HHS Public Access
Author manuscript
J Sch Psychol. Author manuscript; available in PMC 2016 October 01.

Published in final edited form as:
J Sch Psychol. 2015 October ; 53(5): 409–428. doi:10.1016/j.jsp.2015.07.004.

Children's Behavioral Regulation and Literacy: the Impact of the First Grade Classroom Environment

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Abstract

Classroom learning environments are an important source of influence on children's development, particularly with regard to literacy achievement and behavioral regulation, both which requires the coordination of task inhibition, attention, and working memory. Classroom observations were conducted in 18 schools and 51 first grade classrooms for 500 children. The non-instructional activities were recorded for each student in the classroom. Hierarchical linear modeling revealed that children with weaker fall behavioral regulation were more likely to attend classrooms where more time was spent in disruptions and wasted instructional time over the course of the school year, such as waiting for the teacher to gather materials before beginning instruction. For literacy outcomes, children who were in classrooms where more time in disruptions, transitions, and waiting was observed showed weaker literacy skill gains in the spring compared to children in classrooms with lesser amounts of such unproductive non-instructional time and this effect was generally greater for students with initial weaker skills. These results also reveal that the classroom environment and the incoming characteristics of the students themselves influence students' development of behavioral regulation and literacy.

Keywords

Behavioral regulation; Executive functioning; Self-Regulation; Academic Achievement; Literacy; Behavior; Classroom Environment; Reading

According to a recent report by the National Assessment of Education Progress (NAEP), only 34% of children read at or above a proficient literacy level in 4th grade and this number is even lower for children living in poverty (NAEP, 2014). Proficient literacy skills provide the foundation for academic success (NRP, 2000). Therefore, understanding the malleable sources of influence that are associated with stronger literacy skills can inform the development of effective learning opportunities for students, particularly those at risk for academic underachievement. One particularly significant source of influence is the classroom learning environment (Carlisle, Kelcey, Berebitsky, & Phelps, 2011; Pianta, Belsky, Houts, Morrison, & NICHD-ECCRN, 2007). In addition to the classroom environment, there are also a number of child characteristics that can impact literacy achievement and academic success (Duncan et al., 2007; McGee et al., 2002), such as incoming experience with literacy, language, and behavioral regulation skills, with behavior regulation including executive function processes of attentional or cognitive flexibility, working memory, and inhibitory control. Using bio-ecological (Bronfenbrenner & Morris, 2006) and transactional (Morrison & Connor, 2009) frameworks, where the classroom learning environment influences but is also influenced by the characteristics of the students, the purpose of this study was to investigate the interacting relations among first graders' behavioral regulation skills, their academic achievement, and the classroom learning environment focusing specifically on non-instructional activities that take time away from meaningful instruction.

Defining Behavioral Regulation

Previous research has defined behavioral regulation as the integration of cognitive processes, called executive function, that include attentional or cognitive flexibility, working memory, and inhibitory control (Cameron Ponitz et al., 2008; McClelland et al., 2007). Executive function skills are thought to consist of cognitive processes that underlie self-regulated action (Best & Miller, 2010; McClelland & Cameron, 2012; McClelland et al., in press). Recent research has focused on how underlying executive function skills are translated into behavior in young children. This is especially relevant for research on children's early learning in classroom settings. For example, attentional or cognitive flexibility allows children to focus on a task or switch tasks when needed. Working memory involves keeping information in mind while processing new stimuli (e.g., remembering a set of instructions and then carrying out those instructions as accurately as possible). Inhibitory control can be described as the ability to stop incorrect responses and carry out more adaptive solutions, such as waiting to be called on rather than blurting out an answer (Cameron Ponitz et al., 2009). For this study, we use the term behavioral regulation because our aim is to examine how children's executive function skills translate into behavior in classroom settings and how they are related to early reading achievement in first grade (Cameron & Connor, 2004; McClelland et al., 2007).

Strong behavioral regulation skills appear to be key for children to control their thoughts and behaviors so that they can benefit from new learning experiences (Blair, 2002). Research has shown that students who demonstrate more disruptive behaviors and who lack self-control in elementary school are more likely to exhibit later academic difficulties (Vitaro et al., 2005). Some studies have also indicated that children who have poor behavioral regulation can disrupt the overall flow of the classroom and make it more difficult for the teacher to deliver effective instruction (Skibbe et al., 2012; Vitaro, 2005). Thus, it is possible that children's strong behavioral regulation is related to better classroom environments, but also that the quality of instructional time in classrooms may be related to stronger behavioral regulation in children.

The Classroom Learning Environment

Accumulating research reveals that understanding the complex world of the classroom is better explicated using perspectives that include bio-ecological (Bronfenbrenner & Morris, 2006) and transactional theories (Morrison & Connor, 2009; Sameroff & MacKenzie, 2003) of development (Connor et al., 2009b; Justice et al., 2011; Rimm-Kaufman et al., 2005). These perspectives point to the complex and interactive nature of classroom settings where children bring their own personalities and skills and are also influenced by the classroom environment, including the teacher and their classmates. Thus, a child's development is influenced by the complex and potentially reciprocal relations among these multiple factors over the course of time rather than by specific characteristics or the classroom environment operating to influence children's development and learning. The classroom environment influences children's development and, in turn, children in the classroom influence the environment and their classmates' development (Skibbe, Phillips, Day, Brophy-Herb, & Connor, 2012). Thus, it is important to consider how the classroom environment, teachers, and classmates might impact children's behavioral regulation and academic skills may provide understanding of malleable mechanisms that influence both the environment and children's learning. For example, one disruptive student may influence the actions of the teacher as well as other children in the classroom, which may in turn, influence an individual child's behavior or performance in the classroom. This influence may also differ among students. At the same time, a chaotic classroom environment, characterized by high levels of noise, too many changes, or by low levels of structure and routine, generally offers poor learning environments (Maxwell, 2010). Classrooms that lack structure and organization may be problematic for all students, but this may be especially true for children with poor behavioral regulation skills who struggle to control their behavior and may not receive sufficient scaffolding from teachers to strengthen these skills (Connor et al., 2010). Whereas disorganized classrooms may interfere with learning behavioral regulation skills (Maxwell, 2010), a classroom environment that is well-planned and organized and expects that students are self-regulated is generally associated with stronger student achievement (Connor et al., 2010). At the same time, such a classroom might be more difficult to accomplish if the proportion of children with weak behavioral regulation is high (Skibbe et al., 2012). Although teacher organization and disruptions are not the only important factors to consider for producing a productive and efficient classroom learning environment, these factors can be problematic for academic success and are important to consider.

Non-Instruction

In this study, non-instruction refers to activities in the classroom that do not explicitly focus on instruction that is intended to teach children skills and information (e.g., literacy instruction). Non-instruction includes the classtime that students spend going off-task, causing disruptions, switching activities, cleaning up, and waiting for the teacher. Non-instruction also includes time spent where the teacher is disciplining students or when the teacher is giving directions for an upcoming activity that does not contain any actual reading instruction, or is expressing expectations for general classroom behavior. For example, before the students return to their desks, the teachers might tell them they are going to complete a set of worksheets, where they will find the materials they will need, and so on.

The key is that she is not actually teaching the children how to, for example, write. More examples of non-instruction are provided below.

Teacher-Managed vs. Child-Managed Non-Instruction

In the current study, classroom activities were conceptualized as being either teacher or child-managed (Connor et al., 2009). During teacher-managed interactions (TM) teachers are actively engaging with their students and this may be highly interactive – essentially jointly managed by both the teacher and the student. For example, the class sits on the floor while the teacher gives directions for an upcoming writing activity by telling the students what they should write about, how long their paper should be, etc. The students might ask questions about how long they will have to complete the task, and so on. During child-managed interactions (CM), students are working independently or with peers and the teacher is not part of the interaction. An example of a child-managed non-instructional activity would be two students working on a sentence worksheet together at the writing center when instead of completing their work; they begin chatting about a TV show. Within both TM and CM activities, we examined time spent in non-instruction.

Productive and Unproductive Non-Instruction

Non-instruction includes times when students are listening to directions, going off-task, being disciplined, switching between activities, waiting for the teacher, or when students are cleaning up, lining up, or using the restroom. While all of these activities are considered non-instructional in that it is time spent that is not explicitly focused on learning, some may support learning (e.g., explaining why a lesson is important), which is productive, while others take time away from learning, which is unproductive (e.g., dealing with a disruptive student). Strong teacher organization and classroom management as well as efficient switching between activities, examples of productive non-instruction, can support an effective and efficient learning environment for students. However, student's off-task behavior, disruptions, and waiting time that take away from learning time are considered unproductive to the classroom learning environment because instructional time is lost. Within both productive and unproductive non-instruction, activities were considered either teacher or child-managed depending on whether the students were working on their own or with peers (CM) or with the teacher (TM). We describe the types of productive and unproductive non-instruction in more detail below. Please see Table 1 for specific examples of Teacher and Child-Managed productive and unproductive non-instruction.

Productive Non-Instruction

Activity switching

Activity switching represents the time students are moving from one activity to the next. An example of activity switching might be when the class switches from reading a book on the floor and moves to their desks to complete a worksheet on the book they just read. During centers, students may switch between working at the listening center where they listened to a book on tape to the vocabulary center table where they will complete a worksheet using their vocabulary words in a sentence. Such activities may indicate the use of small groups, which is associated with stronger student outcomes (Connor et al., 2011; Wharton-McDonald, Pressley, & Hampston, 1998) and may create opportunities for students to work independently and with peers. When used efficiently, time spent switching between activities can provide students with the opportunity to practice following directions and procedures and managing their own behaviors. However, to the best of our knowledge, further research on activity switching is needed in order to better understand the association between activity switching, behavioral regulation, and students' reading outcomes.

