade-level words before the 100 words (i.e. behavioral momentum condition) or spread throughout the 100 words (i.e., interspersal condition). Statistically significant results in the group design indicated that participants in the behavioral momentum condition read the target list of 100 words more fluently than participants in the control condition.

Together, these studies of high-*p* sequences in language arts show that high-*p* sequences can be used to increase the amount of work students complete during independent practice, and that initial fluency increases established through momentum may persist into more challenging work. In terms of behavioral engagement, this could represent an increase in time-on-task, and–in terms of ALT–high-*p* sequences could increase overall success during those assignments.

Reading connected text. One study has examined the insertion of high-*p* sequences in a continuous reading task. Vostal and Lee (2009), working with three adolescents enrolled in an alternative school for students with EBD, inserted a high-*p* paragraph (i.e., a sequence of high-*p* sentences) written at participants' independent level of oral reading fluency (i.e., greater than 100 WCPM; Hosp & Hosp, 2003) before a low-*p* paragraph written at participants' instructional level of oral reading fluency (i.e., 70-100 WCPM). Compared to traditional passages written exclusively at participants' instructional level, results indicated that momentum effects of reduced latencies to initiate low-*p* tasks could be established from the increase in response rate represented by independent level oral reading fluency. Also, when response rate was lowered during instructional level paragraphs, latencies to initiate subsequent high-*p* paragraphs were increased compared to the high-*p* measure. Thus, response rate was concluded to establish momentum effects, and simultaneous reinforcement rate increases were suggested because decoding individual words may have represented conditioned reinforcers. However, as predicted by the DTCH, preference assessments suggested that students did not discriminate increased reinforcement in the continuous task to a degree necessary to impact preference in the high-*p* passages, even though their behavior during reading was affected.

In sum, studies of high-*p* sequences in free operant academic responding indicate that they reliably establish momentum effects on the latency to initiate subsequent task components, and can lead to increases in the total amount of work completed and fluency in that work during independent practice. Behavioral momentum theory indicates that greater reinforcement density associated with a particular behavior is responsible for that behavior's resistance to disruption in the face of environmental change. These studies suggest that high-

p sequences overtly increase response rate and momentum effects are apparent. In line with behavioral momentum theory, then, the increase in response rate seems to simultaneously increase reinforcement rate in a manner described through the DTCH.

Additionally, the studies reviewed above offer some evidence that endurance and momentum are related. While endurance–in PT literature–describes fluent performance over prolonged periods of time (Kubina & Morrison, 2000), it also includes the aspect of stability, or the resistance to distraction (i.e., disruption) of that performance (Binder, 2004). Momentum, in turn, describes persistence of behavior (Nevin, 1996), and the reduction in latencies measured in free operant studies of high-*p* sequences indicate the resistance of those responses to disruption when more challenging tasks are presented. If endurance and momentum describe the same phenomenon (Porritt et al., 2009), then the measure of reduced latencies prevalent in high-*p* studies may be a measure of stability. If that is the case, it is possible that teaching practices designed to increase fluency–particularly those fostering endurance–may also produce reductions in latencies between task components in a manner consistent with applications of behavioral momentum theory through high-*p* sequences.

Building Reading Fluency to Establish Momentum

If endurance and momentum describe the same phenomenon, and endurance is an outcome of fluency, then fluency-building instructional practices should also establish the momentum effects found through embedded high-*p* sequences. These momentum effects appear to be established by the simultaneous increases in response and reinforcement rate stemming from high-*p* sequences, as described through the DTCH. Specifically, in terms of reading behaviors, the velocity described in behavioral momentum theory is represented by reading fluency (Vostal & Lee, 2009), where fluent reading describes high, accurate response rate. That is, an individual reads more words correctly in less time. Therefore, fluent reading may increase access to response-contingent reinforcement because individual words may act as conditioned reinforcers. Because high-*p* sequences could be embedded into reading passages through the addition of paragraphs that controlled oral reading fluency (Vostal & Lee), then it may be possible to build fluency through repeated reading to detect similar momentum effects.

Reading fluency is measured through words correct per minute (WCPM; Meyer & Felton, 1999; NRP, 2000; Therrien, 2004; Wexler, Vaughn, Edmonds, & Reutebuch, 2008). Moreover, while reading fluency is recognized as emblematic of decoding achievement (NRP, 2000), the combination of decoding speed and accuracy provides a parsimonious, observable measure of general reading proficiency (Archer, Gleason, & Vachon, 2003; Kostewicz, 2008). For students completing 5th grade, reading fluency should be least 150 WCPM (Hasbrouck & Tindal, 1992), and older students should certainly read at or near this rate (Meyer & Felton). Recent evidence suggests that students' reading fluency aims should actually be higher, approaching 200 WCPM (Kubina, Amato, Schwilk, & Therrien, 2008), in order to affect the retention of those gains over time. Additionally, even though too much focus on accuracy reduces students' reading rates (Samuels, 1979), most researchers agree that a sound fluency measurement requires both accuracy and rate (Mercer, Campbell, Miller, Mercer, & Lane, 2000). This accuracy may be necessary for fluency to affect comprehension. According to LaBerge and Samuels' (1974) theory of automatic information processing, fluency is a prerequisite to comprehension because slow decoding creates a "bottleneck" that constrains attention to understanding.

While there is some argument that rapid oral reading is not a very functional skill (Freeland, Skinner, Jackson, McDaniel, & Smith, 2000), it is possible that poor readers expend so much of their energy decoding words, that they are unable to remember what they read (Homan, Klesius, & Hite, 1993). Evidence supports the correlation between fluency and comprehension at younger grades (e.g., Slocum, Street, & Gilberts, 1995; Paris, Carpenter, Paris, & Hamilton, 2005). For older readers, some evidence suggests that reading fluency is necessary but insufficient to increase reading comprehension to a meaningful degree (Wexler et al., 2008). Nevertheless, fluency remains an important aspect of interventions for older, struggling readers (Rasinski, Padal, McKeon, Wilfong, Friedaur, & Heim, 2005), for whom fluency deficits are commonplace (Strong, Wehby, Falk, & Lane, 2004). These deficits exacerbate engagement problems in secondary settings, where students must keep up with large quantities of written text (Swanson & Hoskyn, 2001), and reading fluency deficiencies hinder students' ability to keep up with class content (Woodruff, Schumaker, & Deschler, 2002), limiting the total amount of text students can read in allotted class time (Mastropieri, Leinart, & Scruggs, 1999). For struggling readers to achieve adequate levels of reading proficiency, systematic opportunities to read more text are critical to improving their fluency (Archer, et al., 2003).

One of the most effective reading fluency interventions across grade levels is repeated reading (NRP, 2000; Therrien, 2004; Wexler et al., 2008). Repeated reading is defined by Samuels (1979) as an intervention in which students reread short, meaningful passages several times until a satisfactory level of fluency is reached" (p.404). There are several variations of repeated reading, including *unassisted repeated reading*, where students read with no adult supervision; *assisted*, where students read along with fluent readers; and *prosodic*, where students are directed toward syntactic and rhythmic cues in the reading through listening to a model (Meyer & Felton, 1999).

Based on data from his meta-analysis, Therrien (2004) recommended guidelines for effective repeated reading interventions. First, interventions should require students to read passages aloud to an adult who delivers corrective feedback, rather than a peer. Second, if the purpose of repeated reading is to read a particular passage more fluently with comprehension (i.e., nontransfer dependent measures), students should be cued to read for either speed or understanding, and they should read the passage three or four times. Third, if the purpose of repeated reading is to improve overall reading fluency and comprehension (i.e., transfer dependent measures), corrective feedback is essential, and passages should be read until a WCPM performance criterion or a specified time period is reached. Components other than these were not found to be harmful, but effects were not great enough to suggest inclusion in efficient interventions.

Repeated reading studies with secondary students. The body of literature on repeated readings for secondary students is reviewed by Wexler et al. (2008). In general, their review supports Therrien's (2004) meta-analytic results that repeated reading improves fluency on rehearsed passages and passages with a high degree of word overlap. Unlike Therrien's results, Wexler et al. found that the fluency gains did not generalize to passage comprehension, though the authors did not differentiate between transfer and nontransfer measures in their review.

One study included in both Wexler et al. (2008) and Therrien's (2004) meta-analysis offers insight into the effects of repeated reading on secondary students' proficiency on nontransfer measures. O'Shea, Sindelar, and O'Shea (1987) examined the relative effects of number of repeated readings on nontransfer measures of fluency and comprehension using a treatment comparison group design. Participants included 29 adolescents identified with learning disabilities, and procedures compared students given a cue to read for speed or comprehension prior to reading passages one time, three times, or seven times. Results demonstrated that the largest fluency gains were made between the first reading and the third, with only smaller fluency gains made when participants continued through seven repeated readings. Additionally, results showed that comprehension improved in both repeated reading conditions (i.e., three readings and seven readings) over only a single reading of the passage. This study illustrates the efficiency of three repeated readings and the use of cues when nontransfer measures are of primary interest, conclusions drawn in Therrien's meta-analysis.

A second study examining repeated reading on nontransfer measures, published after the inclusion dates for Therrien (2004) and Wexler et al. (2008), was Alber-Morgan, Ramp, Anderson, and Martin (2007). Researchers compared effects of repeated reading and repeated reading with prediction on measures of fluency and comprehension. Participants included four adolescents identified with high-incidence disabilities (i.e., two with learning disabilities, two with EBD) attending a day treatment program. Using a three-phase (i.e., baseline, repeated reading, repeated reading plus prediction) multiple baseline design, researchers found positive level changes in reading fluency upon implementation of the repeated reading phase (i.e., two readings) that trended upward throughout the condition. This upward trend continued into the repeated reading plus prediction phase (i.e., predication of content based on title, then two readings), but there was not an additional level change. Comprehension results, measured through correct answers to (a) literal and (b) inferential questions, showed variability in baseline, with three participants achieving ceiling on at least one literal question data point. Repeated reading produced positive, immediate level changes for three participants' literal question responses, stabilizing at ceiling for two participants. Mean correct responses were higher for all four participants on both literal and inferential questions throughout the repeated reading phase, and higher again in the repeated reading plus prediction phase. While the highest mean comprehension scores during the final phase might indicate a practice effect, these results confirm Therrien's finding that repeated reading does have a positive impact on fluency and comprehension in nontransfer measures for secondary students.

Another study offers some indication that effects of repeated reading may extend into direct measures of behavioral engagement. Scott and Shearer-Lingo (2002) examined effects of repeated reading on both reading fluency and time-on-task. Researchers implemented a phonics intervention and then a repeated reading intervention with three seventh grade students identified with EBD in a three-phase (i.e., baseline, phonics, repeated reading) multiprobe-multiple baseline design. Numerous methodological limitations (i.e., too few measures of time-on-task, partial interval time-sampling measure for behavior targeted for increase, repeated measurement of fluency on the same passage across all phases introducing practice effects) severely limit the conclusions that can be drawn from this study, but reported results suggest repeated readings of the target passage improved fluency on that passage. Also, time-on-task was observed to be greatest during the repeated reading phase of the study. Anecdotal reports of participants' behavioral engagement throughout the study suggested that all three demonstrated improvements in attention to reading tasks during the repeated reading phase. Recognizing the limitations present in this study, results generally supported the finding in McDowell and Keenan (2001) that on-task behaviors increased during fluency instruction.

