Self-Recording of Productivity: How Intermittent and Summative Procedures Affect Reactivity

Dissertation

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Doctor of Philosophy

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ABSTRACT

I examined the effects of self-recording on student academic performance and behavior. Self-recording is a self-management procedure that capitalizes on reactivity to modify performance. Scores of studies show that self-recording affects behaviors across settings and contexts. This study compared the effects of two separate self-recording procedures, intermittent and summative self-recording, on individuals' productivity.

The current study employed a combination of multiple-baseline and alternating-treatment designs, developed to isolate the effects of student self-recording within a controlled setting. Through analysis of the data, I concluded that the addition of the self-recording procedure had a positive effect on rate of responding, but the effects on attending to task and accuracy of responding were not as obvious. Additionally, the results show that summative self-recording may have a larger effect on productivity than intermittent recording.

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APPROVAL OF THE DISSERTATION PROPOSAL

This dissertation proposal, ("*Self-Recording of Productivity: How Intermittent and Summative Procedures Affect Reactivity*.") has been approved by the Graduate Faculty of the Curry School of Education in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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CHAPTER 1—MANAGING PERFORMANCE

John Dewey (1939), an early educational philosopher stated, "The ideal aim of education is creation of power of self-control" (p. 41). Self-control, frequently used interchangeably with self-management, refers to "those behaviors that a person deliberately undertakes to achieve self-selected outcomes" (Kazdin, 2001, p. 303). Children attend school not only to learn academic content, but also to develop their ability to function independently of others. At an early age, students are taught how to unpack their personal belongings and hang up their coats. Similarly, students in older grades are expected to enter the appropriate classroom before the bell rings, sit in their assigned seats, and quietly get started on the day's activity. As adults, we are expected to monitor our speed when driving, arrive for appointments on time, and produce quality work at our jobs in order to earn a living. In sum, education environment is intended to teach self-management skills that students will continue to need as they enter the work force, and are contributing members of their communities.

In modern society, a person who exhibits a strong degree of self-control generally makes greater contributions to his or her community than those with lower self-management ability (Epstein, 2007). Individuals with strong self-control are able to forgo immediate personal satisfaction, in order to secure greater later outcomes or even to benefit the greater good of society as a whole. Conservation of resources, resisting drugs and violence, as well as receiving higher education all require an individual to resist immediate satisfaction for an investment in the future. Differences in ability to manage one's own behavior may provide some explanation of individual differences in achievement. For example, why do some people seek long-term reinforcement, while others are more motivated by immediate reinforcers in the present environment?

Within educational as well as work environments, a person's achievement is based on her or his ability to make a quality product. Noting the importance of production within the workplace, research efforts have addressed means to increase production (e.g. effects of incentive pay, Frisch & Dickinson, 1990), which in turn benefit companies and corporations. The more work individual employees can produce, the fewer employees need to be hired. Therefore, employee value can easily be based on the quantity and quality of their work. Similarly, educators assess students' academic performance based on work samples, commonly referred to as permanent products (Cooper, Heron, & Heward, 2007). Permanent products are concrete outcomes of a behavior that can be used to assess performance. Without adequate production, the ability for an educator to assess student performance is limited (Lee & Laspe, 2003). Limited work production could be an indicator that students are performing below performance standards.

Behavior modification procedures can be used to increase independent functioning and performance–some of which are self-managed. This project expanded the literature on this topic. In upcoming sections, I discuss behavior modification procedures used to increase performance in academic as well as professional settings. I distinguish between procedures that are directed by others and those that are self-managed. Finally, I argue the need for academic productivity in students, and as well as continued experimental research examining productivity as a student outcome.

Organizational Behavior Management

The field of Applied Behavior Analysis (ABA) as defined by Baer, Wolf and Risley (1968) extends the findings of basic lab research into applied settings. The defining characteristics of ABA include promoting socially relevant behaviors, determining a functional relationship between treatment and outcome, replication and generalization. Grounded in operant conditioning, application of the techniques and practices of ABA have demonstrated behavior change in early studies with animals (e.g. rodent discrimination training; Skinner (1933), as well as a suitable therapy for students with autism (e.g. decreasing self-injurious behavior, Lovaas & Simmons, 1969; teaching pro-social behavior, Lovaas, 1987). By manipulating antecedents and consequences maintaining behaviors (three-term contingency), researchers have been able to modify and shape behaviors and promote pro-social behavior, benefitting not only the subject, but also others in proximity. Of increased awareness is how behavior change principles of ABA can be generalized to professional settings to increase performance in individual employees, as well as promote effective organization within a corporate structure (Daniels & Bailey, 2014).

Organizational behavior management (OBM), also referred to as performance management (PM), refers to techniques grounded in ABA that are used to promote performance in employees. When trying to reinforce positive behavior within the workplace, Daniels and Bailey (2014) discuss first "pinpointing" the behavior needed for change, in terms that are observable and measurable, and avoiding mentalistic interpretations of behavior. Skinner (1974) explains mentalistic interpretations of behavior as those we assume to cause behavior to occur based on our own histories, not those we can observe. Once we are able to pinpoint behavior in need of change, commonly referred to as identifying target behaviors in ABA (e.g. inattention, self-injury, perseveration), we can plan for behavior modification. Frequently in OBM, the pinpointed behaviors in need of modification are mutually exclusive to adequate work production (Austin & Caar, 2000). The literature includes approaches to promote productivity in the workplace by adjusting antecedent or consequence events. Office managers are frequently trying to implement strategies to increase performance; however, some strategies that can be taught are self-lead, increasing worker independence (Daniels & Bailey, 2014).

Fully Managed Procedures

Supervisor-lead behavior modification procedures include altering antecedents and consequences to maximize employee work performance. Antecedent modifications are proactive procedures designed to increase the likelihood that positive behavior will occur. For example, businesses frequently create policies and procedures for employees to follow, along with a professional physical environment to promote compliance to a standard for production (Daniels & Bailey, 2014). Other antecedents involve manipulating the motivating operations, or events that alter the present value of a particular reinforcer. For example, if a company notices that employees are frequently leaving the office to purchase coffee, the company could consider providing quality coffee at the office. In doing so, the motivation to leave the office to access coffee has decreased. The employees can now access the reinforcer within the work environment, decreasing the amount of time away from the office; increasing potential work production.

Additionally, consequences can increase performance, but when they are manipulated they are reactive procedures that are applied after the target behavior has occurred. Feedback is commonly used to increase an individual's performance when it's paired with a consequence, is based on a set criterion, and provides explicit information on how to improve (Daniels & Bailey, 2014). When an individual receives feedback, she gains the information needed to change her performance. When feedback causes behavior change, it does so one of two ways: positive reinforcement as a result of positive feedback or negative reinforcement as a result of negative feedback. For example, an employee who is complimented for arriving to work on time will be more likely to continue this pattern of behavior. Conversely, if an employee is confronted for being late to work, the employee may begin arriving on time in order to escape punishing reprimands. Austin (2008) determined that performance feedback paired with discrimination training and self-recording improved the posture of business professionals while seated. Performance feedback has also demonstrated significant effects in decreasing household energy consumption (reduced use of electricity; Darley, Seligman, & Becker, 1979), improving performance in forklift drivers (increased precision; Ludwig & Goomas, 2009), as well as reducing employee-based errors at a retail furniture distribution center (reduced the number of items shipped incorrectly, Berglund & Lugwig, 2009).

Other consequences to increase performance include providing reinforcers, such as incentive pay. Frisch and Dickinson (1990) conducted a parametric analysis using college students to determine the effects of incentive pay on production. Groups receiving incentive pay outperformed production of nut and bolt assembly than groups receiving no incentive pay. Results suggest that incentive pay increases production, but the percentage of additional incentive pay was not directly correlated with the quantity of production. One can interpret these results to suggest that access to reinforcement to any degree increases performance.

Self-Managed Procedures

Although performance management procedures delivered by others are effective strategies to increase production, successful employees are expected to be able work independently of managerial support. Self-managed interventions such as self-talk and the use of checklists are frequently discussed in the OBM literature as effective strategies to improve performance for professionals in the workplace as well as professional athletes. Self-talk strategies require the individual to pinpoint what he or she wants to accomplish and mentally devise a plan of action. She will then mentally coach herself through the necessary procedures, so when it is time to perform, she feels prepared and confident.

Self-talk has been shown to promote generalization of a skill from one environment to another. Austin and Caar (2002) described generalization with the example of a basketball player who shoots free-throws during practice with close to 100% accuracy but has a much lower percentage during games. If before practicing free-throw shots the player engages in self-talk, he can then follow the same self-talk procedure during games with similar performance. Similarly, self-talk strategies have also been found effective with youth athletes. Hatzigeorgiadis, Galanis, Zourbanos, and Theodorakis (2014) tested the effects of a 10-week self-talk intervention on adolescent swimmers. The treatment group demonstrated significant increases in swim times during competitions compared to the control group, which received no training in self-talk. Similarly, the effects of self-talk were tested on the response time in of 203 participants trained in martial arts using a randomized control design (Hanshaw & Sukal, 2016). Participants assigned to a self-talk condition decreased their response time when completing “roundhouse” movements during competition in comparison to the control group.

Used frequently to ensure quality control as well as maintaining safety standards are self-managed checklists. A checklist, which is referred to as a task-analysis in ABA, can be used as a form of self-recording; a person must evaluate whether each of the behaviors was performed, and then record a response (Mace, 2001). It is a reactive procedure, requiring the person to record that the behavior was completed successfully, or it was not. This allows the individual an opportunity then to modify performance. Pilots are routinely required to follow checklists to increase treatment fidelity in following safety protocol while flying (e.g. Safety Operation Behavior Scale; You et al., 2009) as well as to decrease errors during take off and landing of an airplane (Kools & de Voogt, 2006). Similarly, checklists are frequently followed by medical staff to assist in making proper diagnosis in patient care (diagnosing depression, Gates, Petterson, Wingrove, Miller, & Klink, 2016), as well as to decrease misdiagnosis of diseases (Ely, Graber, & Croskerry, 2011).

Performance Management in Schools

In the previous section, I presented literature on strategies aimed to increase independence and productivity in the work place; similar strategies are also used in educational settings to increase student behavior. At the classroom level, teachers are able to maximize time spent engaged in instruction with use of strong classroom management practices that decrease the time spend managing problem behavior (Gettinger, 1995). However, instructional time is still limited and cannot necessarily be increased for students with skill deficits. To increase instructional time, teachers must be able to increase the amount of time students are actively engaged with material. In the next sections I discuss teacher-lead as well as student-managed interventions that can be used to increase academic performance.

Teacher-Lead

Teacher-lead interventions require that the teacher alter the conditions in the environment to make the high-rates of work production more probable. Altering antecedent as well as consequence events, similar to those described earlier in the OBM literature, can make noticeable differences in student performance. Some antecedent manipulations require minimal effort and can increase behavior success, therefore increasing the likelihood that learning can occur. Teachers can alter the physical classroom environment, so it is well organized, and free from unnecessary distraction (Evertson & Emmer, 2012). This is similar to how professional office environments are generally free from clutter and contain necessary technology.

Additional antecedent events that can affect academic performance are clear rules and expectations, similar to procedural guidelines within OBM. Rosenberg (1986) tested the effects of a token economy with and without an explicit rule review before beginning a daily lesson. While under the rule review condition, students exhibited a lower degree of disruptive, off-task behavior than when beginning the day's lesson without a rule review.

Other examples of antecedent manipulations are specifically designed to increase student responding. Carnine (1976) tested the effects of inter-trial intervals, or the amount of time spent between completing one trial and introducing the next, on student performance. During the fast-paced condition, one trial followed immediately after the previous trial, whereas during slow-paced, there was a delay between trials. Students demonstrated greater levels of engagement, responding, and accurate responding during the fast-paced instruction over the slow-paced instruction. In these cases, decreasing the wait time between trials increased responding.

When considering the time in which teachers allow for a student to respond following a stimulus prompt, increasing wait time may increase student responding. Riley (1986) tested the effects of altering wait times (1-second, 3-second, and 5-second) when asking students to answer knowledge-based and comprehension science questions. Results indicate that the type of assessment question may impact the amount of wait time that is most beneficial. Students answered more knowledge-based questions accurately given a 3-second wait time and more comprehension-based questions when provided 5-second wait time. Similarly, Johnson and Parker (2013) tested the effects of wait time (1-second, 5-second, 10-second, and 15-second) on students with multiple disabilities. Results indicate that responding increased more than 50% for all participants when wait time increased from 1-second during baseline to 5-seconds or more during intervention phases. However, responding decreased in some participants as the time was extended to 15-seconds, suggesting that too much wait time may slow instruction.

Whereas some teacher-directed strategies promote an increase in performance before the behavior has occurred, positive reinforcement is a consequence procedure that is frequently used in education (Zipoli, 2016). Many forms of positive reinforcement are available to teachers including social reinforcement (approval and praise), use of primary reinforcers (e.g., candy), as well as secondary reinforcers (e.g., points) which have no intrinsic value but can be traded in at a later time for a primary form of reinforcement (e.g., token economies). Rosenberg (1986) tested the effects of token economies with and without an explicit rule review as mentioned previously. Although reviewing the rules prior to beginning the lesson caused stronger student outcomes, the token economy condition without rule review did produce increases in student time on-task and student responding. Knapczyk and Livingston (1973) measured the effects of a token system paired with a self-recording intervention to increase reading accuracy of special education students. Increases in accuracy were demonstrated when the token conditions were introduced, were most significant when paired with self-recording, and returned to baseline levels with removal of the token reinforcement. Manipulation of antecedents and consequences; therefore, can increase the occurrence of behavior.

Student-Lead

Student-lead procedures frequently contain the term “self” to indicate that they are managed by the individual in need of behavior modification. Self-lead, or self-managed, interventions generally provide students with a systematic approach to reinforcing positive performance. These strategies involve teaching the student how to rearrange the antecedent and consequence conditions to increase the likelihood that a positive behavior will occur in the future. In doing so, the student is able to reinforce himself or herself free of the support of an adult in the near proximity.

