EXAMINING THE IMPACT OF TASK DIFFICULTY ON STUDENT ENGAGEMENT AND LEARNING RATES IN MATHEMATICS

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Abstract: Modifying task difficulty has been examined in the research as a relatively non-invasive antecedent-intervention to address both behavior and academic problems for students. The current study aimed to examine the effects of task difficulty on engagement at the class-wide level. In addition, growth rates were examined to determine if there were significant differences between levels of task difficulty when engagement was controlled for. Participants consisted of 56 fourth grade students in three general education classrooms in central Oklahoma. Participants were assigned to an easy and difficult math skill utilizing curriculum-based assessments. Easy probes were defined as math skills in which a student scored 30-50 DCPM and difficult probes were math skills in which a student scored less than 20 DCPM. In study 1, student behavior was audio and video taped during 5-minute sessions for both conditions. In study 2, engagement was held constant to the time students were engaged on the difficulty probes in study 1 therefore students were given two minutes and 39 second sessions. Engagement was later assessed using systematic observations for on-task behavior and growth was assessed using DCPM scores on daily math probes. Results from study 1 indicated statistically significant differences between the easy and difficult probe conditions. The easy condition resulted in significantly more DCPM session growth at a faster rate than the difficult condition. On average, students grew 1.16 DCPM more per session in the easy condition. Students were also significantly more on-task in the easy probe condition than the difficult probe condition with the odds of on-task behavior in the easy condition being 1.666 greater than the difficult condition. Findings in study 2 indicated that while both conditions resulted in continual DCPM growth over time, the growth was substantially less than in study 1. The interaction between task difficulty and growth was not significant which suggests that engagement was a substantial contributor to the growth differences in study 1. Limitations to the study include possible maturation, lack of generalizability due to the use of only one grade level of participants in general education placements, and generalizability of results across curricular areas.

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CHAPTER I

INTRODUCTION

Enhancing both academic and behavioral performance are two key objectives of the educational system. Successful students are those who are able to respond to instruction and perform academically as well as behave appropriately in the classroom. Research indicates a strong relationship between curricular and instructional variables and problem behaviors in the classroom (Dunlap & Kern, 1996; Gickling & Armstrong, 1978; Gilbertson, Duhon, Witt, & Dufrene, 2008; Umbreit, Lane, & Dejud, 2004). Behavioral interventions that involve the direct manipulation or adjustment of curricular and instructional variables can be used to intervene on problem behavior in the classroom. Applied research and consultation conducted inside schools indicates individualizing curricular demands is a viably executed manipulation of task demand that accomplishes both an academic and behavioral intervention at the same time (Dunlap & Kern, 1996). While modifying instructional demands has been shown to decrease off-task behavior for individual students, there is little to no research about the application of this practice for class wide intervention. Disruptive classroom behavior is an expressed concern of educators and is often not intervened on until the problem becomes unmanageable in the classroom setting. Subsequent intervention for extreme problem behavior is often intensive, time consuming, and requires additional expertise.

Classroom Management and Behavior

There has been considerable focus in both research and practice on positive behavioral supports for school-wide systems to address behavioral concerns in the classroom. Research is also uncovering the potential benefits of modifying instruction and other curricular variables as a principal component of behavioral management in schools (Dunlap & Kern, 1996). The classroom environment is comprised of countless numbers of variables that can affect student behaviors: variety of environmental stimuli, instructional materials, lighting, peer and social interactions, teacher-student interactions, and even more difficult to control, intra-individual factors (Dunlap & Kern, 1996). The instructional environment in a classroom is variable day to day including assignments, content and difficulty of task, daily schedules, seating arrangements, availability of feedback and reinforcement, presentation of instructional material, etc. This variability and the variety of contributing factors to classroom environments is difficult to control on a daily basis for one student, let alone class wide. However, classroom management and the effectiveness of the classroom is considered the single greatest factor affecting student academic growth (Sanders & Horn, 1998).

Often, off-task behavior in the classroom is not considered a problem until the frequency or the severity of an occurrence has reached a level of urgency, resulting in time consuming assessment and intensive intervention. While off-task behaviors may not be considered serious problem behaviors in most classrooms as a whole, over time off-task behaviors lead to reduced access to the curriculum, increased levels of disruptive behavior, and increased off-task interactions with both teachers and peers (Umbreit et al., 2004).

Classroom management encompasses many facets of effective teaching. Effective classrooms are defined as "those general environmental and instructional variables that promote consistent classroom-wide procedures of setup, structure, expectations, and feedback" (Stichter et al., 2009). An important aspect of effective teaching involves being aware of the relationship between task difficulty and problem behaviors and effectively differentiating instruction to meet the needs of a variety of diverse learners. Academic failure and subsequent behavioral concerns often result from assumption of student competence (Haydon, 2012). With the mandated expectation of inclusion through Free and Appropriate Education (FAPE), the practice of inclusion in the general education classroom needs to consider the level of instructional practice in the classroom setting as to better differentiate to whom those practices are effective and for whom they are not (Stichter et al., 2009). Effective teaching, according to Haydon (2012), dictates that teachers should be able to identify the relationship between academic and behavioral problems and tasks that demand independent work by a student should only be assigned after a student has demonstrated competence during guided practice.

Antecedent Interventions for Problem Behavior

Effectively managed classrooms combine elements of active teaching (lecturing and demonstration of academic information and concepts), repeated practice, specifically directed requests for actions or responses, increased opportunities for students to respond, feedback and reinforcement (contingent and non-contingent), and individualized or differentiated instruction (Stichter et al., 2009). Due to the variability of behaviors and constant changes of environmental variables present in the classroom, antecedent modifications can be particularly useful to implement in the classroom setting. Antecedents alter the effectiveness of stimuli by informing the individual of the availability of reinforcement or alters the value of a consequence which can increase or decrease the likelihood of a behavior occurring (Conroy & Janine Peck, 2003). Manipulations of antecedents can effect behaviors in the classroom and can more easily produce positively functioning classroom environments that are conducive to learning for each individual student as well as the class as a whole (Park & Scott, 2009). Examples of antecedent modifications to the classroom in the literature include providing prompts, availability of preferred materials for students, access to prosthetic instructional aids, curricular modifications, and differentiating task demands (Dunlap & Kern, 1996; Munk & Repp, 1994; Park & Scott, 2009). Antecedent-based interventions are often referred to in the literature as non-aversive approaches or stimulus-based treatments as they are relatively nonintrusive. Antecedent interventions involve manipulating conditions that are already occurring in the environment as opposed to traditional interventions for problem behavior that add new conditions to the environment and involve manipulating consequences of the behaviors (Munk & Repp, 1994). Antecedent-based interventions are exceptionally useful in applied and naturalistic settings because they rely on existing behavior-environment relationships. As a result, changes in these behaviors are more readily observed and will generally persist in the absence of additional stimuli as opposed to more traditional consequence-based interventions for behavior (Conroy & Janine Peck, 2003).

Problem behaviors often have a fundamental relationship with antecedents present in the environment in which they occur. This functional relationship has a substantial role in the remediation of problem behaviors within the classroom (Dunlap & Kern, 1996). Simply applied antecedent interventions have the propensity to eliminate or greatly reduce the appearance of both attention and escape maintained problem behaviors as well as increase academic engagement and subsequent achievement (Haydon, 2012).

Instructional Match and Task Difficulty

Research has shown that antecedent interventions that involve assessment-based modifications and curricular adjustments have resulted in improved behavior for students of varying academic levels, ages, differing diagnoses. Assessment-based modifications and interventions have proven successful in both general and special education settings using multiple instructional methods (Umbreit et al., 2004). Curricular adjustments include reducing or increasing task difficulty, altering task duration, familiarity of task, minimizing opportunities for errors, etc. (Munk & Repp, 1994; Park & Scott, 2009).

Matching student ability to academic tasks demands is a process of instructional differentiation. Task difficulty is defined as the level of skill mastery assessed by how accurately a student learns a new skill and how fluently, or efficiently, that skill is performed (Gilbertson et al., 2008). The more accurately and fluently a student performs a given task, the greater opportunity for increased response rates which have been shown to correspond with increased task endurance, retention, and generalization to more complex tasks (Gilbertson et al., 2008). Task difficulty is an important curricular variable in classroom instruction and encompasses the interaction between the instructional stimuli presented and the current level of student skill (Lannie & Martens, 2004). Appropriate instructional matching for a student minimizes the propensity for errors, facilitates rapid acquisition of novel skills, and reduces learner frustration while still engaging the student in the instructional task (Munk & Repp, 1994). A study by Gickling & Armstrong (1978) supported the existence of a curvilinear relationship between learning and instructional difficulty. When students are given tasks that are too difficult for their level of instruction, the frustrational task can serve as an aversive stimuli, resulting in lower percentages of task-completion, task-comprehension, and increased negative behaviors, often as a function of escape (Gickling & Armstrong, 1978; Munk & Repp, 1994). On the alternative, when students are given tasks that are too easy at the independent level of instruction, comprehension and task-completion are too easily achieved resulting in lower rates of learning and increased rates of off-task behavior (Umbreit et al., 2004). Assigning students' academic tasks that are too easy decreases academic engaged time and reduces learning opportunities resulting in higher rates of off-task behavior. However, when students are given tasks demands that match their appropriate level of instruction, task-completion, comprehension, and on-task behaviors are consistently high (Gickling & Armstrong, 1978).

Lee, Sugai, and Horner (2012) described the phenomenon of instructional match as the magnitude of reinforcement in a relationship with matching theory. Lee and colleagues suggested that use of good instruction is associated with high rates of opportunities for correct responding which in turn results in high rates of positive reinforcement. Instructional conditions where students have a high failure to learn (i.e., too difficult or too easy conditions) will present fewer opportunities to receive positive reinforcement, or satiation of reinforcement, and can likely result in off-task behaviors (Lannie & Martens, 2004). Optimal instructional conditions (defined as tasks at the student's instructional level) acquire appropriate rates of reinforcement, encourage academic engagement, and can be effective interventions for off-task behaviors (Treptow, Burns, & McComas, 2007). Differentiated instruction creates more salient learning opportunities for students because of the appropriate match to their individual learning needs and results in increased academic engagement, minimizes errors, and improves academic outcomes (Haydon, 2012; Simonsen, Little, & Fairbanks, 2010).

There is little research on the application of instructional match as an intervention for classroom behavior and little investigation into the differing effects of engagement and task difficultly on learning rates. The purpose of the current study was to examine the effects of task difficulty on engagement on a class wide level and academic growth over time. In addition, growth rates were examined to determine if there were significant differences between levels of task difficulty when engagement was controlled for.

Specifically, the current study aimed to answer the following questions: 1) Does task difficulty differentially impact learning rate, 2) Does task difficulty impact engagement class-wide, and 3) Does level of task difficulty impact learning rates when engagement is controlled for?

It was hypothesized that students would complete more DCPM on the easy probes than on the difficult probes and show the highest levels of engagement in the easy probe condition in study 1. It was also hypothesized that students would show relatively similar growth over time between the difficult probe condition and the easy probe with truncated time condition in study 2 as a byproduct of student engagement.

CHAPTER II

REVIEW OF LITERATURE

A review of the empirical literature on classroom management, antecedent interventions, task difficulty, instructional match and academic performance is discussed. The relevant research included examined the effects of multiple variables within these broad constructs on problematic behavior in students.

Classroom Management

The literature on classroom management focuses on self-reported practices and direct observations of classroom management strategies. Research in this area investigates utilization, frequency and efficacy of use, teacher perceptions, and outcomes of effective classroom management. Isolation of individual classroom management strategies in the naturalistic setting is difficult resulting in the majority of research focusing on classroom management as a broader construct through the utilization of self-report measures.

Clunies-Ross, Little, and Kienhuis (2008) conducted a study to investigate the association of self-reported and actual use of classroom management strategies by primary-school teachers.

