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Off-task Behavior in Elementary School Children

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Abstract

This paper reports results from a large-scale observational study investigating attention allocation during instructional activities in elementary school students (kindergarten through fourth-grade). In Study 1, 22 classrooms participated while a more diverse sample of 30 classrooms participated in Study 2. This work investigated temporal patterns in children's attention allocation by collecting observational data on children's on- and off-task behaviors at three different time points (i.e., beginning, middle, and end of the school year) [Study 1]. We also investigated whether patterns of attention allocation changed as a function of student characteristics (gender, grade-level, SES), teachers' instructional design choices (instructional format and duration of an instructional activity), and school type (private, parochial, public charter schools) [Studies 1 & 2]. Children's patterns of attention allocation fluctuated over the course of the school year. Female students were found to be more on-task compared to male students. On-task behavior tended to decline as the instructional duration increased. The lowest rates of on-task behavior were observed while children were engaged in whole-group instructional formats. An effect of school type was found with higher proportions of on-task behavior observed in parochial schools. However, the effect of grade-level was equivocal across studies. These findings can begin to form a foundation for the development of research-based guidelines for instructional design aimed to support engagement among students in elementary classrooms.

Keywords: Off-Task Behavior; Attention; Time On-Task; Instructional Design

Off-task Behavior in Elementary School Children

Loss of instructional time due to off-task behavior is a well-established problem in educational settings, recognized by researchers (e.g., Carroll, 1963; Karweit & Slavin, 1981; Lee, Kelly, & Nyre 1999) and practitioners (e.g., Lemov, 2010) for over a hundred years (cf. Currie, 1884 as cited in Berliner, 1990). Off-task behavior has been documented to negatively impact academic achievement, although the magnitude of this impact is unstable across studies (for reviews see Frederick & Walberg, 1980; Goodman, 1990). Off-task behavior is an indicator that students' attention is not focused on the instructional activity. The link between the quality of attention and task performance has also been documented in the cognitive psychology literature (e.g., Choudhury & Gorman, 2000; Dixon & Salley, 2007; DeMarie-Dreblow & Miller, 1988). Despite considerable prior research on off-task behavior, designing effective, easy to implement, and scalable interventions to reduce off-task behavior has been challenging. Roberts (2002) suggests that many existing interventions may be unsuccessful because they do not take into sufficient account the conditions that lead to off-task behavior. The goal of the present study is to elucidate some of the factors involved in off-task behavior in elementary school settings.

Off-task Behavior in Elementary School Students

There is a variety of reasons why loss of instructional time occurs in schools; these reasons include but are not limited to: weather (e.g., snow days), sudden onset interruptions (e.g., announcements over the loudspeakers), and special events. However, student inattentiveness (i.e., off-task behavior during instructional time) has been found to be the biggest factor that accounts for loss of instructional time (Karweit & Slavin, 1981). Prior research estimates that elementary

school students spend between 10% and 50% of their time off-task in regular education classrooms (e.g., Fisher et al., 1980; Lee et al., 1999; Lloyd & Loper, 1986; Karweit & Slavin, 1981). Inattention or off-task behavior is a serious challenge educators face. In fact, off-task behavior has been identified as one of the most common reasons for student referrals (Roberts, 2001). While eliminating all off-task behavior is not a realistic expectation, reducing rates of off-task behavior is an important goal given the challenges that off-task behavior causes for classroom management as well as the potential implications of off-task behavior on academic achievement.

A large number of prior studies have examined off-task behavior in elementary school students; however, the generalizability of prior work is limited due to its relatively narrow scope. For example, some studies observed a few classrooms within a single grade level (e.g., Lahaderne, 1968; Samuels & Turnure, 1974). Other studies involved a large number of classrooms (e.g., 18 to 25 classrooms), but only observed a small subset of students within each classroom (e.g., Fisher et al., 1980; Karewit & Slavin, 1981). Indeed, the wide range in estimates of off-task behavior reported in the literature may be partially attributed to the relatively small sample sizes utilized in prior research, as small samples are more susceptible to the influence of extreme data points. In order to establish a more comprehensive understanding of children's on and off-task behaviors during early and middle childhood, research examining children's patterns of attention allocation on a larger scale and across multiple grade-levels is clearly needed.

The present work makes a contribution to the field due to its size and scope: this work includes a large sample size both in terms of the number of classrooms which were recruited (e.g., Study 1: 22 classrooms, Study 2: 30 classrooms) as well as the number of children within each classroom who were observed (i.e., all students in attendance were included in the study). In

contrast to some prior work which tended to focus on one particular grade or a small range of grade-levels, this work conducts observations across a broad range of grade-levels in elementary school (i.e., kindergarten through fourth-grade).

A second contribution of this work pertains to the detailed coding scheme that was employed to provide a more nuanced examination of the sources of off-task behavior common in elementary school settings. Previous work examining off-task behavior in classrooms tended to treat off-task behavior as a unitary construct (e.g., Carnine, 1976; Frederick et al., 1979; Karweit & Slavin, 1981). Consequently, the sources of children's off-task behavior remain underspecified. In the present study we delineate common types of off-task behavior including off-task peer interactions, self-distraction, and off-task behaviors directed towards aspects of the classroom environment. Identifying common types of off-task behavior in elementary school settings is critical as interventions targeting inattention will be successful only to the extent that they adequately address the source of children's off-task behavior. The types of off-task behavior measured in the present work were based on the results of a teacher survey. Thirty elementary school teachers were asked to rate the frequency of students' off-task behaviors on a scale from 1 to 4, where 1 indicates that the behavior occurs rarely and 4 indicates that the behavior is very frequent. Peers (M = 3.21, SD = 0.62) and self-distractions (M = 2.62, SD = 0.90) were identified by teachers as frequent sources of off-task behavior. Additionally, walking around the classroom (or being out of one's seat) was identified as a frequent off-task behavior by 14 of the teachers (M = 2.50, SD = 0.85). Off-task behavior relating to the environment was identified as another common source of distraction (M = 1.83, SD = 0.85). Studying off-task behaviors associated with the classroom environment is of particular interest because of the hypothesized link between off-

task behavior and visual design features of elementary school classrooms (e.g., Fisher, Godwin, & Seltman, 2014; Godwin & Fisher, 2011). Primary classrooms often contain large amounts of stimulating sensory displays intended to increase children's motivation and engagement (Barrett, Zhang, Moffat, & Kobbacy, 2012; Tarr, 2004; Thompson & Raisor, 2013). However, there is no empirical evidence demonstrating that this design choice increases motivation and engagement. By contrast, large amounts of stimulating displays in classrooms have been described as "visual bombardment" (Bullard, 2010, p. 110) and a "cacophony of imagery" (Tarr, 2004, p. 1). Barrett and colleagues (Barrett, Zhang, Moffat, & Kobbacy, 2012) recently reported that, contrary to their initial hypothesis, high amounts of color (i.e., the degree and manner in which color was utilized in the classroom walls, furniture, and displays) was negatively associated with elementary school children's achievement scores (although note that a follow-up study by Barrett, Davies, Zhang, and Barrett (2015) reported that very low amounts of color are also negatively associated with achievement, suggesting that there may be a level of visual stimulation that is optimal for classroom settings). Furthermore, there is recent experimental evidence supporting the notion that highly decorated learning environments may actually promote off-task behavior in young children and thereby decrease learning (Fisher, Godwin, & Seltman, 2014; Godwin & Fisher, 2011).

Despite a large number of studies documenting rates of off-task behavior in elementary school students, there has been limited research examining the factors associated with off-task behavior. The present work aims to address this gap in the literature by conducting an exploratory study which examines four main research questions: (1) Do patterns of attention allocation change over the course of the school year? (2) Are student characteristics (e.g., gender, grade-level, and SES) related to children's attention allocation patterns? (3) Are instructional design strategies (e.g.,

instructional format and duration of instructional activity) related to children's tendency to engage in on and off-task behavior? (4) Is school-type related to children's attention allocation patterns? Below we briefly discuss how each of these factors may be related to patterns of attention allocation in elementary school students.

There has been limited investigation of the variability in children's patterns of attention allocation as a function of time (Martin et al., 2015). The idea that students' attentional capacity fluctuates over the course of the school day is a common belief in education circles. Indeed, teachers' report that they modify their instruction in response to fluctuations in students' levels of attention by avoiding challenging instructional activities following lunch or at the end of the school day (for discussion see Muyskens & Ysseldyke, 1998; Ammons et al, 1995). Observational research examining the effect of time of day on school children's classroom behaviors has found that inappropriate behaviors are more frequent in the afternoon compared to the morning (Muyskens & Ysseldyke, 1998). Similar findings have been obtained with children who have attention deficit disorders (e.g., Antrop, Roeyers & De Baecke, 2005; Zagar & Bowers, 1983). Furthermore, studies using performance-based measures of attention (e.g., paper and pencil visual search tasks in which participants are asked to locate and cross out a target object from a group of distractors) have found that performance on tests of attention is highest in the mid-morning and declines mid-day, although there is some variability in the observed attention patterns for preschool children and students in primary grades (e.g., Janvier & Testu, 2007). Although levels of attention have been found to oscillate over the course of the school day, it is currently an open question if and how patterns of attention allocation change across the school year. Specifically, the proportion of on-task behavior as well as the prevalence of different types of off-task behavior

may fluctuate as children become more familiar with their teacher, school rules, peers, and their classroom environment. For example, self-distractions may be more common in the beginning of the school year, but as time progresses children may become better acquainted with their classmates, leading to more off-task behavior directed towards peers in the middle and end of the school year. Another possible outcome is that children may habituate to their classroom visual environment. Therefore, off-task behavior directed at the visual features of the classroom may decrease from the beginning of the school year compared to the end of the school year.