Included under the umbrella of self-management procedures are goal setting, self-evaluation, self-reinforcement, self-punishment, self-instruction and self-recording (also referred to as self-monitoring); many people use these procedures every day (Alberto & Troutman, 2013). Although these frequently used practices have procedural variations (see Table 1.1), they share some commonalities. First, all of these interventions are self-lead, and all are designed to increase a person's ability to manage his or her own behavior. Through a series of planned stimulus manipulations, the individual is able to reinforce her own positive behavior.

Table 1.1

Specific Self-Regulation Procedures, Descriptions and Examples

Self-Regulation Procedure	Description	Example
Goal Setting	Determining what the individual wants to achieve within a set timeframe.	Running a mile in under 9 minutes.
Self-Evaluation	Comparing one's performance to standard or criterion.	Correcting one's math homework.
Self-Reinforcement	Reinforcing oneself for one's own behavior.	Allowing oneself a special dessert for eating healthy.
Self-Punishment	Punishing oneself for one's own behavior.	Denying oneself dessert for eating poorly.
Self-Instruction	Providing oneself verbal prompts for task completion.	Reading a set-by-set manual to repair a machine.
Self-Recording	Assessing one's performance and creating a written record.	Making a tick mark each time one makes a social initiation.

Problem Statement

The Individuals with Disabilities Improvement Act of 2004 (IDEA) stipulates that positive behavior interventions be developed to support those students whose behavior is impeding their ability to learn. Positive behavior supports are proactive approaches to correcting negative behavior before it occurs (Zirpoli, 2016). Self-recording is positive behavior support that can teach students how to regulate their behavior within the school environment. It is critical that students develop the skills necessary to function independently in the classroom and produce quality work within the educational setting, as these skills must be generalized into a person's adult life. Students who exhibit independent work skills require less teacher support; therefore, decreasing the restrictiveness of the learning environment.

As discussed previously, every behavior has a natural consequence. If a person does not follow safety measures when driving, he or she is at greater risk of being involved in an accident. Similarly, individuals who are unable to meet demands or meet behavior expectations are at increased risk for experiencing a consequence that is potentially displeasing. At school, students who do not complete assignments or meet classroom expectations may face unwanted consequences, such as staying in from recess or a phone call home. Such consequences are intended decrease the likelihood that students will fail to meet expectations in the future; however, what if the student does not have the means to manage his or her behavior? In these cases, would a displeasing consequence increase the likelihood that students would meet expectations in the future? It is more likely that these students would continue to face punishment for the same deficiency, as punishment procedures do not teach new behavior (Alberto & Troutman, 2013). Sidman (2001) notes that teachers may interpret skill deficits as non-compliance, which can increase the probability that teachers will negatively reinforce positive behavior in students, that is, students will strive to meet expectations to remove the addition of an undesirable consequence, rather than to access a desired consequence.

Negative consequences for poor self-management is not limited to the educational setting; it has been correlated to have long-term consequences in adulthood including increased risks with weight management (Bub, Robinson, & Curtis, 2016), substance abuse, law breaking, and general maladjustment (Moffitt et al., 2011). If individuals are unable to exhibit self-control, they are of decreased ability to delay instant gratification in order to achieve a long-term pay out (to be discussed in the subsequent chapter).

There is a need for teachers to implement proactive interventions such as teaching pro-social behavior to early learners. Self-management strategies increase a person's reactivity when evaluating performance and are motivating (Zirpoli, 2016). Self-management teaches the learner to be his or her own behavior change agent, responsible for evaluating, recording, and reinforcing his or her own behavior. These strategies have been used with high-incidence behaviors such as disengagement (Briere & Simonsen, 2011; Rafferty, 2012) as well as more severe behaviors such as physical aggression (Jackson & Altman, 1996). In teaching a student how to self-manage, the student is learning how to independently control his or her own behavior to meet instructional demands.

Purpose of the Present Study

The present study expanded the research base on self-management interventions within educational settings. Specifically, drawing on the work of researchers who have investigated the effects of altering specific self-recording components (e.g. attention versus productivity targets, Harris, 1986; addition and removal of audio cue, Heins, Lloyd, & Hallahan, 1986). I investigated the effects of students recording their own progress on an academic task. I sought to isolate this variable during the treatment condition, so all effects could be attributed solely to the addition of the recording procedure. I investigated the effects of the recording process following two commonly used forms of self-recording that have been studied in previous research: intermittent and summative recording. The results of this study emphasize the importance of teaching students to quantify and produce a written record of production independently.

CHAPTER 2—RESEARCH ON SELF-MANAGEMENT PROCEDURES

In this literature review I discuss self-control, the ability to self-manage, and the conflicting theories analyzing the self-management process. I then narrow the scope of self-management procedures to focus on self-recording, the two-step process involving an evaluation of one's own performance ("self-evaluation" or "self-assessment") followed by immediate recording ("self-recording") of the result. After, I will discuss self-recording interventions within the educational setting using productivity as the target behavior. Then, I discuss gaps in the literature that support the development of my research questions.

What Affects Self-Control?

To understand and plan for behavior change, one must consider contingencies of reinforcement; namely the relationship between a person's behavior and the events that affect the person's behavior (Kazdin, 2005). At several points through any given day, an individual is faced with competing contingencies (Hughes & Lloyd, 1983). Although multiple contingencies are competing at any given time, the weight of each contingency of reinforcement is ultimately what controls an individual's response. Many events of course are attributed to determining the weight of one contingency over the other (see Figure 1). Presuming that other contingencies are equal, should an individual have a well-paying job that offers flexibility and a strong benefits package, she is more likely to respond to a morning alarm by getting out of bed and getting ready for work than she is to continue to sleep if she had a job with less value. Similarly, should she develop a severe cold, the benefits of staying in bed may outweigh going to that well-paying job. Generally speaking, the power of competing contingencies depends on a person's ability to manage his or her own behavior. Is the person able to resist immediate gratification for a stronger payout in the long run?

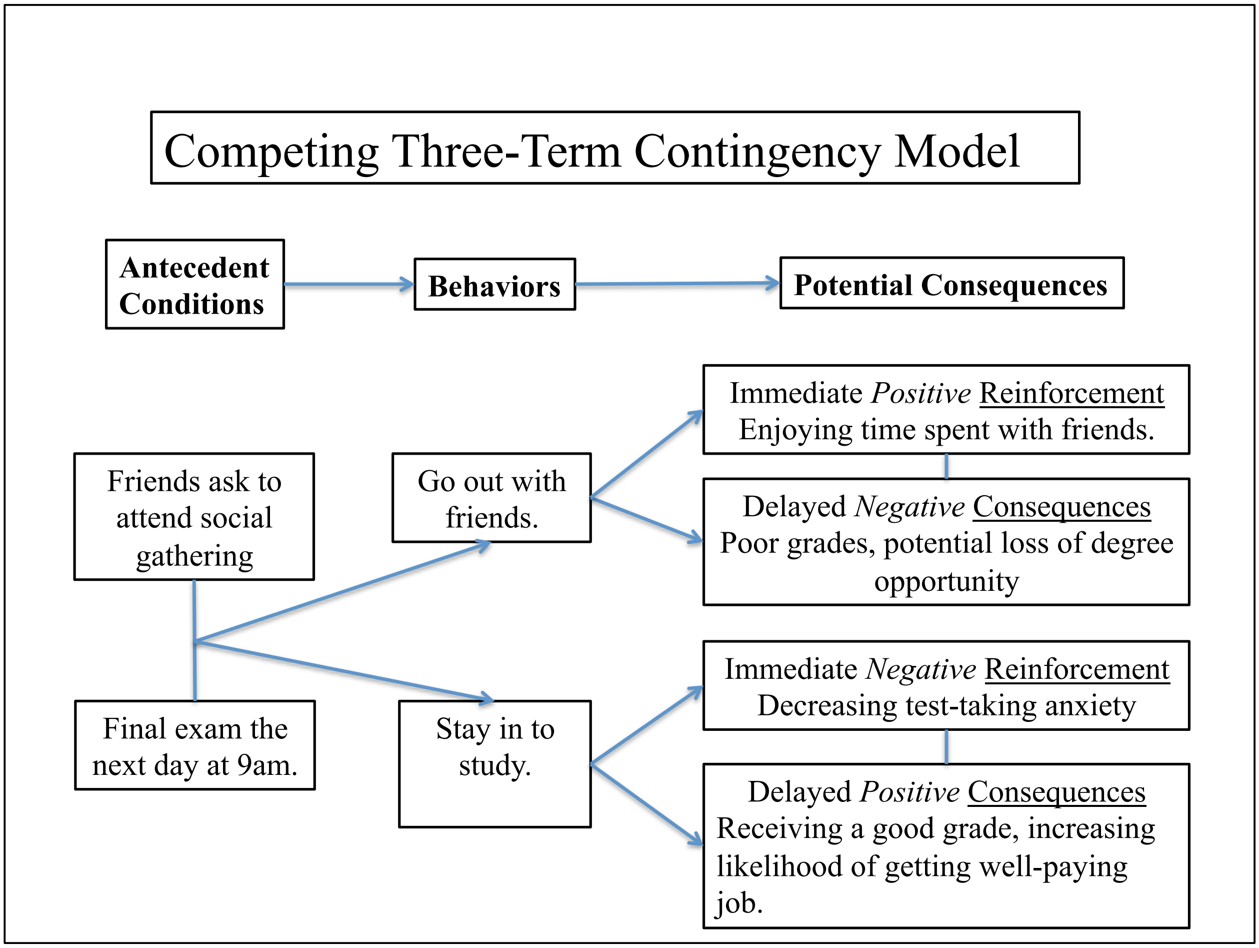


Figure 2.1 - Visual representation of a competing three-term contingency.

How Do People Manage Their Behavior?

Self-management can be thought of as the manipulation of one's behavior or feelings to benefit herself as well as others around her (Skinner, 1974). As we interact with our environment, we are constantly seeking reinforcement–the weight of reinforcers are not all equal; therefore, the stronger of competing contingencies in effect will guide behavior. Skinner makes the distinction between the "selfish" being and the one who self-manages, emphasizing that the individual who self-manages considers methods to alter her behavior in such a way that the consequences of her actions are both more pleasing to herself as well as reinforcing to others. A child may prefer to speak to a classmate across the room to completing independent math practice at her desk. So, why does she continue completing her classwork, free from social attention that is reinforcing? The managing self will consider the learning of others, the expectations of the teacher, possibly expectations of parental figures, as well as have internal motivation to do well in school. Although completing a math assignment is not immediately reinforcing, social approval for doing well in school is motivating.

Individuals who have trouble with self-control or self-management are often more affected by immediate contingencies than long-range contingencies (Brigham, 1983). Contingencies that offer immediate effects can be extremely pleasing to the individual in the present, and although they may be accompanied by aversive consequences later, the aversion in the present is not strong enough to deter the actions. Brigham references the student who decides to go out drinking with his friends instead of studying for an exam. The immediately reinforcing effects of socializing with one's friends may be more motivating than the negative consequence of receiving a poor score on one assessment. However, delayed consequences, although they may not have strong immediate effects, can have a large positive or negative effect over time. A person who resists socializing with friends to study will in the long run receive larger reinforcing value from a well-paying job that allows freedom and flexibility, than countless nights socializing with friends while enrolled in school. Similarly, delayed negative consequences for smoking can outweigh the immediate benefits of satisfying an immediate craving for nicotine.

Other weaknesses in self-control can be attributed to history events. What separates the student who decides to stay in and study for a test from the student who decides instead to socialize and drink with friends? As previously established, people's decisions can be controlled by their ability to forgo immediate reinforcement in order to access a larger reinforce at a later time. Our history of reinforcement is another variable that controls our behavior (Cooper et al., 2007). If a consequence following an individual's behavior is pleasing, that behavior is likely to be reinforced, increasing the rate of that behavior in the future. If a person has previously been reinforced for resisting contingencies of reinforcement that are immediately available in order to receive a larger reinforcer at a later time, self-control will be strengthened, and more likely to be exhibited in the future (Brigham, 1983). To manipulate behavior, it is necessary to identify alternative incompatible responses for implementation, as well as situations that have previously been discriminative stimulus (S^{D}) for the undesired response. If situations that serve as an S^{D} for undesired behavior are avoided, it is less likely that the target behavior will be evoked. For example, if a person is trying to quit smoking cigarettes, she may want to avoid drinking coffee early in the morning as well if those two events typically occurred in succession. Instead, she may replace this morning routine with visiting a favorite bakery to purchase a satisfying edible. Similarly, if a student has a history of being easily distracted by a particular peer, the student should not be placed near this peer during demand situations. Instead, it may be in the best interest to place the child away from other students. It is possible to manipulate the environment to increase positive behavior. For example, when a person is on a diet, she generally will only purchase healthy items to keep in the home; therefore eliminating potential to eat unhealthy foods.

Conflicting Theories of Self-Management

Of great debate are how the process of self-management is developed, and why these procedures are effective (Hughes & Lloyd, 1993). Does the individual make a cognitive decision to change his or her behavior in order to access preferred consequences, or does she or he change behavior in reaction to a consequence? Within the classification of "behaviorist" there are divisions within this group: radical behaviorists and cognitive behaviorists.

Major differences in these two philosophies of behavior are examining the relationship between environmental operants and a person's behavior. Radical behaviorists argue operants shape a person's behavior, and are responsible for the occurrence of a behavior (Brigham, 1983; Skinner, 1974). Therefore, individuals' behaviors are constantly reacting to antecedent and consequent events. Cognitive behaviorists hold a contrasting view, arguing that people change their behavior in order to change the conditions they are experiencing in the environment (Brigham, 1983). Noting the two competing philosophies on behavior, Hughes and Lloyd (1993) analyzed the conflicting theories on the self-management process and why these procedures are effective. The authors referred to these differing views of self-management as the "behaviorist" and the "cognitive" perspectives on self-management. Whereas the behavioral perspective views the process of self-management as an individual's reaction to events in the environment, the cognitive mindset perceives individuals as consciously making a decision to change their behavior to change the environment subsequently. Regardless of the argument analyzing how self-manage procedures come to fruition, they both recognize that self-management interventions involve a reactivity component that is involved in the change of a behavioral outcome.