The effects of proactive (stating rules and expectations, providing student support, modifying teaching style) and reactive strategies (rewards and punishments, removing child from classroom, corporal punishment) on teacher stress and student behavior were also examined. The researchers hypothesized that using primarily proactive management strategies would result in higher amounts of student on-task behavior and lower levels of reported teacher stress. Teacher participants in this study completed four self-report measures. The first questionnaire gathered information on participant demographics including level of education and number of years teaching. The second measure gathered reports of teacher perceptions of disruptive behavior within their classrooms and the frequency of use of classroom management strategies. The third questionnaire asked teachers about the types of management strategies they applied for managing problem behaviors. The final rating scale asked teachers to rate the amount of stress they attributed to student misbehavior, workload, professional recognition, time/resource difficulties, and poor relations with colleagues. Direct observations were conducted using the *Observing Pupils and Teachers in Classrooms Schedule* (OPTIC) measure. Teacher observations were conducted by the investigators during 30-minute sessions. Systematic recording methods were used to measure the frequency and type of behavioral management strategy utilized while teachers were engaged in instruction. Student on-task behavior was recorded using the same observation measures. The results from this study revealed that the most troublesome and most frequently observed student problem behavior was talking out of turn, followed by distracting other children. Observed levels of on-task behavior class wide averaged 71.96% of observed time on-task. Teachers reported that 47.4% dealt with student behavior problems five or more times during a typical school day, 28.9% reported dealing with problem behaviors three to four times a day, and 23.7% reported managing behaviors once or twice day. All of the teacher participants reported managing problem behaviors daily. Teachers reported utilizing more proactive classroom management strategies and 84% believed that they had sufficient knowledge to manage student behavior. The relationship between self-reported and observed use of management strategies were analyzed indicating a strong relationship between self-reported use and observed use of proactive classroom management strategies. As hypothesized, teachers employing proactive classroom management strategies to student behavior reported lower levels of job related stress. However, proactive strategies and student on-task behavior were not significantly related. The authors cautioned that this non-significant finding could be due to the effectiveness of the proactive strategies utilized by the majority of their participants.

Reupert and Woodcock (2010) conducted a study to identify behavioral management strategies employed by pre-service elementary school teachers, rates of confidence, and perceptions of strategy effectiveness. The researchers utilized the Survey of Behavior Management Practices (SOBMP) rating scale developed to assess frequency, confidence and success of classroom management strategies. Items on this instrument were factor analyzed into four categories: preventative strategies, rewards, initial corrective and later corrective strategies. Preventative strategies included items such as establishing routines, seating arrangements, and class rules. Classroom management strategies using rewards included the use of stickers or other tangible reinforcers. Initial corrective strategies included low or mildly intrusive approaches such as proximity and re-directs, while later corrective strategies were more intrusive and included time out and behavioral contracts. The SOBMP was found to have acceptable internal reliability for frequency, confidence, and success. Results from this study revealed the most frequently reported management strategy was initial correction (M =3.76), which was used significantly more frequently than both preventative (M =3.42), rewards (M = 2.75), and later corrective strategies (M =1.84). The most commonly reported classroom management strategies were specifically related to proximity, use of non-verbal body language, and verbal warnings. Classroom management strategies with the highest confidence ratings were initial correction followed closely by preventative strategies. The same results were found for reported success of management strategies. Specifically, the highest success ratings were reported on the use of regular routines, close proximity, teaching behavioral expectations, and implementing systems to deal with transitions. The results of this study demonstrate that classroom management strategies most likely to be frequently, confidently, and successfully employed by pre-service teachers are low or mildly intrusive.

Reddy et al. (2013) conducted a study to assess general education teachers' use of commonly employed classroom management strategies. The researchers also examined whether two factors, grade-level and years of experience, impacted the frequency of use. The Classroom Strategy-Scale (CSS) was utilized to measure the frequency of strategy use as well as discrepancy scores between recommended and actual use of classroom management strategies. Participants included 317 general education teachers. Participants were observed using the CSS measure during classroom instruction. Part 1 of the CSS involved the observer measuring frequency counts of six teaching strategies (concept summaries, opportunities to respond, clear commands, vague commands, praise, and corrective feedback). Post-observation rating scales were completed which rated the instructional and behavioral management strategies utilized during the observation period. Frequency ratings were based on how often the teachers used specific positive instructional and behavioral management strategies. Recommended ratings were based on how often the observer measured opportunities for the teacher to utilize each strategy. The CSS also measured the presence of specific classroom structure procedures including visible displays of classroom expectations, charts for monitoring student behavior, and academic progress. The results of this study indicated that the most frequently utilized classroom management strategy was opportunities to respond (M =27.25), followed by clear commands (M =17.09), and praise (M =11.36). The most frequently used instructional strategy was performance feedback (73%) and instructional delivery (71%). The data revealed that directives and transitions (73%) were the most frequently used proactive method of classroom management used by teachers. The results indicated that the frequency with which teachers' utilized classroom management strategies was lower than the observer recommended frequency (e.g., praise to corrective feedback was delivered at 1:1 as opposed to the recommended 3:1 and 4:1). The two factors (grade-level and years of experience) investigated by the researchers had no significant relationship to the use of classroom management strategies, with the exception of praise statements. Teachers' use of praise significantly declined in upper elementary grades and significantly declined for teachers with 10 to 19 years of experience. The results from this study show that although teachers were found to utilize recommended classroom management strategies, the frequency of use was lower than the recommended amount.

A study by Stichter et al., (2009) analyzed the impact of teachers' use of opportunities to respond and effective classroom management strategies across 35 general education classrooms. Descriptive assessments were collected during five total hours of direct observation per classroom (one hour per day across five days) during literacy instruction. Each classroom was assessed twice on overall classroom management. The assessment included measurements of student classwork, classroom setup, classroom procedures, accuracy and feedback on academic work. The researchers utilized Level 1 (common classroom-wide procedures) and Level 3 (instructional talk, prompts, wait time, and feedback) of the *Setting Factors Assessment Tool* (SFAT). The SFAT was designed to help address ongoing limitations in the assessment of classroom-based antecedent variables. Data was collected using teacher interviews and direct observation coding on the SFAT. Results from this study indicated that natural rates of instructional talk occurred during a mean of 69% of the classroom observations. The data indicated that teacher prompts occurred at a mean of 2.61 per minute, the mean of positive-to-negative feedback ratio was 4.5:1, and the mean wait time was 2.9 seconds. The researchers' findings were consistent with previously reported optimal rates for the investigated classroom management variables. Direct observations of classroom management strategies in this study revealed the use of both antecedent and consequent interventions for classroom management.

Jack et al. (1996) investigated the relationship between teachers' reported use of classroom management strategies and observed teacher-student interactions. Student-teacher social interactions were compared between two groups: teachers who reported frequent use of planned behavioral management techniques and those who did not. All student subjects (N=20) included for participation in this study exhibited high rates of aggressive or disruptive behaviors. Structured interviews were coded to define the two groups of teachers. Interviews gathered information on the use of four empirically validated behavioral management strategies shown to improve disruptive behavior. The four strategies were token economies, punishment, classroom rules, and classroom organization. Ten direct observations of student-teacher interactions were conducted in each classroom during 30-minute observation periods. Observations were coded using the *Multiple Option Observation System for Experimental Studies* (MOOSES). An interaction was operationally defined as a social exchange between the target subject and an adult or peer. Interactions were coded as positive (positive social behavior and no negative behavior), negative (negative behavior without precipitating positive behavior), mixed (both positive and negative behaviors occurred), or neutral (no positive or negative behaviors). The results from this study indicated that over 20% of the observed interactions that took place between students and teachers were negative. No significant differences were found between the two groups of teachers on rate or duration of negative, mixed, or neutral interactions. Although small, there was a significant difference in positive interactions between the two groups. The high frequency use group engaged in positive interactions 5% of the observed time while the low frequency group engaged in positive interactions for 2% of the observed time. Results from this study showed largely negative interactions between students and teachers despite the reported frequent use of behavioral management strategies. Although behavioral management strategy use is frequently reported in the literature, the accuracy of management techniques and isolation of individual strategies is an area of need in the research.

Antecedent Interventions

The research on antecedent interventions for classroom and problem behavior is vast due to the relatively non-invasive nature of antecedent interventions in naturalistic settings. A study conducted by Lam et al. (1994) examined the effects of a self-monitoring intervention on task assignment, academic accuracy, and disruptive behaviors in the classroom. Students selected for this study (N=3) were referred due to low levels of on-task behavior, high rates of inappropriate social interactions, and low levels of academic performance compared to peers. Experimental sessions occurred during the last 10-minutes of math instruction. On-task behavior was defined as eyes on assigned work or writing on the assigned worksheet. Disruptive behaviors were defined as out-of-seat, touching other people's property, vocalizations, playing, noise making, and aggression towards others. Baseline behavior data was collected on all subjects during the assigned observation period. Participants were individually trained on self-monitoring behavior involving the use of an auditory tone and color-coded sheets to help participants differentiate between the three self-monitoring conditions. The three conditions were self-monitoring for on-task, academic accuracy, and disruptive behavior. During the self-monitoring conditions, students were prompted to individually record their own behavior on the color-coded recording sheets. The on-task self-monitoring condition would prompt the student with the auditory tone to ask the question, "was I paying attention?" The academic accuracy condition would provide the prompt to cue the students to mark the problem they were working on and check their answers with an answer key. The final self-monitoring condition prompted the students to distinguish between disruptive and non-disruptive behaviors by asking the question, "was I disruptive?" following the presentation of the auditory cue. The results from this study showed that the auditory and visual prompts were effective interventions for self-monitoring behavior. Levels of on-task behavior increased from baseline for each student during the on-task self-monitoring phase. The participants also showed an increase in academic accuracy during the accuracy self-monitoring condition from baseline. Most clear from the results was the reduction in disruptive behaviors for all students in the study from baseline condition during the self-monitoring for disruptive behaviors condition. The researchers also found generalization between the conditions. Self-monitoring behavior during the academic accuracy phase generalized to on-task and non-disruptive behaviors, implicating that a self-monitoring intervention for academic skills may be a powerful intervention for off-task behaviors.

A study conducted by Amato-Zech, Hoff, and Doepke (2006) examined the effects of a tactile prompt on self-monitoring for problem behavior in the classroom. Participants were recruited from teacher referral of students with low levels of on-task behavior. Referrals were confirmed by direct observations of student behavior (on-task behavior occurred less and 55% of the observed intervals) for participants in the study. The researchers utilized the MotivAider, a pager that attached to the students' belt or waistband, that delivered a pulsing vibration as a cue to self-monitor behavior. Structured observations were made using 15-second partial interval recording. On-task behavior was defined as active and passive attention to task and the absence of off-task behavior during the observed interval. Off-task behaviors were coded as off-task motor, off-task verbal, and passive off-task. Baseline observations of behavior were recorded and a reversal design was utilized for each participant. Students were trained to observe and record their own behavior during two-training sessions and two practice sessions within the classroom. The participants were trained to recognize on-task and off-task behaviors, practice self-monitoring through overt audio cues, and then faded the audio cues to only using the MotivAider. The students were observed using the MotivAider until they could use the tool without assistance. During the intervention phase, the vibration would be activated to cue students to record their behavior (paying attention or not paying attention) at that moment. The MotivAider was set at 1-minute fixed intervals for the first week of intervention, and 3-minute intervals during the following phases. Results from this study showed a significant increase in on-task behavior from baseline (less than 60% of intervals observed) to the initial intervention phase using the prompt (>90%). When conditions were returned to baseline, levels of on-task behaviors steadily decreased. Upon reinstatement of the intervention, on-task behavior immediately increased to an average of 90% of observed intervals for all students. The results of this study revealed the success of a tactile prompt as an antecedent-intervention for students' off-task behavior in the classroom.

Other antecedent interventions for problem behavior discussed in the literature include curricular modifications and task preference. A study by Kern et al. (2001) was conducted to examine the effects of curricular modifications on behavior for children exhibiting extreme problem behaviors in a naturalistic setting. Participants (N=2) were fifth grade students who exhibited high levels of off-task behaviors and low levels of task-engagement. The dependent variables for this study were task engagement (working on an assigned activity in accordance with teacher instructions) and disruptive behavior (including nonverbal noises, talking out, inappropriate language, out of seat, and noncompliance within 5 seconds of a given instruction). Observations of behavior were conducted during the total duration of classroom assignments (or until 15 minutes had elapsed) using 15-second continuous interval recording. Functional assessments were conducted to help identify antecedents associated with the students' disruptive behaviors and to identify preferences and potential reinforcers for the participants. The assessment information revealed that problem behaviors occurred primarily during activities which required the used of paper and pencil. The information gathered revealed both subjects had difficulty with handwriting resulting in noncompliance for tasks that required writing. A reversal designs was utilized to test the influence of a preferred medium or interest versus the traditional pencil and paper method for assignments on task engagement and disruptive behavior. Results from this study indicated that the preferred method condition (assignments on the computer) was consistently associated with higher rates of engagement and lower rates of disruptive behavior than the traditional condition.