Student characteristics also likely influence children's patterns of attention allocation. For example, prior work suggests that males exhibit more off-task behavior compared to females (Marks, 2000; Matthews, Ponitz, & Morrison, 2009). Consequently, it is of interest to investigate whether gender differences emerge in a large sample of elementary school children and to investigate whether the specific types of off-task behavior children engage in vary as a function of gender. Grade level is another factor that may contribute to children's tendency to engage in off-task behavior as prior research has documented that the ability to engage in selective sustained attention improves with age (e.g., Bartgis, Thomas, Lefler, & Hartung, 2008; for review see Fisher & Kloos, in press; White 1970). Additionally, it is possible that specific types of off-task behavior may be more prevalent in younger grade levels (e.g., self-distraction) while other types of distraction may be more pervasive across grade levels (e.g. peers). Furthermore, rates of on and off-task behavior may vary as a function of SES. Prior work has found that executive function skills are typically weaker in children from a lower socioeconomic background (e.g., Wiebe et al., 2011); consequently, these children may have greater difficulty inhibiting distractions and thus be more likely to engage in off-task behaviors.

Instructional design choices (i.e., average duration of an instructional activity and instructional format) may also be related to off-task behavior in elementary school children. For example, the duration of an instructional activity may influence children's ability to attend to the ongoing instruction. Specifically, children may be better able to maintain a state of focused attention when instructional activities are shorter in duration, this may be particularly true for younger children who are still developing the ability to efficiently regulate their attention. This possibility is consistent with studies suggesting that in laboratory settings the duration of focused attention increases gradually with development, from approximately 4-minutes in 2- and 3-year-old children to over 9-minutes in 5- and 6-year-old children (for review see Fisher & Kloos, In Press). Surprisingly, this issue has not been investigated systematically in genuine education settings. Consequently, there is a dearth of evidence-based guidelines that teachers can utilize to inform their instructional design choices. Teachers typically have considerable autonomy when determining how instructional time is allotted (Rettig & Canady, 2013). At the same time, better insight into what the optimal durations of instructional activity might be for maintaining high rates of on-task behavior in elementary schools would be valuable information for educators.

It is also possible that some types of instructional format (e.g., whole-group instruction, small-group instruction, etc.) are more likely to be associated with higher rates of off-task behavior than other instructional formats. There is evidence indicating that small-group instruction (when groups are formed on the basis of student ability) is more effective than whole-group instruction with regards to student achievement (for reviews see Lou et al., 1996; Kulik, 1992). However, the size of this effect is relatively small and variability in effect sizes across individual studies is substantial. For example, Lou et al. (1996) reported that the effect size of small-group versus

whole-group instruction ranged from -1.96 to 1.52, with an average effect size of 0.17. Thus, some researchers have argued that the large variability in effect sizes severely limits the degree to which it can be concluded that small-group instruction is superior to whole-group instruction (Prais, 1998, 1999). The possibility that the type of instructional format is related not only to achievement but also to off-task behavior has to our knowledge been largely unexplored (see Goodman 1990); however, some prior research has documented higher rates of student engagement during teacher led activities (BTES as cited in Goodman, 1990; Good & Beckerman, 1978; Ponitz & Rimm-Kaufman, 2011). The present work provides a nuanced examination of the relationship between off-task behavior and specific instructional formats (e.g., individual work, small-group or partner work, whole-group instruction at desks, whole-group instruction while sitting on the carpet) in elementary school students. Obtaining evidence to evaluate this possibility is important because it can empower teachers to choose instructional formats that are likely to optimize children's attention allocation.

Lastly, rates of on and off-task behavior as well as the types of off-task behavior that children engage in may vary as a function of school type (e.g., public schools, private schools, parochial schools). For example, schools may have different group cultures or norms regarding student behavior. These shared expectations may influence children's patterns of attention allocation.

The Present Study

Within this paper, we report the results of two studies. Study 1 investigates the temporal patterns in children's attention allocation [Research Question 1]. Additionally, Study 1 examines whether student characteristics and specific instructional design choices are associated with

patterns of attention allocation in elementary school children, both in terms of the overall amount of on and off-task behavior but also the form which off-task behavior takes [Research Questions 2 and 3 respectively]. Data for Study 1 contains a relatively homogeneous set of schools, as all participating schools were part of the same public charter school organization. Study 2 investigates whether the results obtained in Study 1 regarding the role of student characteristics and instructional design strategies on children's selective sustained attention can be generalized to a more diverse sample of schools. In Study 2, we collected data from a more heterogeneous sample of schools that varied in terms of the socioeconomic status of the student population [Research Question 3] as well as school type (i.e., public charter schools, private schools, and parochial schools) [Research Question 4].

Study 1: Temporal Patterns of On- and Off-Task Behavior Across the School Year

In order to address Research Question 1, Study 1 examined temporal patterns in children's attention allocation by collecting observational data on children's on- and off-task behavior over the course of the school year. To this end, we conducted observations at three different time points: the beginning, middle, and end of the school year. For each time point the proportion of on- and off-task behavior was modeled in order to determine if children's attention patterns fluctuated or remained stable throughout the school year. Additionally, we examined the possibility that the prevalence of certain types of off-task behavior may change over time. We also examined whether children's patterns of attention allocation changed as a function of student characteristics [Research Question 2] or based on instructional design strategies [Research Question 3].

Method

Participants

Twenty-two classrooms participated in Study 1. Participating classrooms were selected from 5 charter schools located in or near a Northeastern medium-sized city in the United States of America. Five grade-levels were recruited: kindergarten through fourth-grade[1]. The distribution across the five grade-levels was as follows: 5 kindergarten classrooms, 4 first-grade classrooms, 5 second-grade classrooms, 2 third-grade classrooms, and 6 fourth-grade classrooms. The average class size was 21 students (10 males, 11 females). However, due to absences the average number of children observed in a single observation session was 18.9 children. The number of children observed per session ranged from 15 to 22 children.

Design and Procedure

The observation sessions were staggered across three time periods (Time 1: October 2011 - December 2011, Time 2: February 2012 - April 2012, Time 3: May 2012 - June 2012). In order to minimize measurement error and obtain more stable estimates of on- and off-task behavior for each classroom, two observation sessions were conducted during each time period for a total of six observations per classroom. However, due to scheduling constraints, in four of the 22 classrooms only five observation sessions were conducted. Thus, a total of 128[2] observation sessions were conducted in Study 1. The average delay between observation sessions within a

[1] Due to the nature of the IRB approval for this study, no identifying information, including date of birth, was collected. Consequently, we are unable to provide the mean age per grade-level. However, according to the National Center for Education Statistics (2001), the average age at school entry for U.S. kindergarten children is 5.5 years.

[2] Two observation sessions were excluded from analysis due to disruptions that occurred during the observation session.

single time period was 3.6 days (the delay ranged from 1 to 14 calendar days). The average delay across time periods was 90.5 days. Each observation session lasted approximately one hour. The average number of observations per session was 346.13 and the average number of observations per child within a session was 19.27. For the purposes of the analyses reported below, children in each session were treated as a different set of students because student identifiers could not be collected. As a result, it was not possible to link observations across the six sessions. Therefore, a total of 2,402 student-session pairs were observed. A student-session pair refers to a specific student observed by a coder within a specific session. However, treating the children within each session as a different set of students artificially inflates statistical power. In order to mitigate this concern, a more conservative alpha level was used in the analyses reported below. Specifically, the alpha level was adjusted to .0083 (the commonly accepted alpha level of .05 was divided by 6, the total number of observations, in order to more closely approximate the true size of the sample).

Coding On- and Off-task Behaviors

All coders were trained in the *Baker-Rodrigo Observation Method Protocol* (BROMP) for coding behavioral data in field settings (Ocumpaugh, Baker, & Rodrigo, 2012). All coders received extensive training consisting of coding videotapes and live observation sessions. Inter-rater reliability was established prior to the study proper. Kappa values ranged from 0.79 to 0.84. This level of reliability is in line with past classroom research coding off-task behavior, and exceeded the 0.75 threshold to which Fleiss (1981) refers to as "excellent" in field settings.

Field coding was conducted using the HART app for Android handheld computers (Baker et al., 2012), which enforces the BROMP protocol. Children were observed using a round-robin coding strategy, in order to reduce the tendency of observers to attend to more salient instances of

off-task behavior. In the round-robin coding strategy, each child present in the classroom was observed individually in a prescribed order determined at the beginning of each session. Each time a child was observed, the observation lasted for up to 20 seconds. The first unambiguous behavior observed during the 20 second period was recorded. Quick glances were considered ambiguous behaviors, and coders were instructed to wait for an unambiguous behavior to occur (i.e., a behavior that was sustained long enough for the coder to identify and code the behavior based on the coding scheme described below). If a behavior was noted before 20 seconds elapsed, the coder proceeded to the next child, and a new 20 second observation period began. This process was repeated for the duration of the session; in this way each child was observed multiple times throughout the observation session. Coders observed the children using peripheral vision or side-glances in order to avoid looking directly at the student being observed. This technique makes it less apparent to the child that s(he) is being observed. This procedure has successfully and reliably captured students' behavior in prior work which assessed behavior and affect in middle and high school students (e.g., Baker, 2007; Baker, D'Mello, Rodrigo, & Graesser, 2010; Ocumpaugh et al., 2012).

Coders first classified children's behavior as on- or off-task using primarily the direction of the child's gaze. If the child was looking at the teacher (or classroom assistant), the instructional activity, and/or the relevant instructional materials, they were categorized as being on-task. If the child was looking elsewhere, they were categorized as being off-task. Contextual clues (i.e., teacher instructions) were also taken into consideration when distinguishing between on- and off-task behaviors. For example, if a child was instructed to discuss an idea with a partner, coders

would classify conversing with another peer as on-task unless the coders could clearly discern that the conversation was unrelated to the task.