Self-Management Procedures

Self-management strategies have been applied across domains to improve individual performance and quality of life. Medical patients have been taught to manage their behavior at home in treatments for Multiple Sclerosis (Freeman et al., 2016), insulin levels for diabetes (Song & Lippman, 2008), self-efficacy levels of individuals with chronic illness, coping skills for individuals with chronic depression and anxiety (Zoun et al., 2016), among others. Similarly, self-management strategies have been used to increase individuals' physical activity and monitor calorie intake (Houben, Dassen & Jansen, 2016). These procedures are appropriate for any instance in which an individual is responsible for controlling repeated behaviors or feelings. A similarity across multiple behavior targets, is that the individual is able to develop strategies for regulating events that are known to occur. An individual with diabetes will need to measure for blood glucose repeatedly just as a person with chronic depression may need to monitor their use of coping and problem solving skills repeatedly in anxiety provoking situations. These situations are predictable; therefore, self-regulation skills can be repeatedly practiced until becoming part of the individual's behavioral repertoire.

Research on Self-Recording

Self-recording capitalizes on a phenomenon known as "observer reactivity." Reactivity refers to the likelihood that people's behavior is different when they know that behavior is being observed than when they do not know it is being observed (Lapinski & Nelson, 1974). Usually, researchers work to avoid observer reactivity. However, when it comes to self-recording, educators can take advantage. The reactive effects of the recording procedure serve as a natural consequence. First, as noted in the two-step process described previously, the participant must observe his or her own behavior, decide if the behavior has occurred, and then (second) she must record the occurrence or absence of the behavior (Mace, 2011). Generally, there will be a cue to signal when the recording should occur. This cue serves as a prompt for the student to begin the assess-record process. With adequate training, including practice opportunities, the student can efficiently respond to the cue, record, and then return to the task at hand with minimal effort. Routine checks for treatment fidelity will allow teachers to confirm if the procedures are being followed as intended.

Self-recording has been utilized within the classroom setting to modify many behaviors including reducing disruptive behavior (Cavalier, Ferretti, & Hodges, 1997), increasing social initiations (Deitchman, Reeve, Reeve, and Progar (2010) and increasing attention to task (Rafferty, 2012; Moore, Anderson, Glassenbury, Land, & Didden, 2013). The two-step process of evaluating the occurrence or non-occurrence of a behavior and recording this judgment can be applied across multiple contexts, supporting the generalizability of the practice. In addition, this strategy has been successfully used to increase behaviors in students with a variety of diagnostic and disabilities categories including learning disabilities (Harris, 1986; Wolf et al., 2000), attention-deficit disorder (Merriman & Codding, 2008), emotional and behavior disorders (Carr, 1993; Mooney, Ryan, Uhing, Reid & Epstein (2005)) and severe brain injury (Selznic & Savage, 2000) amongst others.

Previous studies examined the effects of self-recording interventions when specific components have been added to or removed. Thus far, we know that students must self-evaluate performance, and must make a record of the behavior. Hallahan, Lloyd, Kneedler and Marshall (1982) compared student self-assessment to teacher assessment of performance. In the self-assessment condition, a student with substantial behavior challenges assessed and recorded whether he was attending to task. In the teacher-assessment condition, the teacher made the assessment and relayed this decision to the student, who then recorded the behavior. The student's on-task behavior was clearly higher under the self-assessment condition than under the teacher-assessment condition. The comparison of the two treatments indicated that the "self" in self-recording is a necessary component to obtain the greatest effects. To test the effects of the recording component in self-recording interventions, Lloyd, Hallahan, Kosiewicz and Kneedler (1982) tested the effects of self-assessment and self-assessment plus recording. In both conditions, the participants were taught to evaluate the presence or absence of attention to task, but only in the self-recording condition did the participants physically record these decisions. Results indicate that although self-assessment alone can increase on-task behavior, when the recording component was added, there was a differential increase in performance. Student engagement as well as productivity increased more when asked to make a record of the behavior.

Selection of Target Behaviors

Research suggests students can be taught to record a wide range of behaviors. Schonwetter, Miltenberger, and Oliver, (2014) taught adolescent swimmers to self-record and publically display the number of laps completed in order to improve swimming performance and attendance. Within the school setting, self-monitoring has been used to increase academic performance, as well as social behavior. For example, if the behavior in need of modification is disruption during math class, a teacher might have a student monitor his or her level of disruptive behavior, or taking a more positive approach, the level of engagement during that time period. The target behavior for monitoring could be asking the question, "Am I working?" (e.g., McDougall, Morrison, & Awana, 2012) or "Am I on-task?" (e.g. Moore, Anderson, Glassenbury, Land, & Didden, 2013). Shimabukaro and Prater (1999) taught students to record the number of problems completed during math, reading, and writing. The intervention affected student academic performance as well as engagement. Similarly, Mulcahy and Krezmien (2009) taught students to record the number of math problems completed in total during a set interval, as well as the number of those problems that the students answered correctly. To test the effects of self-recording on social skills, Deitchman et al., (2010) taught students with autism to record the number of appropriate social initiations witnessed during video feedback and they found that the procedure yielded increases in appropriate social behavior. Similarly, Cavalier et al. (1997)

taught students with learning disabilities within a self-contained setting to record the number of inappropriate verbalizations, which caused a subsequent decrease in inappropriate comments directed towards others.

I acknowledge that there are a variety of targets that can be used for the purpose of self-recording; however, there is little research to support the increased effects of one target over another. Briere and Simonsen (2011) considered behavior function, or the consequences that are maintaining problem behavior, when selecting a target behavior. They taught one of their participants who exhibited work avoidance to self-record a functionally relevant behavior (academic engagement) to increase work production as well as a behavior that was not functionally relevant (appropriateness of interactions with peers). They found that academic engagement increased when self-recording engagement as the target behavior. Similarly, Maag, Reid, and deGangi (1993) tested the separate effects of self-monitoring of attention, accuracy, and productivity on student on-task behavior, work accuracy and work production. Productivity and accuracy outcomes were higher when students were using productivity and accuracy targets over the attention target. These findings suggest that although students can be taught to monitor a range of target behaviors, it is essential that the behavior in need of modification be chosen for students to monitor and record.

Self-Recording of Productivity

Production recording requires the individual to record the amount of work that is produced within a given time frame. For example, when writing a paper, a person may want to record how many words are written at the end of every five-minute interval. This form of self-recording can allow a person to ensure that adequate progress is being made. Unlike self-monitoring interventions requiring students to pose a personal evaluation of attention behavior, such as “Am I on task?” (e.g. Lloyd et al., 1982), this intervention requires that students objectively quantify production and make a record.

Self-recording of academic productivity has demonstrated effectiveness in increasing academic performance across settings with students who have a wide array of learning needs. To test the effects across multiple settings, Caar (1993) taught students with EBD to self-monitor the number of math, reading, and spelling problems completed within a resource room setting. Results indicate that recording increased both the quantity and accuracy of work produced across all content areas. Shimbukuro and Prater (1999) ran a similar study within a resource classroom with students who had learning disabilities and attention deficit disorder with similar results. Although many self-recording interventions occur within more restrictive settings, there are many that have yielded significant effects in increasing academic productivity within inclusion settings (e.g. Rafferty & Raimondi, 2009; Rock, 2005) as well as regular education environments (e.g. Kirby, Fowler, & Baer, 1991; Rock & Threat, 2007). The ability of this intervention to generalize to many separate environments indicates that when a student is self-monitoring, it may go unnoticed by others. Rafferty and Raimondi (2009) collected teacher social validity data to support this belief. Teachers indicated after the intervention that the procedure was unobtrusive to the students surrounding those who were involved in the intervention.

Studies indicate that the effects of production recording expand beyond the increase of the target behavior. The majority of studies that have examined the effects of self-recording on productivity have also evaluated the effects on academic engagement and found that these two outcome variables are highly correlated (e.g. Harris, 1986; Lloyd et al., 1989; Maag et al., 1993). In addition, the effects of self-recording on other student outcome variables, such as accuracy

(Knapczyk & Livingston, 1974; Merriman & Codding; Mulcahy & Krezmien, 2009) and social behavior (Kirby et al., 1991), have been examined with positive results.

Bruce, Lloyd, and Kennedy (2012) in a review of studies comparing the targets of self-monitoring interventions (attention and productivity), categorized productivity procedures into two distinct categories: summary production and intermittent production. The criteria used to distinguish between these two procedures was when the recording occurred and how frequently. Studies that used summary production taught the students only to record once – at the end of the session. Students were instructed to count the amount of work that had been accomplished within a time frame and to record the score (e.g. Harris, 1986; Harris, 1994). Studies that used intermittent production had students repeatedly assessing the amount of work produced throughout a session (e.g. Lloyd et al., 1989; Maag & Reid, 1993). This is similar to many self-recording of attention studies in which the students were taught to responds to a cue, record their behavior and return to task (e.g. Lloyd et al., 1982; Rafferty & Raimondi, 2009; Rafferty, 2012).

Present Study–Research Questions

The present study examined whether differential effects were present between two different schedules of recording: formative and summative. During the intermittent recording condition, students were prompted to record periodically throughout the session. During the summative recording condition, students recorded only once, at the end of the session. I wanted to understand the effects that the two self-recording procedures had on performance.

In conducting this study, I addressed the following questions:

1. Whether self-recording of productivity will increase engagement, response rate, and accuracy for students exhibiting problem behavior.

2. Whether formative self-recording or summative self-recording will produce the greatest effects on student engagement, response rate and accuracy.
3. Whether students prefer to use an intermittent procedures or summative procedures to quantify and record behavior.
4. Whether teachers rate intermittent procedures or summative procedures as more acceptable and effective for modifying student behavior.

CHAPTER 3—METHODS

In this section I outline the research methods used to address the research questions. Prior to initiating the study, I obtained approval through the institutional review board (IRB) at the University of Virginia. The participating teacher signed a letter of consent for her participation in the study, as did the legal guardians of the students who participated.

Participants

Five elementary school students were selected from a rural public school system in Central Virginia. This main industry in the area is agriculture, and the majority of the residents live on or near locally owned farms. At the time of the study, the county was composed of fewer than 2,000 students (Virginia Department of Education School Quality Profiles, 2017). The majority of the student population was Caucasian and received free or reduced lunch. At the time of the study, the county was performing in the lower 50% of counties in the state of Virginia according to statewide assessment data. There were four schools in the county; two elementary schools, one middle school, and one high school. The study took place in one of the two elementary schools, serving grades three, four, and five. The school had not been fully accredited by Virginia state standards for three consecutive years and had a formal School Improvement Plan (SIP) in place.

Students

All of the participants chosen for this study were enrolled in the fifth grade, and had a documented disability. To identify target students, I met with the building administrators as well as grade-level teaching teams. During this discussion and after a review of academic and behavior records, the fifth-grade team identified five students who were deemed most at risk for academic failure due to disruption, inattention, or both. All of these students were performing below grade level in math and reading according to standardized assessment data. Although all of the students selected have a diagnosed disability, only two of the students, Chuck and Max were receiving special education services (see Table 3.1). All of the students selected were enrolled in the lowest performing classes, which were collaborative sections taught by a general educator and a special educator in the same room.

Table 3.1

Participant Demographics and Descriptive Measures

Student	Gender	Age (months)	Disability Label	Level of Performance
Chuck	Male	137	SLD, AHDH	1st Grade
Kate	Female	124	ADHD	2nd Grade
Devon	Male	128	ADHD	4th Grade
Braden	Male	127	ADHD	4th Grade
Max	Male	145	ASD	3rd Grade

In addition to documented academic issues and office referrals, all of the students selected for the student were receiving government assistance for low social economic status. During the time of the study, Chuck was experiencing homelessness and had moved to three separate residences over the several weeks of the study–one of which was located in a different county, approximately 45 minutes away from the school. All of the other students lived in single-family households, and had little parental support in the home according to teacher report. In addition, one of the students, Max, was absent for many sessions (20% total), including the first seven sessions of the study. Nine out of the ten absences were during the first phase.

Teacher

The teacher who participated in this study was responsible for running the self-monitoring intervention each day. She was a white, 30-year-old special educator with six years of experience in the county. She had worked in the same building for the duration of her career, and was a local resident. She had experience working across grade levels, and was the case manager for the two student participants receiving special education services.

Setting

The participating teacher conducted two regularly scheduled experimental sessions each day in her classroom. The classroom was approximately 5 meters by 4 meters and had two rows of student desks. Three desks were in the front row and two were in the back. The desks were approximately three feet apart from each other to obstruct the students' views of others working. All students were seated facing the white board posted on the wall at the front of the room.

Measures

Descriptive Variables

To assess the effects of the intervention, I assigned students math computation problems from the commercially available AIMSweb (www.aimsweb.com), math curriculum based measurement (M-CBM) probes. Curriculum based measurement is a research-based practice that was designed to assess academic growth across basic skill domains such as early literacy and math computation (Fuchs, 2004; Lembke & Stecker, 2007). Research on the use of CBM during math intervention has found these measurements sensitive to change in student performance (Shapiro, Edwards, & Zigmond, 2005). Multiple probes were combined to form student work packets that would be used to measure change in performance over time.

Level of performance. Students were individually assessed to determine which grade-level probe was most appropriate according to their level of functioning. I placed students within the grade level on which they scored between the 50^{th} and 75^{th} percentile according to the AIMSWeb normative data. Since the intervention did not have an active teaching component for math computation, if students scored between the set range for two separate grade levels, the lower of the two grade levels was chosen for student placement. Students remained in the same grade-level for the duration of the study in order to avoid variance in student responding caused by the difficulty of the task.

Dependent Variables

Responses per minute. Student productivity was measured by counting the number of digits the students wrote correctly per minute. To calculate this number, each digit in the student response was scored for accuracy. To be considered correct, the digit must be transcribed in the correct place value. For example, if the answer was 32, and the student wrote 32, she would have written two digits correctly–the number three in the tens place and the number two in the ones place. If the student wrote 31, she would only have written one digit correctly–the three in the tens place. Note, should the student have written 23 instead of 32, zero digits would be scored correct, since neither of the digits in the student's response is in the correct place value. The same logic would apply if the student wrote 321. In this case, the student would have scored zero digits correct, because none of the student responses are in the correct place value. To determine rate per minute, the total number of digits correct was then divided by the length of the work session in minutes. For example, 162 total responses, divided by twelve minutes, equals a rate of 13.5 digits per minute.