In sum, studies of repeated reading with secondary students seem to support Therrien's (2004) conclusions about their utilization for nontransfer measures. In addition, it is possible that students' behavioral engagement can be increased through participation in repeated reading interventions, though data in support of that claim are tenuous. Nevertheless, while secondary students appear to benefit from repeated reading, at least on nontransfer measures, Wexler et al., (2008) caution that comparative group designs suggested that comprehension gains from repeated reading interventions were no different from comprehension gains from non-repeated reading interventions focused on increasing the overall amount of text participants encountered (i.e. wide reading interventions). In fact, given the weak correlation between fluency and comprehension as students get older (Paris et al., 2005), Wexler et al. suggest that other factors play a larger role in facilitating comprehension for secondary students as they encounter more complex texts. There is some evidence that one of these factors may be vocabulary knowledge, and explicit vocabulary instruction may increase secondary students' comprehension of text (NRP, 2000; Faggella-Luby & Deshler, 2008).

Reading and Vocabulary Instruction

As many as 10% of adolescents demonstrate deficits in identifying words and knowing their meanings (Curtis, 2004), and those who are most in need of vocabulary development never engage in enough reading from a variety of sources to gain meaningful knowledge about words from texts (Baker, Simmons, Kame'enui, 1995; Beck, McKeown, & Kucan, 2002). And while the general importance of vocabulary instruction has been widely accepted (Graves, 2009), the NRP (2000) found that specific vocabulary instruction was an essential component of reading comprehension instruction. According to results from their meta-analysis, preteaching vocabulary before reading facilitates both vocabulary acquisition and comprehension. And while the NRP ultimately found support for both explicit vocabulary instruction and indirect vocabulary learning, the report emphasized the necessity of explicitly teaching words necessary to comprehend specific texts.

Nevertheless, powerful vocabulary instruction takes time (Graves, 2009). Vocabulary knowledge is a complicated, multifaceted construct that has implications for how words should be taught (Beck et al., 2002). And, since secondary teachers may have limited time to focus on struggling learners in general (Faggella-Luby & Deshler, 2008), they should be concerned about the amount of time they can devote to the most powerful vocabulary instruction (Greenwood, 2002). Even though teaching vocabulary is likely to impact students' comprehension, it would be impossible to teach every unknown word a student might encounter. While no clear formula exists for selecting age- or grade-appropriate vocabulary, words have differing levels of utility that should guide selection of words to teach, thus making direct instruction feasible (Beck et al., 2002). Ultimately, teaching vocabulary requires (a) teaching particular words (b) to particular students (c) for particular purposes (Blachowicz & Fisher, 2000).

Teaching particular words. While there has traditionally been nothing scientific about the way words were identified for attention in schools (Beck et al., 2002), Graves (2009) recommended considering the following when determining the words to teach: (a) the importance of the word to understanding the selection, (b) necessity of knowing the specific concept represented by the word, (c) students' acumen in using context to understand the word, (d) skills that might be fostered through trying to understand the word, and (e) usefulness of the word outside the classroom. Similarly, Stahl and Nagy (2006) focused on the importance of the words in passages to be read. Clear within both recommendations was the idea that words should have immediate utility; Graves and Stahl and Nagy agree that a word's usefulness in understanding a passage that is about to be read is the most important consideration for teaching it.

In an attempt better systematize the vocabulary-from-text selection process, Flanigan and Greenwood (2007) recommended a six-step process: (a) read the text and determine instructional goals; (b) identify words students should know; (c) chunk instruction by grouping related concepts; (d) decide which words should be taught before reading; (e) decide which words can be taught after reading; (f) determine what students must know about words in order to select instructional strategies. While this process offers direction for vocabulary selection, one limitation it presents is that it does not verify that individual students need instruction in selected words.

Teaching words to particular students. In order to optimize instructional time, identifying which of the particular words in a text are unknown to particular students should be included in the process. Stahl and Nagy recommended a simple survey, based on the work of Curtis (1987), to determine students' word knowledge. The survey lists possible words for instruction–such as those selected using Flanigan and Greenwood's (2007) process–along with three choices: (a) "I've never seen this word before;" (b) "I've seen this word, it has something to do with...;" or (c) "I know this word and can use it in a sentence and define it" (p.103). Students' responses on the checklist can guide teachers' initial selection of words to teach. Use of a survey such as this may streamline instruction through ensuring time is not spent on words students already know.

Teaching words for a particular purpose. The final step in Flanigan and Greenwood's (2007) vocabulary selection process indicates that instructional strategies should match the instructional purpose necessitating word knowledge. If the purpose is to facilitate basic comprehension of a passage and this is about to be read, then the efficiency of the instructional strategy should be of paramount consideration. One portion of this efficiency recognizes that words can be learned to different degrees. Stahl and Fairbanks (1986) described three levels of vocabulary knowledge: (a) *association,* connecting words with definitions or synonyms in a single context; (b) *comprehension*, demonstrating understanding through manipulating definitions, identifying antonyms, classifying words, and showing comprehension of words in decontextualized sentences; and (c) *generation,* producing vocabulary in new contexts. These levels suggest that if the goal of vocabulary instruction is to facilitate comprehension in a single passage (i.e., a single context), then the association level of knowledge may be sufficient (Wannarka, 2009), which in turn suggests that the most efficient form of association-level instruction may be optimal.

Constant time-delay. One instructional strategy noted for its efficiency is constant time-delay (CTD; Keel & Gast, 1992; McDonnell, Johnson, Polychronis, & Risen, 2002; Schuster, Stevens, & Doak). In CTD, a teacher systematically models a correct response until a student produces that response in the presence of the target stimulus without prompting. For example, if CTD was used to teach vocabulary, initial presentation of the vocabulary word (e.g., target stimulus) would be followed immediately by the definition (e.g., controlling prompt); subsequent presentations of the vocabulary word would then be followed by a "wait time" or constant time-delay (e.g., 3 or 5 s) during which the student would attempt to provide the definition. If the student did not respond correctly, the teacher would again state the definition. One strength of CTD procedures is that they produce near-errorless learning, while establishing frequent opportunities for students to respond (Hughes & Fredrick).

In reading, word identification skills–rather than vocabulary definitions–have often been targeted for instruction using CTD. For example, Keel and Gast (1992) taught three elementary students with learning disabilities to identify multisyllabic words. Researchers used a 3 s delay, and each student received 5 trials of targeted words per session. Results indicated that all students acquired words to criterion in three to four sessions. In another study targeting word identification skills along with spelling, Keel, Slaton, and Blackhurst (2001) instructed 15 students with learning disabilities to identify and spell two sets of four words matched to individual students. Students were taught in groups and received 5 trials per target word per session using a 3 s delay, while sometimes writing only their own targeted words and sometimes writing targeted words from other students in their group as well. Results from the repeated measures design indicated there was no difference in students' identification of words regardless of spelling condition. Together, these two studies illustrate that word identification can be taught efficiently through a 3 s constant time-delay.

Four studies were identified that used CTD procedures to teach vocabulary definitions. One was Schuster, Stevens, and Doak (1990). Researchers used a 5 s delay to teach three elementary students with learning disabilities two separate sets of five words. They offered no explanation as to why a 5 s delay was selected over a 3 s delay. Dependent measures required participants to state the definition when shown the word on a flashcard.

Instructional sessions included six trials per word. Employing a multiple probe design in which introduction of the intervention to each participant for each set was staggered similar to a multiple baseline design, results indicated that CTD led to all participants acquiring target definitions in eight to nine sessions and maintaining those definitions up to 14 weeks after instruction.

McDonnell et al. (2002) used CTD in *embedded instruction*, separate instruction for students with disabilities in an inclusive setting. Two of the four middle school participants, identified with cognitive impairments, were taught content-area vocabulary definitions by a paraprofessional. Sessions included a 3 s delay and trials continued until participants reached a 100% accuracy criterion. Dependent variables included percent correct stating the definition when shown the word on a card, as well as number of trials to criterion. Results showed that both participants achieved criterion in fewer than four trials per word.

In another study employing CTD to teach vocabulary definitions, Hughes and Fredrick (2006) used classwide peer tutoring and targeted three students identified with learning disabilities in middle school. Words were taught in three sets of five, and instructional sessions lasted eight minutes per student using a 5 s delay. Again, no explanation for 5 s rather than 3 s was provided. The dependent measure required participants to write the correct word when given the definition. Results showed that all three students mastered targeted vocabulary and maintained correct responding across time. One student (i.e., Student 2) maintained responding at 100% accuracy during maintenance probes spanning more than 30 sessions.

A fourth study employing CTD to teach vocabulary definitions was Wannarka (2009). Using a peer tutoring structure, three pairs of middle school students instructed each other in content-area vocabulary. Two students were identified with learning disabilities. Dependent measures included stating definitions when shown targeted words, as well as stating targeted and incidental words (i.e., those taught to the partner) when shown definitions, identifying targeted and incidental words when shown the words, and identification of correct usage of targeted and incidental words on a multiple choice exam. Results indicated that five of the six students reached 100% accuracy on targeted words. Additionally, students accurately identified words, produced words when shown definitions, and stated incidental definitions.

Together, these studies using CTD to teach vocabulary show that students can master new definitions rapidly, and that either instructors or peers can effectively implement procedures. Also, students learn not only target words, but when acting as peer tutors, can learn non-target words. The efficiency of CTD suggests that it may be effective for preteaching vocabulary before students read those vocabulary words in a text, which in turn should impact students' comprehension of that text (NRP, 2000). While CTD may achieve only an association level of word knowledge, this may be sufficient during reading immediately after learning the words; the association may reflect that words have appropriate stimulus control over students' comprehension-related behaviors.

Summary

The purpose of this literature review was to trace links within the concepts that served as the foundation of the present study. Specifically, this review focused on (a) behavioral engagement and its importance in academic settings, (b) research into endurance that should be central to behavioral engagement in academic tasks, (c) the relation between endurance and behavioral momentum, and applications of momentum in academics, (d) the use of repeated readings to increase behavioral velocity and engagement during reading, and (e) the selection of vocabulary and the use of CTD to teach vocabulary in order to increase comprehension during reading.

Overall, researchers grounded in ABA have examined many procedures to increase students' behavioral engagement. Two lines of this research (i.e., studies of endurance in PT and studies of behavioral momentum in academics) may be related through their effects on behavioral engagement. Specifically, the aspect of endurance called stability and behavioral momentum may represent the same phenomena in academic behaviors. In the academic behavior of reading connected text, one effective intervention to increase fluency (i.e., behavioral velocity or response rate) is repeated reading, which theoretically should simultaneously establish endurance and momentum effects on reading behaviors. Unfortunately, repeated reading may have limited effects on comprehension for older readers. For these readers, vocabulary instruction may be more important, and one efficient method for teaching vocabulary is CTD. But, it is unclear whether CTD would have any effect on students' behavioral engagement during reading, even if it did increase comprehension. Therefore, the present study was guided by the following research questions:

1) Does repeated reading and/or time-delay vocabulary preteaching reduce latency to initiate subsequent paragraphs, thus establishing momentum effects on indicators of behavioral engagement?

2) Does repeated reading and/or time-delay vocabulary preteaching increase reading fluency, thus establishing reading endurance as an indicator of behavioral engagement?

3) Does repeated reading and/or time-delay vocabulary preteaching increase comprehension?

4) How much time do repeated reading and time-delay vocabulary preteaching take to implement?

5) Does repeated reading or time-delay vocabulary demonstrate greater social validity for pre-reading intervention, as demonstrated by participant preference at the end of the study?