Another study utilizing functional assessment to identify effective antecedent interventions was conducted by Park and Scott (2009). The researchers used information gathered during brief structural analyses to test whether a functional relationship could be demonstrated between antecedent-based interventions and observed changes in student behavior. Following the behavioral assessment, the researchers aimed to experimentally validate an antecedent-based intervention effect on behavior. A single-subject treatment withdrawal design was conducted to compare baseline performance to performance during intervention phases. Observations for baseline data utilized 10-second partial interval recording for disruptive behavior. Disruptive behavior was defined as verbal outbursts, inappropriate physical contact and off-task behaviors. For the first subject, a proximity to high-interest materials antecedent intervention was developed. The experimental intervention developed for the second subject included defined seating arrangements and high-interest materials. The third subject's intervention phase included high interest materials and proximity to teacher. For all participants (N=3), baseline and intervention levels of disruptive behaviors were measured during whole-group instruction. For the first participant, immediate effects were seen on levels of problem behavior between baseline (*M* =64%) and intervention phases (*M* =21%) and continued through withdrawal and reintroduction of the intervention phase. Proximity and high interest materials resulted in a significant decrease in problem behaviors. For the second participant, changes in problem behavior recorded between baseline and intervention phases were less clear. Baseline levels of on-task were moderately high (ranging from 23% to 69% of observed intervals). During the implementation of the high interest material intervention phase, levels of on-task behavior were variable. During the withdrawal phase, there was an immediate decrease in on-task behavior and the intervention was immediately reintroduced. The reintroduction of the high interest intervention phase resulted in high levels of on-task behavior (*M* =87%) as compared to baseline. The baseline levels of disruptive behavior for the third participant were high (*M* =75% of intervals observed). Implementation of the intervention phase involving high interest materials and close proximity to teacher resulted in immediate and significant decreases in disruptive behaviors (*M* = 11%). The withdrawal phase resulted in immediate and significant increases of disruptive behavior, exceeding baseline levels. Reintroduction of the intervention phase resulted in the same significant reduction in disruptive behaviors (*M* = 7%). Results from this study indicate the successful use of a variety of antecedent intervention strategies developed from brief structural analyses to increase engagement and decrease occurrences of disruptive behaviors.

Another antecedent intervention for behavior reviewed in the literature is manipulating task demand. A study conducted by Moore, Anderson, and Kumar (2005) combined the use of functional behavioral and curriculum based assessment to examine the effects of an instructional intervention (reduction of task demand) on off-task behavior. The subjects for this study were nominated for participation due to high levels of inappropriate behavior and low performance on emerging math skills. Observations were conducted during whole-class instruction and individual seat-work during a 20-minute observation period. Partial-interval time sampling procedures were utilized using 10-second intervals for observation and 5-second intervals for recording behavior. The dependent variable in this study was off-task behavior which included passive off-task, noncompliance, inappropriate vocalizations, out of seat, inappropriate use of materials, or disruptive behavior. An alternating treatments design was used to compare if there were differential effects between the two treatment conditions (intervention condition and business as usual condition). The intervention condition reduced the task demand by shrinking each assigned task into easily completed steps. The business as usual condition involved whole task presentation. During the intervention phase, the teacher would present the student with small, easily completed portions of the task until the student has completed the assignment. Results from this study showed that levels of off-task behavior were significantly reduced on intervention treatment days (M = 14.5% of observed intervals) compared to non-treatment days (M =51.9%) during independent seat work. The manipulation of task demand as an antecedent intervention in this study revealed significant decreases in off-task behaviors for their subject.

Task Difficulty and Problem Behavior

The literature on differentiating task difficulty as an aid to ameliorate problematic behaviors originated in attempts to provide an intervention for children that could be implemented with more ease than time consuming formal evaluation, verification, and eventual placement. Gickling and Armstrong's (1978) study sought to quickly identify children based on their daily academic and behavioral performance when exposed to frustrational, instructional, and independent level materials. The researchers measured engagement during 20-minute observation sessions over a period of seven weeks. The level of task-difficulty was manipulated by controlling the ratios of known to challenging items on language arts assignments. The investigators found the existence of a curvilinear relationship between learning and instructional difficulty. The data revealed that when assignments are too difficult, percentage of on-task behavior was low for all subjects (N=8) and when assignments were at the independent level of functioning, the tasks were too easy resulting in high percentages of off-task behaviors. However, when assignments were at the student's instructional level, the percentage of engagement was high. The results of this study implicated that modifying instructional difficulty to match student performance at a specific criterion level can make behavior changes very predictable and in such, readily changeable through minimal intervention.

The majority of the research examining the effects of task difficulty on problematic behavior have been conducted with small populations. Subsequent literature focused on subjects diagnosed with emotional and/or behavior disorders and included methodological identification of behavior functions as escape and/or attention as inclusionary criteria for participants. Lee, Sugai, and Horner (1999) investigated the functional relationship between easy and difficult math tasks and the occurrence of off-task behaviors in students exhibiting severe problematic behaviors. This study implemented an instructional intervention component designed to increase task-accuracy in aims of reducing frustration that resulted in off-task behaviors in their subjects. The researchers aimed to answer if a functional relationship existed between task difficulty and off-task behavior. If so, then manipulating task difficulty through academic instructional modifications would reduce problem behaviors. The subjects were exposed to alternating treatments between an independent and teaching phase designed to increase knowledge of component math skills unknown to the subjects during independent tasks. During the teaching phase, instruction was provided to get the participants to perform 85% of the difficult tasks correctly. Observations were conducted during 10-minute sessions using partial interval time sampling. The results revealed that the component skills instruction resulted in increases in accuracy on difficult tasks and subsequent reduction of escape-motivated off-task and problem behaviors. By manipulating the task difficulty through instruction, the aversive features of difficult tasks were reduced resulting in decreased problematic behaviors.

Similarly, Sanford and Horner (2012) investigated the effects of task difficulty on problem behaviors in a small sample of students whose behavioral function was escape from difficult tasks. Their study implemented an instructional component that matched task demands with individual student skill level in an attempt to reduce an aversive stimulus hypothesized to produce problem behaviors. Subjects were observed during 10- to 15- minute observation periods. Frustrational level tasks were defined as those tasks in which the student performed at less than 90% accuracy at below grade-level reading fluency while instructional level tasks were performed at 90-94% accurate at grade level fluency in reading. The researchers found a neutral to reduction level in problem behaviors and a positive change in level for academic engagement. Altering the level of difficulty during reading tasks from the frustrational to instructional level resulted in reductions of problem behaviors for students who struggled during reading instruction and engaged in escape motivated problem behaviors in the classroom setting.

Gilbertson et al. (2008) examined the effects of task difficulty on behavior with students exhibiting both low levels of engagement as well as low levels of math performance. Individual subject's ability levels were defined using a pre-test measure of performance on mathematics skills (single digit addition and single digit multiplication). Task-difficulty levels were defined as fluent (more than 19 DCPM with fewer than 2 errors), instructional (between 10 and 19 DCPM), and frustrational (less than 10 DCPM). Math probes in the three conditions were administered in counterbalanced order, four days per week during a six minute observation period during regularly scheduled math instruction. The researchers predicted that higher rates of on-task behavior, defined as time on task, would be present in the fluent condition. Results from the research showed that for three of the participants, percentages of on-task behavior were consistently higher than during the frustrational condition across all sessions. Contrary to previous studies, there was a clear differentiation between the fluent and instructional conditions with the highest levels of on-task behavior occurring in the fluent, or easy, condition. The researchers hypothesized that their findings could be due to methodological differences including testing the effects of brief explicit timing probes on behavior which had not be examined in previous studies.

Several studies have specifically investigated the effects of mastery, or too-easy, tasks on problematic behaviors. Umbreit et al. (2004) examined the effects of increasing task difficulty when inadequately challenging tasks were assigned to their subject during routine classroom activities in a case study. The researchers hypothesized that the student's on-task behavior would improve if he were assigned more challenging tasks that matched his ability. A reversal design was implemented to test the effects of a typical task versus a challenging task in reading and math over time. The study results indicated that altering the level of task difficulty was highly effective in increasing on-task behavior of their subject pointing to a clear functional relationship between instructional level and task engagement. The maintaining consequence of problem behavior in this study as opposed to subjects in the previously mentioned research points to the generalizability of task differentiation as an antecedent-only intervention for students with diverse ability levels.

Another study examining the effects of mastery level tasks was conducted by Simonsen, Little, and Fairbanks (2010) using a population of identified gifted students to test whether higher task difficulty demonstrates a link to increased on-task behaviors in distinction to previously studied populations. The study examined the effects of task difficulty and teacher attention on off-task behaviors motivated and maintained by some feature of the task and/or the available attention. The tasks in this study were differentiated by modifying and adding problems to the teachers' existing curricular materials, with reference to relevant pretest performance for each student. Results from this study indicated that off-task behaviors did not appear to be occasioned by hard tasks, unlike previous studies of non-gifted subjects. Alternatively, the harder tasks did not appear to increase off-task behaviors in this population due to the match between task difficulty and student ability.

Instructional Match and Academic Performance

The relationship between instructional match and student engagement would serve to predict that instructional modifications may also impact future academic performance. Few studies have examined the outcomes of instructional matching and future academic performance by measuring learning rates and student growth over time.

In addition to measuring on-task performance, Gickling and Armstrong (1979) also measured the effects of task-difficulty on comprehension and task completion. The researchers found the same curvilinear relationship between instructional match and problematic behavior as they did for task-difficulty and academic performance. Assignments at the independent level resulted in high percentages of comprehension and task completion yet had an adverse effect on behavior. However, when assignments were at the student's instructional level, percentages of task completion, comprehension, and engagement were all consistently high yielding optimal academic performance.

A study from Sanford and Horner (2012) also measured oral reading fluency and accuracy in addition to behavior in their study described above. Their study added an assessment component to monitor student reading performance to assess if improved academic engagement was also associated with academic gains. Oral reading fluency and accuracy was monitored using the median of three reads on DIBELS reading probes across conditions. The study found a substantial range of growth over time in reading performance pre to post intervention. Two participants showed fairly substantial growth while the other two subjects showed lower growth rates across time. This study highlights the need to explore level of instructional difficulty required to substantially increase student learning over time.

Daly (1996) investigated the effects of instructional match on passage reading. The study examined whether subjects in a matched condition (materials assigned at an individual's skill level with high rates of accuracy and fluency) or mismatched condition (materials beyond student ability) would produce greater generalization to novel reading materials. The subjects were identified students receiving special education services with individualized education plan objectives in the area of reading. Levels of accuracy and fluency on reading passages were examined as a pre-test measure to determine instructional levels. The study included an instructional component which varied between the two conditions. The participants were instructed in targeted phonics skills at two levels of text difficulty which either matched or mismatched their instructional skill level. Generalization was assessed with reading passages at two levels of similarity to the instruction phase reading passages (low vs. high content overlap). Results showed the highest level of reading accuracy and fluency for all participants occurred when assessment passages were matched to student skill, including high content overlap from the matched instructional phase passages. Maintenance data collected one-month post treatment also confirmed the finding that student's performance was higher in instructionally matched conditions, even in the absence of the targeted phonics instruction.

A study conducted by Lannie and Martens (2004) examined the effects of instructional difficulty on allocation of responding on math worksheets. Four students were assessed to identify their baseline levels of functioning in math skills of addition. This pre-test data was used to define the easy and difficult math conditions: Easy tasks were defined as skills in which the students performed at 40+ DCPM and difficulty material were skills in which the students performed at 0 to 19 DCPM. Academic performance and on-task behaviors were measured over time. The results of this study found that the total number of digits correct per session for all students was the lower in the difficult conditions than in the easy conditions. Students' academic performance was higher when the task difficulty was more closely matched to their ability levels.