If the child was classified as off-task, the type of off-task behavior was recorded. Five[3] mutually exclusive categories of off-task behavior were logged: (1) *Self-distraction*, (2) *Peer distraction*, (3) *Environmental distraction*, (4) *Walking*, or (5) *Other*. *Self-distraction* entailed engagement with something on the child's own body, such as an article of clothing or an appendage, as well as episodes in which the child would close their eyes. *Peer distraction* was defined as interacting with or looking at another student when not directed to do so. *Environmental distractions* include interacting with or looking at any object in the classroom that was not related to the task at hand. *Walking* was operationalized as a student physically walking around the classroom when it was not considered appropriate for the task. *Other distractions* included student behavior that was off-task but did not clearly align with the five aforementioned categories. A sixth category *Unknown* was also included to capture rare instances in which it was unknown whether the child was on- or off-task, and it was impossible or inappropriate for the observer to relocate in order to obtain a better view of the child. *Unknown* was also used when students left the classroom

[3] Mind wandering, also referred to as "Stimulus independent thought" (Killingsworth & Gilbert, 2010, p. 932) and daydreaming (see Smallwood, Fishman, & Schooler, 2007), can be considered another form of off-task behavior. However, in the present study mind wandering was not included as a category of off-task behavior due to methodological concerns. This particular form of off-task behavior is not readily observable. Instead, mind wandering is typically assessed using thought sampling (Smallwood, Fishman, & Schooler, 2007). However, it is unclear whether young children possess the metacognitive capabilities to self-report the occurrence or frequency with which they experience mind wandering. Relying on self-report may also be particularly problematic since mind wandering can occur without awareness (see Schooler et al., 2011; Smallwood, Fishman, & Schooler, 2007). Additionally, young children may be particularly susceptible to demand characteristics which may diminish the accuracy of thought sampling procedures. A thorough discussion of mind wandering is beyond the scope of the present paper; however, interested readers can refer to Killingsworth and Gilbert (2010), Smallwood, Fishman, and Schooler (2007) or Schooler et al. (2011) for discussion of recent findings in the mind wandering literature.

for various reasons (e.g., to use the restroom). Since the category *Unknown* is not informative in terms of children's patterns of attention allocation it was excluded from the analyses. The category *Unknown* accounted for 5% of the total observations coded.

As discussed previously, instructional format was included as a variable in order to examine whether certain instructional formats elicit differential amounts of off-task behavior. Six different instructional formats were coded: (1) individual work (when students are working on an activity individually, for instance when the teacher directs the students to complete a worksheet or other activity by themselves or without any help from classmates), (2) small-group work (when students are divided into smaller groups and each group works on an activity independently of the other groups; this category includes small-group work, partner work, and centers), (3) whole-group instruction at desks (when students are sitting at their desk or table while the teacher instructs the whole class in an activity), (4) whole-group instruction while sitting on the carpet (when students are sitting on the carpet or floor while the teacher instructs the whole class in an activity), (5) dancing, and (6) testing. It is important to note that observations were scheduled during instructional time; however, on rare occasions testing and dancing were observed resulting in a limited quantity of data gathered during these formats. As a result, testing and dancing were excluded from the analyses.

Results Study 1

Overall, the percentage of off-task behavior averaged across all observations (29.30%) was within the range of previously reported estimates of off-task behavior in elementary school students (i.e., 10% to 50%). In the present study, the three most common types of off-task behavior

observed included: *Peer distractions, Environment distractions,* and *Self-distractions*. These three sources of distraction accounted for 85% of children's off-task behaviors. The percentage of children's on and off-task behaviors are reported in Table 1.

A three-level hierarchical logistic regression was performed with observations nested within students, nested within classrooms using SAS PROC GLIMMIX. Random intercepts for students and classroom were included in the model. Separate models were run for on-task behavior and the three most common types of off-task behavior (*peer distractions*, *environmental distractions*, and *self-distractions*). For all models the test of the covariance parameters were significant indicating that both random intercepts are needed (all *ps* < .0001). All off-task models are conditional on being off-task. Fixed effects included Time of Year (beginning, middle, and end of the school year), Gender (Males, Females), Grade-level (Kindergarten, First, Second, Third, and Fourth grades), and Instructional Format (individual work, small-group, whole-group instruction at desks, whole-group instruction while sitting on the carpet). Using this approach our results reflect the effect of each independent variable controlling for the others and the correlations induced by the hierarchy.

Question 1: Do patterns of attention allocation change over the course of the school year?

Time of Year and On-task Behavior

On-Task Behavior. Controlling for gender, grade-level, and instructional format, a significant effect of time of year on rates of on-task behavior was found ($F(2, 2341) = 26.16$, $p < .0001$). In general, on-task behavior was found to decline at the end of the school year with children engaging in significantly less on-task behavior at the end of the school year than at the beginning

of the school year ($t(2399) = 3.13$, $p = .0018$, Odds ratio [OR] = 1.13, 95% multiplicity-adjusted confidence interval [CI] = [1.03, 1.23]) or the middle of the school year ($t(2431) = 7.17$, $p < .0001$, OR=1.31, 95% CI = [1.20, 1.44]). Thus, children were 1.13 times more likely to engage in on-task behavior at the beginning of the school year compared to the end of the school year and 1.31 times more likely to be on-task in the middle of the year compared to the end of the school year. However, higher rates of on-task behavior were found in the middle of the school year compared to the beginning of the school year ($t(2216) = -4.32$, $p < .0001$, OR=1.17, 95% CI=[1.07, 1.27]).

Time of Year and the Sources of Off-Task Behavior

Next, we examined temporal changes in the three most common types of off-task behavior: *peer distractions*, *environmental distractions,* and *self-distractions*. A significant effect of *Time* was found for all three types of off-task behavior. However, fluctuations across time were not uniform. The results for each type of off-task behavior are described below.

Peer Distractions. Controlling for gender, grade-level, and instructional format, *peer* off-task behaviors, relative to all other types of off-task behavior, were found to vary across time ($F(2, 2117) = 7.20$, $p = .0008$). Children exhibited a significantly higher rate of *peer* off-task behavior, relative to all other types of off-task behavior, at the middle of the school year compared to the beginning of the school year ($t(2073) = -3.43$, $p = .0006$, OR=1.21, 95% CI = [1.06, 1.38]) and the end of the school year ($t(2151) = 3.12$, $p = .0019$, OR=1.20, 95% CI=[1.04, 1.38]). Specifically, children were 1.21 (OR) times more likely to engage in *peer distractions* in the middle of the year compared to the beginning of the year and 1.20 (OR) times more likely to engage in *peer distractions* in the middle of the year compared to the end of the school year. There

was no significant difference in the frequency of *peer* off-task behavior, relative to all other off-task behaviors, between the beginning and end of the school year ($t(2133) = -0.15$, $p = 0.88$, OR=0.99, 95% CI=[0.86, 1.14]).

Environmental Distractions. Controlling for gender, grade-level, and instructional format, a significant effect of time of year was found on rates of off-task behavior directed towards the environment relative to all other off-task behaviors ($F(2, 2331) = 8.08$, $p = .0003$). In general, off-task behavior directed toward the environment increased over time, as a fraction of all off-task behaviors, with children exhibiting a significantly higher rate of environment based off-task behaviors (relative to all other types of off-task behavior) at the end of the school year compared to the beginning of the school year ($t(2430) = -3.69$, $p = .0002$, OR=1.33, 95% CI=[1.10, 1.59]). Children were 1.33 (OR) times more likely to engage in *environmental distractions* at the end of the school year compared to the beginning of the school year. Similarly children were 1.27 (OR) times more likely to engage in off-task behavior directed toward the *environment* in the middle of the school year compared to the beginning of the school year ($t(2384) = -3.22$, $p = .0013$, OR=1.27, 95% CI = [1.06, 1.52]). There was no significant difference in rates of *environmental distractions* (relative to all other off-task behaviors) between the middle and end of the school year ($t(2195) = -0.58$, $p = .56$).

Self-Distractions. Controlling for gender, grade-level, and instructional format, a significant effect of time of year was found on rates of *self-distraction* relative to all other types of off-task behaviors ($F(2, 2337) = 32.35$, $p < .0001$). The results for the proportion of *Self-distractions* across time points was similar to the observed pattern of results for *Environmental distractions*. The frequency of *self-distractions* relative to all other types of off-task behavior

increased significantly across all three time points (all *ps* < .0013). For instance, *self-distractions* were 1.86 (OR) times more likely at the end of the school year compared to the beginning of the school year ($t(2400) = -7.98$, $p < .0001$, OR=1.86, 95% CI = [1.54, 2.24]).

Question 2: Are student characteristics related to children's attention allocation patterns?

In order to evaluate the putative relationship between student characteristics and children's attention allocation, the fixed effects for gender and grade-level were examined. The results are reported below for on-task behavior as well as the three most common types of off-task behavior (*peer distractions, environmental distractions,* and *self-distractions*).

Effect of Gender

Gender and On-task Behavior. Controlling for grade-level, instructional format, and time of year there was a significant effect of gender ($F(1, 2264) = 58.46$, $p < .0001$). Females were more likely to engage in on-task behavior than males, and this difference was statistically significant ($t(2264) = 7.65$, $p < .0001$, OR=1.26, 95% CI = [1.19, 1.34]). Female students engaged in 1.26 (OR) times more on-task behaviors than males. For example, at the end of the school year, in an average classroom, in the whole desk format, the average fourth-grade girl has 1.98 on task behaviors for every 1 off-task behavior, while the average boy has 1.57 on task behaviors for every 1 off-task behavior.

Gender and Peer-Distractions. Controlling for grade-level, instructional format, and time of year there was a significant effect of gender on the rates of *peer-distraction* ($F(1, 2048) = 21.37$, $p < .0001$). Relative to all other off-task behaviors, females were more likely to engage in *peer* off-

task behaviors compared to males, and this difference was statistically significant ($t(2048) = 4.62$, $p < .0001$, OR=1.24, 95% CI = [1.13, 1.36]). Thus when a female is off-task, her off-task behavior is 1.24 times more likely to be an off-task behavior directed towards her *peers* than for a male in the same grade-level, classroom, instructional format, and time of year.

Gender and Environmental Distractions. Controlling for grade-level, instructional format, and time of year there was a significant effect of gender on rates of off-task behavior directed toward the environment ($F(1, 2369) = 10.75$, $p = .001$). Relative to all other off-task behaviors, males were 1.22 [1.08, 1.38] (OR and 95% CI) times more likely to engage in *environmental distractions* compared to females, and this difference was statistically significant ($t(2369) = 3.28$, $p = .001$).

Gender and Self-Distractions. Contrary to the results for *peer distractions* and *environmental distractions* there was no significant effect of gender on the rate of *self-distractions* relative to all other off-task behaviors after controlling for grade-level, instructional format, and time of year ($F(1, 2249) = 0.20$, $p = .65$).

Effect of Grade-Level

The analyses for grade-level revealed no significant effect of grade-level for on-task behavior (F (4, 17) = 1.32, $p = .30$) and no significant effect of grade-level for each type of off-task behavior (*peer distraction* $p = .16$, *environmental distraction* $p = .41$, *self-distraction* $p = .68$) after controlling for gender, instructional format, and time of year.