Accuracy. I calculated the students' accuracy percentages by dividing the total number of digits written correctly by the total number of digits attempted, then multiplying by 100 to obtain a percentage (i.e. 90 digits written correctly divided by 100 digits written in total = 0.9 x 100 = 90%). In some cases the student wrote more digits than were in the answer. For example, if the answer was five, and the student wrote 15. In this case there was an extra digit in the tens place that was not included in the answer. For this response, the student would receive credit for the one digit correct. However, there was an error in the response as well, which would be factored into the accuracy percentage. To correct for the error, an additional digit would be added to the total number of digits attempted. For a comprehensive set of directions for scoring the students' written responses, please see Appendix A.

Engagement. To define the target behavior, I followed the criteria used by Lloyd et al., (1982). Engagement was defined as the student sitting in the assigned area, with the student's eyes directed towards the assignment. Any observable behavior incompatible with the engagement criteria was recorded as off-task. Non-examples of engagement included looking away from the assignment, talking with other students or engaging with objects inappropriately (i.e. taking apart a mechanical pencil, pulling objects out of one's desk that are not necessary to complete the assignment, touching hair, etc.). Students who were observed counting on their fingers or using manipulatives were also considered on-task. Off-task behaviors included any action incompatible with the definition for academic engagement.

Observations Systems and Reliability

Observers collected direct observation data in the classroom. I was the primary data collector for this study. The second observer was a graduate student working on a master's degree in teaching. The observer training was collected during practice sessions prior to the beginning of the study, while students were completing independent assignments for their classes. Training occurred until the observers obtained above 80% reliability. This level of agreement was achieved after two 12-minute sessions.

We assessed student performance following a 5-second momentary time-sampling procedure that sequentially rotated through students. Momentary time sampling procedure records student performance at precise moment in time at the end of an interval (Cooper, Heron,

& Heward, 2007; Kubany & Slogget, 1973). To record the behavior of multiple students, I followed an audio recording that prompted me rotate through the students individually. I sampled student 1's behavior at the end of the first five-second interval, and then would sample the student 2's behavior at the end of the second five-second interval. I would follow this procedure through student 3, 4, and 5. The cycle repeated until the conclusion of the 12-minute observation session. See Appendix B for the observation protocol.

I conducted inter-observer checks for agreement o 12 of the 49 observation sessions (24.5%) and calculated agreement using Cohen's Kappa (Cohen, 1960). I chose Kappa for agreement because it is a more robust measure than percent agreement calculation. Kappa accounts for the possibility of agreement occurring by chance, calculating observer agreement of occurrences as well as non-occurrences of behavior. Average agreement was high for direct observation of engagement across phase conditions (*Mean* Kappa = 0.73; *Range* = 0.52 – 1). Rate per minute and accuracy data were calculated after scoring student work samples for the number of digits correct and errors. Checks for inter-scorer reliability were conducted for 10 of the 49 sessions (20.4%). Reliability was high (*Mean* Kappa = 0.99; *Range* = 0.94 – 1).

Experimental Conditions

Student behavior was assessed under a control condition and a self-recording condition. Within the self-recording condition, students were trained to employ an intermittent recording procedure and a summative recording procedure. Student behavior was observed across conditions to determine if the unique features of the conditions would differentially affect students' outcomes.

General Procedures

The participating teacher ran the intervention with the students twice a day. The intervention occurred as soon as the students arrived at school and once again before the students went to lunch. To ensure the procedures were followed consistently, the teacher followed a pre-intervention checklist resembling the treatment fidelity checklist (see Appendix C).

Before the students arrived, the teacher first prepared the physical environment. The teacher would systematically arrange all of the desks into an assigned location and, turn on the overhead projector to display the ClassDojo website for positive behavior monitoring (www.classdojo.com). Using the ClassDojo program, each student was assigned a colorful monster image with his or her name posted below the monster. Above each student's monster was the number of points that child had earned for displaying positive behavior. In addition, a group total would be displayed, so the students could know how many points the students had earned as a whole.

To decrease transition time into the treatment environment, the teacher placed the materials needed for the work session on the students' desks prior to the students entering the room. Each child received individually leveled work packets composed of CBM math probes. To avoid ceiling effects in production, students were given approximately 40% more work than they were able to complete. As students became more fluent in completing math problems, the teacher increased the amount of work given to each student. In addition, the teacher gave each student a folder containing the following: a number line, a hundreds chart, a multiplication chart, and a progress graph. The progress graph visually presented the student's accuracy percentage from the previous session on a line graph (see sample in Appendix D).

As the students entered the room each session, they were greeted at the door and were taught to go directly to their assigned seats. While the students were getting settled, they were prompted to evaluate their accuracy performance as presented on their progress graphs. During this time, the teacher made sure each child had a non-mechanical pencil and set a visual timer for 12-minutes on the ClassDojo website that was projected on the screen. Before starting the timer she would remind the students to "do their best work," and "work the whole time." The teacher would then start the visual timer and students would work silently until the timer went off to signal the end of the session. The students would then hand all of their work samples to the teacher and would place their folders in a designated crate by the door when exiting the classroom.

To promote positive behavior while working on the math probes, the teacher arranged an interdependent group contingency for students to access reinforcement when meeting instructional demands. Interdependent group contingencies require students to work as a single unit to gain access to a reinforcer (Implementing group contingencies; Hirsch, MacSuga-Gage, Park, & Dillon, 2016). Students could individually earn points for exhibiting positive behavior, which would be compiled for a group total. A preference assessment was administered to the group prior to beginning the work sessions in order to identify tangibles and activities that were reinforcing to the group members (See Appendix E). For example, after earning the first 150 points, the group earned time to play math games on the iPad.

Students could earn five points for exhibiting specific behaviors during each work session. First, each student had the opportunity to earn a point for following directions of how to enter the room and second for how to exit the room properly. This included arriving prepared with writing materials and cleaning up the work area after the work session. In addition, three opportunities to earn points occurred during the work session for "working hard." The length of the intervals for each opportunity to receive reinforcement was randomly selected prior to the work session. Each student who was on-task at the moment the teacher scanned the room would receive a point as well as a small edible on his or her desk (i.e. skittle, M&M, etc.). Pairing of the edible with the point occurred to strengthen the reinforcing value of the point given for on-task behavior, (Pairing; Alberto & Troutman, 2013). Loss of the opportunity to earn a point was the only consequence for off-task behavior during the work session.

Control Condition

To isolate the effects of quantifying performance, I introduced all stimulus variables that would be included during the treatment condition. First, a randomized treatment plan was introduced during the control condition and continued through treatment. Although I did not teach the students to self-record during the control, I introduced all variables specific to self-recording following the alternating treatment schedule. To decrease the probability of multiple treatment interference, color-coded all student materials as was done in Lloyd et al., (1989) to strengthen the discrimination between intermittent and summative treatments. Color-coded materials were used through the full duration of the study. In addition, to eliminate the hypothesis that audio cues could affect performance, tones were included during the baseline conditions following the alternating treatment schedule. The tones were emitted following a 90-second variable interval schedule, and would continue to be used during one of the treatment conditions to prompt the self-recording procedure.

Intermittent Self-Recording

The unique characteristics of intermittent recording include the presence of the audio stimulus to prompt self-recording throughout the duration of the independent work session as well using gray colored materials to strengthen the discriminating stimulus. The students' individual work packets as well as a self-recording sheet were gray in color.

Students were trained to respond to the stimulus and follow the intermittent self-recording procedures. When a tone occurred, students would stop working, circle the last problem completed, and would count the total number of problems completed during that interval. Students would then record this number onto their self-recording sheet (see Appendix F). This procedure mimics the self-recording of productivity procedures used by Lloyd et al., (1989). After recording, the students would return to completing their math assignments. The students would complete this process each time a tone occurred. If students were not able to complete a math problem within the interval, students were to record zero on their recording sheets. The self-recording sheet for the intermittent condition would therefore contain problem amounts to quantify work completed during each 90-second variable interval during the 12-minute session. The teacher would give a new self-recording sheet to the students for each session this condition was implemented.

Summative Self-Recording

The summative condition was paired with blue work materials and a blue recording sheet to be completed only once, at the conclusion of the 12-minute work session. The visual 12-minute timer would signal when the work session was complete. The students were trained under this condition to count the total number of problems completed when the session was over. They were then to record this total number onto the self-recording sheet along with the date. The same sheet was used over multiple sessions. See Appendix F for the summative recording sheet. Quantifying the number of items completed at the end of the work session mimics the recording procedures frequently used in research on self-recording of productivity (i.e. Harris 1986; Reid, 1993; Harris et al., 1994). Unique to this condition, students can evaluate performance over time.

Design

To answer the research questions, I employed a combination of a multiple baseline and alternating treatment designs. The combination of two single-subject methods assessed first if there is a functional relationship between self-recording and increased student outcomes, and second if participants perform differently under the two self-recording conditions.

Multiple Baseline

Following the recommendation of Kazdin (2011), I staggered the introduction to treatment across participants to demonstrate at least three interaction effects at three separate occasions. Additionally, I randomly selected the sequence of participants entering the intervention phase to increase the internal validity of the findings (Kratochwill and Levin (2010). Following the What Works Clearinghouse standards for single-case research (Kratochwill, Hitchcock, Horner, Levin, Odom, Rindskopf & Shadish, 2010), each participant was trained with the self-recording procedures and remained in treatment for at least five data points to evaluate if there is a distinct change in performance before training a second participant. After three treatment effects were observed individually, the last two participants entered treatment as the same time.

Each participant was systematically trained first on summative procedures. Training occurred directly before the second assessment session of the day. When introduced to the procedures, students were first told that self-recording would help the student work more quickly and complete more math problems. The participant was then given five minutes to complete as many math problems as possible, and was taught to then count the total number of problems completed and record this amount on the self-recording sheet. Afterwards, the student evaluated how many problems he or she was able to complete, and verbally set a goal for how many problems the student was striving to answer in the next practice opportunity. The student then practiced the summative recording procedure once more. The training session lasted approximately 20-minutes.

After self-recording under the summative condition for two consecutive assessment sessions, the student was trained on how to complete the intermittent procedures. This training, like the summative training, occurred before the second work session of the day; it lasted approximately 20 minutes. Students were already familiar with quantifying the amount of work completed when signaled with a timer under the summative condition. Students were told that this time instead of recording only once at the conclusion of the session, they would be self-recording the amount of work completed at multiple times throughout the work session. They again practiced the recording procedure twice and then implanted it in the following two consecutive sessions.

After I taught the recording the two recording procedures to each student, the standard, random alternation of sessions began again. That is, when a student was receiving training, there were two consecutive sessions of summative recording, followed by two consecutive sessions of intermittent

Table 3.2

Distribution of Sessions Across Conditions

	Number of Work Sessions		
Student	**Baseline**	**Intermittent**	**Summative**
Kate	8	18	18
Chuck	16	15	15
Devon	28	11	10
Braden	34	8	7
Max	25	7	7

recording. Then the irregular variation of sessions resumed.

Alternating Treatments

To determine if the students would perform differently under different stimulus conditions (Kazdin, 2011), I alternated implementation of the summative recording and intermittent recording procedures. The schedule for alternating treatments was randomized across session as well as the time of day (first session and second session) to further strengthen the internal reliability of the findings (Kratochwill & Levin, 2010). One restriction of the randomization was that no more than three consecutive sessions of the same condition were implemented. The proportion of sessions under each treatment condition was balanced across participants (see Table 3.2). Of the two final participants to enter baseline, Max, had significantly fewer days in baseline and three fewer during treatment, due to multiple absences.

Maintenance

Two weeks after ending the treatment, maintenance probes were administered to students under identical conditions to assess if students would continue to respond similarly to the self-recording procedures. This data will be used to support the generalizability of self-recording as an intervention to promote increase academic performance and behavior.

Data Analysis

To examine the effects of the treatment conditions, I employed visual inspection procedures examining changes between baseline and intervention phases in level, trend and immediacy as defined by Kratochwill and Levin (2010). I also employed White & Haring's (1980) "split middle," inter-quartile method to identify changes in trend. Also, I calculated descriptive statistics (mean, median, range and standard deviation) for each of the conditions to identify cumulative changes in student performance under the separate stimulus conditions.

Calculation of Tau-U was used to supplement visual analysis for each of the outcome variables. The Tau-U estimate was needed to correct for positive trend during baseline for multiple students (Parker, Vannest, Davis, & Sauber, 2011). Tau–U scores range for 0 to 1. The Tau-U score indicates the percentage of the data that does not overlap between baseline and intervention phases and does not improve between phases (Parker et al., 2011). Parker and Vannest (2009) provide the following ranges for interpretation: weak effects, 0-.65; medium to high effects, .66-92; and strong effects, .93-1.0. I calculated the effect size for general of self-recording procedures, summative procedures and intermittent procedures for each of the dependent measures.

CHAPTER 4—RESULTS

In Chapter 4, I present the data necessary to answer the research questions as well as report procedural fidelity. I reported data for each student variable separately. I visually inspected the data for changes in level, trend and immediacy, following the definitions of Kratochwill and Levin, (2014). Consistent with the research questions, I first employed these criteria to assess whether there is a treatment effect between the control condition and the self-recording conditions overall.

Next, I employed the same criteria to identify changes from the control condition to the intermittent self-recording and the summative self-recording conditions separately. Last, I examined differences between the effects of the two self-recording procedures according to the same set of criteria. I also reported descriptive statistics and calculation of the Tau-U effect size for the separate intervention procedures.

Productivity

I measured students' arithmetic computation productivity by counting the number of correct digits written for problems during each session divided by the duration of the session. That is, the measure was rate per minute (RPM) of correct responses. In this section, I examine each of the research questions separately with regard to this dependent variable. In the first section, I provide results for self-recording in general and then report the results for each of the two conditions separately. Last I report the data for the comparison of the two.