Researchers Treptow, Burns, and McComas (2007) examined the effects of instructional match for three third-graders who were struggling readers with low levels of on-task behavior. The researchers hypothesized that these students would exhibit the highest reading comprehension in the instructional condition in which reading passages contained 93-97% known words or in the independent condition (>97% known words) than in the frustrational condition in which students knew less than 93% known words. The study results showed that the subjects' reading comprehension scores were higher overall at the instructional level and the independent level than the frustrational level for all three of their participants. Consistent with previous research, comprehension was found to be highest at the independent level.

Summary and Conclusions

The empirical literature presented examined classroom management, antecedent interventions, task difficulty and problem behaviors, and instructional match and academic performance. The research indicates classroom management techniques that are proactive in nature are highly effective for intervening on student behavior. Non-invasive antecedent interventions are feasibly executed and highly effective means for addressing problematic behaviors in the classroom. Overall, the research suggests that a match between task difficulty and student ability increases task engagement resulting in a significant reductions in problem behavior. The research also indicates a strong functional relationship between instructional match and task engagement. The research is a little less clear when looking at academic performance and instructional match. Some studies found significant growth in academic performance during independent, or easy, level assignments while other studies found contrary or neutral results. Although the research indicates that academic performance is higher when closely matched with student ability, research has not investigated to what degree that is attributed to student engagement versus task difficulty.

Several limitations exist within the presented literature with implications for future research to inform practice. Most notably, the majority of research on instructional match as an antecedent intervention to increase engagement has targeted students with identified disabilities exhibiting high intensity off-task behaviors. Very few studies have investigated the effects of instructional difficulty on non-identified populations and few, if any, have applied their research class-wide as an antecedent intervention for classroom management. The literature has also not investigated to what degree academic growth is due to instructional match or the subsequent increases in student engagement.

CHAPTER III

METHODOLOGY

Participants and Setting

Participants consisted of 56 fourth grade students in three general education classrooms in a rural northeastern region of Oklahoma. Inclusion in the study required participants to complete a pre-assessment phase utilizing curriculum-based assessment involving single-skill mathematics probes in the skills of addition to 9, multiplication to 81, and division to 81. Individuals included in the study were students who met the task difficultly criteria of 30-50 digits correct per minute (DCPM) for the easy condition and less than 20 DCPM for the difficult condition with the skills assessed. Participating classrooms were randomly assigned daily to an easy or difficult condition. Easy math skills ranged from addition to 9 (18%), multiplication to 81 excluding multipliers of 0 and 1 (11%), and multiplication to 81 (71%). Difficult math skills included division to 81 excluding divisors of 0 and 1 (55%) and division to 81 (43%). Participants ranged in age from 9 to 11 years old. Of the participants, 58% were female and 42% were male. Thirty-nine participants were Caucasian (70%), six were American Indian (11%), five were African American (9%), three were Asian (5%), and three were Hispanic (5%). 28.9% of the school population were economically disadvantaged.

This study received full IRB approval from both university and board of education institutional review boards. Classroom teachers implemented the daily treatment phases, while the principal investigator and graduate student assistants from the school psychology program collected measures of the dependent variables.

Materials

Participants were provided folders containing four examiner-constructed single-skill math probes, developed through Microsoft Excel, each afternoon of the study. Addition and multiplication math probes consisted of 64 problems per page (8 problems per row) and division math probes consisted of 72 problems per page (8 problems per row). Group-administered curriculum-based assessment (CBA) in mathematics was conducted to determine the task difficulty levels prior to treatment delivery. The CBA facilitated participant selection and subsequent daily evaluation of math skill learning rates. Easy level math tasks were assessed using single-skill math probes and were defined as those set-sizes in which a student scored between 30 and 50 DCPM with an accuracy of greater than 95%. Difficult level math tasks were also assessed using CBA math probes and were defined as those set-sizes in which a student scored 20 or less DCPM with an accuracy of greater than 90%. Math probes generated using Microsoft Excel were used to collect baseline and each data point throughout the study.

Direct observations of behavior were gathered and recorded using 12-second interval observation forms. The forms used whole-interval recording for on-task behavior during 5 minute observation sessions during study 1 and two minutes and 39 second observation sessions in study 2.

Experimental Design and Analysis

This study used a longitudinal repeated measures design to determine whether alterations in the antecedent conditions differentially effected classroom behavior and academic learning rates.

The data was analyzed using forms of Hierarchical Linear Modeling (HLM). Specifically, the study used two forms of HLM: traditional growth curve modeling for continuous data and logistic generalized linear modeling.

Independent Variable. The independent variable was difficulty of the math probe tasks assigned to participants. Easy level math tasks were defined as a set-size in which a student scored between 30 and 50 DCPM with an accuracy of greater than 95% during baseline. Difficult level math tasks were defined as a set-size in which a student scored 20 or less DCPM with an accuracy of greater than 90% during baseline. Each participant received timed practice on easy and difficult worksheets for 5 minutes during study 1, and timed practice on easy worksheets for two minutes and 39 seconds in study 2.

Dependent Variables. Student engagement, defined as on-task behavior, and digits correct per minute (DCPM) on easy and difficult math probes were used as dependent variables for the study. Student engagement was measured by conducting observations of recorded classroom behavior. Class-wide levels of on-task behavior were tallied utilizing systematic whole-interval recording. On-task behavior was defined as student behavior that is engaged in tasks relevant to the given assignment or any behavior required of the assigned activity while off-task behaviors were those that were irrelevant to the given task (Gickling & Armstrong, 1978; Umbreit et al., 2004). On-task behavior was operationally defined as working actively on assigned math probes, actively raising hand to receive teacher attention, or actively engaged in behaviors that were relevant to the assigned task. Audio and video recording via mounted iPads was utilized during the observation periods and classroom assessments of on-task behavior were conducted by reviewing the video recordings of the observation periods circulating through each student in each classroom.

Digits correct per minute (DCPM) on the difficult and easy math probes were calculated to obtain math fluency scores, enabling the experimenter to calculate learning rates (Shinn, 1989). Learning rates in this study assessed behavior change (learning) measured over procedural minutes applied over time (Skinner, 2008). DCPM were obtained by counting the correct digits for each problem, totaling digits correct, and then dividing by five to obtain a per-minute metric in study 1. In study 2, the total number of digits correct were divided by 159 (number of total seconds) and then multiplied by 60 (total number of seconds in one minute) to get DCPM scores.

Procedures

Conditions. This study implemented specific methodology in a single treatment phase across two studies. Study 1 systematically manipulated academic task while study 2 manipulated engagement. The first study's treatment phase included easy and difficult level math assignments and the second study's treatment phase involved only easy math assignments with access to materials being systematically restricted to match that of engagement under the difficult condition in study 1. The restricted access to material condition was defined as the amount of time the students were on-task in the difficult treatment condition in Study 1. Students were on-task an average of 53% of the observation periods during the difficult condition in study 1; participants were given two minutes and 39 seconds in the restricted access condition in study 2.

Collection of the Dependent Variables. Procedures were applied in the classroom during scheduled math instruction. Treatments were introduced as independent seat work and behavior was observed utilizing iPads to audio and video record student behavior. The classroom teachers read the students a prompt instructing them to work quietly and independently at their desks on the assigned math probes in their folders for the duration of 5 minutes. If the students had questions, they were instructed to raise their hand and wait for teacher attention. The researcher and graduate assistants timed participants and indicated to the classroom teachers when to instruct the students to stop working. The assessment probes were then collected and scored.

Study 1. During Study 1, participants were randomly assigned to one of two conditions: seat work material in the form of mathematics probes at the easy (i.e., single skills in which the class averaged 30-50 DCPM at greater than 95% accuracy) and difficult level conditions (i.e., single skills in which the class averaged 20 or less DCPM at greater than 90% accuracy). Throughout the duration of a 5-minute period, independent seat work behavior was video and audio recorded and later assessed through direct systematic observation. Levels of on-task and off-task behavior were recorded. Study 1's treatment phase data was collected over twelve total sessions (six sessions per condition).

Study 2. During study 2, participants were given seat work material in the form of mathematics probes at the easy level with restricted access. The same direct observation methods were conducted during this study throughout the two minutes and 39 second observation periods. Study 2's treatment phase data was collected over six total sessions.

Interobserver, Intra-observer, and Inter-scorer Agreement and Procedural Integrity

Inter- and intra-observer agreement (IOA) was calculated for observed classroom behavior by comparing results across two independent observers, or observations, for 35% of the behavior observations. Percentage of agreement for on-task behavior was calculated by dividing the number of agreements by the total number of agreements and disagreements and multiplying that by 100% (Lannie & Martens, 2004). Interobserver agreement ranged from 85% to 100% (M = 98%) and intra-observer agreement ranged from 85% to 100% (M = 95%).

Inter-scorer agreement on math probe scoring was also calculated on participant's responses on the daily math probes across all students and conditions for 33% of all assessment probes. Percentage of agreement for digits correct per minute (DCPM) was calculated on a problem by problem basis by dividing the number of agreements of correct problems by the number of agreements and disagreements of digits correct and multiplying that by 100% (Lannie & Martens, 2004). Inter-scorer agreement ranged from 89% to 100% (M = 99.77%).

Procedural integrity of treatment sessions was measured by a second experimenter, utilizing a checklist of the treatment protocol. Percentage of integrity was calculated by dividing the number of steps completed by the total number of steps and multiplying that by 100%. Procedural integrity was assessed for 39% of treatment sessions. Procedural integrity was 100% for all recorded sessions.

CHAPTER IV

FINDINGS

Data for the current study were analyzed using two forms of hierarchical linear modeling (HLM): traditional growth curve modeling for continuous data and logistic generalized linear modeling (Raudenbush & Bryk, 2002). This family of analyses is ideally suited for educational research as it considers the multilevel, or nested nature, of the data and captures the general characteristics of growth for both the group as a whole and for the individual students within the group (Curran, Obeidat, & Losardo, 2010). Growth curve modeling is used to analyze growth rate differences over time at both the individual and group level and answers questions about which variables exert important effects on the rate of development (Duncan & Duncan, 2004). Defined presently, it is the multilevel parallel to traditional ordinary least squares regression and provides similar coefficients. In contrast, Logistic HLM, one member of the family of generalized multilevel models, is used to analyze discrete outcomes and is similarly used to fit data with a hierarchical structure (McCullagh, 1989). Like traditional logistic regression, the multilevel form summarizes model information in the forms of odd ratios and log-odds units.

HLM uses information from clustered samples to explain between- and within-cluster variability for an outcome variable. Using HLM controls for violations of independence, assesses change in an outcome variable over time, and allows the modeling of slope and level differences in relation to selected predictors by considering the repeated measure (level 1) nested within individual students (level 2; Arnold, 1992; Gentry & Martineau, 2010).

Study 1

Observation points in study 1 included six data points per condition collected across the time of the study (12 data points per student). For study 1, the final two-level model was defined as:

Level-1 Model: $DCPM_{ti} = \pi_{0i} + \pi_{1i}*(LINCEN_{ti}) + \pi_{2i}*(PROBE_{ti}) + \pi_{3i}*(INTER1_{ti}) + e_{ti}$

Level-2 Model: $\pi_{0i} = \beta_{00} + r_{0i}$

$\pi_{1i} = \beta_{10}$

$\pi_{2i} = \beta_{20}$

$\pi_{3i} = \beta_{30}$

where $DCPM_{tj}$ represents an individual student's fluency score *j* at each time point *t*. Group assignment was dummy coded so that the easy probe was coded as D0 and the difficult probe was coded as D1. The parameter π_{0i}, the intercept, was centered at the final data point. This allowed for significance testing of final data point performance across groups. The parameter, π_{1i}, defines the growth trend, or slope, over time. Two unconditional models were first tested to examine whether a linear or quadratic trend best explained the pattern of results for this parameter. It was found that a quadratic model was not significant, $t(650) = -0.033$, $p = .973$, so the linear model was a more accurate representation of growth. Conditions were staggered such that the first easy session was defined as time .5, the first difficult session as time 1, the second easy session as time 1.5, …, across all sessions. The intercept was freed to vary by student, $\pi_{0i} = \beta_{00} + r_{0i}$. Freeing additional parameters did not result in a better model fit.

Descriptive data from the two conditions are presented in Table 1 and Figure 1 for average initial data point and final data point scores. For the initial measurement period there were 15 missing data points: 9 from D0 and 6 from D1. For the final measurement period there were 11 missing data points: two from D0 and 9 from D1.

Table 1.