Question 3: Are instructional design choices related to children's attention allocation?

In order to evaluate the role of instructional design strategies on children's tendency to engage in on and off-task behaviors, the fixed effects for instructional format were examined. The results are reported below.

Instructional Format and On-Task Behavior. Controlling for gender, grade-level, and time of year there was a significant effect of instructional format on the rates of on-task behavior ($F(3, 4803) = 8.35$, $p < .0001$). Recall that significance is based on the adjusted alpha level of .0083 in which the commonly accepted alpha level of .05 was divided by 6, the total number of observations. The p-values are also adjusted for multiple comparisons using the Tukey-Kramer method. In general, on-task behavior was most likely to occur during activities that took place in a small-group format (small-group vs. whole-group carpet: $t(4803) = 4.97$, adj. $p < .0001$; small-group vs. whole-group desk: $t(4803) = 2.97$, adj. $p = .016$ [marginally significant based on the more conservative alpha level]; however, the contrast between individual and small-group instruction was not statistically significant adj. $p = .03$). On-task behavior was 1.23 [1.11, 1.37] (OR and 95% CI) times more likely in the small-group format compared to whole-group instruction on the carpet and 1.12 [1.02, 1.24] (OR and 95% CI) times more likely compared to whole-group instruction at desks. There was no significant difference in the rates of on-task behavior across the remaining instructional formats: individual, whole-group at desks, and whole-group on the carpet (all adj. $ps \geq .08$).

Instructional Format and Peer Distractions. Controlling for gender, grade-level, and time of year there was a significant effect of instructional format on rates of *peer* off-task behavior

($F(3, 3914) = 70.87$, $p < .0001$). Adjusted for multiple comparisons (using the Tukey-Kramer method) relative to all other off-task behaviors, *peer distractions* were most likely to occur during activities that took place in an individual instructional format or small-group format compared to whole-group instruction at desks or on the carpet (all adj. *ps* < .0001). There was no significant difference in the frequency of *peer distractions* between individual and small-group formats ($t(3914) = 1.60$, adj. $p = .38$); nor was there a significant difference in the frequency of *peer distractions* (relative to other off-task behaviors) between the two whole-group instructional formats: whole-group instruction on the carpet and whole-group instruction at desks ($t(3914) = 1.84$, adj. $p = .26$). *Peer* off-task behaviors were approximately twice as likely during individual or small-group instruction compared to whole-group instruction with odds ratios ranging from 1.70 (small-group vs. whole-group instruction on the carpet) to 2.16 (individual vs. whole-group instruction at desks).

Instructional Format and Environmental Distractions. Controlling for gender, grade-level, and time of year there was a significant effect of instructional format on rates of *environmental distractions* ($F(3, 3914) = 28.58$, $p < .0001$). Adjusted for multiple comparisons (using the Tukey-Kramer method) relative to all other off-task behaviors *environmental distractions* were least likely to occur during activities that took place in an individual instructional format or small-group format; all adj. *ps* < .0001. There was no significant difference in the rates of *environment* based off-task behavior, relative to all other off-task behaviors, across these two instructional formats ($t(3914) = -1.50$, adj. $p = 0.44$, small-group:individual OR=1.19, 95% CI=[0.88, 1.58]). Relative to all other off-task behaviors, *environmental distractions* were most likely to occur during whole-group instruction at desks and whole-group instruction on the carpet.

Specifically, children were 2.07 [1.60, 2.68] (OR and 95% CI) times more likely to exhibit *environmental distractions* during whole-group instruction on the carpet than during individual instruction and e*nvironmental distractions* were 1.75 [1.36, 2.26] (OR and 95% CI) times more likely during whole-group instruction on the carpet than during small-group work. Similarly, students were 1.94 [1.51, 2.51] (OR and 95%CI) times more likely to engage in *environmental distractions* during whole-group instruction at desks compared to individual instruction and 1.64 [1.29, 2.09] (OR and 95% CI) times more likely to engage in *environmental distractions* during whole-group instruction at desks compared to small-group work. There was no significant difference in the rates of environment based off-task behavior across the two whole-group formats ($t(3914) = 0.74$, adj. $p = 0.88$, desk:carpet OR=0.94, CI=[0.75, 1.18]).

Instructional Format and Self-Distractions. Controlling for gender, grade-level, and time of year there was a significant effect of instructional format on rates of *self-distraction* ($F(3, 3914) = 139.14$, $p < .0001$). Adjusted for multiple comparisons (using the Tukey-Kramer method) relative to all other types of off-task behavior, *self-distractions* were highest during whole-group instruction on the carpet compared to all other instructional formats (all adj. *ps* < .0001). For example, self-distractions were 5.24 [3.95, 6.90] (OR and 95% CI) times more likely during whole-group instruction on the carpet than during small-group work. The second highest rates of *self-distraction,* relative to all other types of off-task behavior, occurred during whole-group instruction at students' desks compared to small group and individual instructional formats (both adj. *ps* < .0001). There was no significant difference in the frequency of *self-distractions,* relative to all other off-task behaviors, between small-group and individual instructional formats ($t(3914) = -0.90$, adj. $p = .81$, small-group:individual OR=1.13, 95% CI = [0.80, 1.58]).

Discussion Study 1

Several novel findings have emerged from Study 1. First, the results from Study 1 indicate that children's patterns of attention allocation are not stable across the school year. Variations in the proportion of both on-task and off-task behavior were observed as a function of the t*ime of year* (i.e., the beginning, middle, or end of the school year). The findings suggest that on-task behavior declines by the end of the school year. The frequency with which children engaged in different sources of off-task behavior was found to fluctuate over time. Notably, *peer* off-task behavior was found to increase during the middle of the school year while *self-distractions* and *environmental distractions* increased at the end of the school year. The latter finding is notable because it contradicts the possibility that over the course of the school year children habituate to their environment and engage in less off-task behavior related to the environment – Study 1 suggests the opposite to be the case. Recall that in the present work we observed children twice at each time point in order to minimize aberrations and obtain more stable estimates of children's behavior. However, future research should aim to replicate these findings using a greater density of observations at each time point.

Second, children's patterns of attention allocation also varied as a function of certain student characteristics (i.e., gender). For example, in line with prior research, females tended to engage in more on-task behavior than males. Interestingly, there were also differences in the types of off-task behaviors that children tended to engage in as a function of gender with males being more likely to engage in off-task behavior directed toward the environment (relative to other off-task behaviors) and females engaging in more peer off-task behaviors (relative to other off-task

behaviors). In contrast to the results for gender, there was no significant effect of grade-level on children's on or off-task behaviors.

Third, the results from study 1 also suggest that instructional design choices are related to children's attention allocation, as rates of on and off-task behavior varied as a function of the instructional format (e.g., small-group, individual, etc.). On-task behavior was most likely to occur during small-group instruction. Different instructional formats also appear to elicit different types of off-task behavior. For instance, *peer distractions* were most common in individual or small-group instructional formats, whereas *environmental distractions* were least likely to occur during these two instructional formats but were more likely to occur during whole-group instruction.

Taken together the results from Study 1 indicate that children's patterns of attention allocation are influenced by external factors such as time of year and instructional design strategies; however, there is also some evidence to suggest that certain student characteristics such as gender influence the rates of children's on-task behavior and to some extent the form in which off-task behavior may take.

Study 2: Assessing the Generalizability of the Relationship Between Student Characteristics, Instructional Design Strategies, and Attention Allocation

Study 1 contained a relatively homogeneous set of schools, as all 5 of the participating schools were part of the same public charter school organization. Thus, it is an empirical question as to whether the results obtained in Study 1 would replicate with a more diverse sample. The goal of Study 2 was therefore to examine whether the findings obtained in Study 1 could be generalized to other schools and student populations. Consequently, in Study 2 a more heterogeneous sample

of schools was recruited. The schools varied in terms of the socioeconomic status (SES) of the student population as well as school type (i.e., public charter schools, private schools, and parochial schools). Specifically, Study 2 investigated how patterns of attention allocation change as a function of student characteristics (gender, grade-level, SES) [Research Question 2], instructional design strategies (i.e., instructional format and average duration of an instructional activity) [Research Question 3], and school type (i.e., public charter schools, private schools, and parochial schools) [Research Question 4].

Method

Participants

Thirty classrooms participated in Study 2. The classrooms were recruited from 9 schools which included: 4 charter schools, 3 private schools, and 2 parochial schools. Data were also collected based on the percentage of students belonging to low-income families. The distribution of schools in each SES quartile was as follows: 5 schools had 0-25% low-income students; 0 schools had 25-50% low-income students; 3 schools had 50-75% low-income students; 1 school had 75% and above low-income students.

Students were recruited from five grade-levels: kindergarten through fourth-grade. The distribution across the five grade-levels was as follows: 7 kindergarten classrooms, 7 first-grade classrooms, 7 second-grade classrooms, 3 third-grade classrooms, and 6 fourth-grade classrooms. Information regarding the class size and gender distribution was provided by 20 out of 30 participating teachers. The average class size was 18.71 students (9.25 males, 9.95 females). Due to absences, the average number of children observed in a single observation session was 18.58 children. The number of children observed per session ranged from 14 to 23.

Design and Procedure

Each classroom was observed two times during the school year, resulting in a total of 60 observation sessions. The observation sessions occurred between October 2012 and December 2012. The average delay between observation sessions within a single time period was 3.8 calendar days (the delay ranged from 1 to 10 days). Each observation session lasted approximately one hour. The average number of observations per session was 263.93 and the average number of observations per child within a session was 16.17. A total of 1,113 student-session pairs were observed. Recall that a student-session pair refers to a specific student observed by a coder within a specific session. As mentioned in Study 1, treating the children within each session as a different set of students artificially inflates statistical power. As a result, a more conservative alpha level was employed; specifically the alpha level was adjusted to .025 (the standard alpha level of .05 was divided by 2, the number of observations, in order to more closely approximate the true sample size).