CHAPTER 3

METHODS

Participants and Initial Screening

Three students enrolled at a chartered alternative school for students with EBD in a large northeastern state participated in this study. Their teacher identified all three students as demonstrating comprehension difficulties in reading and disengagement during typical instruction (i.e., failure to initiate and complete academic tasks). All participants returned signed parent/guardian permission to participate in the study, as well as individually assenting to participate. A fourth student returned signed permission and initially assented to participate. He participated in three sessions of baseline before withdrawing his assent. Because he never experienced either intervention, his data are not included in this study.

Initially, all students read a passage comparable to those used in the study; the topic of the passage was, "The Origins of the First Americans." The passage contained 670 words in eight paragraphs. Readability was measured using the Flesch-Kinkaid Grade Level Index and found to be 12.0 (i.e., at a level where most grade 12 students could decode it accurately). To be included in the present study, participants had to orally read the passage with at least 70 words correct per minute (WCPM) but no more than 150 WCPM. The lower criterion was one identified as the lower boundary of oral reading fluency at an instructional level through normative samples (e.g., Fuchs & Deno, 1982; Hosp & Hosp, 2003); the higher criterion was associated with the upper boundary of oral reading fluency at the instructional level established within Precision Teaching literature (Kubina & Starlin, 2003), which specifies greater behavioral fluency aims than those typically identified through norms. Thus, students who read between 70 and 150 WCPM demonstrated sufficient fluency to be able to decode material presented in this study, but demonstrated a need for improvement to meet behavioral fluency aims.

Jeremiah was a 19-year-old, white male, enrolled in 12th grade. In addition to an EBD identification, Jeremiah was identified with traumatic brain injury (TBI) after suffering grand mal seizures. During initial screening, he read the passage at an average fluency of 89 WCPM. Michael was a 15-year old, white male, enrolled in 10th grade. During the initial screening, he read the passage at an average fluency of 135 WCPM. Candice was a 17 year-old, white female, enrolled in 11th grade. During the initial screening, she read the passage at an average fluency of 113 WCPM.

Setting

Intervention sessions took place in a one-on-one tutoring format in a conference room adjacent to the classrooms at the school. Students sat at a table in the center of the room; the researcher sat across the table for pre-reading intervention. During independent reading, the researcher moved away from the table to a nearby desk in order to decrease his impact as a discriminative stimulus for responding. A computer with video recording capabilities was placed on the table to record the participant throughout each session.

Materials

Passages. Passages were selected from the online American History textbook *Digital History* (Mintz, 2007). The textbook was separated into forty-five chapters, and within each chapter were multiple sections. One or two sections from each of the first 20 chapters were modified to be 8-9 paragraphs of 600-700 total words. Modifications were minimal, and consisted of eliminating or combining sentences, paragraphs, or sections to fit the above guidelines. The section from the first chapter was used in the initial screening, and 19 passages were used during the study. Average readability of these modified passages was measured at 11.9 (range 11.0 – 12.0). Each paragraph was presented on an individual page, requiring participants to turn the page at the end of each paragraph. This is similar to material presentation in Vostal and Lee (2009), where paragraphs of alternating readability were presented on separate pages, and Lee et al. (2004), where traditional and high-*p* sequences of math problems were presented on separate cards. All paragraphs were presented in 1.5-spaced, 20-point, Cambria font in black ink on white paper.

Vocabulary. Researchers selected eight words from each passage for possible vocabulary instruction based on the guideline recommended by Stahl and Nagy (2006) and Graves (2009), who suggested that words central to understanding a passage should be explicitly taught to students. Flanigan and Greenwood (2007) operationalized this guideline by suggesting that teachers first preview passages to determine words with which students may have difficulty, then determine these difficult words centrality to passage comprehension. To this end, two researchers previewed all passages and individually identified eight words per passage for possible instruction. Overall agreement between the words selected for each passage was 82% (range 50%-100%). Researchers discussed each disagreement in relation to passage content and came to a final agreement of eight words per passage.

Participants then completed a pretest on their level of word knowledge similar to a survey of word knowledge (Curtis, 1987; Stahl & Nagy). Words were listed in the left column, followed by blanks in which students indicated one of three choices: (a) "I've never seen this word before;" (b) "I've seen this word; it has something to do with...;" or (c) "I know this word and can define it." Participants completed this assessment orally over three days (i.e., 128 words from 15 passages used in the intervention conditions, separated into 48, 40, 40 words per day), and the researcher recorded responses in writing and using digital video. If students chose option (b), they were instructed to indicate with what they associated the word. If students chose option (c), they were told to state a brief definition. In the end, five words were selected for instruction for each participant from each passage based on the following hierarchy of inclusion: words the participant indicated he or she had (a) never seen before, (b) defined incorrectly, or (c) seen before but could not name an association.

The researcher created vocabulary flash cards for each word scheduled for instruction for each participant. Each card measured approximately 5.8 cm by 8.8 cm. The vocabulary word was printed on the front of the white card in black ink, 36-point, bold, Cambria font. On the back of the card, a simplified form of the definition presented in the *Oxford American Dictionary* was printed in 20-point font. The definitions were simplified to fewer than six words (range 2-6). A second researcher examined each definition on each flashcard to determine its accuracy. Agreement on the accuracy of the simplified definitions was 100%.

Procedures

One session was conducted per day during participants' first period homeroom class. Each participant came to the intervention room individually. The teacher, who used the homeroom time for individual conferences with students on their academic and behavioral progress, determined the order of participants each day. Upon entering the room and sitting at the table, the researcher thanked the participant for attending and reminded the participant that the session was recorded. The researcher pressed record on the computer screen, and then blacked out the screen so that the participant could not view her or himself during the session.

To maintain some contiguity of text, all passages were presented in the same order to all participants. To control for order effects, the intervention conditions under which participants read the passages were counterbalanced across sessions with the rule that the same condition could not be presented more than twice in a row. Each participant read a passage under each intervention condition five times.

Baseline. In the baseline condition, students were presented a passage and told, "You will read this passage out loud. When you are finished, you will tell me what it is about. Please begin reading now." No pre-reading intervention took place. Then the researcher walked to a desk in the corner of the room as the participant read aloud. Upon completion of the passage, the researcher returned to the table, sat across from the participant, and asked, "What was passage the about?"

Repeated reading. In the repeated reading (RR) condition, students were presented an oral reading fluency rehearsal session prior to reading the target passage. Procedures for conducting the RR session were based on recommendations from Theirren (2004) and Therrien and Kubina (2006). Paragraphs for repeated reading consisted of every other paragraph from the target passage for that session, in a manner congruent with the presentation of alternating high-*p* paragraphs in Vostal and Lee (2009). Alternating repeated paragraphs (i.e., high-*p*) with unpracticed (i.e., low-*p*) paragraphs allowed for examination of latencies between paragraphs both before and after unpracticed (i.e., low-*p*) paragraphs, measures indicative of persistence and effects of behavioral momentum (Belfiore et al., 2002; Lee et al., 2006). Students were shown the paragraphs and told they would read them three times, each time trying to read faster than before, and then the paragraphs were mixed into the total passage for a fourth and final reading. Four total readings was used for RR because Therrien indicated that if the purpose of repeated reading was to read a particular passage more fluently, then students should be cued to read for speed and should read the passage three or four times.

The researcher told the participant, "Before you read the entire passage, you are going to preview a few paragraphs from it. You are going to read these paragraphs a first time as fast as you can. Then you will read them a second and third times, each time reading as fast as you can. I will tell you how fast you read and any words you mispronounced after each reading. Please start reading now." The researcher started timing when the participant read the first word and marked errors on a second copy of the passage. If the participant hesitated on a word for more than three seconds, the researcher pronounced the word. Timing stopped when the student read the final word. Students were told the duration of reading, and the researcher pronounced any misread words and instructed the participant to pronounce them correctly.

As soon as the third reading and feedback were completed, repeated paragraphs were mixed back into the target passage and placed in front of the participant. The researcher told the participant he or she would read the entire passage out loud, and said, "Please begin reading now," then walked to the desk in the corner of the room, and the participant read aloud. After reading, the participant was asked what the passage was about in the same way as the baseline condition.

Time-delay vocabulary. In the time-delay vocabulary (TV) condition, students were presented a vocabulary rehearsal session prior to reading the passage. Procedures for introducing the TV flashcards were based on the CTD procedures in Keel, Slaton, and Blackhurst (2001) and Schuster, Stevens, and Doak (1990). Initially the researcher said, "Before you read the entire passage, we are going to preview some words from the passage. I will hold each card with the word, and then tell you the definition. After we have gone through all the cards once, I will hold up a card with a word, and you should tell me the definition." Each of the five words was introduced using a 0 s delay, in which the researcher held up the card, stated the vocabulary word, and then stated the definition. Then, cards were shuffled to increase the likelihood that participant responses were controlled by the target stimulus itself, and not the order of presentation. If the student gave an incorrect definition or did not respond after 3 s, the researcher stated the definition and asked the student to repeat it. This was continued until the participant identified each definition for each word within 3 s. Then, the participant was instructed to read a passage in the same format as in baseline and RR conditions. The researcher walked to the desk in the corner of the room, and the participant read aloud. After reading, the participant was asked what the passage was about in the same way as the baseline and RR conditions.

Experimental Design

The experimental design employed in this study was a single-subject, combined multiple baseline-multielement design (Kennedy, 2005), in which two conditions were alternated during the treatment phase. Kennedy notes "combined designs are often the analytical tool of choice when researchers are interested in understanding the basic mechanisms influencing behaviors of educational interest" (p.188). A strength of the combined design is that if one component of the design (e.g., multiple baseline) fails to demonstrate a functional relation, the other component (e.g., multielement) may still demonstrate experimental control (Kennedy). The multiple baseline across participants component allowed detection of the functional control replication across tiers within the graph (i.e., participants' data paths). The multielement (i.e., alternating treatments) component of the design relied on response differentiation among rapidly alternated conditions in order to establish functional relations, and allowed for detection of participants' response differentiation between the two conditions (i.e., RR and TV). The advantage of the multielement design over other single-subject designs (e.g., ABAB) is that it makes direct comparison of multiple conditions possible. The multielement component of the design has been used to examine effects of pre-reading activities (e.g., Beck, Burns, & Lau, 2009), effects of high-*p* sequences (e.g., Lee et al., 2004) and high-*p* readability (Vostal & Lee, 2009) on measures of persistence, and effects of interspersed brief problems on math endurance (Montarello & Martens, 2005). Analysis of single-subject designs such as that employed in this study relies on visual inspection of graphs (Kennedy, 2005). Patterns within phases are examined for variability and trend, and between phases for level changes. Additionally, means within phases are often compared across phases to examine intervention effects (e.g., Lee et al., 2006)

A limitation of multielement designs is the potential for interaction effects (Kennedy, 2005), where responding in one condition carries over into another condition. One method of reducing possible confounds associated with interaction effects is through counterbalancing conditions. The fact that each condition was presented independently on separate days in a random order, as well as the fact that stimuli associated with each intervention condition were quite different, limited the possibility of interaction. Moreover, there was no reasonable expectation of interaction between tiers of the multiple baseline component of the design to act as a confound to functional relations established through that component; therefore, this combined design offered strong evidence of any functional relations established through the three conditions (i.e., baseline, RR, TV).

Data Collection

All sessions were video recorded using software and a built-in camera on a laptop computer. Files were converted to full-quality digital videos with audiowave files, and then saved on DVDs. Sessions were scored directly from these files, using the time-stamped counter and visual audiowave. The audiowave allowed for precise measurement of the point at which a participant initiated and subsequently completed reading each paragraph. The digital files were used for primary data scoring, as well as agreement scoring.