General Effects of Self-recording on Productivity

Figure 4.1 shows the combined effects of the two treatment conditions on students' productivity. Note that initially, I am considering the comparison between the control condition and the two self-recording conditions taken together (i.e., combined). As can be seen, the introduction of the self-recording procedures resulted in increased student productivity. There were distinct increases in level of responding when I introduced the self-recording procedure for each student. Changes in the data paths at the interrupt for all but one of students support the argument that this change was immediate. Chuck, the second student to enter treatment, demonstrated an increase in level compared to his performance at the

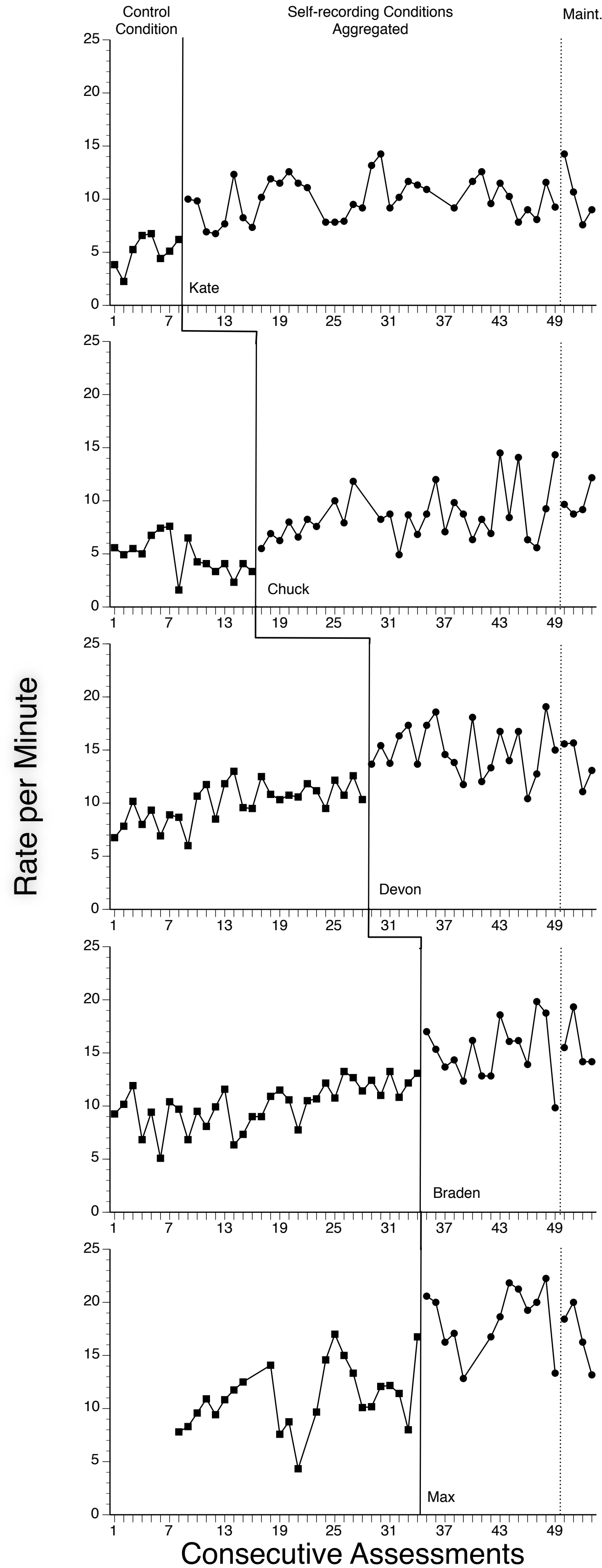


Figure 4.1 - Combined Effects of Self-Recording on Rate of Digits Correct Per Minute (RPM)

onset of treatment; however, his performance when introduced to treatment did not exceed his highest recorded performance during the control condition, indicating that change was not immediate. Inspection of the panels in Figure 4.1 also supports the treatment's effect on performance trend. Devin's, Brayden's, and Max's performance appears to have a positive trend during the control condition, and this interpretation is supported by Tau-U calculation of baseline trend (discussed subsequently); Kate's performance during the control condition appears to accelerate, and a quarter-intersect analysis (White & Haring, 1980) supports that interpretation. At the phase change, the increasing slope in Kate's performance decreased, becoming more stable. For three others (Devin, Braden, and Max), what had been an increasing slope appears to have been exceeded by a greater increasing trend at the phase change. Unlike the other participants, the data for Chuck demonstrated a slight decreasing trend during the control condition and developed a positive trend when treatment was introduced.

As can be seen in the final phase, students' levels of responding continued to be high during maintenance assessments. When I reassessed their behavior under the self-recording conditions two weeks following the last active self-recording session, there were no appreciable drops in any student's productivity. All students maintained RPM at a fairly consistent level to that exhibited during treatment, and was higher than exhibited during the original control condition. Although the RPM for three of the students was not as high as the last recorded data point during treatment (Chuck, Devon & Max), the performance of two of the students (Kate and Braden) exceeded the highest previously recorded performance during the treatment condition.

Table 4.1 provides a summary of the change in student performance for the productivity measure. It includes data across the control, self-recording, and maintenance phases. For the present reporting, about when self-recording was introduced, refer to columns titled "General Procedures" and "Self-Recording."

Table 4.1

Descriptive Statistics for Rate of Digits Correct Per Minute (RPM)

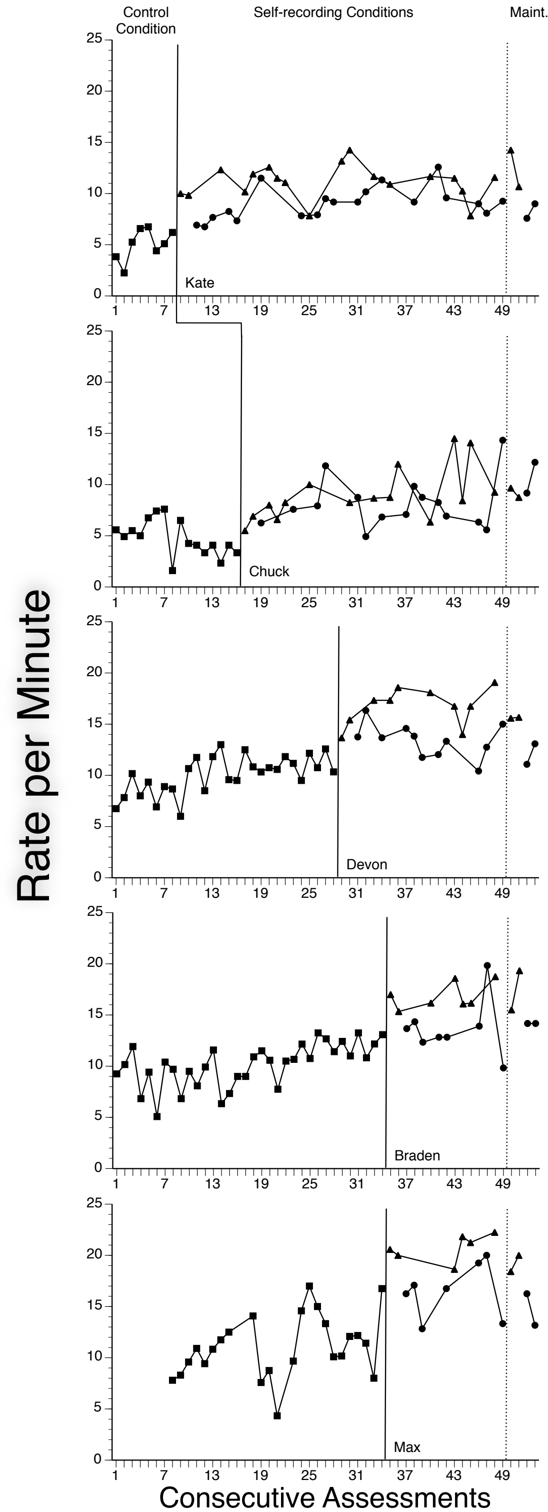
	Control Condition				Self-Recording Condition												Maintenance			
					General Procedures				Intermittent				Summative							
#	*M*	*SD*	*Med*	*R*	*M*	*SD*	*Med*	*R*	*M*	*SD*	*Med*	*R*	*M*	*SD*	*Med*	*R*	*M*	*SD*	*Med*	*R*
1	4.77	6.00	4.59	2-8	8.56	2.55	8.25	5-15	8.08	2.44	7.58	5-14	9.29	2.65	8.42	6-15	9.21	0.64	9.21	9-10
2	10.16	2.09	10.54	5-13	15.18	2.73	15.34	10-20	13.69	2.83	13.25	10-20	16.87	1.32	16.17	15-19	17.42	2.71	17.42	16-19
3	10.17	1.70	10.46	7-13	14.97	2.38	14.58	10-19	13.40	1.64	13.67	10-16	16.70	1.83	17.04	14-19	15.63	0.06	15.63	15-15
4	5.05	1.53	5.18	2-7	10.03	1.91	10	7-14	9.01	1.57	9.17	7-13	11.11	1.64	11.5	8-14	12.46	2.53	12.46	11-14
5	10.98	4.22	9.17	4-17	18.69	3.16	20	13-22	16.49	2.70	16.75	13-20	21.25	0.83	21.42	20-22	19.21	1.12	19.21	18-20

Note. Students were given an identifying number located on the left column of the table. Student 1 = Chuck, Student 2 = Braden, Student 3 = Devon, Student 4 = Kate, and Student 5 = Max.

As can be seen in Table 4.1, all students demonstrated an increase in mean as well as median performance during the self-recording condition, consistent with the visual analysis of changes in level. Calculation of the Tau-U effect size indicates a small overall effect of self-recording. Tau-U for the general recording procedures was .09, indicating that 9% of the data showed improvement between phases.

Effects of Summative Self-recording on Productivity

Figure 4.2 presents the results for both the summative and intermittent conditions as compared to the control condition. Examination of the change criteria indicates that summative recording had a clear impact on RPM. Each of the five participants demonstrated an increase in level during the summative condition in comparison to the control condition. In



addition, four of the five students demonstrate immediacy at the phase change, as seen by the clear changes in the data paths. At the phase change, it can also be seen that the trend does not continue from control into summative treatment. Examination of the data trends using the White-and-Haring (1980) analytic method shows a decrease in positive trend from control into summative treatment for three students (Kate, Braden and Max). Chuck's performance, which was declining during the control condition, also appears to increase in trend with introduction to the treatment. Conversely, the effect of summative recording appears to have an immediate increase in level for Devon with a declining trend.

The statistical results support the visual analysis (see Table 4.1, columns titled "Control Condition" and "Summative"). All students had an average increase in RPM during the summative compared to the control condition. Kate doubled her performance during control (6.06 RPM increase) and Max nearly doubled his previous performance (10.27 RPM increase). In addition, Median scores also increased in all students further supporting the visual appearance of an increase in average level of responding when completing the summative procedure.

Effects of Intermittent Self-recording on Productivity

As seen in Figure 4.2, there appears to be modest changes in student performance at the phase change from the control condition to intermittent recording. There is a demonstrated increase in level of average student responding; however, the intervention does not appear to have an immediate impact on level. At the phase change, all students performed under intermittent conditions similarly to the highest level of achievement recorded during the control condition. Furthermore, it appears that student performance during treatment does not exceed the positive trend during baseline for four of the students (Kate, Devon, Braden and Max). Rather, performance during treatment appears to be a possible continuation of the trend exhibited during the control condition. However, at the phase change the trend in Chuck's performance appears to increase gradually and then drastically increases towards the end of the treatment condition.

Examination the summary data in Table 4.1 for the intermittent condition shows that the mean and median levels of productivity were higher under intermittent self-recording than the control condition. The average differences support the argument that there was a benefit to the intermittent self-recording condition. I discuss possible reasons that these differences might be factual or illusions in a later section.

Comparative Effects of Summative and Intermittent Self-recording on Productivity

Although there appears to be some overlap between the two self-recording conditions, Figure

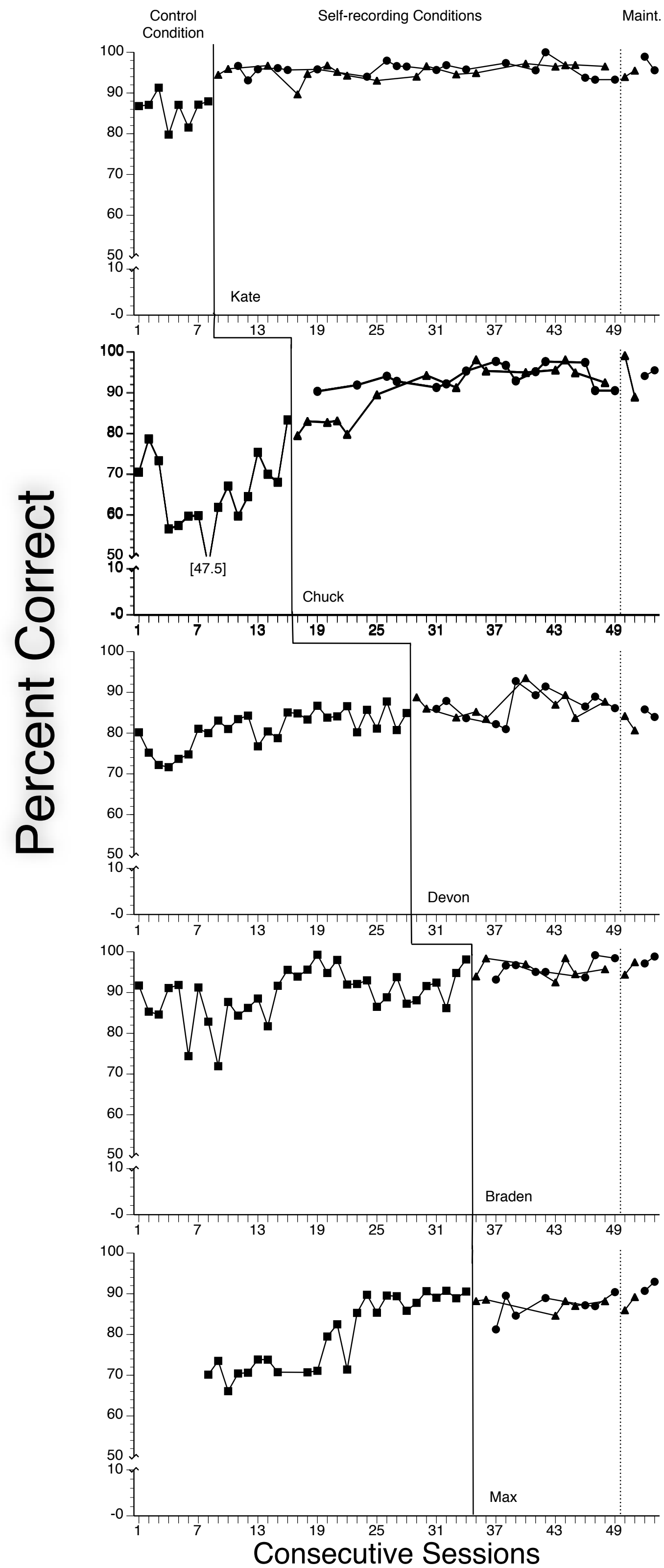


Figure 4.3 - Separate Effect of Self-Recording on Response Accuracy

4.2 shows a trend toward increased performance under the summative recording condition. As can be seen, the data paths for the two treatment conditions do not intersect for Max and Devon; summative recording clearly resulted in higher performance. For one of the students (Braden), there is only one intermittent data point that intersects the summative recording data path; the intersecting point however was the highest measure of performance during the self-recording condition. Across all students, the level of RPM is clearly higher during the summative recording condition. In addition, summative recording resulted in a stronger immediacy effect than intermittent recording, as can be seen in the panels for three of the five students (Kate, Braden, Max). The first data point at the phase change for summative is higher than previous performance; this is not the case for intermittent recording. Neither treatment appears to have a strong immediacy effect on Chuck and Devon's performance; however, both students appear to have responded at an increased rate under summative recording with additional sessions.