Teachers' organization

In order to create an efficient and fully functioning classroom, teachers' organization may be a strong source of influence for individual students and the class as a whole both from an academic and behavioral standpoint (Bohn et al., 2004). Teachers who have stronger classroom management skills and can effectively establish routines and implement rules are more likely to experience significantly fewer difficulties with classroom management (Borko & Niles, 1987). Organization has been described as the teacher clearly explaining the purpose of current and upcoming activities, and creating (and allowing) opportunities for children to rehearse the necessary task-related behaviors (Pressley et al., 2001). In classrooms where the teacher is better organized and provides clear explanations, there are fewer opportunities for children to go off-task or to cause disruptions. When assignments and expectations are made clearer, less time may be spent in transitions, especially when the teacher can establish these expectations at the beginning of the school year (Cameron, Connor, & Morrison, 2005). More importantly, a well-organized classroom creates a more effective learning environment for students because they know what is expected of them and spend less time in non-instructional activities and more time in instructional activities (Brophy, 1983; Cameron, Connor, & Morrison, 2005; Connor et al., 2009a). Additionally, students who are in classrooms that are better organized generally demonstrate greater gains in literacy skills and behavioral regulation (Bohn et al., 2004; Connor et al., 2009b). Another recent study found that in classrooms where students' average level of behavioral regulation was lower, it appeared to be more difficult for teachers to manage their classroom and to provide effective instruction (Skibbe et al., 2012). In the current study, we judged time spent in organization to be productive.

Unproductive Non-Instruction

Students' off-task behavior

Children with low behavioral regulation skills are more likely to spend more time in off-task behaviors (Rimm-Kaufman et al., 2005). Evidence suggests that less time in off-task and more time on-task may positively impact student learning (Burns & Dean, 2005). While off-task behaviors may be observed during teacher-managed or child-managed instruction, these behaviors may be more frequent during center or stations times with child-managed activities when the teacher is working with a small group of students while the rest work independently or with peers when these students do not have supervision from the teacher (Stright & Supplee, 2002). This is worth considering because accumulating research suggests that teacher-managed instruction conducted with small groups of students is generally more effective than whole class instruction (Connor et al., 2009b). Off-task behavior was judged to be unproductive in this study as it takes time away from learning and can be disruptive to both the teacher and other students in the classroom.

Student-initiated disruptions/discipline

If a child has an outburst in the middle of class, this can disrupt and distract other children in the same classroom (Bell et al., 2008). Children who have poor behavioral regulation are more likely to demonstrate delinquent and aggressive behaviors in the classroom (Crundwell, 2005; McCabe & Brooks-Gunn, 2007). Student-initiated disruptions/discipline differs from off-task behavior in that the behavior is recognized by the teacher. For example, if two students are talking instead of working on their assignment, this would first be considered off-task until the teacher stepped in to actually discipline the students for going off-task. When students cause more disruptions, this in turn, forces the teacher to stop what they are doing and to discipline that child, taking time away from instruction for all children. Students with weaker behavioral regulation skills may also be more likely to interrupt their teacher and/or peers during instructional time. For example, the teacher is giving a lesson on the floor and one student starts to distract another student. The teacher then has to stop the lesson to discipline that child. Such disruptions might be more problematic for children with worse behavioral regulation because they likely have more difficulty refocusing their attention after the disruption. Like off-task behavior, disruptions were considered to be unproductive to the classroom learning environment.

Student transitions/waiting

Student transitions/waiting occurred when students were waiting for the teacher to begin the lesson, time spent when children went to the restroom, cleaning up materials from a previous activity, and the time spent in lining up to leave the classroom. Unlike activity switching, excessive amounts of time spent on cleaning up and lining up may be an indication of poor classroom organization in that students may not understand how to make these types of transitions more efficiently and this may be especially difficult for students with poor behavioral regulation. Research has found that transitions can be disruptive and can have a negative impact on children's performance because they take away from instructional time (Fudge et al., 2008). Additionally, children are more likely to exhibit off-task behaviors during unstructured transitions, especially when these transitions occur without any scaffolding from the teacher (i.e., during child managed activities when children are responsible for managing their own attention; Arlin, 1979). However, the research on transitions is limited and there have been, to our knowledge, no studies that examined specific types of transitions and their relation to learning, the classroom environment, and literacy achievement.

Study Rationale

In the current study, the classroom learning environment was characterized using bio-ecological and transactional systems frameworks by modeling child incoming characteristics, the classroom environment at the individual child level and at the teacher and classroom level. We examined management at both the teacher and child level because we hypothesized that more non-instruction occurs during activities in which the teacher is not involved, for example, when a student is working individually or with peers. Students may be more likely to go off-task or be more disruptive during small group activities in which the teacher is not present (Connor et al., 2010). Thus, another aim of this study was to examine if more non-instruction occurred during activities in which students were managing each other's (e.g., peer assisted learning) or their own attention and the teacher was not involved.

Accumulating research suggests that there are a number of mechanisms through which students' behavioral regulation and the classroom learning environment might operate to impact student achievement. Although previous research has focused on how aspects of the classroom environment significantly relate to positive student outcomes, few studies have examined the complex relations among aspects of the learning environment (instructional and non-instructional time), children's characteristics (e.g., behavioral regulation), and academic outcomes. The present study examined these complex relations using direct assessments and detailed observations of children in classrooms over the first grade year. The use of direct measures of individual children's behavioral regulation and academic achievement and observational measures has been relatively rare in previous research and this is, to the best of our knowledge, the first study to combine all three. We directly assessed students' reading and behavioral regulation skills in the fall and again in spring and observed their classrooms in the fall, winter, and spring of the first grade year.

We hypothesized that children with weaker behavioral regulation may be more likely to be inattentive or demonstrate behavior problems and hence might spend more time in off-task and disruptive behaviors in the classroom. We anticipated that the kind of disruptive behavior may, in turn, proscribe the learning opportunities offered to the specific child and to the class as a whole. It is also possible that children with low behavioral regulation who also display more off-task behavior are also disruptive to the classroom environment, which again will be indicated by greater unproductive time. Thus, children's behavioral regulation may influence the classroom environment and, in turn, the classroom environment may influence children's behavioral regulation and literacy gains. The current study considered the relations among children's behavioral regulation and literacy skills and the classroom environment: in particular, we investigated how students' behavioral regulation and incoming reading skills interact with the classroom learning environment to impact student reading and behavioral regulation gains in first grade. We selected first grade because it is a critical instructional year for many children learning to read (Connor et al., 2013), particularly children attending higher poverty schools who frequently have less experience with reading prior to school entry.

Although a large body of research has previously examined behavioral regulation and related skills as predictors of achievement in preschool, secondary school, and college students, much less is known about how children's behavioral regulation operates in the context of early elementary classrooms when children are in middle childhood (a time of rapid cognitive and emotional development, Del Giudice, 2014), and how this might be related to their literacy development (McClelland et al., 2007; Zimmerman, 1994). In the current study, complex relations were examined among children's reading skill gains and their behavioral regulation within the context of the classroom learning environment in first grade. Our goal was to better understand the associations between children's behavioral regulation, students' literacy achievement, and the classroom environment, particularly time spent in non-instruction. While quality of instruction is clearly important for improving student outcomes, time in non-instructional activities may also be related to students' behavioral regulation and literacy outcomes because it is time taken away from instruction and is a characteristic of the classroom learning environment. This study utilized a complex classroom observational system that allowed for us to measure the precise amount of time that each student spent in non-instructional activities such as time off-task, classroom disruptions, time in transition, and teachers' organization. The following research questions guided this study:

Research Questions

(1) What is the nature and variability in the amount of time individual students spend in unproductive versus productive non-instruction over the course of the school year by type of activity? (2) To what extent is the amount of time students spend in productive and unproductive non-instruction related to their behavioral regulation skills from fall to spring? (3) Does the amount of productive and unproductive non-instructional activities in which students participate interact with their fall behavioral regulation and reading skills to predict students' spring reading skill and behavioral regulation?

Method

Participants

Children from 51 first grade classrooms in 18 elementary schools in one school district in a mid-sized southern city in Florida participated in this study during the 2006-2007 school year. Participants were part of a larger cluster-randomized control field trial that was designed to help teachers learn how to individualize their literacy instruction called Individualizing Student Instruction (ISI; Connor et al., 2007). Schools were matched by percentage of students qualifying for Free or Reduced Price Lunch and Reading First Status. Each matched school pair was then randomly assigned to the ISI intervention and the other school was assigned to a wait-list control condition. Student participants were recruited through backpack mailings. Parents provided informed consent for 89% of the children recruited. Of this sample, a sub-sample of target students was randomly chosen based on initial fall reading scores on the WJ letter-word identification subtest with 4 students from the top third group of readers in the class, 4 from the middle third, and 4 from the bottom third were selected from each classroom. The final sample size was approximately 500 students. On average, each class had approximately 25 students total (range was 21-30 students per class) with 9.1 target students per class, which ranged from 6 to 12 students. While we hoped to get 12 per class, some classes had lower percentages of consent, thus we were not able to get 12 consented students for every class although most had more than 12 consented students. Students without consent were kept off camera. In five of the schools, 80% or more of the children qualified for free and reduced priced lunch (at the school level). Forty-three percent of the students were African American, 43% were Caucasian, 14% other ethnicities including Hispanic and Asian. Fifty-one percent of the students were male and 48% were female. The average age of the students was 7.3 years old (SD = .483). Fifty-one teachers volunteered to participate in the study. Seventy-three percent were Caucasian, 24% were African American, and 3% other. All but two of the teachers were female. On average, teachers had 11.73 years of teaching experience and 46% had a Master's degree or higher. Teachers taught literacy using one of two core literacy curricula (Open Court [Open Court Reading, 2000] & Reading Mastery [McGraw-Hill, 2003]) during a 120-minute block of time dedicated to literacy instruction. Classroom rules and expectations were made explicit by most of the teachers. We were not aware if there was a universal school-wide behavioral system in place, however many teachers seemed to use their own. For example, some teachers utilized the "red light, yellow light, green light" system where when a student first misbehaved, they would be moved from green to yellow and then to red.