Dependent Measures

Momentum. The first dependent measure was mean latency to initiate subsequent paragraphs, which provided an index of momentum. Latency was defined as the time between orally reading the last word of the preceding paragraph (i.e., the stimulus to turn the page and continue reading) and the initiation of the first word in the next paragraph. Belfiore et al. (1997) initially established this dependent variable as the primary measure of momentum effects on persistence to complete academic tasks. Subsequent studies (e.g., Lee et al., 2004; Lee et al., 2006; Vostal & Lee, 2009) used this measure in studying applications of behavioral momentum and high-*p* sequences to increase persistence.

Endurance. The second dependent measure was words correct per minute (WCPM), which provided an index of endurance (i.e., fluency over long sessions). Montarello & Martens (2005) used a similar measure (digits correct per minute; DCM) in their study of endurance during math problems. In that study, researchers looked at the total digits correct across a session, as well as rate per minute of the session, facilitating a comparison of students’ work completion across individual minutes. In the present study, total words correct across the entire passage was divided by the number of minutes read to calculate an overall index of students' reading endurance. Also, number of words correct per paragraph divided by time to read that paragraph was used to compare fluency across repeated paragraphs in the RR condition.

Comprehension. The third dependent measure was retell thought units, which provided an index of comprehension. Following scoring procedures based on those used in Gardill and Jitendra (1999), each retell was transcribed verbatim for scoring. Thought units were defined as expressions of thought that related to a specific passage containing a subject and predicate. Additionally, since participants were not instructed to speak in complete sentences during retell, any predicate that completed the clause, “This subject was about…” was scored as an individual thought unit if it related to a specific passage. One strength of this measure of comprehension is that it is not limited by possible ceiling effects that could occur with a series of researcher-prepared comprehension questions (e.g., Valleley & Shriver, 2003; Alber-Morgan et al., 2007).

Duration. The fourth dependent measure was pre-reading duration. Pre-reading duration was defined as the amount of time between the researcher introducing the session and the participants' first word read in the target passage. Pre-reading duration was measured only for the two intervention conditions. This measure was recorded in order to offer some insight into the feasibility of using either condition as a preteaching intervention in applied settings.

Social Validity

In order to assess the social validity of interventions, participants selected their preference between the two interventions (i.e., RR or TV) at the end of the study. Also, participants explained why they preferred their chosen intervention, as well as what they did not like about the intervention that they did not choose. Finally, participants were asked what their teachers could do to help them stay engaged in textbook reading in class. Participants responded orally, and their responses were recorded on digital video.

Agreement and Procedural Integrity

Agreement. Two observers collected interobserver agreement (IOA) on 20% of the sessions. At least three sessions were randomly selected from each participant for agreement. The secondary observers viewed the video files on the same computer as used for primary scoring and scored all dependent measures using the time-stamped counter and audiowave on the video file. For the latency measure, an agreement was scored if the second observer's recorded latency was within .1 s of the primary observation. The interval (i.e., point-by-point) agreement method (Kennedy, 2005) was used to calculate IOA, where the number of agreements was divided by the number of agreements plus disagreements; latency agreement was 90.1% (range 83.3% - 100%). Setting a threshold for agreement at a more liberal .5 s (i.e., still a stricter threshold than any published study of the effects of high-*p* sequences), latency agreement was 100%.

Agreement procedures used in the repeated reading study presented in Kostewicz (2008) were employed for other measures. For the WCPM measure, the total agreement method (Kennedy) was used to calculate IOA by dividing the smaller number of correct words read per session by the larger number of correct words; WCPM agreement was 99.0%

(range 97.8 - 100%). Similarly, for the retell thought unit and pre-reading duration measures, total agreement was used; retell thought unit agreement was 100%, and pre-reading duration agreement was 100%.

Procedural integrity. Another observer assessed procedural integrity through the use of a checklist of the procedures (e.g., researcher welcomed student, delivered assigned pre-reading intervention; see Appendix B) on 20% of the sessions. At least three sessions from each participant were randomly selected. Procedural integrity was 100%.

CHAPTER 4

RESULTS

Momentum

Latency to initiate subsequent paragraphs was measured as an index of momentum. Shorter latencies indicate that participants turned the page and continued reading more quickly, a factor that would lead to greater time-on-task when observed across an entire assignment. Figure 1 presents a representation of two latency measures observed during the RR condition, in which repeated readings of every other paragraph was hypothesized to establish high-*p* and low-*p* conditions. Data for pre low-*p* latencies (H-L) are the traditional measure of momentum effects in free operant academic responding (e.g., Belfiore et al., 1997; 2002). Data for post low-*p* latencies (L-H; i.e., latency to initiate a repeated paragraph after reading an unpracticed paragraph) document additional evidence of momentum effects when combined with the typically reported pre low-*p* latency (i.e., measures should be higher, thus showing expenditure of momentum through low-*p* tasks; Lee et al., 2006). Table 1 shows mean latencies and standard deviations across conditions.

Figure 1: Representation of latency measures from high-p (i.e., repeated) to low-p (i.e., unpracticed) paragraphs (H-L) and low-p to high-p paragraphs (L-H).

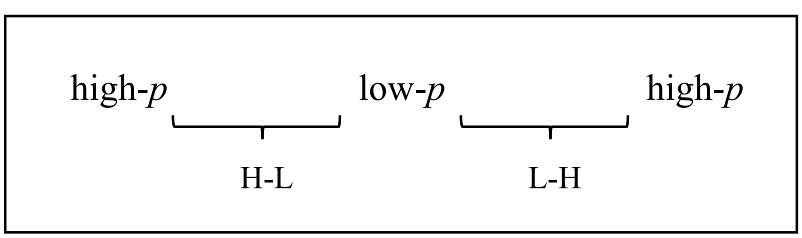


Table 1

Mean latencies (standard deviations) across conditions in seconds

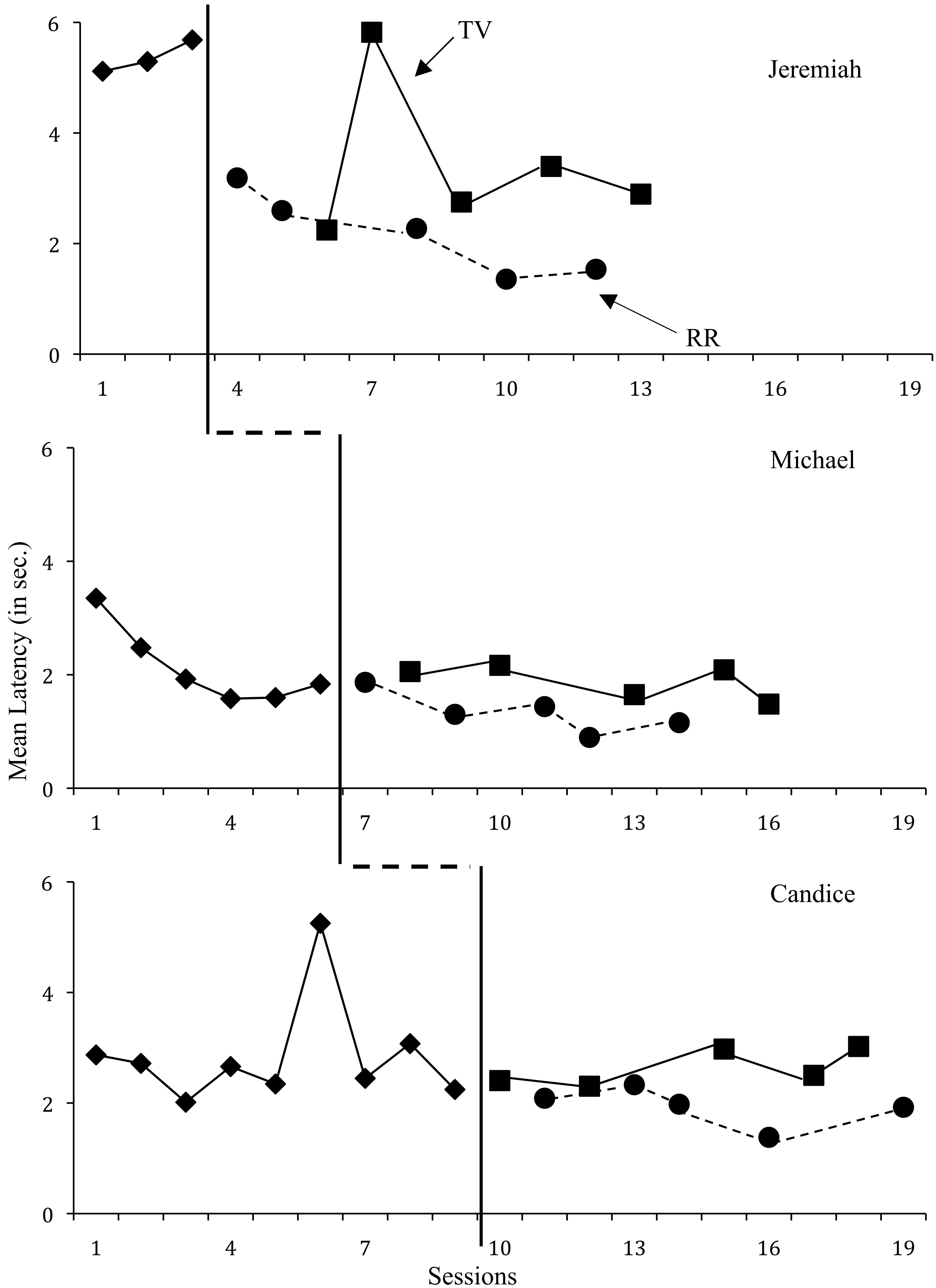
Participant	Baseline	Repeated Reading		Time-delay Vocabulary
		H-L[a]	L-H[b]	
Jeremiah	5.36 (.29)	2.19 (.76)	3.03 (1.69)	3.42 (1.40)
Michael	2.13 (.68)	1.33 (.36)	1.42 (.21)	1.89 (.30)
Candice	2.85 (.96)	1.94 (.35)	2.44 (.72)	2.64 (.33)

[a] Latency between repeated paragraph and initiation of unpracticed paragraph within the target passage reading (i.e., 4th read).

[b] Latency between unpracticed paragraph and initiation of repeated paragraph within the target passage reading (i.e., 4th read).

Momentum results considered through mean latencies across sessions followed the same pattern for all three participants. Mean latency to initiate subsequent paragraphs was highest for all three participants in the baseline phase. Mean latency dropped in the TV condition, but was lower still across both measures in the RR condition. Mean latency to initiate subsequent paragraphs was lowest after reading high-*p* paragraphs in the RR condition. Data establishing these means are presented in Figure 2, which shows latency to initiate subsequent paragraphs per session in baseline, followed by the comparison between mean latency per session to initiate subsequent paragraphs in the TV condition and the mean latency per session to initiate subsequent low-*p* paragraphs after reading a high-*p* (i.e., rehearsed) paragraph in the RR condition.

Figure 2: Mean latency after high-*p* paragraphs in repeated reading (RR) and after time-delay vocabulary (TV).



For Jeremiah, mean latency to initiate subsequent paragraphs was 5.36 s (*SD* = .29) during baseline. Mean latency to initiate unpracticed paragraphs after a high-*p* (i.e., repeated) paragraph was 2.19 s (*SD* = .76), while mean latency to initiate repeated paragraphs after a low-*p* (i.e., unpracticed) paragraph was 3.03 s (*SD* = 1.69). The high-*p* mean represents a 59% reduction and the low-*p* mean represents a 43% reduction from baseline. Mean latency in the TV condition, 3.42 s (*SD* = 1.40), was 36% lower than baseline. Visual inspection of data for Jeremiah indicated that mean latency per session demonstrated variability in the TV condition, with one point dropping below the data path during the RR intervention. Data in the RR condition demonstrate a downward trend across sessions, but typically lower than TV, and always lower than baseline.