The descriptive statistics show all students demonstrated increased performance (mean and median) under the summative recording condition than during the intermittent condition in comparison to the control (see Table 4.1). There were no clear differences in deviation from the mean between the summative and intermittent recording conditions. Additionally, calculation of the Tau-U effect size for both treatment conditions indicates a small effect for both intermittent and summative conditions. The Tau-U effect size for intermittent recording was .10, and the Tau-U effect size for summative recording was also .10, indicating no difference in power of effect between the two conditions.

Accuracy

Accuracy in responding was calculated by dividing the total number of digits written correctly during the 12-minute session by the total number of digits attempted. The number of attempted digits included all errors in responding, including additional digits written into the student's response. In this section, I present the effects of self-recording on accuracy in comparison to performance during the control condition. Next, I discuss student accuracy during summative recording and intermittent recording separately. Last, I examine if there are any differences in computation accuracy depending on procedure.

General Effects of Self-Recording on Accuracy

The effects of the self-recording intervention on computation accuracy are shown in Figure 6. As can be seen, introduction to the intervention appears to have limited influence on student accuracy. Split, inter-quartile analysis show positive trend for all students aside from Kate. At the phase change, this positive trend appears to have already decelerated, as the data path continues into the treatment condition. However, immediate changes in level can be observed at the phase change for two of the panels (Kate and Chuck). Although the other students do not appear to have an increase in level of accurate responding with introduction to treatment, addition of the self-monitoring procedures does not appear to have a negative effect on student responding. All students sustained level of accuracy as demonstrated during the control condition.

As can be seen in the final phase, students' levels of response accuracy continued to be high during maintenance assessments. All students continue to perform similar to the treatment condition. Although Devon's response accuracy does appear to decline at the phase change, these changes are not drastic.

Table 4.2

Descriptive Statistics for Response Accuracy

	Control Condition				Self-Recording Condition												Maintenance			
					General Procedures				Intermittent				Summative							
#	*M*	*SD*	*Med*	*R*	*M*	*SD*	*Med*	*R*	*M*	*SD*	*Med*	*R*	*M*	*SD*	*Med*	*R*	*M*	*SD*	*Med*	*R*
1	65.85	9.25	92.98	48-83	91.99	5.35	92.87	80-98	93.78	2.72	92.92	90-98	90.20	6.70	92.50	80-98	94.07	7.19	94.07	89-99
2	89.63	6.08	100	72-99	95.91	2.12	95.74	93-99	95.99	2.13	95.85	93-98	95.81	2.27	95.74	93-99	95.95	2.17	95.95	94-98
3	81.12	4.47	92.90	72-88	86.89	3.34	86.52	81-94	86.89	3.68	86.52	81-93	86.89	3.13	86.53	84-94	82.46	2.50	82.46	81-84
4	86.09	3.68	89.10	80-91	95.53	1.80	95.80	90-100	95.77	1.75	95.80	93-100	95.28	1.86	95.57	90-97	94.74	1.10	94.74	94-96
5	80.29	8.76	96.55	83-91	87.21	2.45	88.19	81-91	87.46	3.17	87.17	81-90	87.48	1.48	88.82	85-89	87.61	2.28	87.61	86-89

Note. Students were given an identifying number located on the left column of the table. Student 1 = Chuck, Student 2 = Braden, Student 3 = Devon, Student 4 = Kate, and Student 5 = Max.

Review of the statistical data in Table 4.2 showed increases in mean performance during the treatment condition over the control condition (see “Control Condition and “General Self-Recording”), further supporting that the introduction to the treatment did not have a negative effect on performance. In addition, during the treatment condition, standard deviation decreased in comparison to baseline, supporting less variance in responding accuracy. The Tau- U effect size for general self-recording on student accuracy was weak according to the interpretation guidelines proposed by Parker et al. (2013); the Tau-U effect size was .08.

Effects of Summative and Intermittent Recording on Accuracy

As can be seen in Figure 4.3, there do not appear to be significant differences in level, trend, or immediacy between response accuracy during summative recording and intermittent recording procedures. An immediacy effect can be seen at the introduction to intermittent self-recording on accuracy, and the level of responding under this condition is sustained. Summative recording does not appear to have the same effect of immediacy; however, the level of responding in this condition is indistinguishable from intermittent self-recording after multiple sessions.

Statistical data further suggests there are no distinct differences in responding accuracy between the two self-recording conditions (see Table 4.2). There is no clear data trend across participants for mean, median or standard deviation to suggest accuracy one condition is more effective than the other. Tau-U further suggests there is little difference in effect between the two conditions; both conditions had a small effect on student accuracy. The Tau-U effect size for intermittent recording was .10. Summative recording also had an effect size of .10 indicating weak effects.

Engagement

Engagement data were collected through direct observation during the work session following a 5-second momentary time sample procedure. Student behavior was recorded as "on-task" if the student met engagement criteria. If not, "off-task" was recorded. Engagement data were collected for each session through the duration of the research study.

General Effects of Self-Recording on Engagement

Engagement remained high for all participants throughout the duration of the study, as can seen in Figure 4.3. The introduction of treatment was responsible for only slight changes in level. Ceiling effects limited the potential increase for engagement. All students aside from Chuck had demonstrated 100% engagement for at least one data point during the control condition. There does appear to be a change in trend with the introduction to the treatment condition. All students with the exception of Chuck appear to have an increasing slope during the control condition, which increases and appears to stabilize when treatment at the phase change. There are no effects of immediacy with the introduction to treatment, aside from Chuck, whose engagement appear to increase to previously demonstrated high levels of engagement. Table 4.3 displays the statistical results of the effects of self-recording (see "Control Condition" and "Self-Recording"). Mean engagement data show slight increases in engagement with the introduction of the treatment. In addition, deviation from the mean appear to decrease in all but one student (Chuck) once treatment is introduced. The Tau-U estimate of effect size indicates weak effects on student engagement. The Tau-U effect was .09 indicating that 09% of the data during treatment showed improvement over performance recorded during the control condition.

Student levels of engagement remain stable during maintenance. All students were engaged 100% of the time for at least one of the recording sessions, mimicking performance during the treatment phase.

Table 4.3

Descriptive Statistics for Engagement

	Control Condition				**Self-Recording Condition**												**Maintenance**			
					General Procedures				**Intermittent**				**Summative**							
#	*M*	*SD*	*Med*	*R*	*M*	*SD*	*Med*	*R*	*M*	*SD*	*Med*	*R*	*M*	*SD*	*Med*	*R*	*M*	*SD*	*Med*	*R*
1	93.14	7.14	92.98	79-100	94.06	8.41	96.55	71-100	92.14	10.98	100	71-100	95.98	4.04	96.55	86-100	89.29	15.15	89.29	79-100
2	97.31	3.66	100	89-100	99.52	1.26	100	96-100	100	0	100	100-100	98.98	1.74	100	96-100	100	0	100	100-100
3	92.28	6.06	92.90	76-100	98.21	2.53	100	93-100	97.56	3.03	100	93-100	98.94	1.71	100	96-100	100	0	100	100-100
4	86.65	10.66	89.10	64-97	95.52	5.25	96.55	79-100	95.67	4.14	96.43	86-100	95.39	6.25	96.55	79-100	100	0	100	100-100
5	94.75	6.72	96.55	75-100	98.90	3.05	100	89-100	97.96	4.05	100	89-100	100	0	100	100-100	98.22	2.54	98.22	96-100

Note. Students were given an identifying number located on the left column of the table. Student 1 = Chuck, Student 2 = Braden, Student 3 = Devon, Student 4 = Kate, and Student 5 = Max.

Effects of Summative and Intermittent Recording on Engagement

The separate effects of summative and intermittent recording on engagement mimic the general effects of the treatment condition as discussed in the previous sections. As can be seen in Figure 4.4, for all five students, the data pathways for the two conditions overlap, indicating no clear differences in effect. The statistical data in Table 4.3 support this claim. The data are distributed similarly under both treatment conditions. Tau-U estimate of effect size further supports minor differences between effect of summative and intermittent self-recording. The effect size for summative recording was .11 and was .10 for intermittent recording, showing a weak effect size for both treatment conditions.

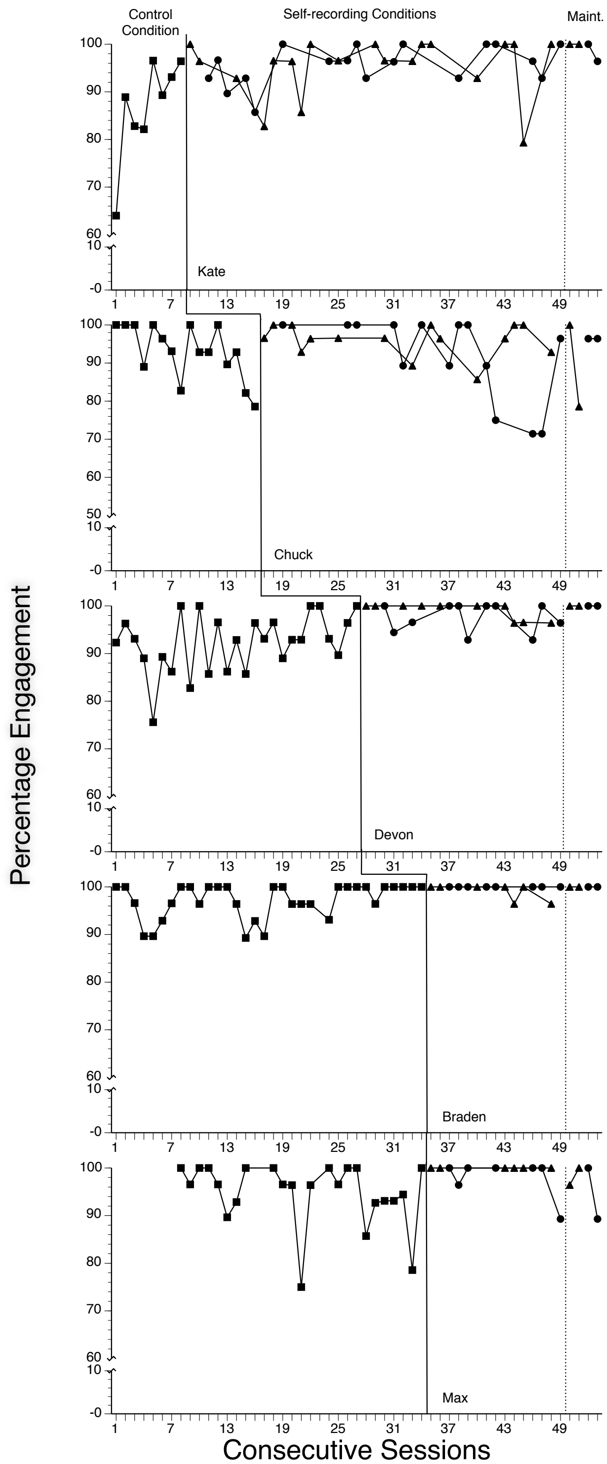


Figure 4.4 - Separate Effects of Self-Recording on Academic Engagement

Treatment Fidelity

I assessed the fidelity of implementation in two ways. First, I examined in the procedures were followed correctly using an 11-item checklist (see Appendix G) for 100% of the work sessions. Treatment fidelity for implementation of procedures was 100% for all sessions. Second, I calculated the number of problems each student accounted in his or her self-recording records and compared it to the actual number of problems completed for each session. If students under-calculated the number of problems completed, this score was below 100%. If the student over-calculated, the score was above 100%. Accuracy percentage was calculated by dividing the number of completed problems the student quantified by the number of problems completed.

For the summative recording condition, the percentage of problems accounted for was 95% (range, 72% to 104%), 100% (range, 95% to 101%), 106% (range, 89% to 116%), 100%, (range 92% to 103%) and 99% (range, 91% to 102%) for Kate, Chuck, Devon, Braden, and Max respectively. For the intermittent recording condition, the percentage of problems accounted for was 65% (range, 60% to 125%), 98% (range, 92% to 106%), 92% (range, 72% to 100%) and 107% (range, 87% to 125%) for Kate, Chuck, Devon, Braden, and Max respectively.

Social Validity

I measured the acceptability and perceived effectiveness of the separate self-recording conditions from the perspective of the participating students and teacher. Quantifiable data were gathered for the separate conditions using student-focused and teacher-focused rating scales. Qualitative data were gathered through a semi-structured interview with the teacher at the conclusion of the intervention as well as a focus group with the students.