Measures

Reading—The letter-word identification and the passage comprehension subtests of the *Woodcock Johnson Achievement Tests*-III (WJ-III; Mather & Woodcock, 2001) were used to assess children's early reading skills. The letter-word literacy task asks children to identify and name letters and words, and then asks them to read progressively more unfamiliar words from lists. The passage comprehension task asks students to read a passage to themselves and identify key words that are most appropriate in the context of the passage. The sub-tests of the WJ-III have reliabilities ranging from .81 to .98. The median test-retest reliability score on the letter-word literacy sub-test is .97 and .96 for the passage comprehension sub-test for children aged 6 to 7 years old. For all analyses, W scores were used. W scores are a form of a Rasch score and provide a common scale that represents both task difficulty and a person's growth. For each test, the W score is centered at 500, which is set as the approximate average performance of a child at age 10 years. W scores were obtained using the WJ-III Compuscore software program.

Behavioral regulation—A direct measure of behavioral regulation, the Head Toes Knees Shoulders task (HTKS) was used. It was designed to assess the coordination of executive function processes -- working memory, attentional flexibility, and inhibitory control. The task has been used with children between preschool and third grade (Connor et al., 2010; McClelland et al., 2007; Gestsdottir et al., in press). Previous research has found the HTKS to be significantly related to parent-reported attention and inhibitory control (r′s .20-25); teacher ratings of self-regulation in the classroom using multilevel models (β′s .20 - .40) (Cameron Ponitz et al., 2009; Gestsdottir et al., in press; McClelland et al., 2007; Wanless et al., 2011) and to direct assessments of working memory, inhibitory control, and cognitive flexibility (Lan, Legare, Cameron Ponitz, Li, & Morrison, 2011; McClelland & Cameron, 2012). In a recent study, the HTKS was significantly related to direct measures of cognitive flexibility, working memory, and inhibitory control in prekindergarten and kindergarten in multilevel regressions (β′s .15 -.42) (McClelland et al., 2014). In a study using the measure with first-grade children, the HTKS was significantly related to teacher ratings of classroom behavior and behavioral regulation (r′s .23 - .28; controlling for vocabulary scores [Connor et al., 2010]). The HTKS uses four behavioral commands: "touch your head" and "touch your toes"; "touch your shoulders" and "touch your knees". Children are instructed to respond with the opposite response (e.g., touch their toes when told to touch their head). Additional opposite rules are added (e.g., knees/shoulders) as children progress through the task. The task is intended to assess behavioral regulation by requiring the use of three skills: (1) attending to the tester's instructions and commands, (2) using working memory to remember instructions while processing new commands, and (3) inhibiting natural response to commands (McClelland et al., 2007). In the alternate version of the task, the students start with their knees and shoulders, and then move to head and toes. Children received two points for a correct response, one point if they began to respond incorrectly but spontaneously corrected their response (self-correction) and 0 if they responded incorrectly. There were 20 items and scores were summed into an overall score ranging from 0 to 40. Previous research has found strong evidence for the reliability and validity of the HTKS, including predictive relations to academic achievement in diverse samples (McClelland et al., 2014; Wanless, McClelland, Tominey & Acock, 2011). The HTKS has been significantly related to academic achievement levels and gains on the WJ tests of achievement and other standardized assessments (e.g., Kaufman Assessment Battery; Kaufman & Kaufman, 2004) between preschool and early elementary school (including first grade) in a range of U.S. and international samples (preschool through first grade) using multilevel regressions (β′s .19 - .40) (Cameron Ponitz, McClelland, Matthews, & Morrison, 2009; McClelland, M. M. et al., 2007). There are two forms of the task (items are counterbalanced with commands between the two forms). Previous studies have not found significant differences between the forms and there was no significant difference in scores between the two forms in the present study when means for each form were compared. Examiners achieved excellent inter-rater reliability (Kappa =.95 for self-corrections, .98 overall). In previous research, moderate to strong correlations have been found between fall and spring HTKS scores in preschool and early elementary school (r = .60 - .74) (McClelland et al., 2014).

Classroom Variables

Classrooms were videotaped 3 times throughout the school year, once each during the fall, winter, and spring, to measure the amount of time individual children spent in off-task activities, disruption, transition, and listening to or watching teachers' organizational behaviors. Observations were scheduled at the teacher's convenience and were conducted during the 2-hour block of time dedicated to language arts. For each observation, research assistants used two video cameras with wide-angle lenses so that we could capture as much of each classroom as possible. In order to capture details that were difficult to see on video, field notes were taken throughout the observation period that explained activities that could not be seen on camera, the specific times when students entered and left the classroom, and descriptions of center activities (e.g., ‘students at the listening center start chatting with one another’). Detailed child descriptions were also recorded at the beginning of each observation period. Whereas child descriptions were taken for all students that were present, only the activities of the target students were coded from the video. Target students were not chosen until after the observations were completed so videographers were instructed to focus on the entire classroom and not on particular students.

Videos were coded using the Noldus Observer Pro software (Noldus Information Technologies, 2001). The coding system was designed to record the amount of time, in minutes: seconds, that target students were involved in various activities (Connor et al., 2009). Although previous work has examined similar classroom variables (Kontos et al., 2002; Powell et al., 2008), our coding system is unique in that it allowed us to record duration rather than frequency of non-instruction. In addition, students were not coded simultaneously during the observation, rather they were taped and then coded at a later time, which allowed for us to closely observe and code time throughout the entire observational period for each child as opposed to in shorter intervals. One potential issue with coding in real time is that the observer can often miss what is going on with other students as they can only be focused on one or a few students at time. Coding from video allowed for us to rewind and go back and forth so we could watch each child during the entire observation. Activities lasting a minimum of 15 seconds were coded by trained research assistants in our laboratory. Because the focus of this coding system was on duration of activities as opposed to frequency, 15 seconds was chosen because it allowed us to capture significant detail about the classroom, and was the smallest unit of time at which inter-rater reliability could be achieved. Activities that lasted less than 15 seconds were still considered, but were grouped with the most appropriate adjacent code instead of being coded separately. Codes were all inputted into the Observer Pro software. Coders underwent an extensive training procedure that lasted 4-6 weeks where they received one-on-one training with an experienced coder as well as individual practice until they were prepared to code a reliability video. Coders were blinded from knowing which teachers were in the treatment and control groups for the larger study and since the current study utilized archival data, they were also blind to the purposes of the study. Target students were coded on two dimensions: management and content. The management dimension considered who was focusing the child's attention, the teacher, the child, or both the child and the teacher together.

Our final dimension captured the content of each classroom activity. We coded the amount of time target students were involved in non-instructional activities. Non-instructional activities included teachers' organization (time spent explaining upcoming activities or expectations for behavior), student-initiated disruptions, blatant off-task behaviors, activity switching, transitions involving cleaning up, lining up, or using the restroom, and the time students spent waiting for the teacher to give instruction. The non-instructional codes were grouped under content; however, it was also of interest to examine within each types of management (TM or CM) that these non-instructional activities occurred.

The variables we focus on in this study are non-instruction codes (both TM and CM): Unproductive Non-Instruction and Productive Non-Instruction. Productive Non-Instruction was comprised of the following two codes: (1) Activity switching, which represent the time a student spends switching between activities; (2) Teachers' organization, which represents the time teachers spend explaining upcoming activities or assignments and explaining expectations for classroom behavior and procedures. Unproductive Non-Instruction is made up of the following codes: (see Table 1): (1) Students' off-task behavior (e.g., twirling a book instead of reading it); (2) Student-initiated disruptions/discipline, for example if a group of students were reading a book with the teacher and one student started talking to another and the teacher had to stop the activity in order to discipline the students who caused the interruption; (3) Student transitions/waiting, which occurred when students were cleaning up materials after completing an activity, going to the restroom, lining up to leave the classroom, or were waiting on the teacher to begin instruction. Activities could be either

TM or CM depending on the context. For example, the teacher might be supervising a child switching between activities (TM-productive) or students might be switching activities between centers while the teacher works with a small group of students (CM-productive). To see more detailed descriptions of these non-instructional codes see Appendix A. All codes were coded for each individual target student (i.e., at the child level) rather than at the classroom level. This allowed us to capture the precise amount of time that each student spent in the target classroom activities. Coding of these videos was completed approximately one year after the observations took place so each coder was assigned to a classroom at random and that coder was responsible for coding the fall, winter, and spring observations for that class. Coding typically took 3 to 4 weeks for all three observations (fall, winter, and spring) per classroom. It took approximately 6-7 months to code all of the observations. There were two reliability checks, one was done prior to the team beginning coding and the second check was done once coders had coded half of the observations (about 3 months later). Both reliability checks consisted of one video and all coders had to code the same 20 minute time block within a designated video. Winter videos were used for the reliability checks because research has shown winter observations represent the most stable time of the year (Hamre, Pianta, Downer, & Mashburn, 2007). We used a random number generator using our teacher ID numbers to select the teacher, and then once the observation was chosen, we then used the generator again to select a time, so 1-120 were selected for the range (120 being the maximum time of the language arts block). If 11 was the number given, the time for the reliability check should start at 11 minutes within that video and last for 20 minutes. So for example, it would be teacher 2016, winter, 11 minutes-31 minutes. In addition to these two checks, the coding team also met weekly to discuss what videos they were coding and had the opportunity to ask questions and for suggestions with how to code certain activities in the video(s) they were coding that particular week. The mid-year check and weekly meetings were designed to prevent drift in reliability.

Reliability analyses to calculate kappa are included in the Observer Pro software and allowed for comparison between each coder. Coders were required to achieve at least 70% reliability with the experienced coder as well as the team as a whole. Inter-rater reliability was very strong at both reliability checks (mean inter-rater reliability = 87% [kappa]).

Procedures

Assessment Procedures—Children's behavioral regulation (HTKS) and literacy skills were assessed in the fall and the spring in a quiet room or in a quiet hallway outside the students' first grade classrooms.