For Michael, mean latency to initiate subsequent paragraphs was 2.13 s (*SD* = .68) during baseline. Mean latency to initiate unpracticed paragraphs after a high-*p* (i.e., repeated) paragraph was 1.33 s (*SD* = .36), while mean latency to initiate repeated paragraphs after a low-*p* (i.e., unpracticed) paragraph was 1.42 s (*SD* = .21). The high-*p* mean represents a 38% reduction and the low-*p* mean represents a 33% reduction from baseline. Mean latency in the TV condition, 1.89 s (*SD* = .30), was 11% lower than baseline. Visual inspection of data for Michael indicated an initial downward trend in latencies per session during baseline, before starting an upward trend in the final two baseline sessions. There was no immediate effect with the introduction of the alternating treatments phase; however, a functional relation was demonstrated within the alternating treatments phase. The data path in the RR condition remained lower than the data path in the TV condition throughout the intervention phase.

For Candice, mean latency to initiate subsequent paragraphs was 2.85 s (*SD* = .96) during baseline. Mean latency to initiate unpracticed paragraphs after a high-*p* (i.e., repeated) paragraph was 1.94 s (*SD* = .35), while mean latency to initiate repeated paragraphs after a low-*p* (i.e., unpracticed) paragraph was 2.44 s (*SD* = .72). The high-*p* mean represents a 32% reduction and the low-*p* mean represents a 14% reduction from baseline. Mean latency in the TV condition, 2.64 s (*SD* = .33), was 7% lower than baseline. Visual inspection of data for Candice indicated variability during baseline, with mean latency during Session 6 much greater than others. Like Michael's data, there was no immediate effect with the introduction of the alternating treatments phase; but also like Michael's data, a functional relation was demonstrated within the alternating treatments phase as the data path in the RR condition remained lower than the data path in the TV condition across the phase.

Endurance

The RR intervention was hypothesized to increase reading endurance (i.e., fluency across long sessions) greater than other conditions because each repeated reading in the RR condition would result in increased fluency on those repeated paragraphs. The WCPM were measured across each repeated reading and for repeated paragraphs within the target passage to document fluency increases in each repeated reading. Table 2 shows mean reading fluency gains on repeated paragraphs across sessions. These data from the RR condition only are presented first in this section, then data documenting endurance across all conditions when reading entire target passages are presented.

Table 2

Mean reading fluency (standard deviations) across repeated paragraphs during Repeated Reading (RR) rehearsals in words correct per minute (WCPM).

Participant	RR1	RR2	RR3	RR4[a]
Jeremiah	59.12 (8.62)	74.09 (16.83)	84.21 (20.38)	86.13 (17.83)
Michael	130.94 (14.08)	142.91 (13.92)	154.20 (14.42)	155.40 (9.41)
Candice	123.39 (9.74)	146.92 (13.92)	166.42 (12.96)	146.49 (7.98)

[a] Mean WCPM includes latency to initiate following paragraphs, but excludes WCPM and subsequent latencies in unpracticed paragraphs during target passage reading.

Across all RR sessions, each participant demonstrated increased reading fluency between the first and second readings: (a) Jeremiah increased 25%, (b) Michael increased 9%, and (c) Candice increased 19%. Similarly, each participant demonstrated additional increases in reading fluency in the third readings: (a) Jeremiah increased 42% over first readings, (b) Michael increased 18% over first readings, and (c) Candice increased 35% over first readings. The fourth reading of the repeated paragraphs represents an aspect of endurance because it shows fluency over a longer session than the initial fluency training. During the fourth reading of repeated paragraphs (i.e., when mixed into the target passage and alternated with unpracticed paragraphs), Jeremiah and Michael both demonstrated larger increases over first readings (46% and 19%, respectively). Candice demonstrated a smaller increase than she had in earlier readings, with fourth readings averaging only 19% more fluent than her first readings.

Table 3 shows mean WCPM and standard deviations across conditions. Data for all three participants demonstrated greater variability during the baseline phase than during the RR or the TV conditions, and endurance was greatest for all three participants in the RR condition. Figure 3 shows participants' reading endurance in WCPM per session in baseline, followed by the comparison between WCPM per session WCPM in the RR condition (i.e., across the entire target passage during the fourth reading) and in the TV condition.

Table 3

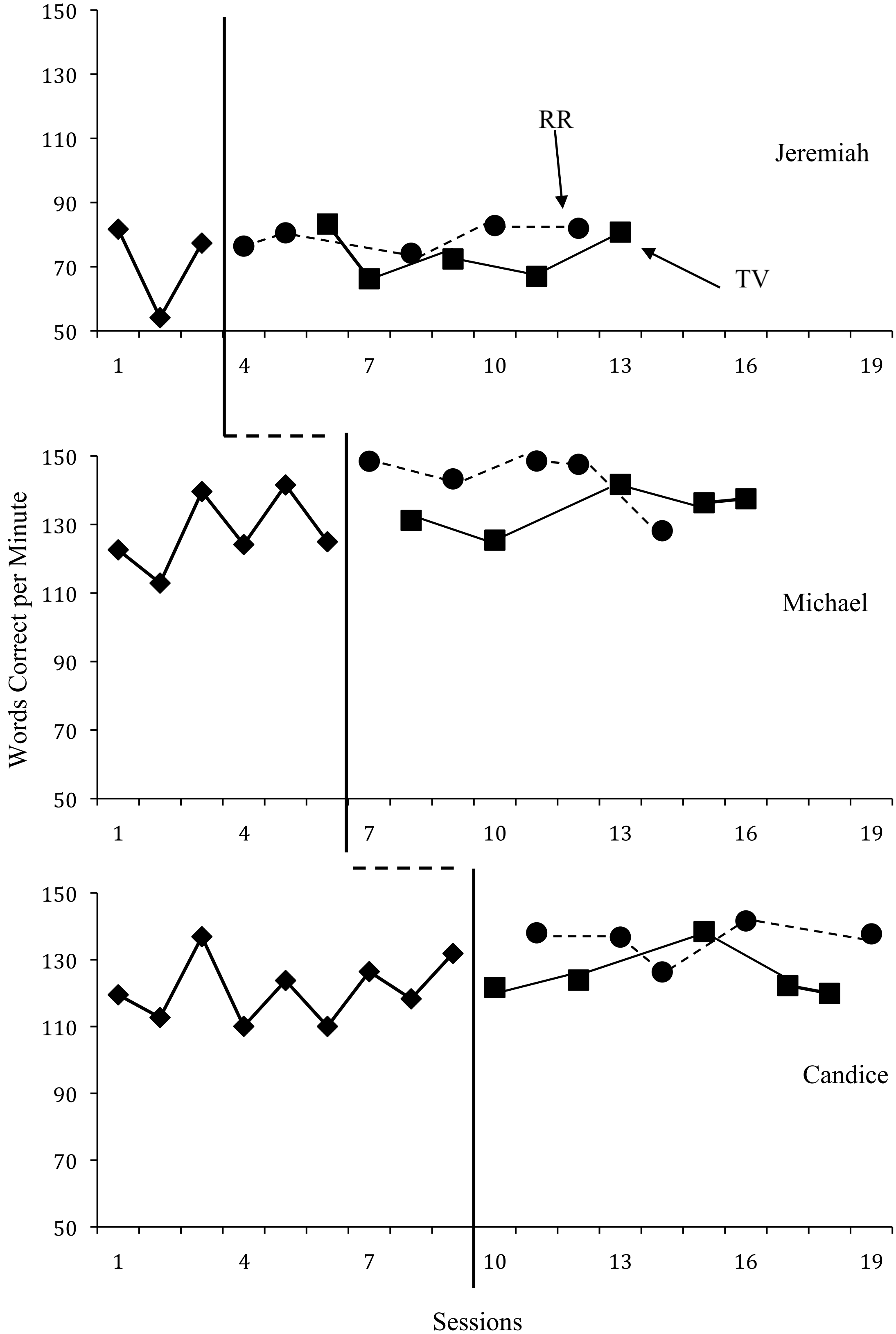
Mean reading endurance (standard deviations) across conditions in words correct per minutes (WCPM)

Participant	Baseline	Repeated Reading[a]	Time-delay Vocabulary
Jeremiah	71.05 (14.84)	79.19 (3.72)	73.94 (7.81)
Michael	127.63 (10.94)	143.20 (8.67)	134.43 (6.27)
Candice	121.07 (9.54)	136.11 (5.76)	125.25 (7.50)

[a] Across entire target passage (i.e., fourth read of repeated paragraphs and first read of unpracticed paragraphs)

For Jeremiah, mean WCPM across all baseline sessions was 71.05 (*SD* = 14.84). During RR sessions, mean WCPM was 79.19 (*SD* = 3.72), representing an 11% increase over baseline. During TV sessions, mean WCPM was 73.94 (*SD* = 7.81), representing a 4% increase over baseline. Visual inspection of Jeremiah's data indicted the data paths for the RR condition and TV condition overlapped, though WCPM was higher in all but one case (i.e., Session 2) in the RR session than in a subsequent TV session.

Figure 3: Words correct per minute after repeated reading (RR) and time-delay vocabulary (TV)



For Michael, mean WCPM across all baseline sessions was 127.63 (*SD* = 10.94). During RR sessions, mean WCPM was 143.20 (*SD* = 8.67), representing a 12% increase over baseline. During TV sessions, mean WCPM was 134.43 (*SD* = 6.27), representing a 5% increase over baseline. Visual inspection of Michael's data indicated that his reading endurance was greater for four out of five RR passages than TV sessions, suggesting a functional relation. In Session 14, the data path for the RR condition intersects with the data path for the TV condition.

For Candice, mean WCPM across all baseline sessions was 121.07 (*SD* = 9.54). During RR sessions, mean WCPM was 136.11 (*SD* = 5.76), representing a 12% increase over baseline. During TV sessions, mean WCPM was 125.25 (*SD* = 7.50), representing a 3% increase over baseline. Visual inspection of Candice's data indicated that the data path for the RR condition was greater than that of the TV condition for eight of the ten alternating treatments sessions, suggesting a functional relation. In session 14, WCPM during the RR condition dropped, while the WCPM in the immediately subsequent TV condition rose, resulting in the data paths' intersection.

Comprehension

The time-delay vocabulary intervention was hypothesized to increase comprehension greater than other conditions. Figure 4 shows retell thought units per session for each participant. Table 4 shows mean retell thought units across all conditions for each participant. Data indicated that all participants' mean comprehension scores were greater in the intervention conditions than during baseline.