Coding of on-task behavior was identical to that in Study 1. Coding of off-task behavior was modified in one important way: Based on reports from coders, we split the *environmental distractions* category into two separate categories to distinguish between distinct types of off-task interactions with the classroom environment. Specifically, in Study 2 *environmental distractions* were defined more narrowly as looking at or interacting with elements of the classroom visual design (e.g., charts, posters, etc.); inappropriate use of objects that were a part of the assigned task (e.g., playing with a pen instead of using it for its intended purpose) were coded as off-task behavior related to school *supplies* (whereas in Study 1 such instances were coded as *environmental distractions)*. The decision to code *supplies* separately from *environmental*

distractions was based on the idea that interventions that target the classroom visual environment may be more feasible than interventions that address the inappropriate use of school supplies. Presumably the classroom environment can be streamlined (i.e., extraneous posters and charts can be removed) while school supplies are by definition tools that students need to complete their assignment and are therefore less amenable to intervention. Furthermore, prior laboratory research has indicated that the classroom visual environment (charts, posters, educational displays, etc.) can be a source of distraction for young children (Fisher, Godwin, & Seltman, 2014). Thus, it was of interest to determine whether this finding would generalize from the laboratory to real-world classrooms. Therefore, a total of six categories of off-task behavior were coded: (1) *Self-distraction*, (2) *Peer distraction*, (3) *Environmental distraction*, (4) *Supplies*, (5), *Walking*, and (6) *Other*. Similar to Study 1, the category *Unknown* was utilized when coders could not establish whether a child was on- or off-task. Since the category *Unknown* was not informative in terms of children's patterns of attention allocation it was excluded from the analyses. The category *Unknown* accounted for 3% of the total observations.

In addition to gender and grade-level, SES was also included as a student characteristic. For each school, SES was based on the percentage of students from low-income families, obtained from the Pennsylvania Department of Education for the 2012-2013 academic year. As such, lower values represent schools in a more affluent community.

Predictor variables pertaining to instructional design strategies included the instructional format and the average duration of an instructional activity. The same four instructional formats were included: (1) individual work, (2) small-group or partner work, (3) whole-group instruction at desks, (4) whole-group instruction while sitting on the carpet. The average duration of an

instructional activity (sec) was operationalized as the total duration of an observation session divided by the number of activities (defined as the number of transitions between instructional activities plus one). Duration of an instructional activity was included in order to investigate whether children were better able to maintain a state of focused attention when instruction consisted of small blocks of activities versus instructional activities that occurred over a longer duration. Transitions were noted every time the teacher paused instruction to change from one activity to another (e.g., transitioning from working on a math problem to listening to a short story). In many cases, transitions coincided with a change in instructional format (e.g., switching from whole-group instruction to small-group instruction); however this was not always the case as transitions could occur without a change in instructional format (e.g., with children rotating from one small-group activity to another). Transitions were frequently marked by the teacher asking the children to get out new instructional materials (e.g., *"Please get out your math binders"*) or requesting that students change locations (e.g., *"Please put your notebooks away and come to the carpet"*).

Results Study 2

Similar to Study 1, and to previous reports in the literature (Lee et al., 1999; Karweit & Slavin, 1981), 26.42% of children's observed behaviors were coded as off-task. In line with the patterns of attention allocation observed in Study 1, the most common types of off-task behavior were: *peer distractions* (49.07%), *self-Distractions* (11.56%), *environmental distractions* (12.10%) and *supplies* (16.86%); see Table 2 for the percentages of children's on and off-task behaviors.

In order to investigate changes in the students' patterns of attention allocation based on student characteristics, instructional design strategies (i.e., format and average duration of an instructional activity), and school type, a three-level hierarchical logistic regression was performed with observations nested within students, nested within classrooms using SAS PROC GLIMMIX. Random intercepts for students and classroom were included in the model. Separate models were run for on-task behavior and the four most common types of off-task behavior (*peer distractions, environmental distractions, self-distractions, and supplies*). The tests of the covariance parameters were significant in all but one model (*self-distractions*) indicating that both random intercepts are needed (all other *ps* < .0001). All off-task models are conditional on being off-task. Fixed effects included: Gender, Grade-level, SES, Instructional Format, Instructional Duration, and School Type (private, charter, parochial).

Question 2: Are student characteristics related to children's attention allocation patterns?

Effect of Gender

Gender and On-task Behavior. Consistent with the findings of Study 1, there was a significant effect of gender after controlling for SES, grade-level, instructional format, duration, and school type ($F(1, 1062) = 23.96$, $p < .0001$). Females had significantly higher rates of on-task behavior than males ($t(1062) = 4.89$, $p < .0001$). The corresponding odds ratio is 1.26 with 95% CI [1.15, 1.37], indicating a 26% higher ratio of on-task behavior for females compared to males. As an example, for an average private school classroom of third graders at the beginning (i.e., duration = 0) of whole desk instruction, an average female of average SES has 2.07 on task

behaviors for every one off-task behavior, while an average male has only 1.65 on task behaviors for every one off-task behavior.

Gender and Peer Distractions. As in Study 1, there was a significant effect of gender on rates of *peer* off-task behavior after controlling for SES, grade-level, instructional format, duration, and school type, ($F(1, 865) = 7.41$, $p = 0.007$). *Peer distractions* were more frequent among females than among males ($t(865) = 2.72$, $p = .007$). Females were 1.24 [1.06, 1.45] (OR and 95% CI) times more likely to engage in peer off-task behavior (vs. other off-task behaviors) compared to males.

Gender and Environmental Distractions. In contrast to Study 1, there was no significant effect of gender on rates of *environmental distractions*, as a fraction of all other off-task behaviors, after controlling for SES, grade-level, instructional format, duration, and school type ($F(1, 962) = 1.60$, $p = .21$)

Gender and Self-Distractions. Based on the more conservative alpha value of .025, the effect of gender on *self-distraction* rates (as a fraction of all off-task behavior) was marginally significant – controlling for SES, grade-level, instructional format, duration, and school type ($F(1, 970) = 4.14$, $p = .04$). *Self-distractions* were more frequent among males than among females ($t(970) = -2.03$, $p = .04$). Males were 1.27 [1.01, 1.59] (OR and 95% CI) times more likely to engage in *self-distractions* compared to females. Note this pattern of results is not consistent with Study 1 in which no significant gender difference for *self-distractions* was found.

Gender and Supplies. A significant effect of gender on children's off-task behavior directed toward *supplies* - controlling for SES, grade level, instructional format, duration, and school type was found ($F(1, 990) = 16.71$, $p < .0001$). Off-task behavior directed towards *supplies*

was more frequent for males than for females ($t(990) = -4.09$, $p < .0001$). Specifically, males were 1.54 [1.25, 1.90] (OR and 95% CI) times more likely to engage in off-task behavior oriented toward *supplies* compared to females.

Effect of Grade-level

Grade-Level and On-task Behavior. In contrast to Study 1, a significant effect of grade-level on children's on-task behavior was found after controlling for gender, SES, instructional format, duration, and school type ($F(4, 25 = 3.84$, $p = .01$). Adjusting for multiple comparisons (using the Tukey-Kramer method), third graders engaged in significantly less on-task behavior compared to students in fourth grade ($t(23) = 3.38$, adj. $p = .02$, OR = 0.41, 95% CI = [0.19, 0.83]). Third graders also tended to exhibit lower rates of on-task behavior compared to first graders; however, this difference was only marginally significant based on the more conservative alpha level of .025 selected previously ($t(25) = 3.04$, adj. $p = .04$, OR = 0.45, 95% CI = [0.20, 0.97). All other grade-level comparisons were not statistically significant (all adj. $ps \geq .23$).

Grade-Level and Peer Distractions. After controlling for gender, SES, instructional format, duration, and school type, the effect of grade-level on *peer distractions*, relative to all other off-task behaviors, was not statistically significant ($F(4, 21) = 1.78$, $p = .17$).

Grade-Level and Environmental Distractions. After controlling for gender, SES, instructional format, duration, and school type, the effect of grade-level on *environmental distractions*, relative to all other off-task behaviors, was not statistically significant ($F(4, 21) = 1.25$, $p = .32$.

Grade-Level and Self-Distractions. Controlling for gender, SES, instructional format, duration, and school type, the effect of grade-level on *self-distractions,* relative to all other off-task behaviors, was statistically significant ($F(4, 1083) = 5.71$, $p = .0002$). Adjusting for multiple comparisons (using the Tukey-Kramer method), fourth graders tended to engage in more *self-distractions* (as a fraction of all off-task behavior) than both kindergarteners ($t(1334) = 3.71$, adj $p = .002$; OR = 2.22, 95% CI = [1.24, 4.00]) and first graders ($t(1220) = -4.44$, adj $p < .0001$; OR =2.36, 95% CI = [1.39, 4.00]). All other grade-level comparisons were not statistically significant (all adj. $ps \geq .15$).

Grade-Level and Supplies. After controlling for gender, SES, instructional format, duration, and school type, the effect of grade-level on children's off-task behavior directed toward *supplies,* relative to all other off-task behaviors, was not statistically significant ($F(4, 21) = 0.37$, $p = 0.83$.

Effect of SES

No significant effect of SES was found on children's patterns of attention allocation after controlling for student characteristics, instructional design strategies, and school type (on task $p = .28$, *peer distractions* $p = .29$, *environmental distractions* $p = .70$, *self-distractions* $p = .83$, *supplies* $p = .90$).

Question 3: Are instructional design strategies related to children's attention allocation?

Effect of Instructional Format

A graphical overview of the distribution of on task and off-task behavior across

instructional formats is provided in Figure 1.

Instructional Format and On-task Behavior. After controlling for gender, grade-level, SES, duration, and school type, a significant effect of instructional format on children's rates of on-task behavior was found ($F(3, 2169) = 27.61$, $p < .0001$). Compared to all other instructional formats, the highest rates of on-task behavior occurred during individual and small-group instruction; all adj. $ps \leq .0001$. The largest OR was 1.62 [1.30, 2.02] for small-group compared to whole-group instruction on the carpet, and the smallest OR was 1.51 [1.28, 1.77], for individual compared to whole-group instruction at desks. There was no significant difference in rates of on-task behavior occurring between individual and small-group formats ($t(2169) = -0.83$, adj. $p = .84$, individual:small-group OR=1.07, 95% CI = [0.86, 1.33]). On-task behavior was least likely to occur during whole-group instruction and there was no significant difference between rates of on-task behavior during whole-group instruction on the carpet and whole-group instruction at desks ($t(2169) = -0.04$, adj. $p = 1.00$, desk:carpet OR = 1.00, 95% CI = [0.83, 1.22]).