Observation and Development of Classroom Observation Variables—As noted above, video observations were completed three times throughout the school year. Once the coded videos were completed, the data were exported from the Observer program into SPSS (IBM Corp, 2013). The four variables used in this study (as described above) were: TM unproductive non-instruction, TM productive non-instruction, CM unproductive non-instruction, and CM productive non-instruction (see Table 1). These variables were created because many of the non-instruction variables that were coded were highly correlated with one another. For example, student's off-task behavior, disruptions/discipline, and students' transitions/waiting were highly correlated with one another. For more details on the descriptive statistics of individual codes, see Table 2. We added the times for each activity together for each observation to create the four theoretically driven variables for each season of the school year.

Results

The aim of this study was to investigate the relations among children's behavioral regulation skills, the classroom learning environment, and their academic achievement in first grade. Overall, children's scores on the letter-word subtest increased from fall to spring (fall mean W score = 410.71, spring mean W score = 459.86) (Table 2). Children also showed overall improvement on the HTKS measure of behavioral regulation as well (fall mean score = 32.59, spring mean score= 34.44). Outliers for the coded variables were examined and the models were run with the outliers in and the results were unchanged, thus the variables were left as is for all of the analyses.

Research Question 1: Nature of and variability in the amount of time individual students spend in unproductive versus productive non-instruction over the course of the school year

Amounts for observation variables are shown in seconds in Table 2. Classroom observations revealed that on average (across fall, winter, and spring), 41% of the typical 120 minute literacy block was spent in activities that were not considered instruction. While some teachers spent as little as 8-10 minutes in non-instruction, some spent as much as 50 minutes or more in non-instruction. Slightly over half of this non-instruction time (22 % of the total literacy block) was judged to be productive time (i.e., switching between activities and teachers' organization) that might contribute to students' outcomes whereas 46% (19% of the literacy block) was judged to be unproductive, i.e., off-task/transitions/waiting/disruptions). Keep in mind that the literacy block is time limited so that any amount of time spent in non-instruction is, ipso facto, time that is not spent in instruction – a zero sum game – thus, on average across these classrooms, only 59% of the literacy block was spent in meaningful instruction. Because we had three observations for each classroom (and student within the classroom), we were able to examine the extent to which the amounts of each type of non-instruction changed from fall to spring. To examine changes in non-instruction amounts from fall to spring, four 3-level hierarchical linear models were used (one for each type of non-instruction) with repeated observations of non-instruction for each student nested in students who are nested in classrooms. The time variable, Month observed, was centered at the winter (January = 0, October = -3, April = 3) and entered at the repeated measures level.

With the exception of CM productive time, which decreased from fall to spring (see Table 2), the amount of time that teachers and students spent in non-instruction did not change over the school year, on average. Between-classroom variance differed for each of the variables with Intraclass correlations (ICCs) of .53 for TM productive, .45 for TM unproductive, .26 for CM productive time, and .28 for CM unproductive time. We then used the empirical Bayes residuals to create intercept and slope variables for each type of activity.

These values were used in subsequent analyses for our third research question. We utilized an empirical Bayes approach because it often provides a more accurate estimate of an individual slope whereas an OLS model assumes the variance is the same for each student. Additionally, empirical Bayes estimates can yield a more reliable estimate of growth by bringing the OLS slope closer to the mean (Petscher, Kershaw, & Koon, 2014).

Research Question 2: To what extent is the amount of time students spend in productive and unproductive non-instruction over the course of the school year related to their behavioral regulation skills at the beginning of the school year?

Zero order correlations for fall and spring behavioral regulation scores revealed only one statistically significant correlation between childrens' behavioral regulation and the non-instructional variables. Children who spent more time in CM productive non-instruction had higher spring behavioral regulation scores (r = .092, p = .050) (Table 3). *P*-values should be interpreted cautiously, however, because the data are nested.

We then used the models described previously and added students' fall behavioral regulation at the student level for both intercept and slope. Results revealed no statistically significant associations with one exception; students with higher fall behavioral regulation scores generally spent more time in CM productive non-instruction time over the school year compared to children with weaker initial behavioral regulation (intercept = 646.25 seconds, behavioral regulation coefficient = 3.42, SE = 1.68, df = 396, p =.042). Although there was no significant association between students' fall behavioral regulation and TM productive non-instruction, children with lower fall behavioral regulation were significantly more likely to be in classrooms that spent more time in overall TM unproductive non-instruction time (See Table 4). In the second model, children's behavioral regulation in the fall was significantly and positively associated with time spent in CM productive non-instruction (Table 4). Thus, children with stronger behavioral regulation were more likely to be in classrooms where more time was spent in CM productive non-instruction than were children with weaker behavioral regulation.

Research Question 3: Does the amount of time in productive and unproductive non-instructional activities in which students participate predict students' spring reading skill and behavioral regulation? Are there fall behavioral regulation X non-instructional activity interactions effects on spring outcomes?

Bivariate correlations were conducted for all of the non-instruction variables (TM and CM productive and unproductive) with fall and spring reading outcomes as well as fall and spring behavioral regulation and free and reduced price lunch (Table 3). CM productive non-instruction was positively associated with both fall and spring literacy scores on both the WJ LW and PC tests. CM unproductive non-instruction was negatively correlated with fall PC scores such that students with lower fall PC scores tended to spend more time in CM unproductive non-instruction. Again, p-values should be interpreted cautiously.

Child Managed Model—A multilevel multivariate model (HMLM; Raudenbush & Bryk, 2002; Appendix B) using both reading measures (LW and PC) was used to investigate the effect of non-instructional activities on spring outcomes and to test for a possible interaction effect between fall behavioral regulation and time spent in non-instruction on students' spring literacy outcomes. First, the model was run with just CM unproductive non-instruction and CM productive non-instruction. Neither of the variables were significantly associated with student outcomes; nor were there significant fall behavioral regulation by non-instruction interactions and so these variables were trimmed from the model to preserve parsimony.

Teacher Managed Model—We then added the TM non-instruction variables – TM unproductive non-instruction and TM productive. To test for possible effects of SES, the model was first run including school percent Free and Reduced Price Lunch status (FARL). While we did observe a trend such that more time in unproductive activities was associated with higher school % FARL, the effects were not statistically significant so FARL was removed from the model. We also tested for possible effects of the larger study for teachers that were in the treatment group (about 75% of the sample). Being in the treatment group for this sample of children was not associated with spring reading so it was also trimmed from the models to preserve parsimony. We then tested whether the model with homogeneous or heterogeneous variance provided a better fit to the data. The χ^2 test suggested that the model with heterogeneous variances provided a significantly better fit [$\chi^2(1) = 127.55$, $p < .001$] although the results of the two models were highly similar.

Results revealed fall reading X TM productive non-instruction interaction effects – one with fall letter-word reading and the other with behavioral regulation (see Table 5). First, results indicated an interaction effect such that students who spent less time in TM productive non-instruction time generally achieved higher literacy scores in the spring and this effect was greater for students with stronger fall reading scores (75th percentile of the sample) and negligible for students with weaker fall reading scores (25th percentile of the sample) (Figure 1, top). When we considered change over the school year (i.e., slope) in non-instruction, students who experienced decreasing amounts of TM productive non-instruction (i.e., negative slope), holding the total amount constant at the mean, demonstrated greater gains in reading. This effect was greater for children who had weaker fall behavioral regulation skills (25th percentile of the sample) and smaller for children with stronger fall behavioral regulation (Figure 1, bottom). Thus students in classrooms where there was a substantial but decreasing amount of TM productive non-instruction generally made greater gains in reading than their peers in classrooms with increasing amounts of TM productive non-instruction, particularly if they had weaker behavioral regulation skills in the fall.

Behavioral Regulation Model—Results revealed a significant fall behavioral regulation X non-instructional activity interaction effect on behavioral regulation such that the effect of time in TM productive non-instruction and TM unproductive non-instruction was moderated by students' fall behavioral regulation (see Table 6 and Figure 2). In general, students who spent more time in TM unproductive non-instruction showed weaker gains in behavioral regulation unless the teacher was systematically *decreasing* the amount of unproductive time from fall to spring. The negative effect on behavioral regulation gains was greater if amounts of unproductive time *increased* over the school year (i.e., positive slope). This model explained 28.97% of the variance in children's spring behavioral regulation.

Next, we considered CM productive and unproductive non-instruction time (see Table 6 and Figure 3). Overall, the more time students spent in CM productive non-instruction, the greater were their spring behavioral regulation scores. Furthermore, for children who had lower fall behavioral regulation scores and whose classrooms had decreasing amounts of CM productive non-instruction, behavioral regulation gains were weaker than they were for their peers with stronger fall behavioral regulation. This model explained 25.63% of the variance in children's spring behavioral regulation.

Discussion

The purpose of this study was to examine the interacting relations among children's classroom environment, specifically time in non-instructional activities, literacy outcomes, and behavioral regulation skills by characterizing the classroom as a dynamic system. Overall, we found a surprisingly high amount of time spent in non-instructional activities – fully 49 minutes out of a typical 120 minute literacy block. Although on average 57% percent of this time we classified as productive, still, time spent in non-instruction is, necessarily, time not spent in meaningful instruction.

We investigated whether children's behavioral regulation at the beginning of the school year was related to the overall time that they spent in both productive (organizing/activity switching) and unproductive (off-task/transitions/disruptions) time. Keeping in mind that time spent in productive non-instruction and unproductive non-instruction is time taken away from meaningful instructional time and that, furthermore, children can influence their classroom environment through their behaviors and actions (Skibbe et al., 2012), which we assessed at the beginning of the school year. We found that children with weaker behavioral regulation generally spent less time in CM productive non-instructional activities compared to children with higher behavioral regulation skills. Within the bio-ecological and transactional systems framework, this supports the implication that students with better behavioral regulation are more likely to be able to work independently. Although these associations cannot speak to causal links, and other unmeasured variables might influence this association, we suggest several possible explanations. For example, students with stronger behavioral regulation might spend child-managed time more constructively than those with weaker behavioral regulation. Children with weaker behavioral regulation might be more likely to be disruptive during the times that are supposed to be spent in productive CM activities. Similarly, teachers might keep these students in more teacher-managed (TM) activities knowing that children might disrupt the entire classroom if left unsupervised.