Study 1 Descriptive Statistics Across Phases and Groups for DCPM

	Initial			Final			Difference Score	
Group	*n*	*M*	*SD*	*n*	*M*	*SD*	*M*	*SD*
D0 (Easy Probes)	47	30.80	10.31	54	39.67	11.83	8.87	
D1 (Difficult Probes)	50	9.70	4.87	47	14.11	7.43	4.41	

Figure 1.

Condition Fluency Growth in DCPM

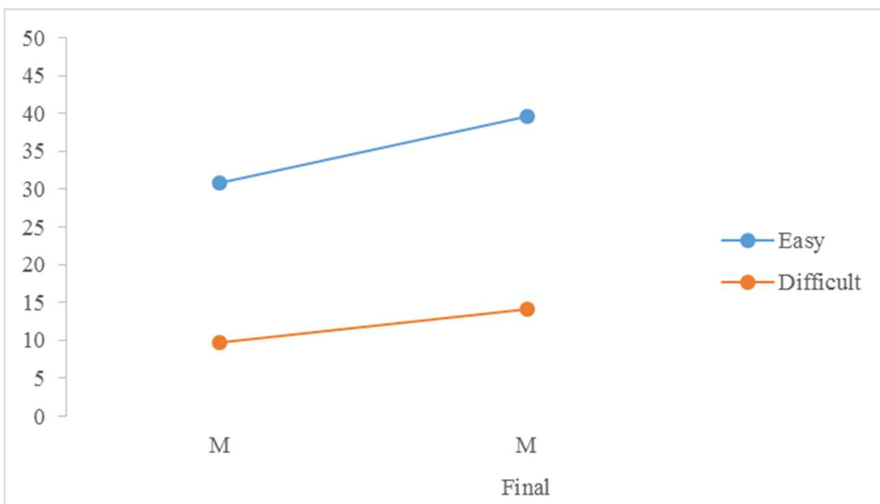


Table 2 presents final data point performance and slope results from the final model. An alpha value of .05 was used to determine significance for all tests of statistical significance of parameters. Results indicate that, across conditions, fluency scores increased over time, $t(649) = 8.608$, $p < 0.001$. Final data point performance results indicate statistically significant differences in final data point intercepts between probe conditions with performance on the easy probes outperforming the difficult probes, $t(73) = 33.761$, $p < 0.001$. Overall, comparisons of conditions indicate students performed an average of 49.59 DCP2M (24.80 DCPM) better on easy probes than on the difficult probes, collapsed over time. The difference was statistically significant, $t(649) = -24.808$, $p < 0.001$. Finally, the interaction of probe type and time was statistically significant, $t(649) = -3.863$, $p < 0.001$, indicating that students grew, on average, 1.16 DCPM more in the easy condition than in the difficult condition.

Table 2.

Growth Curve Model Results of DCP2M Growth Performance and Slope Comparisons

Model Parameters	Coefficient	*SE*	*t*	*df*	*p*
π_{00}	79.405	2.352	33.761	73	<0.001
π_{10}	1.809	0.210	8.608	649	<0.001
π_{20}	-49.592	1.999	-24.808	649	<0.001
$\boldsymbol{\pi}_{30}$	-1.160	0.300	-3.863	649	<0.001

Note. Final model summary: $o^2 = 178.132$, $\tau^2 = 243.932$. τ^2 was statistically significant, $\chi^2(977.266)$, p < 0.001. Model includes unstandardized coefficients.

For study 1 analysis for engagement, the final two level model was defined as:

Level-1 Model: $\log(p_j/1\text{-}p_j) = \phi_{0j} + \phi_{1j}*(PROBE)_j$

Level-2 Model:

$$\phi_{0j} = \gamma_{00} + u_{0j}$$

$$\phi_{1j} = \gamma_{10}$$

where p_j is the probability that an on-task interval will be observed for a student in class *j*. ϕ_{0j} represents the grand mean centered intercept, and ϕ_{1j} represents probe type, dummy coded as described above. As no change in on-task behavior over time was expected, there was no parameter to model growth.

Table 3 presents multilevel results for the analysis of engagement data from the final model. Both coefficients and odds ratios are reported. Odds ratios are interpreted as follows: any ratio above one indicates a higher probability of on-task behavior, given a one unit increase in the predictor, while a ratio less than one indicates a reduction in engagement. Initial session engagement was 100% in the easy condition and ranged from 56% to 88% in the difficult condition ($\overline{X}$ = 70.67%), while final session engagement in the easy condition ranged from 92% to 100% ($\overline{X}$ = 96%) and 36% to 72% in the difficult condition ($\overline{X}$ = 54.67%). The level difference was statistically significant, $t(2) = 7.406$, $p = .018$, which corresponds to the visual data presented in Figure 2. Specifically, the odds of a given student being engaged when working on an easy probe vs. a difficult probe was 1.666 greater than the odds when working on a difficult probe.

Table 3.

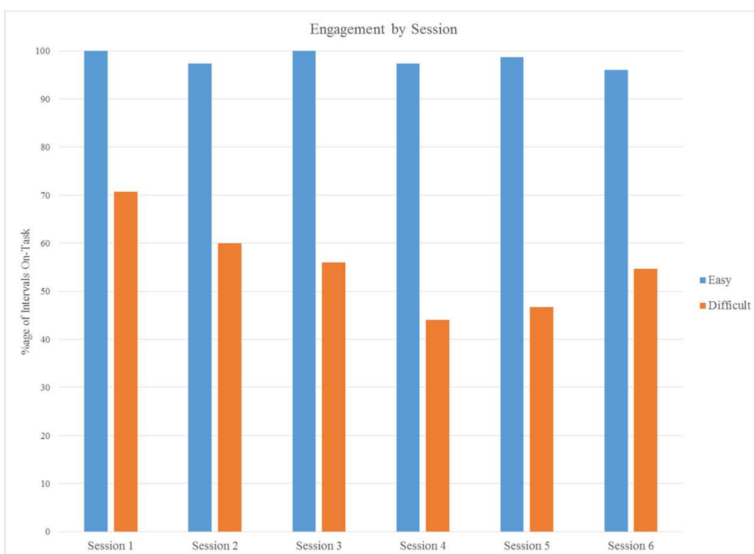
Generalized Multilevel Model Results of Student Engagement and Slope Comparisons

Model Parameters	Coefficient	*SE*	Odds Ratio	*t*	*df*	*p*
ϕ_{00} *(Intercept)*	1.206	0.163	3.341	7.406	2	0.018
ϕ_{10} *(Probe)*	0.510	0.163	1.666	3.131	31	0.004

Note. Final model summary: τ = 0.059. τ was statistically significant, $p = 0.019$.

Figure 2.

Percentage of On-Task Observed Intervals by Session



Study 2

Results for study 2 used the same analysis for DCP2M as in study 1. Observation points in this study included six data points for both conditions collected across the time of the study (12 data points per student). For study 2, the final two-level model was defined as:

Level-1 Model: $DCPM_{ti} = \pi_{0i} + \pi_{1i}*(LINCEN_{ti}) + \pi_{2i}*(PROBE_{ti}) + \pi_{3i}*(INTER1_{ti}) + e_{ti}$

Level-2 Model: $\pi_{0i} = \beta_{00} + r_{0i}$

$\pi_{1i} = \beta_{10}$

$\pi_{2i} = \beta_{20}$

$\pi_{3i} = \beta_{30}$

Descriptive data from the two conditions are presented in Table 4 and Figure 3 for average initial data point and final data point scores. For the initial measurement period there were 11 missing data points: 6 from D0 and 5 from D2. The final measurement period also had 11 missing data points: 9 from D1 and two from D2.

Table 4.

Study 2 Descriptive Statistics Across Phases and Groups for DCPM

	Initial			Final			Difference Score
Group	*n*	*M*	*SD*	*n*	*M*	*SD*	
D0 (Difficult)	50	9.70	4.87	47	14.11	7.43	4.41
D1 (Easy Truncated)	51	39.73	11.97	54	40.94	12.51	1.21

Figure 3.

Condition Fluency Growth in DCPM

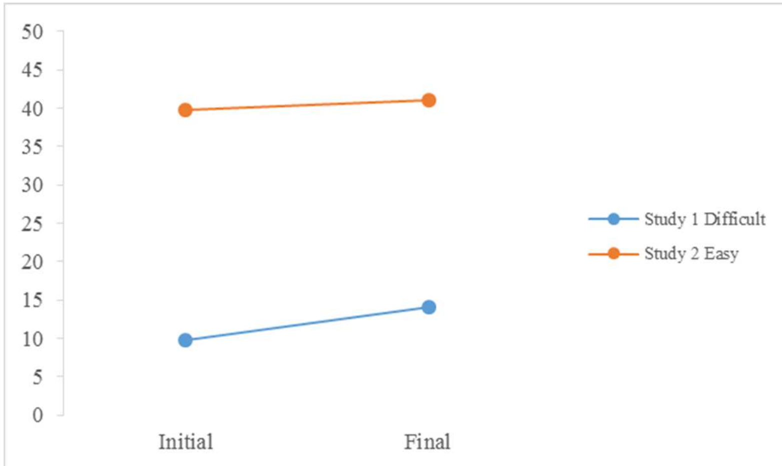


Table 5 presents intercept and slope results for the final model. An alpha value of .05 was used to determine significance for all tests of statistical significance of parameters. Results indicate that, across conditions, fluency scores continued to increase over time, $t(591) = 4.032$, $p < .001$. Final data point performance results indicate statistically significant differences between probe conditions with performance on the difficult probes from study 1 outperforming the easy probes with truncated time in study 2, $t(73) = 12.360$, $p < 0.001$. Overall comparisons of conditions indicate students performed 54.54 DCP2M (27.27 DCPM) more on difficult probes in study 1 than the easy probes with truncated time in study 2, collapsed over time. The main effect difference was statistically significant, $t(591) = 28.875$, $p < 0.001$. Analysis of the interaction between condition and growth indicated no statistically significant difference. Student engagement in the easy probes with truncated time in study 2 remained equivalent with engagement in study 1 as shown in figure 4.

Table 5.

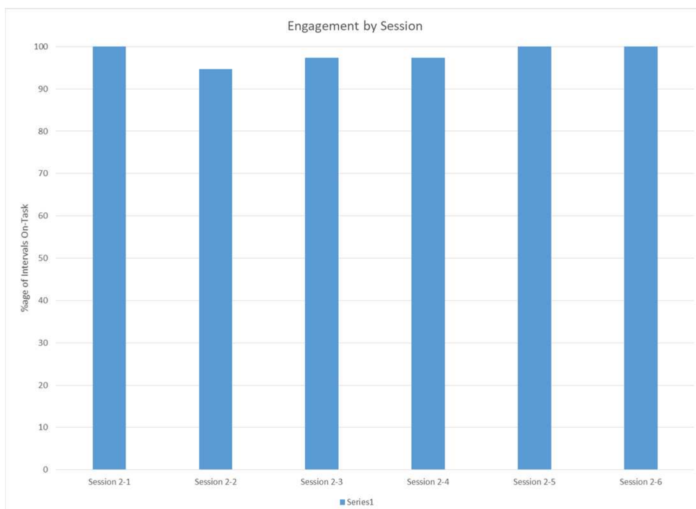
Study 2 Growth Curve Model Results of DCP2M Growth Performance and Slope Comparisons

Model Parameters	Coefficient	*SE*	*t*	*df*	*p*
π_{00}	32.630	2.640	12.360	73	<0.001
π_{10}	54.537	1.889	28.875	591	<0.001
π_{20}	1.650	0.409	4.032	591	<0.001
$\boldsymbol{\pi}_{30}$	-0.755	0.577	-1.309	591	0.191

Note. Final model summary: o^2 = 151.955, τ^2 = 352.050. τ^2 was statistically significant, χ^2(1369.648), p < 0.001. Model includes unstandardized coefficients.

Figure 4.

Percentage of On-Task Observed Intervals by Session



CHAPTER V

DISCUSSION

Research has indicated that proactive classroom management techniques including non-invasive antecedent modifications are highly effective for intervening on student behavior. Several studies have investigated the use of task difficulty manipulations to match student ability as an antecedent intervention for problem behaviors (Gickling & Armstrong, 1978; Lee, Sugai, & Horner, 1999; Sanford & Horner, 2012; Gilbertson et al, 2008; Umbreit et al., 2004; Simonsen, Little, & Fairbanks, 2010). Studies have also found a significant relationship between instructional match and academic performance (Daly, 1996; Lannie & Martens, 2004; Treptow, Burns, & McComas, 2007). Although research has indicated a strong functional relationship between instructional match and engagement, it is important to investigate the outcome of academic growth over time as it is due to instructional match versus student engagement.