Instructional Format and Peer Distractions. After controlling for gender, grade-level, SES, duration, and school type, there was a significant effect of instructional format on children's rates of *peer distractions*, relative to all other types of off-task behavior ($F(3, 1015) = 47.09$), $p < .0001$). As in Study 1, *peer distractions* were most frequent during individual instruction and small-group formats, followed by whole-group instruction on the carpet and whole-group instruction at desks. All formats were significantly different from each other (all adj. $ps \leq .0001$; whole-group instruction on the carpet vs. whole-group at desks was marginally significant, $t(1087) = 2.69$, adj. $p = .04$) with the exception of individual and small-group formats in which there was no significant difference in the rates of *peer distractions*, relative to all other off-task behaviors,

across these two instructional formats ($t(645) = 0.75$, adj. $p = .88$). The largest difference was individual vs. whole-group at desks with an OR of 3.11 with 95% CI [2.32, 4.18].

Instructional Format and Environmental Distractions. After controlling for gender, grade-level, SES, duration, and school type, there was a significant effect of instructional format on children's rates of *environmental distractions,* relative to all other types of off-task behavior ($F(3, 1582) = 18.69$), $p < .0001$). Adjusting for multiple comparisons (using the Tukey-Kramer method) *environmental distractions* (relative to all other off-task behaviors) were most frequent during whole-group instruction on the carpet and whole-group instruction at desks (all adj. *ps* < .0001), and there was no significant difference between these two group instructional formats (adj. $p = .99$). *Environmental distractions* were almost 3 times more likely to occur in whole-group formats compared to any other instructional format (OR's ranged from 2.72 – 2.82). Furthermore, there was no significant difference between rates of *environmental distractions* during individual instruction or small-group formats (adj. $p = 1.0$).

Instructional Format and Self-Distractions. After controlling for gender, grade-level, SES, duration, and school type, there was a significant effect of instructional format on children's rates of *self-distractions,* relative to all other types of off-task behavior ($F(3, 1582) = 45.34$), $p < .0001$). Adjusting for multiple comparisons (using the Tukey-Kramer method), *self-distractions* (relative to all other off-task behaviors) were most frequent during whole-group instruction on the carpet (all adj. *ps* ≤ .007), followed by whole-group instruction at desks (both adj *ps* ≤ .0001), and least likely to occur during individual and small-group instruction which were not significantly different from each other ($t(1582) = 1.49$, adj. $p = .44$). The OR for whole-group instruction on carpet to whole-group instruction at desks is 1.68 [1.11, 2.54], and the ORs for whole-groups at

desk to individual and small-group are 3.13 [1.95, 5.05] and 4.48 [2.73, 7.35] respectively.

Instructional Format and Supplies. After controlling for gender, grade-level, SES, duration, and school type, there was a significant effect of instructional format on children's rates of off-task behavior oriented towards *supplies,* relative to all other types of off-task behavior ($F(3, 1582) = 10.32$), $p < .0001$). Adjusting for multiple comparisons (using the Tukey-Kramer method) *supplies* (relative to all other off-task behaviors) were most frequent during whole-group instruction at desks and during small-group instruction (all adj. $ps \leq .002$ with the exception of the contrast between the small-group format and individual instruction which was marginally significant based on the more conservative alpha level of .025; $t(1582) = -2.70$, adj. $p = .04$). There was no significant difference in the rates of off-task behavior (as a fraction of all off-task behaviors) between the small-group format and whole-group instruction at desks ($t(1582) = -0.77$, adj. $p = .87$). Additionally there was no significant difference between whole-group instruction on the carpet and individual instructional formats ($t(1582) = 1.30$, adj. $p = .57$). Off-task behavior directed towards *supplies* was more than twice as likely in small-group (OR = 2.22, 95% CI = [1.25, 3.97]) and in whole-group instruction at the desks (OR = 2.51, 95% CI= [1.50, 4.20]) than in whole-group instruction on the carpet. Similarly, compared to the individual instructional format off-task behavior directed towards *supplies* was 1.69 [1.02, 2.80] (OR and 95% CI) times more likely in small-group formats and 1.91 [1.30, 2.81] (OR and 95% CI) times more likely in whole-group instruction at the desks.

Effect of Instructional Duration

Recall that the average duration of an instructional activity (sec) was operationalized as the

total duration of an observation session divided by the number of activities (defined as the number of transitions between instructional activities plus one). In many cases, transitions coincided with a change in instructional format; however, transitions could occur without a change in instructional format (e.g., rotating from one small-group activity to another). The duration of activities observed ranged from 6.7 to 39.7 minutes with a median duration of 12.8 minutes, 25% of the activity durations were less than 10.6 minutes and 25% of the activity durations were longer than 17.1 minutes.

Duration and On-Task Behavior. After controlling for gender, grade-level, SES, instructional format, and school type, a significant effect of instructional duration (sec) on children's rates of on-task behavior was found ($F(1, 954) = 7.04$, $p = 0.0081$). The slope estimate is -0.0174 (95% CI [-0.0301, -0.0047]) log odds units per additional minute of activity length. For example, comparing an activity of 10 minutes in length to one of 30 minutes in length, the estimated OR for on task behavior is 1.42 times higher for the shorter instructional activity (i.e., 10 minutes) compared to the longer instructional activity (i.e., 30 minutes). This finding suggests that elementary school children are better able to maintain a state of focused attention when instruction consists of relatively short (e.g., 10 minutes) blocks of instructional activities compared to instructional activities that occur over a longer duration (e.g., 30 minutes or longer). This finding is consistent with laboratory studies which point to a gradual increase in the duration of focused attention during early childhood (Ruff & Lawson, 1990; Sarid & Breznitz, 1997). See Figure 2 for a graphical depiction of the effect of instructional duration on on-task behavior across the different instructional formats.

Duration and Peer Distractions. After controlling for gender, grade-level, SES, instructional format, and school type, the effect of instructional duration (sec) on children's rates of *peer* off-task behavior, as a fraction of all other off-task behaviors, was not statistically significant based on the more conservative alpha level of .025 ($F(1, 392) = 2.91$, $p = .09$).

Duration and Environmental Distractions. After controlling for gender, grade-level, SES, instructional format, and school type, the effect of instructional duration (sec) on rates of *environmental distractions*, as a fraction of all other off-task behaviors, was not significant ($F(1, 731) = 2.31$, $p = .13$).

Duration and Self-Distractions. After controlling for gender, grade-level, SES, instructional format, and school type, the effect of instructional duration (sec) on rates of *self-distractions*, as a fraction of all other off-task behaviors, was marginally significant based on the more conservative alpha level of 0.025 ($F(1, 1582) = 4.89$, $p = .027$). However the estimate was negative (-0.033 log odds units per additional minute of activity length) suggesting that as the duration of a lesson *increased* the rate of self-distractions decreased.

Duration and Supplies. After controlling for gender, grade-level, SES, instructional format, and school type, the effect of instructional duration (sec) on rates of off-task behavior directed towards *supplies*, as a fraction of all other off-task behaviors, was not significant ($F(1, 770) = 0.07$, $p = .79$).

Question 4: Is school type related to children's attention allocation?

Effect of School Type

Recall that three different types of schools were recruited for the present study: Parochial schools, Private schools, and Charter Schools (public). The analyses below examine potential

differences in the rates of children's on-task behavior as a function of *School Type* as well as differences in the frequency of four types of off-task behavior: *Peer* distractions, *Environment* distractions, *self-distractions,* and *Supplies.*

School Type and On-task behavior. After controlling for gender, grade-level, SES, instructional format, and duration, a marginally significant effect of school type on children's rates of on-task behavior was found; $F(2, 24) = 3.81$, $p = .04$ (based on the more conservative alpha level of .025). Parochial schools had higher proportions of on-task behavior than private schools ($t(24) = 2.73$, $p = .01$). Children attending parochial schools were 2.10 [1.07, 4.14] (OR and 95% CI) times more likely to engage in on-task behavior compared to children attending private schools. For example, for an average third-grade boy of average SES in whole-group instruction at desks with the median activity duration in an average classroom at a parochial school the expected on-task rate is 2.77 on task behaviors for every 1 off-task behavior, while a corresponding boy from a private school would have 1.32 on task behaviors per one off-task behavior. Rates of on-task behavior were not significantly different between charter schools and private schools nor was there a significant difference between charter schools and parochial schools (both $ps \geq .36$).

School Type and Sources of off-task behavior

There was no significant effect of school type on any of the sources of off-task behavior (conditional upon being off-task) after controlling for gender, grade-level, SES, instructional format, and duration (*peer distractions* $p = .38$, *environmental distractions* $p = .87$, *self-distractions* $p = .67$, *supplies* $p = .67$).

Discussion Study 2

Even in a more heterogeneous sample, gender remained an important student characteristic that was related to children's patterns of attention allocation: Female students engaged in more on-task behavior than male students. Additionally, there were gender differences regarding the types of off-task behavior that each gender tended to engage in. For instance, *peer distractions* were more common in female students whereas male students were more likely to engage in *self-distractions* and off-task behavior directed towards *supplies*.

A significant effect of grade-level on children's on-task behavior was found in Study 2. Third graders engaged in less on-task behavior than first or fourth graders. Additionally, effects of grade-level were obtained for specific types of off-task behavior (fourth graders engaged in more *self-distractions* compared to first graders and kindergarteners) while no effect of grade was found for *peer distractions*, *environment*, or *supplies*. These findings differ from those obtained in Study 1 in which grade level was not a significant predictor of children's' attention allocation.

In Study 2 a new student characteristic, SES, was added to the model. However, at least in the present sample, no significant effect of SES was found on children's patterns of attention allocation after controlling for student characteristics, instructional design strategies, and school type. One possibility is that SES is confounded with school type. As such the unique contribution of SES may be minimal once school type is taken into account. Consequently, we conducted a follow-up analysis in which school type was dropped from the model of children's on-task behavior. The effect of SES on children's on-task behavior controlling for gender, grade-level, instructional format, and duration remained non significant ($F(1, 28) = 1.73$, $p = .20$).