Children with weaker behavioral regulation in the fall also generally spent less time in TM productive non-instruction (organizing the classroom and giving students thorough directions and expectations and switching between activities) than did children with stronger behavioral regulation. Furthermore, during TM activities, children with lower behavioral regulation were more likely to spend more time in TM unproductive non-instruction (going off-task, waiting for the teacher, disruptions, and discipline) than were children with stronger behavioral regulation. We might speculate that some children with weaker behavioral regulation were in classrooms where the teacher was not as organized (or could not be as organized because of poorly self-regulated children) and, as a result, the students spent more time wandering around aimlessly and/or waiting for the teacher to start a lesson. It is also possible that poor organization skills by the teacher made it more difficult for children with weaker behavioral regulation to pay attention and to follow the rules of the classroom compared to children with stronger behavioral regulation skills. On the flip side, one might suspect that children with poor behavioral regulation may have been more difficult for the teacher to manage, and thus the teacher had to spend more time dealing with disruptions, disciplining them, and redirecting their attention. These results also support other research findings that in classrooms where there are more children with lower behavioral regulation, more time is spent in off-task/waiting/disruptions kinds of activities (Skibbe et al., 2012) and these disruptions can be problematic for all of the children in the classroom as it interrupts the flow of instruction.

Next we examined whether the association between children's behavioral regulation and their spring literacy outcomes was affected by time spent in non-instruction. The models revealed that children who had higher reading and behavioral regulation scores in the fall generally achieved higher spring literacy scores. If teachers *decreased* the amount of TM productive non-instruction over the school year, student's spring literacy growth was generally greater. However, we also found child characteristic X instruction interactions (Connor, Morrison, & Katch, 2004). For children with stronger fall reading skills, overall time in TM productive non-instruction (holding slope constant) was associated with weaker gains in reading over the school year. The effect was negligible for children with weaker fall reading skills. However, the positive effect of *decreases* in productive non-instruction time was generally greater for children with weaker behavioral regulation and notably less for children with stronger behavioral regulation. We conjecture that this was observed because if the classroom was running well the teacher needed to spend less time explicitly organizing and planning time as the year progressed. These results support the findings by Cameron et al. (2008) that many children (and especially those with weaker behavioral regulation skills) may respond more positively to more organization and directions at the beginning of the school year, with decreasing amounts needed over the school year – and hence increasing amounts of instruction as the school year progresses. For example, once children with weaker initial behavioral regulation skills learn the routines and procedures of the classroom and their teacher's expectations for their behavior, the teacher may not have to spend as much time explaining upcoming activities and they will be less likely to be disruptive or go off-task. Establishing clear classroom routines early in the school year may help teachers decrease the amount of time they spend explaining rules and activities so more time can be spent on literacy instruction.

We also examined the association between time spent in non-instruction and students' behavioral regulation gains. We found that in classrooms where more time was spent in TM unproductive non-instructional activities, students with weaker behavioral regulation demonstrated weaker behavioral regulation gains by the spring, on average. The result was only slightly mitigated if the amount of TM unproductive non-instructional activities decreased over the year. This was not the case for students with stronger behavioral regulation skills, where decreasing amounts of unproductive non-instructional activities had a positive effect on behavioral regulation gains. The greatest negative impact was observed for students with weaker behavioral regulation who were in classrooms where the amount of TM unproductive non-instruction increased over the course of the school year.

More time in CM productive non-instructional activities was associated with greater student gains in behavioral regulation, but only for children who started the school year with stronger behavioral regulation. For children with weaker fall behavioral regulation, more time in CM productive non-instructional activities was related to weaker gains in behavioral regulation. Although, we did not examine the quality of organization and planning, it could be that for the children with weaker behavioral regulation, the teacher had to spend more time explaining and maybe even reiterating the instructions for certain activities, which could have detracted from the amount of time they spent actually completing the activity. However, children with stronger skills may have spent more time in organization and planning because they completed activities quickly and had to check in with their teacher more often to get instructions on what to do next. What might be more important to consider is the *quality* of the time spent in organization/planning, especially for children with lower behavioral regulation skills. Again, these are possible explanations and more research is needed to examine potential causal mechanisms.

Results of the present study are unique in that few studies have examined complex relations among instructional and non-instructional time in classrooms, children's behavioral regulation, and academic outcomes, using strong measures (e.g., direct assessments and observations). Furthermore, this study uniquely demonstrated that students generally make greater behavioral regulation gains when the amount of time in unproductive activities such as off-task behaviors, time spent waiting for the teachers to begin instruction, and disruptions decreases over the course of the school year. The results extend prior research findings that classroom management (especially organization) can directly influence children's behavioral regulation and literacy outcomes (Bohn et al., 2004; Pressley et al., 2001; Rimm-Kaufman et al., 2005), suggesting that the construct of behavioral regulation might be fairly malleable, at least in first grade (Connor et al., 2010). This finding is encouraging because behavioral regulation consistently predicts students' achievement. Hence, improving the classroom environment by supporting teachers' classroom organization, planning and management might not only increase the amounts of time available for meaningful instruction, but might directly improve children's behavioral regulation, which would also contribute to achievement. This may be one mechanism whereby positive behavioral support systems operates (Daunic, 2013).

Behavioral Regulation and the Classroom Environment

Results from this study suggest that reducing the amount of time that teachers and students spend in off-task/waiting/disruptions (unproductive time) might help improve both students' behavioral regulation skills and literacy skills, especially for children who begin first grade with weaker behavioral regulation. Future research might consider interventions that help teachers develop better organizational skills and strategies that would help reduce non-instruction time and increase time spent in meaningful instruction. Although there is some suggestion that amounts of organization/planning at the beginning of the year is associated with stronger outcomes, this was only the case when coupled with reducing amounts of unproductive non-instruction over the school year, which may indicate that effective organization and teacher planning at the beginning of the year may help decrease the amounts of disruptions over the school year. It may be that students, especially those with weak behavioral regulation, are better able to regulate their learning when they understand and follow the rules and routines of the classroom, receive detailed instructions of what they are expected to do, and in the order in which they should complete each activity at the beginning of the year and then have less need as the year progresses and time is better spent in instruction (see also Connor et al., 2010). The reverse may be the case as well. There may be less need for organization and planning time if classroom routines and rules for behavior are well-established at the beginning of the school year (Cameron et al., 2005; Cameron et al., 2008). It may also be important for teachers to utilize strong organizational and planning skills themselves. In classrooms where the classroom environments were more disorganized (less time in organization/planning), students often spent more time being disruptive and waiting for the teacher (i.e. unproductive non-instruction). Results from Connor et al. (2010) showed that students who were in classrooms in which their teachers participated in an intervention that aimed to help improve teachers' organization and planning skills had greater growth in behavioral regulation and literacy outcomes by the end of the school year compared to peers in control classrooms. While more time in unproductive non-instruction can impact children's behavioral regulation and literacy skills, it is important to note that these results also point to the reciprocal relations between these constructs. It is possible that children who start the year with poor behavioral regulation and/or poorer literacy skills may have a more negative impact on the classroom environment, leading to more time spent in unproductive non-instruction. For example, a child with poor behavioral regulation causes more disruptions during a lesson.

Future research should consider what might be done to improve the classroom environment by helping teachers improve their own teaching and classroom management skills and develop strategies that can be taught to children to improve their behavioral regulation (Jones, Brown, & Aber, 2011). For children with weaker behavioral regulation skills, students may do better in classrooms where the teacher is more organized and can establish routines early in the year so that children can learn to manage their own attention to stay focused on instructional activities, especially during kindergarten or first grade when children are first learning how to function in the classroom. Additionally, intervention programs that encourage practice for working memory skills, strategies for controlling their own thoughts and behaviors, and how to manage their attention to stay on task from start to finish could be extremely helpful for building strong behavioral regulation skills which in turn, may reduce unproductive non-instruction. (Diamond & Lee, 2011; Raver et al., 2011; Tominey & McClelland, 2011). Again, these findings reveal a potential reciprocal effect -- children's behavioral regulation appears to influence the classroom environment and the classroom environment appears to influence changes in behavioral regulation as well as literacy skills.

Limitations

Although this study revealed important connections among aspects of the classroom environment, reading outcomes, and behavioral regulation, a number of limitations must be noted. First, we did not code all of the students in the classroom. Instead, we randomly selected 10-12 students that had complete data and who represented the range of students' literacy skills in the classroom. Although this meant there were no missing data, it is also possible that children with missing data differed on unmeasured variables and the results should be interpreted with this in mind.

A third limitation was that we did not examine whether or how teacher training might have impacted influenced teacher's instruction and organizational skills. Virtually all of the teachers in this study (about 75%) received professional development that focused on helping them individualize student instruction, which included classroom management (Connor et al., 2010). However, preliminary analyses showed that being in the treatment condition in the larger study was not significantly associated with the variables we focused on this study. It was beyond the scope of this study to examine this further, but it may be important to consider in future work. Future studies might consider looking at specific organizational strategies that teachers might be using. We were also unaware if there were any specific school-wide approaches to classroom management or discipline; however this may also be important to consider for future research.

The study was also limited because it was not possible to assess the quality of teachers' organization time. For example, two teachers could have spent 3 minutes explaining an upcoming activity to students. This time would have been coded as TM organization. One teacher could have used this time efficiently to explain multiple activities that were to be completed. Another teacher could have, however, taken three minutes and might have explained only half of one worksheet because they were constantly being distracted by two students talking. And while the teacher might have taken the time to remind the students to be quiet and pay attention, if this did not last 15 seconds, the disruption (which would be considered unproductive) would not have been coded and the time would still be recorded as organization. Thus, it is possible that more time in organization/planning may not always be better for students. What may matter more is *how* organization/planning time is utilized. Another consideration is that the association of organization/planning time with student outcomes might resemble and inverted U with too little or too much time spent negatively associated with child outcomes.