Student Focused

I administered an adapted version of the *Child Intervention Rating Profile* (Elliott, 1988; Witt & Elliott, 1983) separately for the summative and intermittent recording conditions. The scales were administered after the last session for each treatment condition. The rating scale contained seven items using a 6-digit Likert-scale. The rating scale is out of a total of 42 points, indicating the highest approval rating. Adaptions to the original rating scale changed wording to use familiar language, such as "work hard," (see Appendix H). Average ranging of the intermittent and the summative procedures were equal (Intermittent $M = 40.8$, 97%; Summative $M = 40.8$, 97%). Two students did not give the highest rating to the question, "There are better ways to help me work better," for summative recording, and one student did not give the highest rating on this question for intermittent recording.

During the focus group, when questioned about their overall effectiveness of the two self-recording procedures, the students agreed that both methods of self-recording helped them work harder and complete more math computation problems. They believed both forms of self-monitoring could be used in the general education classroom, and could be applied to other content areas. In addition, they all said they were happy to be trained on how to self-record and would like to continue using one or both of the methods.

When asked which self-recording method was preferred, all of the students chose the summative recording condition. One of the students immediately followed up her selection by saying that she disliked the tones because they slowed her down. Two other students disagreed with this statement, and said they thought the tones helped them focus. One student interjected saying that he believed the tones helped him go faster. When asked to clarify, he said he believed the tones (intermittent) helped him work more quickly than the summative recording condition, even though he preferred to self-record only once at the end of the session.

Teacher Focused

The teacher was asked to complete the *Intervention Rating Profile – 15* (IRP-15, Martens, Witt, Elliott & Darveaux, 1985) for general self-recording procedures, intermittent self-recording as well as summative self-recording. The IRP-15 is composed of fifteen items using a 6-digit Likert scale, totaling a possible 90 points (See Appendix H). Although the teacher rated all three of the conditions as high, she rated general procedures the highest (88, 98%), followed by intermittent (87, 97%) and summative recording (86, 96%) respectively. For each of the conditions, she scored only five of six points for the questions, "Most teachers would find this intervention suitable for the behavior problem described," and "This intervention would *not* result in negative side-effects for the child."

During the interview, I asked the teacher to provide a justification for these ratings. She replied that although she liked that students were self-recording their productivity, and she felt it was a motivating practice, it is difficult to find materials that would be appropriate to use with this form of self-monitoring. She mentioned that the students continuously want to see their scores improve, so it is important to be pairing this practice with materials that are sensitive to change in student performance. In addition, she mentioned that when students did not do as well as they'd hoped, or when they did not answer as many problems as their neighbor, some would get discouraged. She finished this statement noting that the consequence of not doing as well as hoped is likely motivating to try harder next time, but in the moment, it may cause students to act discouraged.

The teacher stated that she believed self-recording was an effective intervention for increasing productivity as well as engagement. She stated she noticed drastic improvements in the RPM and behavior and would continue using this intervention both for small-group settings as well as generalize the intervention into the inclusion setting. She reported that the students were excited to self-record and that she could hear them discussing their work with other students. In addition, she mentioned that the general education teachers had commented to her on numerous occasions how they had noticed improvements on the students' engagement and how quickly they would begin assignments when given.

When asked which self-monitoring procedure she believed produced stronger effects, she had mixed feelings. Although she knew the students preferred summative recording, she commented that she felt intermittent recording was a more proactive approach to increasing engagement and productivity. She believed that the tones served as a reminder to get back to work, which took a good deal of burden off the teacher. The only downside to intermittent recording that was stated was that the responding to the tones appeared to be frustrating to some of the students. She mentioned hearing some of the students grown when the tones would go off, and discussed the struggle experienced by one student who was never able to accurately count the number of problems completed during the interval. She followed up the question stating that she felt both forms of self-recording were valuable and could be integrated into different types of tasks. In particular, she mentioned wanting to try summative recording with reading, believing that the sound of the tones may interfere with comprehension.

CHAPTER 5 - DISCUSSION

This study was implemented to isolate and examine the effects of a self-recording procedure on academic achievement and engagement in a controlled setting. During the control condition, all stimulus variables other than quantifying and recording production were introduced, in order to isolate the effects of recording. Additionally, the study aimed to determine if students would respond differently when completing two separate self-recording procedures. Results of this study suggest that the addition of self-recording increased student productivity and engagement. Furthermore, self-recording does not appear to have a negative effect on accuracy. Differential effects of the two treatment conditions appear present for response rate in favor of summative recording, but there does not appear to be significant non-overlap between the two treatments for response accuracy and academic engagement.

Self-recording–A Positive Practice

Since IDEA (2004), there has been a push to develop positive behavior interventions and supports (PBIS) to promote pro-social behavior. Positive behavior supports are proactive and increase the likelihood that positive behavior will occur unlike punishment procedures, such as office referrals and suspensions, that are reactive in nature (Zirpoli, 2016). If proactive approaches to increasing positive behavior are put in place, these antecedent manipulations automatically decrease the potential for negative behaviors to occur. Therefore, by reinforcing positive behavior, the need to punish negative behavior is reduced.

Self-management strategies are pro-active procedures designed to increase a person's ability to control his or her behaviors. Competing contingencies are present in the naturally occurring environment; the stronger of the contingencies will motivate a person's behavior (Bingham, 1973). However, environmental manipulations can modify the strength of one contingency over another. For example, if a person is trying to stop drinking alcoholic beverages, the person who wants to strengthen self-control will likely modify his or her environment and avoid situations in which alcohol is likely to be present. By explicitly teaching students self-management skills, students can become more aware of the competing contingencies in their own environments, and can attempt to become their own behavior change agents (Zirpoli, 2016). For example, if a student is taught to monitor her level of engagement, she can determine she is engaged and meeting expectations. This procedure increases observer reactivity; therefore, providing the student with an opportunity to receive natural feedback and adjust one's performance (Mace, 2011).

Students who can self-manage in the classroom decrease the level of support required from the teacher to meet social and instructional demands. Rafferty (2012) taught a group of students with emotional and behavior disabilities to self-record multiple behavior expectations (i.e. sitting up straight, answering questions, etc.). In doing so, students demonstrated drastic increases in on-task behavior during student work sessions. When increasing self-management, the student requires less prompting from the adult in the room to adjust performance. If students are able to meet expectations independently, they automatically decrease the risk of encountering negative consequences, or punishments for a lack of self-control or inability to meet school expectations (Sidman, 2001).

Researchers have identified the procedures required to obtain the strongest effects; self-evaluation and recording. Previous studies have determined that students must evaluate their own behavior (Hallahan et al., 1982) and must record their own behavior (Lloyd et al., 1982). When one of these components was removed, student behavior decreased as a result. In the Lloyd et al. (1982) study, the additive effects of self-recording were measured; the current study sought to extend this research with one of the research questions. I sought to measure the additive effect of self-recording on a control condition, in which stimuli associated with self-recording were already present in the environment. In addition, previous research has not compared the effects of intermittent and summative recording procedures; both of which are frequently cited in the literature. Specifically, I looked to expand the research base on self-management literature by examining if observer reactivity was stronger when students recorded overall performance at the end of a work session (summative recording) or when students are prompted to record performance throughout a session (intermittent).

Interpretation of Current Findings

In the present study, I isolated the effects of quantifying and recording performance on three student outcomes: rate of digits correct per minute (RPM), response accuracy, and academic engagement. Data for these dependent variables were collected during a control condition, in which intermittent tones were introduced as well as color-coded materials specific to condition, following a randomized, alternating-treatments schedule. Students were introduced to the active self-recording treatment following a multiple baseline design to demonstrate four separate interaction effects (the last two students entered treatment at the same time). The results from this study suggest the introduction to a self-recording procedure increases performance. The data showed that summative recording may have a larger impact on student responding than intermittently recording.

The results of this study support previous research on the effects of self-recording of productivity on increased student achievement (e.g. Harris et al., 2005; Shimabukuru & Prater, 1999; Wolfe, Heron, & Goddard, 2000). Although the overall effect size of the intervention indicated weak effects, the introduction to self-recording does appear to cause an increase in rate per minute, answering the first research question. These results are compelling, since the study was not testing the effects of an entire self-recording package, rather it isolated the specific variables of quantifying and recording progress. All other variables were held constant, including contingent reinforcement.

The effects of the treatment procedures on responding accuracy and student engagement are less conclusive. Although students responded more accurately during the treatment phase than in the control condition, we cannot establish a functional relationship between the treatment and the outcome. It appears that routine drill practice may be affecting student accuracy. During baseline, there is a positive trend that decreases near the phase change. This decrease also occurs close to the ceiling of 100%. Because the highest accuracy students can score is 100%, there is a ceiling effect that limited the potential for further increases at the introduction to treatment. Most students were already performing on or near 85% when treatment was introduced. However, it can be determined that self-recording does not appear to have an adverse effect on response accuracy. Although all students increased RPM with treatment, no students declined in accuracy as a result. Therefore, I can conclude that increasing rate of responding does not decrease the quality of production. In addition, student engagement remained high throughout the duration of the intervention, which can likely be attributed to the presence of reinforcement for completing tasks. Based on the data, the introduction to the self-recording procedures was not responsible for the high-rate of on-task behavior.

The second research question examining whether the self-recording procedures would have differential effects on student responding. The RPM data show differences in student performance, favoring the summative recording procedure. The majority of students produced more digits correct in the 12-minute work session when using the summative procedure over the intermittent procedure. Examination of the accuracy and engagement data do not show clear differences in student responding according to procedure. These two outcomes were not affected based on procedure used.

Limitations

There are many considerations when interpreting the results of this study. Multiple factors could have impacted the treatment effects, such as environmental variables, design variables as well as procedural elements when completing the self-recording process. Consideration of the following limitations will be necessary if trying to implement the intervention procedures as described in this study.

When interpreting the results of this study, it is important to consider the environmental variables that were controlled before introducing the treatment. First, this study occurred in a highly controlled setting, apart for the regular education classroom. Students were pulled from their regular education classes twice per day to participate. The environment was tightly structured, and materials were assigned that were on each student's independent work level. Work that was typically assigned as part of the students regular instruction was not used for the purposes of self-recording. In addition, positive reinforcement was delivered three times per 12-minute work session for the full duration of the study in order to increase positive behavior. The schedule of reinforcement employed in this study is likely too high for a teacher to implement in a typical classroom setting with the added responsibility of delivering instruction. Furthermore, it is unknown if students would have reacted similarly to the intervention if reinforcement was not available in the environment. Second, observation sessions were limited to 12-minutes, so it is unknown if student performance would have maintained at observed levels for longer durations.

Although we did see differences in rate of production between the two treatment conditions, it is difficult to determine if one method of self-recording causes the students to work faster. During the intermittent condition, the students did not produce as many digits correct during the 12-minute period of time as was demonstrated during the summative recording condition. However, the observers did not calculate the amount of time that students spent engaged in the intermittent recording process. Seeing as students had to pause task completion approximately 12 times throughout the work session, it is possible that while engaged in the task, the students actually produced more work during intermittent recording. However, without duration recording of the amount of time in which the students were engaged in the recording process, this information is unknown.

Furthermore, the results suggest that students performed higher during the summative recording procedure than the intermittent procedure, but these data should be interpreted with caution. First, there is potential that the order of introduction to each treatment could have had an effect on the treatment outcomes. Each student was trained on the summative recording procedures prior to the intermittent recording procedures. The summative recording procedure required fewer steps for the students to complete out of the two, so it is possible that students perceived summative recording as being an easier procedure, which could have effected motivation. During the focus group discussion, some students stated that the use of the tones for intermittent recording helped strengthen concentration, while others insisted that responding to the tones slowed them down and was bothersome. Interestingly, when asked which procedure was preferred if given the choice, all students preferred summative recording, even though some believed they increased performance more during intermittent. This suggests that avoiding the additional effort required for intermittent recording may be more motivating than receiving the satisfaction of maximizing performance. In addition, although nuanced, it is possible that introduction to the second self-recording procedure (intermittent) could have enhanced the effects of the first (summative). Students may have experienced increased motivation when reverting back to the original procedure.

A second consideration when examining the differences in effects between summative and intermittent recording are the specific features of the two self-recording procedures. The summative recording procedure required students to quantify the amount of work completed and record this amount at the end of the 12-minute work session. Therefore, during this condition, the students were able to work for 12-minutes uninterrupted. During the intermittent recording condition, students had to complete the recording procedure approximately once per minute; therefore, interrupting task completion. Without accounting for the duration of time the students spent completing the repeated intermittent recording procedure, we cannot determine the RPM when specifically engaged in task completion. Are data interpretations are limited to student performance solely over a 12-minute work session.

Despite the limitations presented above, these results support previous research that self-monitoring is an effective intervention to increase academic and social behavior for struggling learners. These results also expand the literature by suggesting that even in controlled settings, when students are engaging high levels of engagement, self-recording could further increase positive behavior. The results also suggest that students may only need to record their behavior once, at the end of a session, to obtain the full benefits of self-recording interventions.

Implications and Future Directions

The results from this study have a number of implications for practitioners in classroom settings. First, the results suggest that increasing students' awareness of their performance enhances their motivation to improve. Students became more aware of how they were preforming in two ways: a) they were provided daily accuracy feedback and b) they were taught how to quantify and record their progress. By increasing both awareness of how much was accomplished as well as student accuracy, students are able to receive multiple sources of feedback, which can be reinforcing. Second, the results of study suggest that the use of intermittent cue to prompt the recording process is unnecessary. Summative recording does not require additional audio cues or tactile devices, such as the MotivAider, which has been used in other self-recording studies (e.g. Rafferty, 2012). Since summative recording requires students only self-record at the end of a work session, it is highly discrete, and can go unnoticed by other students in the room. In addition, students prefer this strategy, which arguably requires less effort. Last, although this intervention aimed to increase digits per minute, the same strategies have been used to increase spelling accuracy (Harris, 1986), reading comprehension (Knapczyk & Livingston, 1974), and the number of words written (Harris et al., 1994). This self-management strategy can be applied to across educational context to improve work performance.

Future directions for self-recording interventions should be to continue to investigate the potential benefits of self-recording interventions in typical educational environments. Since IDEA (2004), there has been rise to the number of students with disabilities being educated within the regular education and inclusion settings. Therefore, it is essential that future researchers investigating intervention effects for students with learning needs be conducted in their natural learning environment. In addition, I believe the work of Briere and Simonsen

(2011), who considered functions of behavior before developing a self-management intervention, should be expanded. It is possible that students whose problem behavior serves different functions may respond differently to the separate recording procedures.