Figure 4. Retell thought units after repeated reading (RR) and time-delay vocabulary (TV)

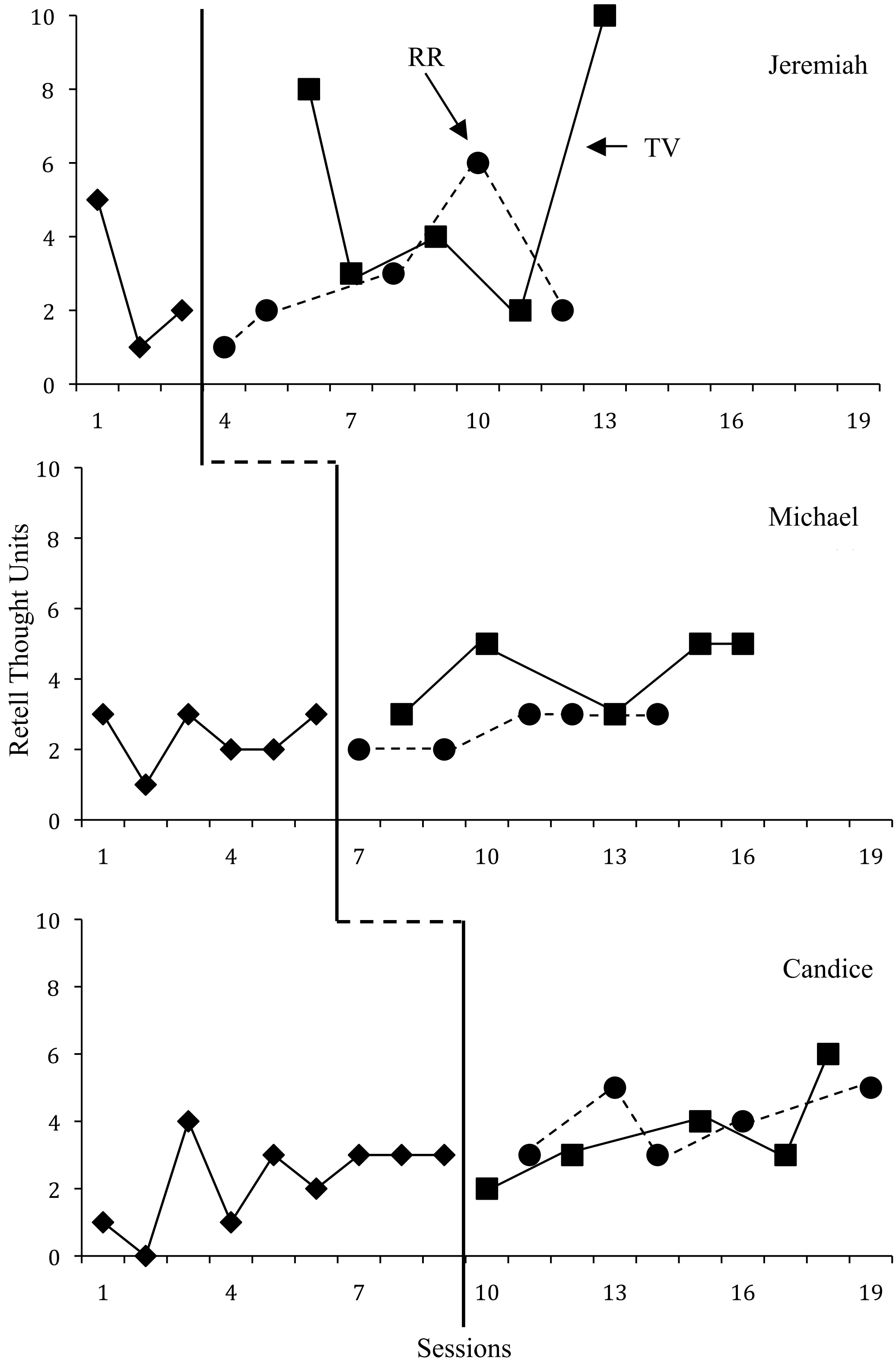


Table 4

Mean comprehension score (standard deviations) across conditions in retell thought units

Participant	Baseline	Repeated Reading	Time-delay Vocabulary
Jeremiah	3.33 (3.21)	3.67 (2.08)	5.40 (3.44)
Michael	2.33 (.82)	2.60 (.55)	4.2 (1.09)
Candice	2.22 (1.30)	4.00 (1.00)	3.60 (1.52)

For Jeremiah, data demonstrated variability in each condition. Mean retell thought units during baseline were 3.33 (*SD* = 3.21). Visual inspection of the data indicated that the number of thought units during the first session (i.e., Session 5) was higher than in either the second or third sessions (i.e., 1 and 2 thought units, respectively), increasing the mean during baseline. During the RR condition, mean retell thought units were 3.67 (*SD* = 2.08), with the highest (i.e., 6) scored in Session 10. During the TV condition, mean retell thought units were 5.40 (*SD* = 3.44). The two highest number of retell thought units were scored in the TV condition: (a) Session 6 was scored at 8, and (b) Session 13 was scored at 10.

For Michael, data were stable during baseline, with mean retell thought units of 2.33 (*SD* = .82). During the RR condition, mean retell thought units were 2.60 (*SD* = .55). During the TV condition, mean retell thought units were 4.2 (*SD* = 1.09). Visual inspection of the data indicated that three sessions (i.e., Sessions 10, 15, 16) were scored at 5, representing the highest individual scores Michael achieved across all conditions.

For Candice, data initially demonstrated variability during the first four sessions of baseline, before stabilizing across Sessions 5 through 9. Mean retell thought units during baseline were 2.22 (*SD* = 1.30). During the RR condition, mean retell thought units were 4.00 (*SD* = 1.00), with highs of 5 scored in Sessions 13 and 19. During the TV condition, mean retell thought units were 3.60 (*SD* = 1.52). While the mean during the TV condition was lower than during the RR condition, the highest individual score Candice achieved (i.e., 6 in Session 18) was scored during the TV condition.

Duration

Table 5 shows the mean duration of the pre-reading interventions for each of the three participants. The TV intervention took longer than the RR intervention for Michael, the student with the greatest reading fluency as measured during the initial screening.

Table 5

Mean prereading duration (standard deviation) across intervention conditions in minutes

Participant	Repeated Reading	Time-delay Vocabulary
Jeremiah	23.06 (4.97)	10.03 (7.22)
Michael	8.60 (1.93)	12.73 (6.46)
Candice	9.05 (2.25)	4.71 (1.68)

Data indicated that the RR intervention took longer than the TV intervention for Jeremiah and Candice, students with lower initial reading fluency as measured in the screening assessment. As noted earlier, Jeremiah made frequent comments during the repeated readings; additionally, he often put his head down between rehearsals and had to be redirected to the task. All of these behaviors were included in the duration measure.

Social Validity

After completion of the study, participants were asked their preference between the two interventions (i.e., RR or TV), as well as for reasons for that choice. Jeremiah preferred the TV intervention, stating that learning the new words was easier. He disliked reading the same passage "over and over again." Conversely, both Michael and Candice preferred the RR intervention to the TV intervention. Michael noted that the RR procedure "was easier" than the TV, and that the TV was "hard trying to go through" the five words. Candice suggested that in going over the reading repeatedly she felt that she understood it better, while the TV intervention helped her understand "only big words." In response to the final social validity question (i.e., "What can teachers do to help you stay engaged in textbook reading?"), Jeremiah said, "Absolutely nothing." Michael and Candice each responded, "I don't know."

Summary

In summary, first, results showed momentum effects of reduced latencies in the RR condition, as predicted. Mean latencies were shortest for each participant in the H-L measure, slightly longer in the L-H measure, and slightly longer still in TV for all three participants, though not as long as in baseline. Second, results showed predicted increases in mean reading endurance (i.e., fluency across longer passages) during RR compared to other conditions for all participants, but all participants demonstrated slight increases in endurance during TV compared to baseline as well. Third, results showed predicted increases comprehension during TV for two participants (i.e., Jeremiah and Michael) compared to other conditions, while Candice demonstrated slightly higher comprehension scores in RR than TV. Fourth, results showed pre-reading duration was shortest in RR for one participant (i.e., Michael), while TV took less time than RR for the other two participants. Fifth, social validity results were mixed, with two participants preferring RR, while one preferred TV.

CHAPTER 5

DISCUSSION

The primary purpose of this study was to explore the mechanism that establishes behavioral engagement during reading; specifically, whether behavioral momentum theory offered insight into the time-on-task variable that is central to behavioral engagement. Behavioral engagement, in turn, represents a critical component of practice, which is necessary to improve reading skills (Stanovich, 1986; NRP, 2000). In reading, as students move from one paragraph to the next they engage in within-task transitions and these transitions may create increased opportunities for students to choose to engage in other, nonacademic activities (Lee, 2006). Reductions in latency to initiate subsequent paragraphs should increase total time-on-task. But, as important as establishing higher levels of behavioral engagement may be, reduced latencies are unlikely to improve comprehension, the central purpose for reading. Vocabulary instruction, on the other hand, has been suggested as a means of supporting reading comprehension (NRP, 2000; Stahl & Nagy, 2006). So, if high-*p* sequences established through a reading fluency intervention alone are sufficient to produce behavioral engagement as well as concomitant increases in comprehension, then teachers have an easy instructional procedure with which to address two key areas in reading. However, if behavioral momentum effects alone do not increase comprehension, teachers may need to use an explicit method of vocabulary instruction to produce meaningful changes in reading behaviors of students with EBD.

To this end, procedures in this study compared the impact of two interventions–chosen based on their theoretical relation to constructs of interest and identified gaps in the literature–on measures related to behavioral engagement (i.e., momentum and endurance), as well as a measure of comprehension. In addition, data were collected to provide some information on the feasibility of these interventions as pre-reading activities through the duration measure, as well as the social validity of their use through the student preference measure. The results are discussed in terms of the separate intervention conditions participants experienced. Theoretical implications and practical implications for teachers working with students with EBD are examined within the context of each intervention. Finally, directions for future research are considered.

Repeated Reading

Results indicated that all three participants' mean latencies to initiate subsequent paragraphs were lowest in both measures of the RR condition. Latencies were lowest in the H-L measure (i.e., latency to initiate unpracticed paragraphs after reading repeated paragraphs) and increased for all participants in the L-H measure (i.e., latency to initiate repeated paragraphs after reading unpracticed paragraphs). These results are consistent with previous work in behavioral momentum in reading (e.g., Vostal & Lee, 2009), in which text alteration increased students' response rate (i.e., reading fluency) and established momentum effects of reduced latencies to initiate subsequent paragraphs.

For Jeremiah, the 59% reduction from baseline latencies in the H-L measure represents a difference of 3.17 s in page turning. That is, on average, he took three seconds longer to turn a page and continue reading during baseline than after high-*p* paragraphs during the RR condition. After low-*p* paragraphs (i.e., L-H), his average page turn was still 2.33 s faster than baseline. For Michael and Candice, mean latency during in the H-L measure reduced .80 s and .91 s, respectively, from baseline. These differences were comparable to those reported in Vostal and Lee (2009), and are predicted by behavioral momentum theory. Similar to Jeremiah, mean latencies to initiate high-*p* paragraphs after low-*p* paragraphs (i.e., L-H measure) remained lower than baseline latencies for both Michael (i.e., .71 s) and Candice (i.e., .41 s). These results indicate that momentum generated in the high-*p* paragraph was not totally expended into the low-*p* paragraph and carried through to the next high-*p* paragraph.

During the RR condition, fluency increases were pronounced between baseline and repeated paragraphs, indicating repeated reading was effective for increasing participants' WCPM. Jeremiah's fourth reading of repeated paragraphs (see Table 2, RR4; i.e., fluency during fourth reading of repeated paragraphs only when mixed into the entire target passage) was 15.08 WCPM (i.e., 21%) greater than the reading endurance demonstrated during baseline (see Table 3). Michael's fourth reading was 27.22 WCPM (i.e., 21%) greater than baseline. Candice's fourth reading was 25.42 WCPM (i.e., 21%) greater than baseline. These fluency increases attenuated across the complete target passage depicted in the total endurance measure (see Table 3) where participants read both repeated and unpracticed paragraphs. That is, while there were fluency gains on the repeated paragraphs, the lower total endurance data indicate that participants' read the unpracticed paragraphs less fluently than repeated paragraphs. These results could be predicted because procedures for repeated reading were based on Therrien's (2004) recommendations for nontransfer measures; that is, procedures in the RR condition were predicted to improve fluency only on the repeated paragraphs. Different procedures have been recommended when the goal is to improve reading fluency on unpracticed passages.