Implications

Results from this study support the bio-ecological systems and transactional view of development (Bronfenbrenner & Morris, 2006; Morrison & Connor, 2009; Sameroff & MacKenzie, 2003) and highlight the importance of considering individual child characteristics, the classroom environment and the complex relations among them including potential reciprocal effects. This study revealed that more time in unproductive non-instructional activities that are teacher-driven, may have particularly negative effects for children with low behavioral regulation. Results from this study also suggest that productive non-instruction activities (such as teachers' organization and activity switching) at the beginning of the year might support student's behavioral regulation gains as well as literacy achievement. When children are working in small groups or individually, the teacher is usually working with another group of students in the classroom and thus cannot give all of their students equal amounts of attention. If however, children are given thorough directions at the start of the activity, it may be that they will better understand what they should be doing and be less likely to be off-task or engage in disruptive behaviors. These findings may be particularly the case for children who have low behavioral regulation skills who appear to be more vulnerable to disorganized and chaotic classroom environments. For example, other researchers find that children who are more resilient may do better in school compared to children who are less resilient (regardless of their academic achievement skills [Kwok et al., 2007]). Having strong behavioral regulation skills may confer some resilience because children are able to persist on activities, control their behavior, and to stay on task even in less than ideal environments (Obradovic, 2010; Sektnan et al., 2010).

Classroom observations were coded only for the 120-minute language arts block. It would be useful in the future to examine amounts of non-instruction time throughout the entire school day and in different content areas such as math or science. It might be that some students spend more time in unproductive non-instruction in certain content areas where they are not as interested or are not as motivated to succeed in which would not necessarily be a reflection of behavioral regulation skills. The finding that on average, 41% of the language arts block was spent in non-instruction was surprising and indicates that looking at what occurs during non-instructional time (and not just during instruction itself) is also important to consider when examining the relations between the classroom learning environment, students' behavioral regulation, and academic outcomes. While teacher quality during instructional time is crucial, how teachers organize their non-instructional time may also be helpful for student's growth in both their reading skills as well as growth in behavioral regulation, particularly for students with lower behavioral regulation skills. More studies that look closely at amounts and specific types of non-instructional time are needed to gain a better understanding of these complex relations. Moreover, regardless of whether non-instruction time is productive or unproductive, it is time taken away from meaningful instructional time. This is underscored by the finding that *decreasing* amounts of teachers' organization time from fall to spring were associated with stronger student outcomes. Thus, future research might aim to help teachers learn new strategies that: (1) decrease the amount of unproductive non-instruction (off-task/waiting/disruptions) (2) encourage teachers to be more organized but to do so in an efficient matter; and (3) spent enough time at the beginning of the school year clearly establishing classroom routines and rules. These findings in combination with others (Connor et al., 2010; Justice et al., 2011; Skibbe et al., 2012) have policy implications as well. For example, when educational leaders (e.g., principals) are assigning children to classrooms, attention to the aptitudes and characteristics of potential classmates and avoiding the tracking of children with poor behavioral regulation and low achievement into the same classroom might improve student achievement overall. This study and others (Connor et al., 2010) demonstrate that it may be possible to improve children's behavioral regulation skills so that children will spend less time in unproductive activities (especially as the year goes on) and hence more time in meaningful instruction. Developing strong behavioral regulation skills may help children be better focused and be less disruptive and thus, be better able to take advantage of the learning environment. Furthermore, helping teachers to reduce unproductive non-instructional time may also have a positive impact on children's behavioral regulation and reading skills.

Appendix A

Individualizing Student Instruction Coding Manual: Non-Instruction Codes

7.2.1 Class Management - Non-Instructional (Behavior) non

The Non-instructional behavior should be used to code those activities which do not contain academic content. *The content of activities should be carefully contemplated prior to assigning a Non-instructional code; many seemingly Non-instructional activities may include academic content* (e.g., singing a rhyming song should be coded under Onset/Rime Awareness>Rhyming, using the calendar for pattern recognition or counting should be coded as Math).

7.2.1.9 Student-Initiated Disruptions/Discipline (Modifier) dis—Non-instructional>Disruption should be coded when an unexpected event interrupts the normal flow of instruction. For example, when teachers or students interrupt the class to announce special goings on, or when students' work is interrupted by a fire drill, or when a student arrives late to class and gives the teacher a late pass and then receives directions to join the class, etc.

Discipline should be coded when the teacher takes time to discipline the entire class (for longer than 15 seconds; this probably won't happen very often). This category is distinct from Non-instructional>Orient codes in that *the teacher does not explain expectations*, but rather expresses disappointment or anger, or describes what children did wrong *without including what they should change for next time*.

7.2.1.13 Activity Switching (Modifier) tac—Non-instructional>Activity Switching should be coded when students are transitioning (organizing materials, physically moving, etc.) to a new activity. The majority of students should be involved in some sort of transitioning action; if two children are passing out papers but the rest of the class is merely waiting for the teacher to begin the lesson, this should be coded as Non-instructional>Waiting.

7.2.1.14 Students' Transition/Waiting (Modifier) wtg—Non-Instructional>Students' Transition/Waiting should be coded when students are waiting for the teacher, cleaning up the prior activity's materials, washing their hands or using the restroom. For example, a group of students is waiting at the teacher table while the teacher gathers materials for an upcoming activity.

7.2.1.23 Students' Off Task Behavior (Modifier) off—Non-instructional>Off Task should be coded when the student is blatantly not completing the activity he/she was assigned, such as being out of their seat for no purpose and/or wandering the classroom.

7.2.1.24. Teachers' Organization (Modifier) org—Organization should be coded for activities where the teacher is providing students with instruction and directions that will help students transition and begin a new activity with greater ease. Codes that will fall under this category include: switch mode (rituals designed to bring children's attention to the teacher to the next activity, or to help the class calm down or be quiet, and Orient activities. Orients include when the teacher takes time to explain expectations and directions for upcoming activities for the day, week, or for homework. This code should only be used when the direction *enhances* the learning experience. For example, if the teacher just says "take out your pencils," this would be NOT be considered a meaningful direction and would be better coded as a transition. Also included in this code are activities in which the teacher gives expectations for how the class should behave (e.g. "sit down at your desks and sit quietly until I call your name."). If this type of orient occurs, it should not contain any discipline. If the teacher gives expectations while also disciplining students, then this should be coded as Discipline.

Appendix B

Research Question 2 &3: Multilevel Multivariate interaction model equation of the relation between Fall Executive functioning (HTKS) and Teacher Managed Non-Instruction – Unproductive intercept (TCNPDCI) and slope (TCNPDCS) and Productive intercept (TCPRODCI) and slope (TCPRODCS) on Spring Reading Outcomes, which is a latent variable composed of Passage Comprehension and Letter-Word Reading (indicators are PCIND and LWIND respectively, controlling for fall Letter-Word Reading (WJ_LW_W) and fall HTKS. Variables are grand mean centered.

Level-1 Model

READINGmij = (PCINDmij)*READING1ij* + (LWINDmij)*READING2ij*

READINGtij* = π0ij + εtij

Level-2 Model

π0ij = β00j + β01j*(WJ_LW_Wij) + β02j*(HTKSij) + r0ij

Level-3 Model

β00j = γ000 + γ001*(TCNPDCIj) + γ002*(TCNPDCSj) + γ003*(TCPRODCIj) + γ004*(TCPRODCSj) + u00j

β01j = γ010 + γ011*(TCNPDCIj) + γ012*(TCNPDCSj) + γ013*(TCPRODCIj) + γ014*(TCPRODCSj)

β02j = γ020 + γ021*(TCNPDCIj) + γ022*(TCNPDCSj) + γ023*(TCPRODCIj) + γ024*(TCPRODCSj)

$\mathrm{Var}(\varepsilon_{ij})=\mathrm{Var}(Ar_{ij}+e_{ij})=\Delta=A*\tau_{\pi}*A'+\mathrm{diag}(\sigma^2{}_1, \ldots, \sigma^2{}_2)$

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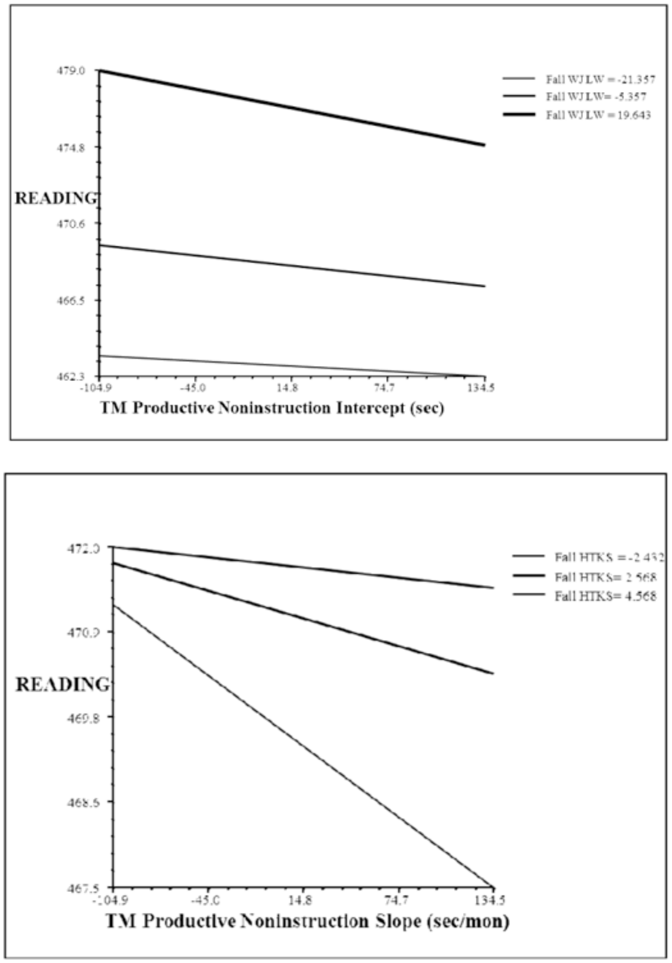

Figure 1.