The purpose of the current study was to answer the following questions: 1) Does task difficulty differentially impact academic growth, 2) Does task difficulty impact engagement class-wide, and 3) Does level of task difficulty impact academic growth when engagement is controlled for? To answer these questions, this study examined engagement and growth rate differences between easy and difficult level math skills identified from individual curriculum-based assessment. The manipulation of task difficulty through individuation of curricular demand has been shown to accomplish both an academic and behavioral intervention at the same time (Dunlap & Kern, 1996). This study controlled for task difficulty by individualizing task demand and investigated its impact on learning by controlling for engagement. Engagement was hypothesized to be a mitigating factor for learning rate differences between groups.

Given the theoretical relationship between task difficulty and learning rate, it was hypothesized that a closer match between task and student ability would result in more academic growth over time: the easy probes would result in more DCPM than the difficult probes over time. Results were analyzed using HLM. Statistically significant differences were found between conditions for final data point intercepts. Additionally, a statistically significant interaction of probe type and time was found. On average, students in the easy condition completed more DCPM than in the difficult condition. Difference score data indicated that, in fact, the easy probes resulted in approximately double the growth of the difficult probes from initial to final data point performance. At the final session, performance on the easy probes was way outperforming the difficult probes with an average of 79.405 DCP2M (39.702 DCPM) more completed in the easy condition. In addition, students, on average, grew at a faster rate on the easy probes than on the difficult probes. Results indicated that students grew, on average, 1.16 DCPM more per session in the easy condition than in the difficult condition. While both probe conditions resulted in academic gains, the easy probe condition showed significantly more growth and at faster rate than in the difficult condition.

Also investigated in this study was the theoretical relationship between instructional match and student behavior at the class wide level. Consistent with previous research, it was hypothesized that students would be more on-task when working on the easy probes than the difficult probes, adding to previous findings that students are more engaged when working on tasks that are more closely matched with their instructional ability. Results were analyzed with logistic generalized linear modeling. A statistically significant level difference was found between the two probes conditions. The results indicated that the odds of a student being engaged when working on an easy probe vs. a difficulty probe was 1.666 greater than the odds when working on a difficult probe which corresponded to visual analysis of the behavior observation data. On average, students were significantly more engaged while working on the easy probes than the difficult probes, as hypothesized.

Given the significance of the results from study 1, study 2 aimed to further examine the relationship between task difficulty and academic growth by controlling for engagement. Engagement was controlled for by truncating the time students were given to work on easy probes to match the time they were on-task in the difficult probe condition in study 1. On average, students were on-task 53% in the difficult condition, therefore they were given two minutes and 39 seconds to work on the easy probes in this study. Results were analyzed using HLM, consistent with the first study. Statistically significant results were found between conditions for the final data point but not for the interaction. Results indicated that, like study 1, both conditions resulted in fluency increases over time. Study 2 showed that on average, performance was greater in the difficult condition than in the easy truncated probes condition. At the final session, performance on the difficult probes was greater than performance on the easy probes with truncated time with an average of 54.537 DCP2M (27.269 DCPM) more completed in the difficult condition. However, analysis of the interaction did not indicate a statistically significant difference between condition and growth, indicating that growth between the two conditions was not significantly different. This result adds to the plausibility that engagement was an important mitigating variable for growth since the growth appears more similar between probe conditions than they did in study 1.

Implications for Practice

There is a need for effective classroom management strategies that also have significant impacts on student learning. Modifying task difficulty or curricular demand is one way to address both behavior and academic problems within the classroom. However, in order to gauge the impact of this antecedent-modification on both engagement and learning, it is important to investigate the relationship of task difficulty on academic growth while controlling for engagement.

The results of the current study lead to several implications for practice as several significant differences were found between probe conditions. In accordance with previous research, task difficulty was found to have a significant effect on both academic growth and student engagement. Students performed better both academically and behaviorally in the probe condition that was most closely matched to their skill level. Although both conditions resulted in increased DCPM over time, working on the easy probes resulted in far greater and faster growth per minute than the difficult probes. Likewise, students class-wide were also significantly more engaged when working on the easy versus difficult probes. This adds to the current research indicating that students not only perform better academically on tasks that are more closely matched to their ability levels, but also are more engaged at the class-wide level.

The results from the current study also add to the literature by investigating the relationship of task difficulty on academic growth while controlling for engagement. The results suggest plausible implications for practice as no statistically significant difference was found between the growth rate slopes of the difficult probe condition and the easy probe with truncated time condition. Because the slopes of the two groups were far more similar in the second study, it is reasonable to assume that engaged time was a mitigating variable for the growth differences between in the two conditions in first study. This finding indicates that while matching task difficulty to ability results in increases in learning over time, engagement in the task may be a more crucial variable to consider.

Limitations and Future Research

There are several limitations to current study. One limitation is that while study 2 showed similar slopes between easy and difficult probes, maturation in the easy condition was not controlled for. Maturation could be a possible explanatory variable for lack of substantial student growth in the easy probe with truncated time condition, however, this is unlikely as student scores, on average, did not exceed 40 DCPM at the final data point.

Another limitation addresses the participants and targeted math skills. Participants were limited to fourth grade students in general education placements and targeted math skills were limited to simple addition, multiplication, and division problems. Results may not be generalizable to students in other grades or educational placements, or to a variety of other math problems or curricular areas.

Future research should aim to correct these limitations and generalize to other populations of students and other curricular areas such as writing or reading. The limitation of maturation could be controlled for by including a difficult probe condition with no truncated time along with the easy probe condition with truncated time to hold number of sessions constant for both studies. Results from a study with this design could better illuminate or validate if statistically significant slope differences exist between task difficulty conditions when engagement is controlled for. Additionally, criteria for easy and difficult conditions should be more closely examined to determine where group growth rate and engagement differences taper off or fail to be significantly different.

Summary

Previous research has highlighted the significant impact that antecedent-interventions applied in naturalistic settings have on both student behavior and academic performance. Previously investigated antecedent-modifications for behavior include prompts, preference choice, prosthetic aids, curricular modifications, and differentiating task demands (Dunlap & Kern, 1996; Munk & Repp, 1994; Park & Scott, 2009). Research has also shown that antecedent curricular modifications such as altering task duration, increasing familiarity of the task, minimizing opportunities for errors, and reducing or increasing task difficulty have proven successful in both general and special education settings (Munk & Repp, 1994; Park & Scott, 2009; Umbreit et al., 2004).

Given the strong impact that task difficulty has on both student engagement and academic performance, there is a need to further investigate the practical application of instructional match on a class-wide level. Furthermore, it is crucial to understand to what degree academic growth can be attributed to student engagement vs. appropriate instructional match between task demand and student ability.

The current study aimed to examine the effects of task difficulty on academic performance and class-wide engagement and also to investigate the impact of task difficulty on academic growth when engagement was controlled for. Participants included students in the fourth grade in general education classroom placements in central Oklahoma. In the first study, participants were given 5-minutes to work on easy and difficult math probes assigned using curriculum-based assessment. Student behavior was audio and video recorded and later analyzed using systematic behavior observations and logistic generalized linear modeling. Daily math probes gathered over six sessions per condition were scored by DCPM and results were analyzed using HLM. In the second study, engagement was controlled for by giving students two minutes and 39 seconds to complete easy probes, matching engaged time to that of the difficult condition in study 1. Daily math probes were gathered over six sessions and were scored by DCPM. Results were compared to that of the difficulty condition in study 1 and analyzed using HLM.

Findings in study 1 indicate statistically significant differences between the easy and difficult probe conditions. At the last treatment session, students completed significantly more DCPM than in the difficult condition. The easy condition also resulted in significantly more DCPM session growth at a faster rate than the difficult condition. On average, students grew 1.16 DCPM more per session in the easy condition. Students were also significantly more on-task in the easy probe condition than the difficult probe condition with the odds being on-task in the easy condition being 1.666 greater than the difficult condition. Findings in study 2 indicate that while both conditions resulted in continual DCPM growth over time, the growth is substantially less than in study 1. The interaction between task difficulty and growth is not significant but suggests that students, on average, gained .75 DCPM more per session in study 1 on the difficult probes than the easy probes with truncated time. With more similar looking slopes, this finding adds to the plausibility that engagement is a significant contributor to the growth differences in study 1.

There are several implications for practice from the current study including providing additional support for the relationship between instructional match and academic and behavioral performance. This study supports the notion that students not only perform better academically on tasks that are more closely matched to their ability level but are also more engaged at the class-wide level. The results from the current study also add to the literature by investigating the relationship of task difficulty on academic growth while controlling for engagement. Findings indicate that while matching task difficulty to ability results in increases in learning over time, student engagement in the task is a crucial variable to consider.

Limitations include possible maturation effecting DCPM growth across studies and the range of participants and targeted curricular areas. A possible explanatory variable for lack of student growth in the easy probe with truncated time condition could be maturation, however, this is unlikely as student scores, on average, did not exceed 40 DCPM at the final data point. Participants were limited to fourth grade students in general education placements, and the targeted math skills were simple addition, multiplication, and division. Therefore the results may not generalize to other groups of students or curricular areas.

Future research should aim to control the issue of maturation by including a difficult probe condition with no truncated time along with the easy probe condition with truncated time to hold number of sessions constant. Controlling for maturation would better illuminate or validate if significant differences exist between task difficulty conditions when engagement is controlled for. Future research should more closely examine DCPM criteria for easy and difficult conditions to determine where growth rate and engagement differences fail to be a significant predictor for academic growth. Additionally, future research should extend the results of this study to other populations and other curricular areas to see if results generalize beyond the scope of the current study.

REFERENCES

Arnold, C. (1992). An introduction to hierarchical linear models. *Measurement & Evaluation in Counseling & Development (American Counseling Association), 25*, 58.

Amato-Zech, N. A., Hoff, K. E., & Doepke, K. J. (2006). Increasing on-task behavior in the classroom: Extension of self-monitoring strategies. *Psychology in the Schools, 43*, 211-221.

Burns, M. K., & Dean, V. J. (2005). Effect of acquisition rates on off-task behavior with children identified as having learning disabilities. *Learning Disability Quarterly, 28*, 273-281.

Conroy, M. A., & Janine Peck, S. (2003). The application of antecedents in the functional assessment process: Existing research, issues, and recommendations. *The Journal of Special Education, 37*, 15-25.

Curran, P. J., Obeidat, K., & Losardo, D. (2010). Twelve frequently asked questions about Growth Curve Modeling. *Journal of Cognition and Development: Official Journal of the Cognitive Development Society, 11*, 121-136.

Daly, E. J. (1996). The effects of instructional match and content overlap on generalized reading performance. *Journal of Applied Behavior Analysis*, 507-518.

Dunlap, G., & Kern, L. (1996). Modifying instructional activities to promote desirable behavior: A conceptual and practical framework. *School Psychology Quarterly, 11*, 297-312.

Duncan, T. E., & Duncan, S. C. (2004). An introduction to latent growth curve modeling. *Behavior Therapy, 35*, 333-363.

Gentry, W. A., & Martineau, J. W. (2010). Hierarchical linear modeling as an example for measuring change over time in a leadership development evaluation context. *The Leadership Quarterly, 21*, 645-656.

Gickling, E. E., & Armstrong, D. L. (1978). Levels of instructional difficulty as related to on-task behavior, task completion, and comprehension. *Journal of Learning Disabilities, 11*.

Gilbertson, D., Duhon, G., Witt, J. C., & Dufrene, B. (2008). Effects of academic response rates on time-on-task in the classroom for students at academic and behavioral risk. *Education & Treatment of Children, 31*, 153-165.

Haydon, T. (2012). Using functional behavior assessment to match task difficulty for a 5th grade student: A case study. *35*, 459-476.

Jack, S. L., Shores, R. E., Denny, R. K., & Gunter, P. L. (1996). An analysis of the relationship of teachers' reported use of classroom management strategies on types of classroom interactions. *Journal of Behavioral Education, 6*, 67-87.