Nevertheless, fluency data in Table 2 correspond with momentum data from the H-L measure in the RR condition (see Table 1). For each participant, mean latencies to initiate low-*p* (i.e., unpracticed) paragraphs were lowest compared to other conditions. Also, for all participants, fluency on repeated (i.e., high-*p*) paragraphs was greatest (see Table 2 and Table 3). High-*p* sequences, as applications of behavioral momentum, are predicated on increasing velocity (i.e., response rate), and subsequent reinforcement, within a response class (Lee, 2006). The fluency improvements found in the RR condition allowed repeated paragraphs to function as high-*p* sequences, where participants demonstrated increased response rates. These data offer some evidence that it was the velocity component (i.e., response rate or fluency) of behavioral momentum that lead to these momentum effects (i.e., latency reductions).

Unlike measures of fluency and momentum effects, no prior investigation has theoretically linked comprehension to behavioral momentum. As predicted by previous research (see Wexler et al., 2008 for review), RR had only small effects on comprehension as measured through thought units. Jeremiah's mean thought units in the RR condition included only .34 more than baseline. Michael's mean thought units in the RR condition included only .27 more than baseline. Together, these results indicated that RR had little effect on their comprehension of passages. Data for Candice, on the other hand, show that her mean retell thought units in the RR condition was 1.78 units higher than baseline, representing a much larger increase than RR established for other participants. This suggests that, at least for some students, repeated reading can simultaneously increase fluency and comprehension on specific passages, as indicated by Therrien (2004)

The RR condition took longer to complete than the TV condition for two students: Jeremiah and Candice. Jeremiah demonstrated the lowest reading fluency of all participants and took the longest to complete the RR condition, on average. Michael, one the other hand, demonstrated the highest reading fluency, and took the shortest amount of time to complete the RR condition, on average. These data indicate that the variability in duration to complete the RR condition was related to overall reading endurance.

Theoretical implications of RR. From a theoretical perspective, results suggest that reductions in latencies attributed to behavioral momentum theory (e.g., Belfiore et al., 1997; Lee et al., 2006) may offer insight into the mechanism that establishes behavioral engagement in reading. That is, after an intervention designed to increase response rate (i.e., RR), momentum reduced the time students were *not* engaged in the target behavior of reading when that reading was disrupted by a page turn. The smaller reductions for Michael and Candice compared to Jeremiah on the latency measure may be due to a possible floor effect. In the end, it takes some time to turn the page and continue reading, so the latency may reduce, but cannot approach 0 s.

Results showing that momentum effects maintained through the RR intervention (i.e. as represented in the L-H measure post low-*p* paragraphs), as opposed to returning to baseline levels, are important. In Vostal and Lee (2009), text readability was lowered to establish high-*p* readability paragraphs, similar to the insertion of single-digit multiplication problems during studies of behavioral momentum in math (e.g., Belfiore et al., 1997). In Vostal and Lee' study, results showed that participants' latencies reduced after high-*p* paragraphs, but increased almost back to baseline after low-*p* paragraphs. These results can be predicted by behavioral momentum theory; the momentum generated by the high-*p* sequence is expended in the low-*p* task (Lee et al., 2006). Therefore, a new high-*p* sequence was necessary to re-establish momentum effects that could be detected through reduced latencies. Results from the RR component of this current study, however, showed that after unpracticed paragraphs (i.e., low-*p*), mean latencies to initiate subsequent repeated paragraphs (i.e., high-*p*) remained lower than baseline, suggesting that the momentum generated by the increased reading fluency in repeated paragraphs was not fully expended through the unpracticed paragraphs. These results suggest that the implementation of fluency training–rather than embedded modification of stimulus tasks (e.g., problems on worksheets; paragraph readability in text)–can result in the maintenance of momentum through low-*p* tasks. Previous studies of embedded task modifications to create high-*p* sequences (i.e., Lee et al., 2006; Vostal & Lee, 2009) suggested that momentum would be expended through low-*p* tasks to a level similar to baseline.

Additionally, the confluence of results from the measures of momentum and endurance offers support for the contention that the two phenomena may be similar (Porritt, Van Wagner, & Poling, 2009). The resistance to disruption represented in reduced latencies may be most closely related to an aspect of fluency–sometimes considered part of endurance (Binder, 1996) and sometimes considered separately (Johnson & Layng, 1996)–called *stability*, in which performance is not easily disrupted. If this is the case, then classroom applications of rate building activities (e.g., Precision Teaching; PT) that have been shown to affect endurance and stability (e.g., Binder et al., 1990) and applications of high-*p* sequences that have been shown to establish momentum (e.g., Belfiore et al., 1997; Lee et al., 2004), which may also improve stability, might be paired to establish effects on students' behavioral engagement in academic activities.

Practical implications of RR. Social validity results offer suggestions for practical implications of using repeated reading. Michael preferred the RR condition, which took him the shortest average time to complete. Jeremiah, on the other hand, did not prefer the RR condition, and it took him the longest to complete. These preferences support results from previous studies that response effort may determine choice patterns in applied settings (e.g., Cuvo, Lerch, Leurquin, Gaffaney, & Poppen, 1998; Hua, 2008). Candice, however, preferred the RR condition, even though it took–on average–twice as long for her to complete as TV. She indicated that she thought RR helped her understand the passages, and the slight increase in mean comprehension scores over the TV condition provided at least partial support for her statement. Both Michael and Candice achieved reading fluency levels above 150 WCPM during the repeated readings, and these increases endured above or near the higher levels of instructional reading fluency suggested in the PT literature (Kubina & Starlin, 2003). Together, these results suggested that RR might be a preferred prereading intervention for students when it increased fluency beyond an instructional level, and that it might enhance comprehension for some students. Combined with other results from the RR condition, it is possible that repeated reading might be an effective and efficient preteaching strategy to enhance some students' behavioral engagement during reading.

Time-delay Vocabulary

A vocabulary intervention was selected specifically because the meta-analysis conducted by the NRP (2000) indicated that vocabulary should promote increased comprehension. Moreover, some evidence suggested that repeated reading interventions alone were insufficient to increase comprehension (Wexler et al., 2008). Some authors speculated that the increased fluency in word reading, such as that which would be expected as part of a vocabulary intervention, might increase overall reading fluency (Beck, et al., 2009; Burns et al., 2009), though the NRP evaluated vocabulary interventions as a component of comprehension instruction, not fluency.

Mean latencies to initiate subsequent paragraphs were lower in the TV condition than baseline for all three participants, though the reduction was smaller than in the RR condition. The difference was most pronounced for Jeremiah, for whom mean latencies in the TV condition were 1.94 s lower than baseline. All students read more fluently in the TV condition than in baseline, but increases were minimal. Jeremiah increased an average of 2.89 WCPM, Michael increased 7.36 WCPM, and Candice increased 4.12 WCPM. Because these results indicated only small increases in reading fluency, they suggested that reductions from baseline in latencies to initiate subsequent paragraphs might not be attributable to endurance gains only.

Data offered some evidence that TV was effective at increasing the number of thought units during participants' oral retell of passages for two of the three participants. Jeremiah's mean retells included 2.07 more thought units in the TV condition than in baseline. Jeremiah's mean, however, was strongly influenced by scores from Session 6 and Session 13 in which was scored 8 and 10 retell thought units, respectively. Similar to Jeremiah, Michael's mean retells included 1.87 more thought units in the TV condition than in baseline. Though Michael scored 4 in two of the TV sessions, which matched his highest score from baseline, the three other scores were higher. Together these data indicated that while there was variability in Jeremiah's and Michael's retells in the TV condition, the intervention did have some impact on their comprehension. Candice's mean retell score in the TV condition was 1.38 thought units higher than baseline, which was a smaller increase than in RR. In the end, both interventions were better than no intervention (i.e., baseline) at increasing Candice's comprehension, but it was not clear that either was significantly more effective than the other for her.

There was variability in preteaching duration across participants in the TV condition. Candice took the shortest amount of time to complete TV, on average. Michael, on he other hand took the longest. These data were not clearly related to comprehension scores, where Candice had the lowest scores of the three participants, but Michael scored in the middle. That is, taking the longest to complete the TV condition did not relate to scoring the highest or lowest on comprehension measures. In fact, it might have been predicted that Candice, who mastered the new vocabulary fastest would be best prepared to employ that vocabulary to aid comprehension, but this was apparently not the case.

Theoretical implications of TV. In the TV condition, reductions in latencies and increases in endurance over baseline were not expected, but nevertheless were found. These results raised the possibility that the mass component of behavioral momentum, that which is most affected by stimulus-response contingencies (Nevin, 1992), may have been involved. Evidence indicates that changes in reinforcer quality, regardless of changes in response rate, may impact measures of behavioral momentum (Nevin, Tota, Torquato, & Schull, 1990; Mace, Mauro, Boyajian, & Eckert, 1997). In other words, during the intervention, participants were offered positive feedback (e.g., "Good, you're right") after each word defined correctly during each trial. So, throughout the time it took students to correctly define each of the five words, students were praised repeatedly. It is possible that these opportunities to be praised, especially for Jeremiah, increased the overall reinforcement density associated with the session, which in turn resulted in reductions in latencies between paragraphs predicted by behavioral momentum theory. Praise, contingent on accurately defining words, may have represented a conditioned reinforcer of great quality. If this was the case, then it seems possible that the positive feedback directly affected the behavioral mass (i.e., resistance to change) component of the reading behavior, rather than behavioral velocity. In fact, there was evidence that behavioral velocity was not influenced by the TV condition, since learning 5 of the 600-700 words did not appear to significantly increase response rate during reading, as indicated by the endurance measure. These results suggested that vocabulary-preteaching formats might be used to examine relative reinforcement quality and schedules, which in turn should shed further light on the components of behavioral momentum (i.e., velocity or mass) that could be impacted in classroom activities in order to establish momentum effects on behavioral engagement.

Practical implications of TV. Data for all three participants showing some increases in comprehension over baseline during the TV condition suggested that CTD might be a feasible pre-reading intervention, in line with prior studies demonstrating the effectiveness of CTD for vocabulary instruction. That is, before reading a passage, students could engage in a brief CTD intervention in much the same way as they did in this study. While the duration of these sessions varied among the three participants, data showed they could be completed immediately before reading and positively impact comprehension.

Limitations

Results from this study should be evaluated in light of its limitations. Two limitations of this study were related to the TV condition. The fact that comprehension scores did not improve to a greater degree in TV over baseline could be attributed to the strength of the intervention. Participants were only required to continue the CTD procedure until they said each definition within 3 s of being presented the word in a single pass through the group of five words. So, if a participant said one correct definition, she or he then said that one over and over until all five were said correctly in one pass. Though the errorless learning nature of CTD indicated that students said each definition correctly each pass through the sets of words, some were mastered faster than others, and this difference in speed of mastery may have affected participants' use of the definition in aiding comprehension. Another possibility was that the retell thought unit measure was insensitive to the comprehension gains the TV condition would likely promote. Eason and Cutting (2009) noted that the selection of comprehension measures could be a challenge for researchers because different measures may target components of reading comprehension in addition to other skills (e.g., working memory, listening comprehension). For example, Pany and colleagues (1982) implemented vocabulary-preteaching procedures and found that comprehension gains were most notable when participants were asked questions in which those vocabulary terms were important in the answer, but were lower during retells of the story. In this study, a retell measure was used rather than researcher-created questions in order to avoid possible ceiling effects, as had been noted in repeated reading studies in which comprehension was a measure (e.g., Valleley and Shriver, 2003). In spite of these limitations, data from this study partially supported the finding in Wexler et al. (2008) that repeated reading alone was insufficient to improve comprehension for some secondary students, and the finding from the NRP (2000) that direct vocabulary preteaching could impact comprehension.