Interactions between fall reading and TM Productive Non-Instruction: fall letter-word reading (top) and fall behavioral regulation (bottom) on Spring Reading Outcomes. WJ LW, HTKS and TM Productive Non-Instruction are centered at their grand means. Amount of TM Productive Non-Instruction time was held constant at the mean (1150 seconds). A slope of 0 indicates no change per month.

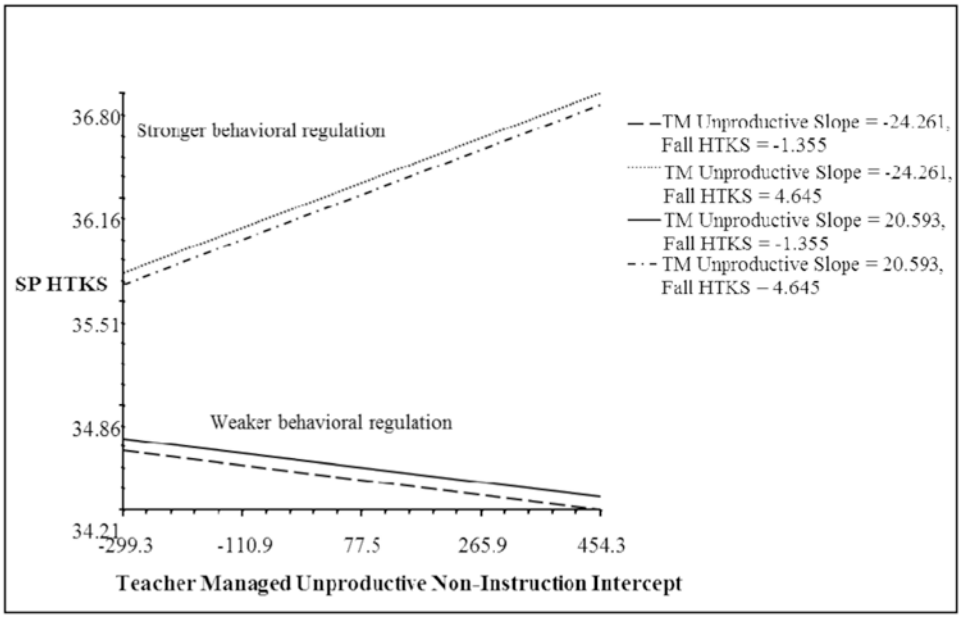

Figure 2.
Interaction Model between TM Unproductive Non-Instruction Time (in seconds) and Fall Behavioral Regulation (HTKS) on Spring HTKS. Both fall HTKS (Fall HTKS grand mean =32.06) and TM Non-Instruction intercept (grand mean = 393.03 seconds/month) and slope (TM Unproductive, grand mean = -.85) are centered at their grand means.

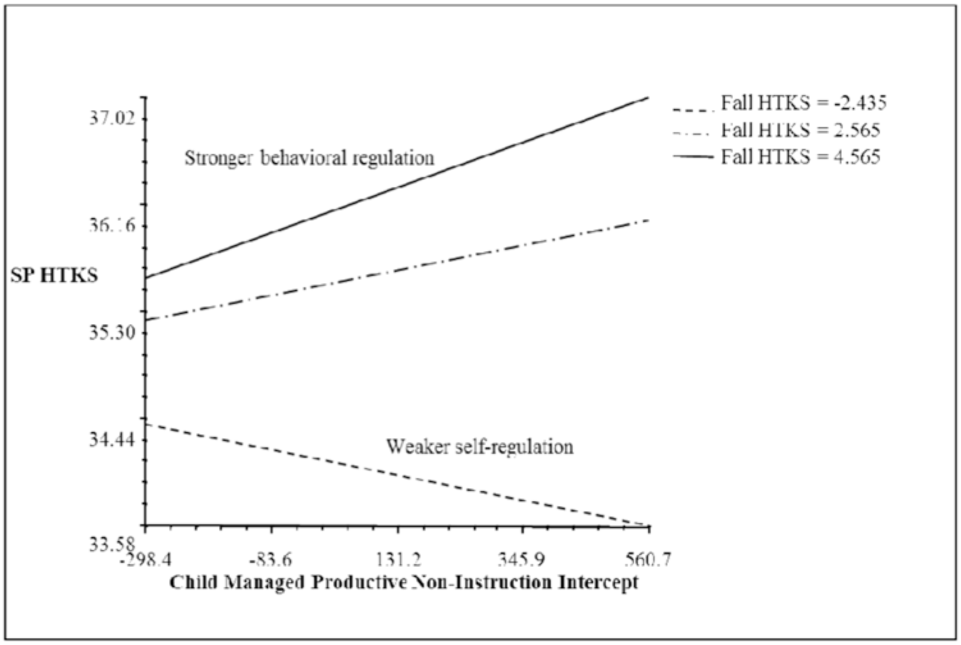

Figure 3.
Interaction Model between CM Productive Non-Instruction Time and Fall Behavioral regulation (HTKS) on Spring HTKS. Both fall HTKS (grand mean =32.06) and CM Productive Non-Instruction intercept (grand mean= 1114.56 seconds/month) are centered at their grand means.

Table 1

The four variables used in this study across the dimensions of management (teacher managed (TM) and child managed (CM) and productive vs. unproductive

Non-Instruction Type	
Teacher-Managed (TM) Productive Non-Instruction	**Example**
Activity Switching	Students are on the floor reading a story and then switch to their desks to complete a worksheet of questions based on that story. The teacher oversees the transition, offers encouragement and praise for quick transitions, and continues working with the students once they move to their desks.
Teachers' Organization	The students are about to break into centers and the teacher takes time to give directions for what the students will do at each center.
Child-Managed (CM) Productive Non-Instruction	
Activity Switching	Students move from the listening center to the writing center. The teacher is busy with another group of students so these students are responsible for switching in an efficient manner on their own.
Teachers' Organization	While at the writing center, two students have a question about the assignment and the teacher gives them further directions.
Teacher-Managed (TM) Unproductive Non-Instruction	
Off-Task Behavior	While listening to a lesson on rhyming from the teacher, two students in the back of the class start chatting instead of listening to the lesson.
Student-Initiated Disruptions/Discipline	Using the example above, the teacher notices the two students talking, stops the lesson and disciplines the students.
Student Transitions/Waiting	Students are sitting and waiting at their desks for the teacher to begin a lesson while the teacher gathers his/her materials. Or, during a lesson, a student gets up, uses the restroom, and then spends three more minutes washing their hands, blowing their nose, etc.
Child-Managed (CM) Unproductive Non-Instruction	
Off-Task Behavior	Two students working at the reading center should be reading quietly to themselves but instead start talking to each other about video games.
Student-Initiated Disruptions/Discipline	Using the example above, the teacher notices the two students talking, scolds them for talking and orders them to get back to work.
Student Transitions/Waiting	After completing an activity on sentence building, students must clean up their materials before moving onto the next activity. Or, a group of students cannot start their vocabulary worksheet because they are waiting for the teacher to make more copies.

Table 2

Child and Classroom Descriptives

	N	Min.	Max.	*M*	*SD*
Child-Level Descriptives					
Classroom Observation Variables (seconds/day)					
TM Productive Non-Instruction Total (Fall/Winter/Spring)	500	0	4577	1001.33	789.94
TM Unproductive Non-Instruction Total (Fall/Winter/Spring)	500	0	4124	325.33	497.18
CM Productive Non-Instruction Total (Fall/Winter/Spring)	500	0	7674	648.06	664.20
CM Unproductive Non-Instruction	500	0	7368	1012.27	1086.63
TM Productive Non-Instruction Fall	500	0	4577	929.26	726.02
TM Productive Non-Instruction Winter	500	0	4124	1241.99	933.28
TM Productive Non-Instruction Spring	500	0	3641	835.28	623.37
TM Unproductive Non-Instruction Fall	500	0	4124	339.06	529.64
TM Unproductive Non-Instruction Winter	500	0	3660	390.22	592.69
TM Unproductive Non-Instruction Spring	500	0	1918	245.82	312.94
CM Productive Non-Instruction Fall	500	0	7674	730.83	822.62
CM Productive Non-Instruction Winter	500	0	3974	660.03	526.68
CM Productive Non-Instruction Spring	500	0	4779	549.35	585.91
CM Unproductive Non-Instruction Fall	500	0	7368	895.33	100.04
CM Unproductive Non-Instruction Winter	500	0	7200	1279.02	1249.80
CM Unproductive Non-Instruction Spring	500	0	6200	867.04	932.73
Student Outcomes					
Fall Passage Comprehension W Score	422	358	497	442.49	24.77
Fall Letter-Word W Score	442	349	511	410.71	29.83
Fall Picture Vocabulary W Score	442	398	513	479.3	10.782
Spring Letter-Word W Score	436	357	556	459.86	26.38
Spring Passage Comprehension W Score	436	405	506	469.42	15.93
Spring Picture Vocabulary W Score	438	430	513	484.78	10.37
Fall HTKS Total Score	401	0	40	32.59	6.71
Spring HTKS Total Score	437	0	40	34.44	5.70
Classroom-Level Descriptives					

	N	Min.	Max.	*M*	*SD*
Classroom Observation Variables (seconds/day)					
TM Non-Productive Non-Instruction Intercept	51	46.68	1866.30	393.03	372.89
TM Productive Non-Instruction Slope	51	-549	408.95	-0.85	107.18
TM Productive Non-Instruction Intercept	51	148.8	2575.10	1150.05	588.83
TM Productive Non-Instruction Slope	51	-203	408.54	-7.08	106.22
CM Non-Productive Non-Instruction Intercept	51	46.68	1866.31	366.51	337.22
CM Non-Productive Non-Instruction Slope	51	-549	408.95	-5.16	104.13
CM Productive Non-Instruction Intercept	51	350.9	2288.40	1114.56	565.53
CM Productive Non-Instruction Slope	51	-547	307.13	-11.07	174.97

Note. TM = teacher-managed; CM = child- managed; HTKS = Head Toes Knees Shoulders task. Times are in seconds/day. Variables calculated using HLM intercept centered at the January observation and slope. Empirical Bayes Residuals were computed by the HLM software and were used as individual teacher values.