Kern, L., Delaney, B., Clarke, S., Dunlap, G., & Childs, K. (2001). Improving the classroom behavior of students with emotional and behavioral disorders using individualized curricular modifications. *Journal of Emotional and Behavioral Disorders, 9*, 239-247.

Lam, A. L., Cole, C. L., Shapiro, E. S., & Bambara, L. M. (1994). Relative effects of self monitoring on task-behavior, academic accuracy, and disruptive behavior in students with behavior disorders. *School Psychology Review, 23*, 44-58.

Lannie, A. L., & Martens, B. K. (2004). Effects of task difficulty and type of contingency on students' allocation of responding to math worksheets. *Journal of Applied Behavior Analysis, 37*, 53-65.

Lee, Y.-Y., Sugai, G., & Horner, R. H. (2012). Using functional behavior assessment to match task difficulty for a 5th grade student: A case study. *Young-Yon Lee, George Sugai, Robert H. Horner, 35*, 459-476.

McCullagh, P. (1989). *Generalized linear models* (2nd ed.). London, New York: Chapman and Hall.

Moore, D. W., Anderson, A., & Kumar, K. (2005). Instructional adaptation in the management of escape-maintained behavior in a classroom. *Journal of Positive Behavior Interventions, 7*, 216-223.

Munk, D. D., & Repp, A. C. (1994). The relationship between instructional variables and problem behavior: A review. *Exceptional Children, 60*, 390.

Park, K. L., & Scott, T. M. (2009). Antecedent-based interventions for young children at risk for emotional and behavioral disorders. *Behavioral Disorders, 34*, 196-211.

Raudenbush, S. W., & Byrk, A. S., (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Thousand Oaks: Sage Publications.

Reddy, L. A., Fabiano, G. A., Dudek, C. M., & Hsu, L. (2013). Instructional and behavior management practices implemented by elementary general education teachers. *Journal of School Psychology, 51*, 683-700.

Reupert, A., & Woodcock, S. (2010). Success and near misses: Pre-service teachers' use, confidence and success in various classroom management strategies. *Teaching and Teacher Education*, 1261-1268.

Sanders, W. L., & Horn, S. P. (1998). Research findings from the Tennessee Value-Added Assessment System (TVAAS) database: Implications for educational evaluation and research. *Journal of Personnel Evaluation in Education, 12*, 247-256.

Sanford, A. K., & Horner, R. H. (2013). Effects of matching instruction difficulty to reading level for students with escape-maintained problem behavior. *Journal of Positive Behavior Interventions, 15*, 79-89.

Simonsen, B., Little, C. A., & Fairbanks, S. (2010). Effects of task difficulty and teacher attention on the off-task behavior of high-ability students with behavior issues. *Journal for the Education of the Gifted, 34,* 245-260,351-352.

Shinn, M.R. (1989). Cirriculum-based measurement: Assessing special children. New York: Guilford.

Skinner, C.H. (2008). Theoretical and applied implications of precisely measuring learning rates. School Psychology Review, 37, 309-314.

Treptow, M. A., Burns, M. K., & McComas, J. J. (2007). Reading at the frustration, instructional, and independent levels: The effects on students' reading comprehension and time on task. *School Psychology Review, 36*, 159-166.

Umbreit, J., Lane, K. L., & Dejud, C. (2004). Improving classroom behavior by modifying task difficulty: Effects of increasing the difficulty of too-easy tasks. *Journal of Positive Behavior Interventions, 6*, 13-20.

APPENDICES

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Script for Recruiting Principals and Teachers

Proposal Title: Examining the Impact of Task Difficulty on Student Engagement and Learning Rates in Mathematics

"I would like to request your permission to collect data for my dissertation at your school and in your classroom(s). I appreciate you spending this time with me and would like to briefly discuss the purpose and methods of the proposed study with you."

The purpose and the research problem in the proposed study:

Enhancing both academic and behavioral performance are two key objectives of the educational system. There has been considerable focus in both research and practice on positive behavioral supports to address effective classroom management strategies. Research is uncovering the potential benefits of modifying instruction and other curricular variables as a principal component of behavioral management in schools. My study aims to determine the effect of task difficulty on student engagement. My study also aims to determine if student learning rates differ between levels of task difficulty when engagement is controlled for. By participating in this study, you will assist in the process of validating an effective and easy to implement antecedent intervention for student behavior for teachers to use in the classroom. You may also learn the optimal conditions to increase student learning.

Methodology:

The participants in the current study will include 4th grade students and their teachers. Participating teachers will be given the opportunity to nominate their classrooms for participation in this study. After parental permission is secured, researchers will briefly observe the classrooms during regularly scheduled math instruction at the beginning of the class period, and then they will be screened using curriculum-based measures in mathematics.

A teacher training for the study's phases will take approximately 30 minutes in a single session. The initial screening of student skills will be conducted in one session lasting approximately 10-15 minutes. Classroom observations will be conducted daily using audio and video recording equipment for a duration of 5 minutes every day through the two phases of the study. The study will last approximately 6 to 8 weeks. My research team and I will prepare and provide all materials to be used during the study.

"Do you give permission for me and my team of one to two other graduate students to collect the data described at your school and in your classroom(s)? Thank you again for your time."

Informed Consent: Principal/Teacher
Oklahoma State University

Project Title: **Examining the Impact of Task Difficulty on Student Engagement and Learning Rates in Mathematics**

Investigators: Gary J. Duhon, Ph.D. Associate Professor Oklahoma State University

Alexis Pavlov, M.S. Graduate Student Oklahoma State University

Purpose:
Research has not investigated to what degree academic growth is attributed to instructional match or student engagement. This study seeks to expand the literature by investigating the effects of task difficulty, applying instructional match as a class wide intervention to measure its effects on student engagement. This study will examine the effects of task difficulty as an antecedent-intervention on engagement on a class wide level. It will also examine learning rates to determine if there are significant differences between levels of task difficulty when engagement is controlled for.

Project Procedures:
The participants in the current study will fourth grade students and teachers. Participating teachers will be given the opportunity to nominate their classrooms for participation in this study. After parental permission is secured, researchers will screen the students using curriculum-based assessment procedures and direct observations of behavior to determine the math skills for the Easy and Difficult level assignments and baseline levels of on-task behavior. A brief teacher training session will be conducted. Daily observations of the student will be observed utilizing audio and video recording for the first 5 minutes of the math class period. The use of audio and video equipment is necessary to accurately assess the behavior of an entire classroom of individual students at the same time. Simple, non-invasive equipment (e.g. Go-Pro video camera) will be utilized and operated by the PI and research assistants. My research team and I will prepare and provide all materials to be used during the study.
Pre-assessment. The pre-assessment phase will be conducted using CBA to define math skills for the easy and difficult conditions utilized in the study. The scope and sequence of the probes will begin with single-digit subtraction with small set sizes ending in double-digit subtraction with small set sizes. Students will be timed for one minute on math probes for each skill in the scope and sequence.
Task Difficulty. For the study's two experimental phases, students will be assigned single-skill math probes in the form of independent seatwork at the Easy (30-50 digits correct per minute; DCPM) and Difficult (less than 15 DCPM) levels.
Study 1. During Study 1, students will be randomly assigned to one of two conditions: seat work material in the form of mathematics probes at the Easy and Difficult level conditions. Throughout the duration of a 5-minute period, independent seat work behavior will be video and audio recorded and later assessed through direct systematic observation for each student. Levels of on-task and off-task behavior will be recorded. Weekly progress monitoring will be conducted to assess growth rate per minute of time.
Study 2. During Study 2, students will be given seat work material in the form of mathematics probes at the Easy and Difficult level and will be randomly assigned to one of two conditions. The students in condition one will be given Easy level material with restricted access while students in condition two will be given Difficult level material with no restriction. Students in the restricted access condition will be given the amount of time the students were on-task in the difficult treatment condition in Study 1 to complete their math assignments. The students in the

no restriction condition will be given the total 5-minute observation time to work.
Experimental design. Teachers will be asked to implement this intervention during the first five minutes of scheduled math instruction throughout the study. Expectations and the studies will be outlined in the teacher training session. All materials will be provided by the research team.

Risks of Participation:
If the teacher does not regularly provide independent seatwork at the beginning of class, the classroom routine may be slightly altered; however, the assignment will be teacher-directed and curriculum related. No other known risks exist associated with this project greater than those ordinarily encountered in the classroom setting.

Benefits:
The current project will increase our knowledge of an effective and easy to implement intervention for improving on-task behavior in students and increase rates of learning in mathematics. Furthermore, you will learn and receive practice and feedback on an easy-to-use classroom management strategy.

Confidentiality:
Every effort will be made to maintain the confidentiality of the data obtained from this study. The data will be housed at Oklahoma State University and only the Principal Investigator and the research assistants working on the project will have access to it. Electronic data, including the audio and video behavior observations will be stored on a password-protected computer with password access only available to the researchers working on this project. Any written results will discuss general trends across all students and will not include information that will identify you or your students (names will not be attached to the testing instruments). Your level of participation will not be shared with other faculty, staff, or administration.

Compensation:
No monetary compensation is offered for participation in the study. The benefits provided by the study are explained above.

Contacts:
If you have any questions with regard to you or your students' involvement in this study please contact us at your earliest convenience:

Gary J. Duhon, Ph.D.	Alexis Pavlov, M.S.
Associate Professor	Graduate Student
Oklahoma State University	Oklahoma State University
(405) 744-9436	(214) 789-2771

If you have questions about your rights as a research volunteer, you may contact Dr. Hugh Crethar, IRB Chair, 219 Cordell North, Stillwater, OK 74078, (405) 744-3377 or irb@okstate.edu.

Participant Rights:
Participation in this study is voluntary and you may choose to withdraw from the assessment at any time. No risks from withdrawal or termination are anticipated.

Signature:
I give my permission for faculty and/or students from Oklahoma State University to assess in my school/classroom for the purposes of this research. I have read and fully understand the consent

form. I sign it freely and voluntarily. A copy of this form has been given to me.

______________________	______________	_____________
Signature of Principal	School Site	Date
______________________		_____________
Signature of Teacher		Date

I certify that I have personally explained this document before requesting that the principal/teacher(s) sign it.

____________________	____________
Signature of Researcher	Date

<u>Parent/Guardian Permission (Consent) Form</u>
Oklahoma State University

Student Name: _________________

Dear Parent(s),

This is a letter requesting parent permission (consent) to include your child in a brief research project within his/her classroom. Your child has been chosen to participate in this research study due to their enrollment in the fourth grade which is the population of interest in this study. Please have your child return this form signed (last page) if you give permission for your student to participate.

<u>Project Title:</u> Examining the Impact of Task Difficulty on Student Engagement and Learning Rates in Mathematics

<u>Researchers:</u> Gary J. Duhon, Ph.D., Associate Professor
Oklahoma State University
Alexis Pavlov, M.S., Graduate Student
Oklahoma State University

<u>Purpose:</u>
This study aims to compare the effects of academic task difficulty level on student on-task behavior and the effects of task difficulty and engagement on learning rates in mathematics.

<u>Project Procedures:</u>
Students who return a parent permission slip allowing participation will be screened using academic measures to assess their instructional level for math tasks. Teachers will participate in a training session on the study's procedures. The math task will be brief and will not alter your child's classroom routine significantly. Classroom observations utilizing simple, non-invasive equipment (e.g. Go-Pro video camera) will be utilized and operated by the PI and research assistants. Observations will be recorded daily for a duration of 5 minutes for approximately 6 to 8 weeks. The use of audio and video equipment is necessary to accurately assess the behavior of an entire classroom of individual students at the same time.

<u>Risks of Participation:</u>
This project will not affect the activities of the general classroom or your child's grades. This project involves minimal risk, as the evaluations and interventions used will be similar to ones used in the everyday classroom. Your child will not be told that their behavior is being recorded via audio and video taping until after data collection is complete. The results of this study would be compromised if the students knew their behavior was being assessed when they were assigned the academic math task. Knowledge that their behavior is being observed would reduce the naturalistic quality of the observation and may cause your child to alter their behavior. An oral debriefing process will be conducted after the study that will provide your child with an explanation of the study's purpose and the need for the use of deception during the data collection procedures.

<u>Benefits:</u>
The current project will add to what we know about classroom management interventions and how best to help increase student engagement and rates of learning. Your student will have the benefit of receiving a mild intervention that already has evidence supporting its usefulness in helping students increase their task engagement.