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APPENDIX A

ACADEMIC PERFORMANCE DATA – SCORING GUIDE

1. *Rate Per Minute (RPM)* – The number of digits written correctly per minute.
   a. Calculate total number of digits written correctly. Each digit is scored separately as correct or as an error. To be scored as correct, the same digit corresponding with the answer key must have been written in the correct place value location.

      Example: The correct answer is 32.

         Student writes “32” – student scores 2 pts. Two digits written in the correct place value (3, tens place; 2, ones place).

         Student writes “22” – student scores 1 pt. and one error. One digit written in the correct place value (2, ones place), one incorrect digit.

         Student writes “30” – student scores 1 pt. and one error. One digit written in the correct place value (3, tens place), one incorrect digit.

         Student writes “2” – student scores 1 pts and one error. One digit written in the correct place value (2, ones place), one digit omitted (error).

         Student writes “3” – student scores 0 pts. and one error. One digit written in wrong place value.

         Student writes “132” – student receives 2 pts. and one error. Two digits written in the correct place value (3, tens place; 2, ones place) and one extra digit included in the hundreds place (error).

   b. Calculate the <u>rate</u> of responding. Divide the total number of digits written correctly by the session length in minutes.

      Example: 120 digits written correctly in 12-minutes.

         120 digits/12-minutes = 12 digits/minute

2. *Response Accuracy* – The percentage of total digits written correctly.
   a. Divide the total number of digits written correctly by total number of digits written correctly, plus the total number of errors. Multiple this decimal by 100 to calculate percent.

      Example: 120 digits written correctly, 20 errors

         120 digits written correctly/120 digits written correctly + 20 errors

         120/140= .86; .86 x 100 = 86%

APPENDIX B

Direct Observation Form

O's Initial _______ Date _________ Length of Observation (minutes)_____________

Morning/Afternoon _______________________Subject_____________________

Sheet # 1 2 3 4 5 6 7 8 9 10

1	**1 Student** Engaged OFF	**2 Student** Engaged OFF	**3 Student** Engaged OFF	**4 Student** Engaged OFF	**5 Student** Engaged OFF
2	**1 Student** Engaged OFF	**2 Student** Engaged OFF	**3 Student** Engaged OFF	**4 Student** Engaged OFF	**5 Student** Engaged OFF
3	**1 Student** Engaged OFF	**2 Student** Engaged OFF	**3 Student** Engaged OFF	**4 Student** Engaged OFF	**5 Student** Engaged OFF
4	**1 Student** Engaged OFF	**2 Student** Engaged OFF	**3 Student** Engaged OFF	**4 Student** Engaged OFF	**5 Student** Engaged OFF
5	**1 Student** Engaged OFF	**2 Student** Engaged OFF	**3 Student** Engaged OFF	**4 Student** Engaged OFF	**5 Student** Engaged OFF
6	**1 Student** Engaged OFF	**2 Student** Engaged OFF	**3 Student** Engaged OFF	**4 Student** Engaged OFF	**5 Student** Engaged OFF
7	**1 Student** Engaged OFF	**2 Student** Engaged OFF	**3 Student** Engaged OFF	**4 Student** Engaged OFF	**5 Student** Engaged OFF
8	**1 Student** Engaged OFF	**2 Student** Engaged OFF	**3 Student** Engaged OFF	**4 Student** Engaged OFF	**5 Student** Engaged OFF
9	**1 Student** Engaged OFF	**2 Student** Engaged OFF	**3 Student** Engaged OFF	**4 Student** Engaged OFF	**5 Student** Engaged OFF
10	**1 Student** Engaged OFF	**2 Student** Engaged OFF	**3 Student** Engaged OFF	**4 Student** Engaged OFF	**5 Student** Engaged OFF

Engaged sums: Stud 1= __/__ Stud 2 = __/__ Stud 3 = __/__ Stud 4 = __/__ Stud 5 = __/__

APPENDIX C

Pre-Intervention Checklist

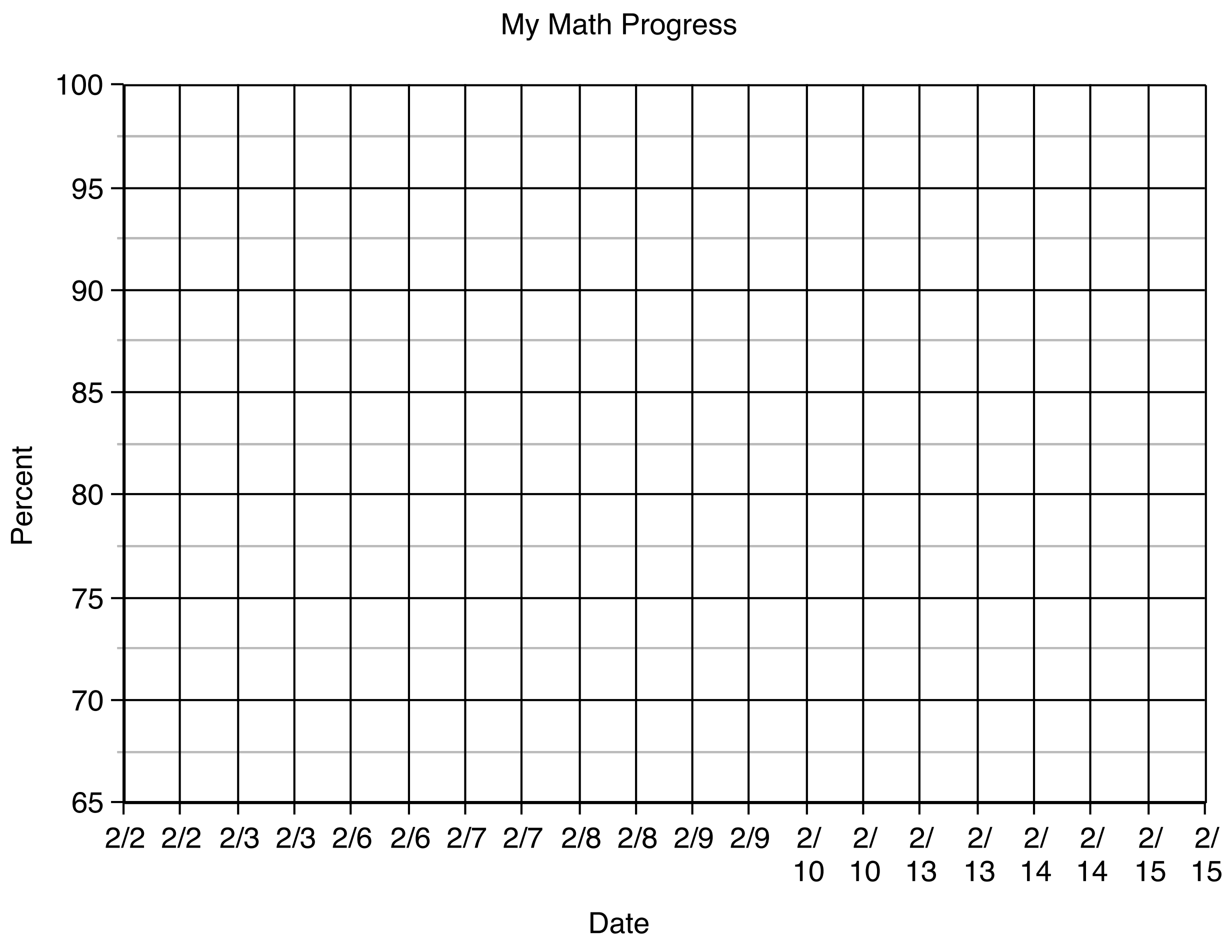
1. Arrange student desks.
2. Have group point goal written on the board.
3. Check Schedule to determine intervention type.
4. Put materials on student desks.
   a. Student folders (math aids + progress graph)
   b. Color Coded Materials
      i. Gray = Intermittent; Blue = Summative
   c. Grade-Level Passages
      i. Chuck – 1^{st}, Kate – 2^{nd}, Max – 3^{rd}, Devon and Braden – 4^{th}
5. Turn on projector.
6. Display ClassDojo website.
7. If **Intermittent** condition, plug in speakers and pull up sound file.
8. Set timer for 12 minutes.
9. Ensure all students have a regular, non-mechanical pencil.
10. Direct students to review their previous performance on the progress graph and remind them to "work hard" and "work the whole time."

Intervention Procedures

1. Reinforce working (no disruptions or head down) by providing a point and an edible 3 times throughout the session.
2. Walk around the room and monitor student performance.
3. Do not offer assistance. Encourage students to do their best.
4. Collect all materials after work session.

APPENDIX D

Sample Progress Graph for Math Computation



APPENDIX E

Student Preference Assessment

Tell me what you like to earn for your group! Circle how much you would like to earn this item using the scale (i.e., I hate it, it's okay, I love it).

Rating Scale	I Hate it!	It's Okay	I Love it!
2. Teacher sends a "good job" note home	☹	😐	☺
5. Candy	☹	😐	☺
6. Play Prodigy Math on the computer	☹	😐	☺
7. Indoor recess	☹	😐	☺
8. Soda	☹	😐	☺
9. Play board games	☹	😐	☺
10. Watch YouTube videos	☹	😐	☺
11. Eat lunch in the classroom with friends	☹	😐	☺
12. Get to eat lunch in the classroom with friends	☹	😐	☺
13. Time on the IPad	☹	😐	☺
14. Ice cream during lunch	☹	😐	☺
15. Watch movie during lunch/recess	☹	😐	☺

APPENDIX F

Self-Recording Forms

Intermittent Self-Recording

NAME ____________ Subject MATH

How much did I complete?

	# of Problems
a)	
b)	
c)	
d)	
e)	
f)	
g)	

Summative Self-Recording Form

NAME ____________ **Subject** MATH

How much did I complete?

Date	# of Problems

APPENDIX G

☐ Primary Sheet ☐ Reliability Sheet

Procedural Fidelity Checklist

School: WYES___________ Teacher: McMahon_______________
Observer Name: _____________________ Observer 2/reliability: ____________________
Date: ________________ Length____________________

Treatment Condition: ☐Intermittent ☐Summative
Length of Student Work Session (minutes): 12 minutes

Self-Monitoring Procedures	**Observed**
1. Student desks are arranged.	**Y N**
2. ClassDojo is projected for students to see.	**Y N**
3. Teacher provides signal (timer) to begin.	**Y N**
4. Students provided feedback on work accuracy.	**Y N**
5. Expectations are provided to students before beginning work session.	**Y N**
6. Students provided with blue color-coded materials.	**Y N N/A**
7. Students provided with gray color-coded materials.	**Y N N/A**
8. Student assignments are accurately leveled.	**Y N**
9. Audio cues (60s var.) are emitted during session.	**Y N N/A**
10. Teacher circulates, observing student work.	**Y N**
11. Teacher reinforces student behavior while working.	**Y N**
12. Materials are collected at the end of the session.	**Y N**

If students are absent for all or part, indicate below:
☐Student 1 ☐Student 2 ☐Student 3 ☐Student 4 ☐Student 5

Self-Recording Accuracy ***If in baseline, circle N/A**		
Student	Intermittent	Summative
1	Y N N/A Percentage: _________	Y N N/A Percentage: _________
2	Y N N/A Percentage: _________	Y N N/A Percentage: _________
3	Y N N/A Percentage: _________	Y N N/A Percentage: _________
4	Y N N/A Percentage: _________	Y N N/A Percentage: _________
5	Y N N/A Percentage: _________	Y N N/A Percentage: _________

Subtract out any items marked N/A when computing your totals.

Total Fidelity Score_____ Total Score Possible_____
Total Score divided by Total Possible = % yes_____

APPENDIX H

Social Validity Rating Scales

Student Intervention Rating Scale

	I agree					*I do not agree*
1. The method used to help me work harder was fair.	+	+	+	+	+	+
2. The teacher was too harsh on me.	+	+	+	+	+	+
3. The method used to help me work harder caused problems with my friends.	+	+	+	+	+	+
4. There are better ways to help me work better than this one.	+	+	+	+	+	+
5. This method used by this teacher would be a good one to use with other children.	+	+	+	+	+	+
6. I like the method used to help me work harder.	+	+	+	+	+	+
7. I think that the method used to help me work harder will help me do better in school.	+	+	+	+	+	+

Note. Adapted from the Children's Intervention Rating Profile (CIRP; Elliott, 1988; Witt & Elliott, 1983).

Intervention Rating Profile-15
(Martens, Witt, Elliott, & Darveaux, 1985)

The purpose of this questionnaire is to obtain information that will aid in the selection of classroom interventions. These interventions will be used by teachers of children with behavior problems. Please circle the number which best describes your agreement or disagreement with each statement.

	Strongly Disagree	*Disagree*	*Slightly Disagree*	*Slightly Agree*	*Agree*	*Strongly Agree*
1. This would be an acceptable intervention for the child's problem behavior.	1	2	3	4	5	6
2. Most teachers would find this intervention appropriate for behavior problems in addition to the one described.	1	2	3	4	5	6
3. This intervention should prove effective in changing the child's problem behavior.	1	2	3	4	5	6
4. I would suggest the use of this intervention to other teachers.	1	2	3	4	5	6
5. The child's behavior problem is severe enough to warrant use of this intervention.	1	2	3	4	5	6
6. Most teachers would find this intervention suitable for the behavior problem described.	1	2	3	4	5	6
7. I would be willing to use this intervention in the classroom setting.	1	2	3	4	5	6
8. This intervention would *not* result in negative side-effects for the child.	1	2	3	4	5	6
9. This intervention would be appropriate for a variety of children.	1	2	3	4	5	6
10. This intervention is consistent with those I have used in classroom settings.	1	2	3	4	5	6
11. The intervention was a fair way to handle the child's problem behavior.	1	2	3	4	5	6
12. This intervention is reasonable for the behavior problem described.	1	2	3	4	5	6
13. I liked the procedures used in this intervention.	1	2	3	4	5	6
14. This intervention was a good way to handle this child's behavior problem.	1	2	3	4	5	6
15. Overall, this intervention would be beneficial for the child.	1	2	3	4	5	6