Table 3

Correlations between Child-Level Non-Instruction Variables (seconds/day centered at January) and Child Outcomes

Teacher Managed Non-Instruction Variables	1	2	3	4	5	6	7	8	9	10	11
1. TM Unproductive Non-Instruction Intercept	-										
2. TM Unproductive Non-Instruction Slope	.195**	-									
3. TM Productive Non-Instruction Intercept	.483**	.302**	-								
4. TM Productive Non-Instruction Slope	.344**	.422**	.231**	-							
5. Fall Passage Comprehension W Score	-.095*	0.016	-0.038	0.035	-						
6. Fall Letter-Word W Score	-0.053	-0.037	-0.077	0.03	.819**	-					
7. Spring Letter-Word W Score	-0.063	-0.057	-0.079	-0.026	.722**	.779**	-				
8. Spring Passage Comprehension W Score	-0.08	-0.073	-.115**	-0.053	.696**	.688**	.829**	-			
9. Fall HTKS Total Score	-0.049	0.053	0.012	0.069	.298**	.221**	.255**	.306**	-		
10. Spring HTKS Total Score	-0.023	0.062	0.032	0.023	.384**	.306**	.351**	.386**	.468**	-	
11. Free and Reduced Price Lunch	0.055	.229*	.184*	-.091	-.251**	-.268**	-.223**	-.234**	-.184**	-.227**	-

Child Managed Non-Instruction Variables	1	2	3	4	5	6	7	8	9	10	11
1. CM Unproductive Non-Instruction Intercept	-										
2. CM Unproductive Non-Instruction Slope	.195**	-									
3. CM Productive Non-Instruction Intercept	.131**	-.079*	-								
4. CM Productive Non-Instruction Slope	-.179**	0.006	-.145**	-							
5. Fall Letter-Word W Score	-0.053	-0.039	0.013	.104**	-						
6. Spring Letter-Word W Score	-0.063	-0.057	0.063	.130**	.779**	-					
7. Fall Passage Comprehension W Score	-.095*	0.011	0.015	.122*	.819**	.722**	-				
8. Spring Passage Comprehension W Score	-0.08	-0.073	0.049	.160**	.688**	.829**	.696**	-			
9. Fall HTKS Total Score	-0.049	0.053	0.037	0.016	.221**	.255**	.298**	.306**	-		

	Teacher Managed Non-Instruction Variables										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
10. Spring HTKS Total Score	-0.023	0.062	0.049	0.092*	.306**	.351**	.384**	.386**	.468**	-	
11. Free and Reduced Price Lunch	-0.016	-0.001	0.050	.225**	-.268**	-.234**	-.251**	-.233**	-.184**	-.227**	-

** Sig. at the 0.01 level (2-tailed).

* Sig. at the 0.05 level (2-tailed).

Table 4

Results of the Four Models showing the Association between Fall Behavioral Regulation (HTKS) and TM and CM Non-Instruction Time (seconds/day)

	Teacher/Child Managed				
Fixed Effect	**Coefficient**	***SE***	***t*-values**	***df***	***p*-values**
Fall HTKS Intercept	32.321	0.329	98.232	46	<0.001
TM Unproductive Non-Instruction Intercept	-0.002	0.001	-2.131	46	0.038
TM Unproductive Non-Instruction Slope	0.001	0.002	0.623	46	0.536
TM Productive Non-Instruction Intercept	0.000	0.001	0.859	46	0.395
TM Productive Non-Instruction Slope	0.005	0.004	1.329	46	0.191
Final estimation of variance components					
Random Effect	*SD*	Variance Component	*df*	Chi-square	*p*-values
Between Classroom Residual	1.078	1.162	46	57.165	0.125
Within Classroom Residual	7.046	49.651			
Deviance	3508.822				
	Child Managed				
Fixed Effect	Coefficient	*SE*	*t*-values	*df*	*p*-values
Fall HTKS Intercept	32.457	0.354	91.479	45	<0.001
CM Productive Non-Instruction Intercept	-0.002	0.001	-1.493	45	0.142
CM Productive Non-Instruction Slope	0.006	0.002	2.420	45	0.020
CM Unproductive Non-Instruction Intercept	0.001	0.001	1.472	45	0.148
CM Unproductive Non-Instruction Slope	-0.001	0.003	-0.236	45	0.814
Final estimation of variance components					
Random Effect	*SD*	Variance Component	*df*	Chi-square	*p*-values
Between Classroom Residual	0.400	0.160	45	40.250	>.500
Within Classroom Residual	7.147	51.079			

	Teacher/Child Managed				
Fixed Effect	**Coefficient**	***SE***	***t*-values**	***df***	***p*-values**
Deviance	2484.271				

Table 5

Multilevel Multivariate Model Results with Spring Letter-Word Identification and Passage Comprehension (Reading) as the Latent Outcome as a function of the non-instructional variables (seconds), fall Letter-Word Identification (Letter-Word, W Score) and fall Behavioral Regulation (HTKS, raw score). Intercept represents the January fitted mean Reading score.

Fixed Effect	**Coefficient**	***SE***	***t*-values**	***df***	***p*-values**
Spring Reading Intercept	470.374	0.610	771.141	46	<0.001
TM Unproductive Non-Instruction Intercept	0.001	0.002	0.085	46	0.933
TM Unproductive Non-Instruction Slope	-0.006	0.006	-0.977	46	0.334
TM Productive Non-Instruction Intercept	-0.001	0.001	-0.323	46	0.748
TM Productive Non-Instruction Slope	-0.011	0.007	-1.662	46	0.103
Fall Letter-Word Intercept	0.350	0.019	18.877	476	<0.001
TM Unproductive Non-Instruction Intercept	-0.001	<0.001	-0.696	476	0.487
TM Unproductive Non-Instruction Slope	<0.001	<0.001	0.412	476	0.680
TM Productive Non-Instruction Intercept	0.001	<0.001	2.705	476	0.007
TM Productive Non-Instruction Slope	<0.001	<0.001	-1.452	476	0.146
Fall HTKS Intercept	0.311	0.077	4.030	476	<0.001
TM Unproductive Non-Instruction Intercept	<0.001	<0.001	1.439	476	0.150
TM Unproductive Non-Instruction Slope	-0.001	0.001	-1.337	476	0.181
TM Productive Non-Instruction Intercept	<0.001	<0.001	-1.070	476	0.285
TM Unproductive Non-Instruction Slope	0.002	0.001	2.242	476	0.025
Deviance	7808.305				

	σ^2	***SE***
PCIND	7.529	9.261
LWIND	317.1633	22.484

INTRCPT1, r_0 τ_π	***SE***
115.0890	12.158

Note. Where PCIND is the indicator variable in the model indicating Passage Comprehension and LWIND is the indicator variable in the model indicating Letter-Word Identification (See Appendix A). Variables grand mean centered.

Table 6

HLM Model with Spring Behavioral Regulation (HTKS) as the Outcome as a function of the non-instructional activity amounts (second/day) and slope, fall Letter-word Identification (LW) W score and fall HTKS

Teacher Managed					
Fixed Effect	**Coefficient**	***SE***	***t*-values**	***df***	***p*-values**
Spring HTKS	34.738	0.223	155.945	47	<0.001
TM Unproductive Non-Productive Non-Instruction Intercept	0.001	0.001	-0.16	47	0.874
TM Unproductive Non-Instruction Slope	0.001	0.001	0.76	47	0.451
Fall LW W Score Intercept	0.038	0.008	4.558	470	<0.001
TM Unproductive Non-Instruction Intercept	0.001	0.001	1.104	470	0.271
TM Unproductive Non-Instruction Slope	0.001	0.001	0.015	470	0.988
Fall HTKS Intercept	0.269	0.058	4.676	470	<0.001
TM Unproductive Non-Instruction Intercept	0.001	0.001	2.178	470	0.030
TM Unproductive Non-Instruction Slope	-0.001	0.001	-1.741	470	0.082
Final estimation of variance components					
Random Effect	*SD*	Variance Component	*df*	Chi-square	*p*-values
Between Classroom Residual	0.348	0.121	47	46.354	>.500
Within Classroom Residual	4.605	21.203			
Deviance	2921.49				
Child Managed					
Fixed Effect	Coefficient	*SE*	*t*-values	*df*	*p*-values
Spring HTKS	34.793	0.228	152.895	45	<0.001
CM Productive Non-Instruction Intercept	0.001	0.001	-0.058	45	0.954
CM Productive Non-Instruction Slope	0.002	0.001	2.436	45	0.019
CM Unproductive Non-Instruction Intercept	0.001	0.001	2.276	45	0.028
CM Unproductive Non-Instruction Slope	0.002	0.001	1.791	45	0.079
Fall LW W Intercept	0.043	0.01	4.165	346	<0.001

Teacher Managed					
Fixed Effect	**Coefficient**	***SE***	***t*-values**	***df***	***p*-values**
CM Productive Non-Instruction Intercept	0.001	0.001	0.779	346	0.436
CM Productive Non-Instruction Slope	0.001	0.001	0.968	346	0.334
CM Unproductive Non-Instruction Intercept	0.001	0.001	-1.175	346	0.241
CM Unproductive Non-Instruction Slope	0.001	0.001	0.555	346	0.579
Fall HTKS Intercept	0.281	0.062	4.529	346	<0.001
CM Productive Non-Instruction Intercept	0.001	0.001	2.595	346	0.010
CM Productive Non-Instruction Slope	-0.001	0.001	-1.868	346	0.062
CM Unproductive Non-Instruction Intercept	0.001	0.001	-1.609	346	0.108
CM Unproductive Non-Instruction Slope	0.001	0.001	-0.408	346	0.683
Final estimation of variance components					
Random Effect	*SD*	Variance Component	*df*	Chi-square	*p*-values
Between Classroom Residual	0.205	0.042	45	39.833	>.500
Within Classroom Residual	4.695	22.04			
Deviance	2322.812				