Similar to Study 1, instructional format was found to be a consistent predictor of children's attention allocation in Study 2. Instructional format was a significant predictor of on-task behavior with the highest rates of on-task behavior occurring during individual and small-group instruction. Instructional format also influenced how children went off-task. For instance, whole-group instruction elicited higher rates of off-task behavior directed toward the *environment* as well as more *self-distractions,* while *peer distractions* were most frequent during individual and small-group formats.

The effect of the duration of an instructional activity on children's attention allocation revealed that on-task behavior becomes less frequent as the length of the instructional activity increases. While duration of an activity was a significant predictor of whether or not children would go off-task, in general the duration of an instructional activity did not influence the type of off-task behavior children would engage in - with the exception of *self-distractions* which were more frequent during shorter instructional activities.

In Study 2, three different types of schools participated: parochial schools, private schools, and public charter schools. A significant effect of school type was found for children's rates of on-task behavior with higher rates of on-task behavior evident in parochial compared to private schools. However, in the present sample school type was not an important determinant of the type of off-task behavior that children would engage in as there was no significant effect of school type on any of the sources of off-task behavior (conditional upon being off-task).

General Discussion

The present study provides a systematic examination of specific factors that may influence elementary school students' on- and off-task behavior. The following factors were explored: Time

of year, student characteristics (gender, grade-level, SES), instructional design strategies (instructional format and duration of instructional activity), and school type (private, parochial, public charter schools). The following findings emerged from the present work (see Table 3 for a summary of key findings).

First, children's pattern of attention allocation is not uniform across *Time of year* [Research Question 1; Study 1]. Specifically, children's on-task behavior was found to decline by the end of the school year. Additionally, the three most common types of off-task behavior (*Peer*, *Environment*, and *Self Distractions*) were all found to oscillate over the course of the school year with *peer* off-task behavior increasing in the middle of the year and *environmental* and *self-distractions* both increasing by the end of the school year.

Second, certain student characteristics influenced children's on-task and off-task behaviors [Research Question 2]. Gender was a significant predictor of children's patterns of attention allocation across studies. In both Study 1 and Study 2, our findings revealed that female students were on-task significantly more than male students. These findings align with previous research suggesting that in elementary school females are consistently more engaged than males (Marks, 2000). It is possible that in this and prior studies the amount of off-task behavior in females was under-estimated if girls tend to engage in off-task behaviors that are less noticeable than off-task behaviors in boys. However, our findings do not support this possibility. Specifically, females tended to engage in more *peer* off-task behaviors than males. Arguably, off-task peer interactions are a highly noticeable type of off-task behavior; therefore it appears unlikely that this study under-estimated the rates of off-task behaviors in girls. The effects for males were more equivocal. In study 1 males tended to engage in more *environment* based off-task behavior while in Study 2

males tended to engage in greater rates of *self-distractions* and off-task behavior directed towards *supplies* than female students. It is possible that these inconsistencies emerged because in Study 2 we separated off-task behavior directed to the *visual environment* from off-task behaviors involving *supplies*, with the latter category driving the gender differences observed in Study 1.

Variations in the absolute proportion of on-task behavior and off-task behavior across grade-levels were not uniform across the present studies. While results from Study 1 indicate no significant effect of grade-level on students' patterns of attention allocation, Study 2 found some evidence that grade-level influenced children's rates of on and off-task behavior. For example, third graders were least likely to engage in on-task behavior (compared to first and fourth grade students). While higher rates of *self-distractions* were found among fourth graders (compared to kindergarten and first graders). The inconsistent effect of grade-level across studies may be due in part to the under-sampling of third-grade classrooms in both reported studies. While we attempted to recruit a representative sample of different grade-levels, third grade teachers were considerably less likely to volunteer to participate in the study than teachers in other grade-levels. One possible explanation for third grade teachers' reluctance to volunteer may be due to added pressures that third grade teachers encounter with the onset of standardized testing in third grade. Overall, the reported results suggest that in elementary school grade-level is an unstable factor in influencing the prevalence of students' on-task and off-task behaviors.

In the present study socioeconomic status (SES) did not influence children's patterns of attention allocation. One possible explanation for this result is that SES is confounded with school type. However, this possibility was not supported in a follow up analysis in which school type was removed from the analysis and the effect of SES remained non-significant. Additionally, it is

possible that any influence from SES may be obscured by under-sampling of very low SES schools. Future research will need to more fully evaluate the influence of SES on attention allocation particularly in these more vulnerable populations.

Third, we also examined the relationship between teachers' instructional design choices and children's on- and off-task behavior [Research Question 3]. Specifically, we investigated two components of instructional design: type of instructional format (e.g., individual work, small-group work, whole-group work, etc.) and the average duration (sec) of an instructional activity. We found that instructional format influenced the overall rate of on-task behavior as well as the form that off-task behavior takes in both a homogeneous sample of charter schools (Study 1) and within a heterogeneous sample of private, parochial, and charter schools (Study 2). Thus, the effect of instructional format appears to be generalizable to a wide range of schools and student populations.

Across both Study 1 and Study 2 we observed a consistent association between the type of instructional format and on-task behavior. Specifically, higher rates of on-task behavior were found during small-group work. These results are largely consistent with the findings that small-group instruction is associated with better learning outcomes compared to whole-group instruction (Lou et al., 1996): greater proportion of on-task behavior for small-group instructional activities might mediate the relationship between instructional type and learning outcomes. Certain instructional formats were also found to elicit different types of off-task behavior. For example, across Study 1 and Study 2, whole-group instruction (e.g., whole-group instruction on the carpet and at the desks) was associated with more off-task behavior directed toward the *environment*. Therefore, it is possible that streamlining the classroom visual environment may help reduce off-

task behaviors in this common instructional format. Overall, the finding that certain types of instructional format are associated with more on-task behavior than others indicates that further research is necessary and important given the potential implications for instruction. However, it is worth noting that instructional duration likely varies across different instructional formats; hence, differences attributed to the instructional format may also reflect effects of the duration of an instructional activity[4]. Additional research is necessary to further explore this possibility.

In regard to the effect of the average duration of an instructional activity, we found that on-task behavior became less frequent as the length of the instructional activity increased. Thus, children may be better able to maintain a state of focused attention when instruction consists of small blocks of instructional activities versus instructional episodes that occur over a longer duration (cf. Ruff & Lawson, 1990; Sarid & Breznitz, 1997). This finding is in line with prior empirical work with adults in which attention was found to wane over time (for review see Middendorf & Kalish, 1996): at the beginning of a lecture, most adult students were able to attend to the lecture for up to 18 minutes before a lapse in attention was observed; however, by the end of the lecture period adults' attention span had decreased to 3 to 4 minute segments (Johnstone & Percival, 1976 as cited in Middendorf & Kalish, 1996). However, to our knowledge no prior studies have examined the effects of duration of instructional activity on children's on-task behavior. Attention regulation skills are certainly not as developed in elementary school children as in adults. In this light, it is interesting to note that in the present study the median duration of an

[4] In the present study, the average duration of an instructional activity is not linked with instructional format. Thus within the current data set it is not possible to determine whether the duration of activities *within* particular instructional formats vary systematically. As mentioned previously, a change in an instructional activity often coincided with a change in instructional format; however, this was not always the case as an activity could change while the instructional format remained constant (e.g., when children rotate from one center to another the format remains small-group even though the instructional activity changes).

instructional activity was 12.8 minutes, and 25% of the instructional activity durations were longer than 17.1 minutes. It is possible that instructional duration interacts with other factors (e.g., activity type, difficulty level, topic interest, novelty, etc.), which may collectively contribute to children's ability to maintain a state of selective sustained attention. Further research is needed to provide educators with evidence-based guidelines on the optimal length of an instructional activity for children at each grade-level; however, the outcomes of this study suggest that long instructional activity durations (i.e., 30 minutes) may be suboptimal in elementary grades.

Lastly, the relationship between patterns of children's attention allocation and *School Type* was investigated [Research Question 4]. A marginally significant effect of school type was found, as school type influenced students' rates of on-task behavior. Specifically, students from parochial schools had higher rates of on-task behavior (compared to students attending private schools). However, the type of school (private, parochial, charter) children attend was not found to be a determining factor of the source of children's off-task behavior. It is not clear what aspects of parochial schools explain the observed patterns of increased on-task behavior found in this sample.

Limitations and Future Directions

The present work reported a number of novel findings; nevertheless there are also important limitations that should be raised and addressed in future research. First, although eye gaze is a common measure of visual attention (see Henderson & Ferreira, 2004; Just & Carpenter, 1976 for reviews), it is admittedly not a perfect measure of attention. For example, it is possible for students to appear to be on-task or attending to the teacher while they are actually daydreaming. Conversely students may be looking elsewhere while still listening to the teacher's instruction. In the latter case one could argue that the student is not off-task as some amount of attention is still

being attributed to the learning activity. However, the student described above is by definition in a state of divided attention which has been demonstrated in the prior literature to be less optimal for performance than a state of selective sustained attention (e.g., Craik, Govoni, Naveh-Benjamin, & Anderson, 1996). To address this limitation, in addition to eye gaze future work may benefit from utilizing multiple measures of attention such as activity level or gross motor movements (e.g., Milich, 1984), and body posture (e.g., D'Mello & Grasser, 2010). Finally, it would also be useful to corroborate the visual eye gaze measures with performance-based measures of attention (e.g., K-CPT: Conners & Staff, 2001; Track-It: Fisher, Thiessen, Godwin, Kloos, & Dickerson, 2013) and teacher or parent reports (e.g., CBCL: Achenbach & Rescorla, 2001).

Second, children's patterns of attention allocation may vary as a function of the characteristics of the learning task. For example, children's ability to maintain a state of selective sustained attention may be greater in self-directed learning activities compared to learning contexts that are more structured (e.g., Geary, 2011). Similarly, the difficulty level of the instructional task may interact with students' patterns of attention allocation. For instance, attention may decline when the difficulty level of the task exceeds a student's ability level (e.g., Shernoff, Csikszentmihalyi, Schneider, & Shernoff, 2003; Imai, Anderson, Wilkinson, & Yi, 1992). Future research should explore in more depth how these factors modulate students' patterns of attention allocation in classroom learning environments.