Confidentiality:
Every effort will be made to keep the scores on assignments, behavioral observation data, and names of participating students confidential and private. Each participating student will be assigned a random identification number using a random number generator and this number will appear on the data collection instruments. This participant number will not be documented on the consent forms and names of the participants will not be documented on the data collection instruments. All audio and video recordings will be kept on a password protected computer only accessible by the primary investigator. All research project records will be kept in a secure location at Oklahoma State University and only the research project assistants will have access. Any results that are published in articles or delivered in presentations will discuss group trends and will not include any information that will identify you, your child, your child's school, or your child's school district. Your child's results from this project will not be shared with your student's classroom teacher nor any other faculty or staff at the school. Your child's participation in this project will not affect his or her daily classroom activity or grades. All records will be destroyed after six years.

Compensation:
No monetary compensation is offered for participation in this research project. The benefits provided by the study are explained above.

Contacts:
If you have any questions with regard to you or your students' involvement in this study please contact us at your earliest convenience:

Alexis Pavlov, M.S.	Gary J. Duhon, Ph.D.
Graduate Student	Associate Professor
Oklahoma State University	Oklahoma State University
214-789-2771	405-744-9436

If you have questions about your rights as a research volunteer, you may contact Dr. Hugh Crethar, IRB Chair, 223 Scott Hall, Stillwater, OK 74078, (405) 744-3377, or irb@okstate.edu.

Participant Rights:
Participation in this study is voluntary and you may choose to withdraw from the assessment at any time. No risks from withdrawal or termination are anticipated.

Parental Signature for Minor:
I give my permission for faculty and/or students from Oklahoma State University to assess my child/student, for the purposes of this research. I have read and fully understand the consent form. I sign it freely and voluntarily. A copy of this form has been given to me. As parent or guardian I authorize ________________________ (print student's name) to participate in the described research.

___________________________ ________________
Parent/Guardian Name (printed) Date

___________________________ ________________
Signature of Parent/Guardian Date

I certify that I have explained this document before requesting that the participant's parent/guardian sign it.

_________________________ _______________
Signature of Researcher Date

ORAL DEBRIEFING SCRIPT

Project Title: Examining the Impact of Task Difficulty on Student Engagement and Learning Rates in Mathematics

Researchers: Gary J. Duhon, Ph.D., Associate Professor
Oklahoma State University
Alexis Pavlov, M.S., Graduate Student
Oklahoma State University

Now that you are finished, I'd like to tell you a little bit more about the study you have been participating in. You were told to complete math worksheets every day as part of your normal classwork. In actuality, we were interested in comparing the effects of task difficulty level on student on-task behavior and the effects of task difficulty and engagement on learning rates in math.

You each were randomly assigned some math tasks that were designed to be difficult and some math tasks that were designed to be easy to see how your behavior would be affected. During the five minutes you were completing the math worksheets each day, your behaviors were audio and video taped to see if you acted differently when the two math tasks were assigned. The study's hypothesis is that students would be more on-task during the easy math tasks than the difficult math tasks. It is also hypothesized that students would have higher learning rates in the easy condition as well due to greater engagement to the task.

We apologize for not telling you the full purpose of the study at the beginning. To protect the integrity of this research, we could not fully divulge our procedures and hypotheses at the start of the experiment. I hope you can see that if participants knew exactly what we were interested in studying, they might change their answers and behavior, which would negatively affect the quality of our research conclusions and reduce the naturalistic quality of the observation and may cause the participants to alter their behavior.

All of the information gathered during this study will be kept strictly confidential. Each participant was assigned a random number and records of your names are not on any data collected including videos and math probes. All information collected is stored in a password protected computer and in a locked office at OSU which is only assessable by the primary investigator.

As you know, your participation in this study is voluntary. If you so wish, you may withdraw at this point, at which time all records of your participation will be destroyed. You will not be penalized if you choose to withdraw. Are you comfortable with us using your data? Do you have any questions? If you have questions later, your parents can e-mail me using the contact information provided on the consent form. If you have questions about your rights as a participant, your parents can e-mail the IRB using the contact info also provided on the consent form.

Thank you very much for your participation throughout this study. We hope you found it enjoyable.

Have a great day!

On-Task Behavior Recording Form

Examining the Impact of Task Difficulty on Student Engagement and Learning Rates in Mathematics

Student ID:		Rater Initials:	Teacher:
Date:	Time:	Study/Condition:	

0-10s	11-20s	21-30s	31-40s	41-50s	51-60s
1 TA PA TO OS OP Engaged	2 TA PA TO OS OP Engaged	3 TA PA TO OS OP Engaged	4 TA PA TO OS OP Engaged	5 TA PA TO OS OP Engaged	6 TA PA TO OS OP Engaged
7 TA PA TO OS OP Engaged	8 TA PA TO OS OP Engaged	9 TA PA TO OS OP Engaged	10 TA PA TO OS OP Engaged	11 TA PA TO OS OP Engaged	12 TA PA TO OS OP Engaged
13 TA PA TO OS OP Engaged	14 TA PA TO OS OP Engaged	15 TA PA TO OS OP Engaged	16 TA PA TO OS OP Engaged	17 TA PA TO OS OP Engaged	18 TA PA TO OS OP Engaged
19 TA PA TO OS OP Engaged	20 TA PA TO OS OP Engaged	21 TA PA TO OS OP Engaged	22 TA PA TO OS OP Engaged	23 TA PA TO OS OP Engaged	24 TA PA TO OS OP Engaged
25 TA PA TO OS OP Engaged	26 TA PA TO OS OP Engaged	27 TA PA TO OS OP Engaged	28 TA PA TO OS OP Engaged	29 TA PA TO OS OP Engaged	30 TA PA TO OS OP Engaged

TO: ______ /30x100 = ______% OP: ______ /30x100 = ______% PA: ______ /30x100 = ______%
OS: ______ /30x100 = ______% TA: ______ /30x100 = ______% Engaged:______ /30x100=______%

Engaged: **Whole Interval**: Student working actively on assigned math probes, actively raising their hand to receive teacher attention, or actively engaged in behaviors that are relevant to the assigned task for the whole 10-sec interval.

Math Probe Scoring Form

Examining the Impact of Task Difficulty on Student Engagement and Learning Rates in Mathematics

Student ID: ___________________ Teacher Name: ___________________

Research Assistant: ___________________ Date: ___________________

Task Difficulty Level: (circle one): **Easy** **Difficult**

Date	Time Allotted 0-5 Minutes	% Completed	Accuracy
		# Problems Completed_____ /# of Minutes ______=______ # Digits Completed_____/# of Digits______=______	# Digits Correct______/# Digits Written ______ = ______
		# Problems Completed_____ /# of Minutes ______=______ # Digits Completed_____/# of Digits______=______	# Digits Correct______/# Digits Written ______ = ______
		# Problems Completed_____ /# of Minutes ______=______ # Digits Completed_____/# of Digits______=______	# Digits Correct______/# Digits Written ______ = ______
		# Problems Completed_____ /# of Minutes ______=______ # Digits Completed_____/# of Digits______=______	# Digits Correct______/# Digits Written ______ = ______
		# Problems Completed_____ /# of Minutes ______=______ # Digits Completed_____/# of Digits______=______	# Digits Correct______/# Digits Written ______ = ______

Sample Math Probe

Examining the Impact of Task Difficulty on Student Engagement and Learning Rates in Mathematics

Study Condition: ___________________ Teacher Name: ___________________

Name:______________________ Date:___________________

2X2 subtraction without regrouping

94	94	45	93	28	45	38
- 62	- 81	- 32	- 02	- 07	- 10	- 16
68	74	24	35	23	26	13
- 43	- 40	- 12	- 24	- 02	- 01	- 02
67	28	37	66	78	16	29
- 56	- 17	- 06	- 04	- 53	- 00	- 13
58	58	43	96	15	58	46
- 05	- 47	- 12	- 20	- 04	- 02	- 10
42	36	73	52	94	29	22
- 00	- 14	- 42	- 40	- 81	- 04	- 10
21	81	22	77	13	73	64
- 00	- 40	- 00	- 11	- 02	- 51	- 41
58	73	39	49	48	34	74
- 15	- 02	- 15	- 22	- 22	- 11	- 61
48	44	25	51	44	59	92
- 12	- 11	- 04	- 20	- 23	- 06	- 11

Treatment Fidelity Form

Examining the Impact of Task Difficulty on Student Engagement and Learning Rates in Mathematics

Teacher Name: __________________ Study (circle one): 1 or 2

Research Assistant: __________________ Date: __________________

Observe study session and indicate the presence or absence of each element.

1. Math probes present on student desks at beginning of observation.	☐Yes	☐No
2. Teacher reads prompt to class.	☐Yes	☐No
3. Students have access to materials for length of observation period (5 minutes in Study 1, 0-5 minutes in Study 2).	☐Yes	☐No
4. After observation time, students stop working on math probes.	☐Yes	☐No
5. Math probes are collected.	☐Yes	☐No

Calculate integrity: # of Yes _____/5 x 100 = ____ % procedural integrity

Feedback / recommendations for teacher, including need for additional training:
Note: Feedback / recommendations *must* be provided for any "no" answer on the checklist.

Feedback was provided to teacher: ☐verbally ☐in writing ☐both

Signature of reviewer: ___________________________

<u>Inter-rater Reliability Form</u>

(Point-by-Point Agreement)

Examining the Impact of Task Difficulty on Student Engagement and Learning Rates in Mathematics

Student ID: ___________________ Teacher Name: ___________________

Calculate point-by-point agreement by dividing the agreement intervals by the total number of agreement and disagreement intervals, then multiply by 100.

Observation Date	Agreement Intervals	Disagreement Intervals	Point-by-Point Agreement

<u>Confidentiality Agreement for Research Team Members</u>

Proposal Title: Examining the Impact of Task Difficulty on Student Engagement and Learning Rates in Mathematics

I, ______________________ have been instructed that all identifying information regarding student names, classroom teachers, schools, etc. that I have access to as a research team member for this research project is confidential. I agree not to share any identifying information with anyone who is not a member of the research team, and agree to protect the confidentiality and identity of all participants involved in this proposed study.

I have read and fully understand the confidentiality agreement. I sign it freely and voluntarily. A copy of this form has been given to me.

____________________________ ________________

Research Team Member (printed) Date

____________________________ ________________

Signature of Research Member Date

I certify that I have explained this document before requesting that the research team member sign it.

_________________________ ________________

Signature of Researcher Date

IRB Approval Letter

Oklahoma State University Institutional Review Board

Date:	Wednesday, March 01, 2017
IRB Application No	ED16121
Proposal Title:	Examining the impact of task difficulty on student engagement and learning rates in Mathematics
Reviewed and Processed as:	Expedited

Status Recommended by Reviewer(s): Approved   Protocol Expires: 2/28/2018

Principal Investigator(s):

Alexis Pavlov	Gary J Duhon
	423 Willard
Stillwater, OK 74078	Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☐ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Hugh Crethar, Chair
Institutional Review Board

VITA

Alexis C. Pavlov

Candidate for the Degree of

Doctor of Philosophy

Thesis: EXAMINING THE IMPACT OF TASK DIFFICULTY ON STUDENT ENGAGEMENT AND LEARNING RATES IN MATHEMATICS

Major Field: Educational Psychology

Biographical:

Education:

Completed the requirements for the Doctor of Philosophy in your Educational Psychology at Oklahoma State University, Stillwater, Oklahoma in May, 2018.

Completed the requirements for the Master of Science in your Educational Psychology at Oklahoma State University, Stillwater in 2014.

Completed the requirements for the Bachelor of Arts in Psychology at University of Texas at San Antonio, San Antonio, Texas in 2012.

Experience:

June 2016 – May 2017
OTISS External Coach (Supervised by Dr. Gary Duhon)
May 2016 – May 2017
Clinic-Based Practicum (400 hours; Supervised by Dr. Terry Stinnett)
August 2015 – May 2016
School-Based Practicum (600 hours; Supervised by Dr. Gary Duhon)
August 2014 – May 2015
Shadow Practicum (240 hours; Supervised by Dr. Brian Poncy)

Professional Memberships:

National Association of School Psychologists, Student Member: 2013 – current
Oklahoma School Psychology Association, Student Member: 2013 – current
American Psychological Association, Div. 16, Student Member: 2016 – current