Another limitation of this study was that while results might offer insights into development of intervention packages for use in classrooms, the specific procedures employed in this study might not. Duration for each preteaching intervention may have been too long to be justified immediately before reading a passage of only 600-700 words. For example, effects on momentum and endurance might be too small in relation to preteaching duration to be feasible in classrooms on a regular basis. Of course, no measure of generalization or maintenance of vocabulary or fluency gains was collected in this study since the purpose was only to determine if behavioral momentum effects could be established through the preteaching interventions. But, if effects did maintain and/or generalize, an extended instructional duration may be well worth the gains it may produce. The procedures used in RR in this study were selected because nontransfer measures were of interest (i.e., measures on the same passage repeatedly read; Therrien, 2004). Repeated reading to a fluency criterion has demonstrated positive effects on transfer measures (e.g., generalization of fluency gains on unpracticed passages with high word overlap as the intervention passages; Therrien). Perhaps intervention packages could be developed that include fluency and vocabulary procedures that facilitate generalization and maintenance of gains.

A fourth limitation stemmed from the absence of gross behavioral performance data, such as an interval measure of overt time-on-task or measures of multiple components of engagement. While the momentum and endurance measures were indicators of time-on-task (i.e., off-task intervals would lower endurance and increase latencies), the absence of the gross measure might limit the direct implications of this study for teachers. Also, while behavioral engagement is a fundamental component of the meta-construct of engagement, it was the only aspect of engagement examined in this study. As Fredericks et al. (2004) suggest, engagement studies ought to examine multiple components to offer the clearest information about malleable factors within engagement variables.

Future Directions

Future studies should implement similar momentum and endurance interventions, along with preteaching vocabulary, in classroom settings. For example, the two intervention conditions compared in this study could be pretaught in a tutoring format, but measurement of the target passages could be conducted in classrooms. The classroom setting would lend itself to the gross time-on-task measure, increasing the external validity of the results. Beck, Burns, and Lau (2008) individually pretaught sight vocabulary to two elementary students with behavior disorders, then measured time-on-task during a subsequent language arts lesson and noted improvements compared to a no-intervention control condition. Similar to Beck et al., conditions from this current study could be evaluated with adolescents with EBD and used to offer evidence of the relative impact of reading fluency interventions versus vocabulary (i.e., comprehension) interventions on subsequent behavioral engagement in classrooms.

Additionally, future studies should examine the possibility of developing a package intervention designed to improve both fluency and vocabulary. For instance, can Precision Teaching techniques used to teach vocabulary fluency (e.g., Daly & Cooper, 1993) be employed to increase behavioral engagement in reading? Does fluency with specific vocabulary translate into improvements in overall reading endurance? How many words must a student master before momentum effects are discovered on transitions within the target reading passage?

Results from this study suggest possibilities for future studies specifically about behavioral momentum theory and its connection to endurance and stability. For example, PT studies, in which endurance and stability are typically examined (Doughty et al., 2004), are predicated on free-operant–rather than discrete trial–tasks (Johnson & Layng, 1996). Basic research into behavioral momentum employs concurrent free-operant conditions (Nevin, 1996). Studies examining the effects of PT on the stability of performance have presented mixed results (Kim et al., 2001). Could concurrent free-operant conditions comparable to those employed in basic behavioral momentum research, or those employed in translational research with humans (Mace et al., 1997), be used in studies examining precision teaching procedures to demonstrate momentum effects, which in turn may be a demonstration of stability? Similarly, future research could examine the effects of preteaching vocabulary in multiple reinforcement schedules (e.g., comparing numbers of praise statements; comparing trials to mastery) in a manner similar to basic studies of behavioral momentum (e.g., Nevin et al., 1983) while holding fluency constant on a subsequent reading passage. Differing effects on measures of momentum could identify quantifiable changes in behavioral mass.

Finally, future research should examine the role of behavioral momentum in all components of engagement. When applications of behavioral momentum (i.e., high-*p* sequences) are implemented regularly in classrooms, do indicators of cognitive and emotional engagement show improvement, in addition to indicators of behavioral engagement? Are indicators of cognitive and emotional engagement, often measured through self-report and rating scales (Fredericks et al., 2004), correlated with direct measures of behavioral momentum (i.e., reduced latencies between task components)?

Summary and Conclusions

This study demonstrated that a reading fluency intervention established increases in endurance and decreases in latencies between paragraphs for three adolescents with EBD. These effects are indicators of increased time-on-task, and as such are critical to enhancing behavioral engagement. While interventions that affect all components of engagement (i.e., behavioral, cognitive, emotional) for students with EBD should be a goal, enhancing behavioral engagement in academic tasks needs to be a focus of any intervention for this population (Sutherland et al., 2008). This study also demonstrated that preteaching vocabulary could impact comprehension for students with EBD. Moreover, there was some evidence suggesting that preteaching vocabulary could impact measures of momentum (i.e., reduced latencies between paragraphs), which in turn would suggest an increase in behavioral engagement. While results were not conclusive, further examination into the relation between preteaching activities that impact fluency and comprehension on measures on engagement during reading for students with EBD is warranted.

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APPENDIX A

PROCEDURAL INTEGRITY CHECKLISTS

Baseline Condition

Completed	Procedure
	1. Present passage to student and show that there is one paragraph per page.
	2. Say, "You will read this passage out loud. When you are finished, you will tell me what it is about."
	3. Say, "Please begin reading now."
	4. Walk away from student to table at side of room.
	5. Student reads passage.
	6. Sit in front of student and say, "What was the passage about?"
	7. Record student answers on copy of passage.
	8. Say, "Thank you for your work today."

Repeated Reading Condition (RR)

Completed	Procedure
	1. Present passage to student and show that there is one paragraph per page.
	2. Say, "Before you read the passage today, we are going to preview some paragraphs. You will read them out loud three separate times, each time trying to read faster than you did before. If you get stuck on a word, do your best to pronounce it. I will tell you how fast you read and help you with any words you could not pronounce after you finish reading the paragraphs."
	2. "Please begin reading now."
	3. Student reads four paragraphs. If student hesitates on a word for three seconds, tell student the word.
	4. Tell student reading duration. Pronounce any missed words.
	5. Say, "No you will read it again. This time try to read it faster. Please begin reading now."
	6. Student reads four paragraphs. If student hesitates on a word for three seconds, tell student the word.
	7. Tell student reading duration. Pronounce any missed words.
	8. Say, "No you will read it again. This time try to read it faster. Please begin reading now."
	9. Student reads four paragraphs. If student hesitates on a word for three seconds, tell student the word.
	10. Tell student reading duration. Pronounce any missed words.
	11. Say, "Now you will read the entire passage out loud. When you are finished, you will tell me what it is about."
	12. Say, "Please begin reading now."
	13. Walk away from student to table at side of room.
	14. Student reads passage.
	15. Sit in front of student and say, "What was the passage about?"
	16. Record student answers on copy of passage.
	17. Say, "Thank you for your work today."

Time-delay Vocabulary Condition (TV)

Completed	Procedure
	1. Present passage to student and show that there is one paragraph per page.
	2. Say, "Before you read the passage today, we are going to preview some important words from it. I will hold each card with the word, and then tell you the definition. After we have gone through all the cards once, I will hold up a card with a word, and you should tell me the definition. "
	3. Hold up one card to student, word facing out and definition facing in. Say the definition as student looks at word.
	4. Repeat through remaining cards.
	5. Hold up one card to student, word facing out and definition facing in. Wait 3 seconds, and then give the definition. If student gives incorrect definition before 3 seconds expires, say "No, (the word) means (definition).
	6. Repeat through remaining cards.
	7. Repeat steps 5 and 6 until the preteaching session of six minutes.
	8. Say, "Now you will read the entire passage out loud. When you are finished, you will tell me what it is about."
	9. Say, "Please begin reading now."
	10. Walk away from student to table at side of room.
	11. Student reads passage.
	12. Sit in front of student and say, "What was the passage about?"
	13. Record student answers on copy of passage.
	14. Say, "Thank you for your work today."

APPENDIX B

INFORMED CONSENT FORM

INFORMED CONSENT FORM FOR SOCIAL SCIENCE RESEARCH

The Pennsylvania State University
(PARENT VERSION)

TITLE OF PROJECT: **The Effects of High-p Fluency on Low-p Task Completion**

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OTHER INVESTIGATOR(S): Brooks Vostal, Brooke Eifert

1. **PURPOSE OF THE STUDY:** The purpose of this research is to examine the relationship between preferred and non-preferred classroom activities and time on task.

2. **PROCEDURES TO BE FOLLOWED:** Teachers will be asked to nominate children who sometimes have difficulty attending to academic tasks. Prior to the start of the study, your child will be asked to complete a short math or language arts assignment in order to determine their instructional level. After this initial assessment, the two parts of the study will begin. In the first part your child will be asked to complete tasks using two different methods. For the first method the tasks will be presented in the manner typically used by your child's teacher. For the second method your child will be asked to complete a series of 3-4 brief preferred academic activities (e.g., 1x1 digit math problems, read easy sentences) prior to a request to complete a less preferred academic activity (e.g., 2x2 digit math problems). If needed, for the second part of the study your child will be asked to complete practice exercises to build speed at completing the preferred tasks. After the speed building activity, your child will again be asked to complete a series of 3-4 brief preferred activities prior to the request to complete an academic activity. A video camera or audio recorder will be positioned to record your child as he or she completes the assignment. The tapes will be erased after three years.

3. **BENEFITS:** Your child will receive extra practice in an academic subject.

4. **DURATION/TIME:** Your child will be asked to participate in the study for approximately 15 hours spread out over five months.

5. **STATEMENT OF CONFIDENTIALITY:** Your participation in this research is confidential. The data and recordings will be stored and secured at 226 CEDAR in a locked file. Only the researchers will have access to the data and recordings. In the event of a publication or presentation resulting from the research, no personally identifiable information will be shared.

6. **RIGHT TO ASK QUESTIONS:** Please contact David Lee at (814) 865-3567 with questions, complaints or concerns about this research.

7. **PAYMENT FOR PARTICIPATION:** Your child will receive several (2-3) small gifts at the

end of the study (e.g., pencil, novelty eraser).

8. VOLUNTARY PARTICIPATION: Your decision to allow your child to participate in this research is voluntary. You can stop at any time. You or your child does not have to answer any questions you/your child does not want to answer. Refusal to take part in or withdrawing from this study will involve no penalty or loss of benefits you/your child would receive otherwise.

If you agree to allow your child to take part in this research study and the information outlined above, please complete the information below.

I give permission for my child, ____, to participate in this research.

You will be given a copy of this consent form for your records.

____ ______________________
Parent Signature Date

____ ______________________
Person Obtaining Consent Date

VITA

BROOKS R. VOSTAL

Education

PhD	2010	The Pennsylvania State University	Special Education
MS	2001	Miami University	School Psychology
BA	1997	University of Illinois at Urbana-Champaign	Teaching of English

Professional Experience

2007 – 2010	Instructor/Teaching Assistant, The Pennsylvania State University, PA
2005 – 2007	Intervention Coordinator, Talawanda High School, OH
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