Inattention or off-task behavior is a significant problem in educational settings as inattention reduces students' opportunities to learn. Therefore, it is imperative that researchers isolate antecedents of off-task behavior in order to identify potential avenues for intervention. The present work provides a detailed exploration of elementary school children's attention allocation

patterns and highlights how the time of year, student characteristics (e.g., gender, grade level, SES), instructional design strategies (e.g., instructional format and duration of an instructional activity), and school-based factors (e.g., school type) contribute to children's on and off-task behaviors in classroom settings. The present findings are a first step in providing empirical evidence to inform interventions that aim to better engage students.

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Table 1. Percentages of on- and off-task behaviors in Study 1

On-Task Behavior			**Off-Task Behavior**	
70.70%			29.30%	
Sources of Off-Task Behavior				
Peer Distractions	**Environmental Distractions**	**Self Distractions**	**Walking Off-task**	**Other Distractions**
44.12%	24.74%	15.91%	3.07%	12.15%

Table 2. Percentages of on- and off-task behaviors in Study 2

On-Task Behavior			**Off-Task Behavior**		
73.58%			26.42%		
Sources of Off-Task Behavior					
Peer Distractions	**Environmental Distractions**	**Supplies Distractions**	**Self Distractions**	**Walking Off-task**	**Other Distractions**
49.07%	12.10%	16.86%	11.56%	3.17%	7.24%

Table 3. An overview of the key findings from Study 1 and Study 2. Consistent effects across both studies are highlighted in blue (with lighter blue highlighting effects that were partially consistent across studies).

Factor	Behavior	Study 1	Study 2
Time of Year			
Time of Year: *Beginning (T1)* *Middle (T2)* *End (T3)*	On-task	Less on-task behavior at end of the year: T3 < T1 and T2; T2 > T1	-
	Peer off-task behavior	More peer off-task behavior in middle of the year: T2 > T1 and T3	-
	Environmental off-task behavior	Environmental off-task behavior increased over the year: T3 and T2 > T1	-
	Self-distractions	Self-distractions increased over the year: T1 < T2 < T3	-
Student Characteristics			
Gender	On-task	Females more on-task: F > M	Females more on-task: F > M
	Peer off-task behaviors	Females more peer off-task behavior: F > M	Females more peer off-task behavior: F > M
	Environmental off-task behavior	Males more environmental off-task behavior: M > F	*ns*
	Self-distractions	*ns*	Males more self-distractions: M > F^{+}
	Supplies off-task behavior	-	Males more supplies off-task behavior: M > F
Grade Level	On-task	*ns*	3rd graders less on-task behavior: 3rd < 1st $^{+}$ and 4th
	Self-distractions	*ns*	4th graders more self-distraction: 4th > K and 1st
Instructional Design Strategies			
Instructional Format: *Individual (Indv)* *Small-Group (SG)* *Whole-Group Carpet (WG Carpet)* *Whole-Group Desk (WG Desk)*	On-task	On-Task most likely in SG: SG > WG Carpet / WG Desk^{+}	On-Task most likely in SG *and* Indv: SG / Indv > WG Carpet / WG Desk
	Peer off-task behavior	Peer off-task most likely in SG and Indv: SG / Indv > WG Carpet / WG Desk	Peer off-task most likely in SG and Indv: SG / Indv > WG Carpet / WG Desk
	Environmental off-task behavior	Environmental off-task most likely during WG: WG Desks/WG carpet > SG / Indv	Environmental off-task most likely during WG: WG Carpet / WG Desks > SG / Indv
	Self-distractions	Self-distractions most likely during WG Carpet: WG Carpet > all other formats WG Desks > SG / Indv	Self-distractions most likely during WG Carpet: WG Carpet > all other formats WG Desks > SG / Indv
	Supplies off-task behavior	-	Supplies off-task behavior most likely during WG Desk and SG: WG Desk / SG > WG Carpet WG Desk / SG^{+} > Indv
Average Duration of Instructional Activity	On-task	-	On-task behavior declines during longer instructional activities Negative association
	Self-distractions	-	Self-distractions declined during longer instructional activities Negative association $^{+}$
School Based Factor			
School Type	On-task	-	More on-task behavior in Parochial schools: Parochial > Private

Note. The symbol '$^{+}$' denotes a marginally significant result

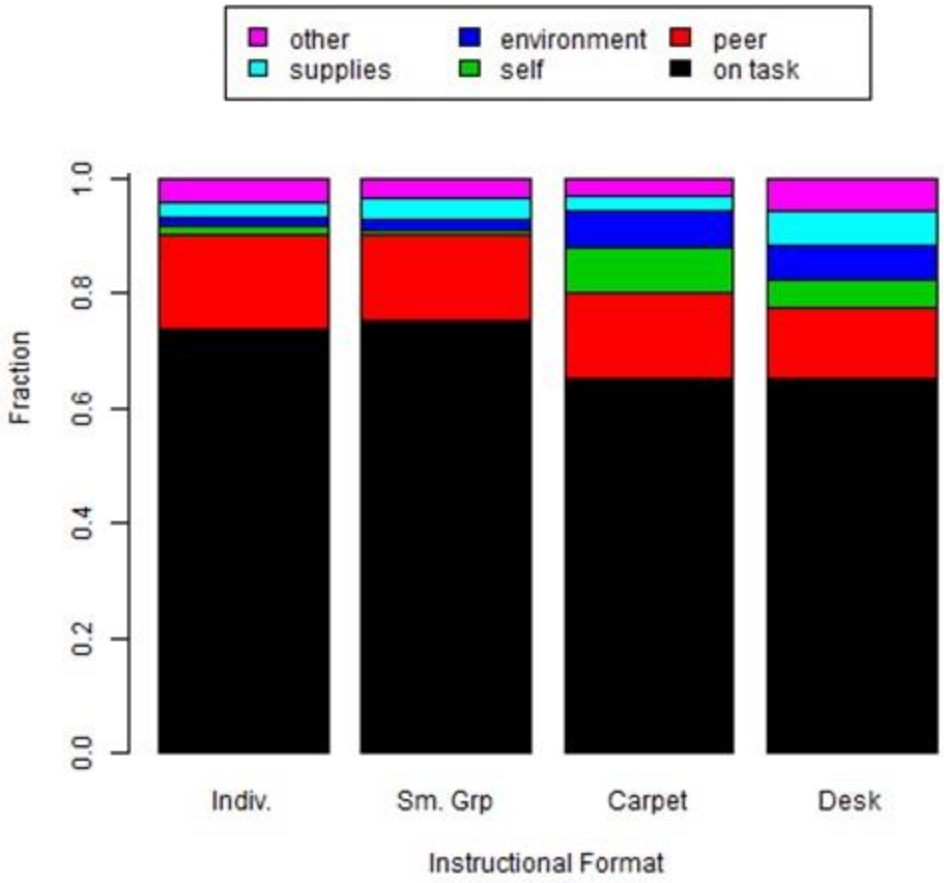

Figure 1. Depicts the full distribution of on and off-task behavior as it differs across instructional formats for the baseline group in Study 2 (i.e., male, third-grade, average SES, average classroom, private school). Please refer to the text for a discussion regarding the statistical significance of the differences displayed here.

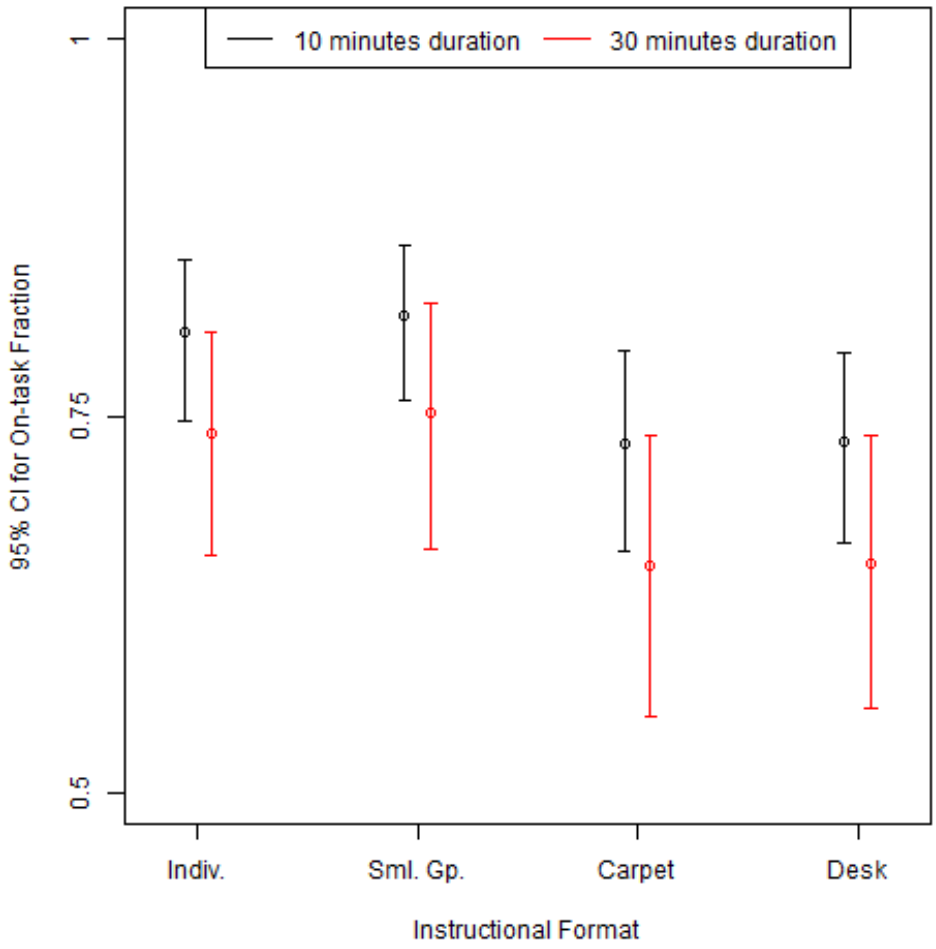

Figure 2. Displays the fraction of on task behaviors for each instructional format at two durations (10 minutes and 30 minutes) for the baseline group in Study 2 (i.e., an average third-grade male with average SES in a private school in an average classroom). Error bars represent the 95% Confidence Intervals. Note that females in the same grade, classroom, SES, and school type show an analogous pattern.