EXECUTIVE FUNCTION DEVELOPMENT

DURING THE KINDERGARTEN TO FIRST GRADE TRANSITION

By

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Thesis

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

MASTER OF SCIENCE

in

Psychology

December, 2016

Nashville, Tennessee

Approved:

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To my parents, Zerrin Ayzit, Cemal Doydum, and Jeffrey Polan, and sister, Hazel,

for their infinite support in all my endeavors.

ACKNOWLEDGEMENTS

The research described here was made possible by a Research and Evaluation on Education in Science and Engineering (REESE) grant (Number 0956855) awarded to Bruce McCandliss and the author's National Science Foundation Graduate Research Fellowship.

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CHAPTER 1

INTRODUCTION

In the course of a school day, children engage in a range of assignments, activities, and games that have overlapping cognitive demands. Many tasks involve inhibiting impulsive behaviors while selectively attending to information in the face of distracting ancillary information or environmental factors. For instance, when responding to a question, children must resist shouting out answers, raise their hands, and wait silently to be called upon by the teacher. In other cases, children must retain rules or facts in memory and switch between rules to achieve desired outcomes. For example, when children learn arithmetic, they are often required to solve mixed addition and subtraction problems on a worksheet. These are two examples of a set of higher cognitive processes referred to as executive functions (EFs). Although there are a number of diverse viewpoints as to exactly which processes are EFs and how they are related, the common strand across these models is that EF is “a process used to effortfully guide behavior toward a goal, especially in nonroutine situations” (Banich, 2009). Some of the cognitive processes described as EFs include inhibition, conflict monitoring/resolution, working memory, and cognitive flexibility (Astle & Scerif, 2008; Huizinga, Dolan, van der Molen, 2006).

EF is crucial to most forms of cognitive performance including learning and functioning in educational settings. EFs are correlated with achievement in math and literacy and account for unique variance in academic outcomes independently of IQ (i.e. Blair & Razza, 2007, Best, Miller, Naglieri, 2011; Lan, Legare, Ponitz, Li, & Morrison, 2011). Studies of EF training with computerized games shows performance improvements on trained tasks as well as transfer to other EF tasks (i.e. Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005). Additionally, new research is evaluating Tools of the Mind, an early childhood education curriculum designed with the notion that EFs can be enhanced in young children through socio-dramatic play. Taken together, this research suggests EF skills have implications for academic outcomes and that these skills may be improved through experience. However, despite our knowledge of the effects of EF on school readiness and academic success, less is known about the contributions of schooling to EF development.

Marked changes in EF are present throughout development. Improvement on indices of EFs demonstrate that children become increasingly more adept at controlling their thoughts and actions across development (i.e. Huizinga et al, 2006; Davidson, Amso, Anderson, Diamond, 2006). Moreover, previous research suggests that adult-level performance on different EF tasks is reached at different ages in development (Best & Miller, 2010). These improvements are due to significant maturational changes in children's neural circuitry, including developments in the prefrontal cortex – a region critical to EFs (Konrad, Neufang, Thiel, Specht, Hanisch, Fan, Dahlmann, & Fink, 2005).

Though developmental differences suggest improvements in EF over the early school years, these findings do not tell us what experiential factors may contribute to EF development. In the present study, we aim to investigate the effects of age and schooling on conflict processing during kindergarten and first grade. The effects of schooling are especially salient during the transition from pre-kindergarten to kindergarten and first grade, when formal schooling places higher demands on children's EFs as instruction in arithmetic and reading are introduced (Blair et al., 2007; Normandeau & Guay, 1998).

Differences in development can be attributed to age-related maturational factors or experiential influences, like schooling. One method in which these influences can be disentangled in research is with the use of school cutoff designs. The school cutoff design takes advantage of the arbitrary schooling cutoff date that serves as a condition for grade entry. Children are entered into kindergarten or first grade depending on where their birthdays fall in relation to the school cutoff date. In the school cutoff study design, participants are selected from whose birthdates fall within a narrow period of time on both sides of the cutoff date so that age differences are minimal. With age equated, students who have received different levels of schooling can be compared. For instance, comparing beginning-of-year scores of the oldest children in Kindergarten with scores from the youngest children in 1st grade would inform us of the effect of kindergarten whereas score differences between these groups obtained from tests administered at the end of the year would inform us of the effect of first grade. Using this method, schooling effects can be isolated from maturational effects.

In one of the few EF studies to employ a school cutoff method, Burrage, Ponitz, McCready, Shah, Sims, Jewkes, & Morrison (2008) examined at the development of working memory and response inhibition over the course of one year in pre-kindergarten and kindergarten students born close to the school cutoff date. They observed that kindergarteners were better at the working memory and word decoding control task in the beginning of the school year, and that these skills improved in both groups as a result of pre-kindergarten and kindergarten experiences. In contrast, improvement in inhibitory control was observed in the pre-kindergarten group between fall and spring but not in the kindergarten group. Taken together, these results suggest that some executive functions may be differentially influenced by school-related experiences. This raises the question of whether other measures of EF are sensitive to early school experiences.

Previous studies of EF have utilized a variety of tasks as measures of conflict processing. Although these tasks are effective for assessing conflict resolution in adults, there are differences among the tasks that make them more or less suitable for use with children. For instance, the Simon task (Fitts & Seeger, 1953) can be administered to very young children but it also taxes working memory because arbitrary stimulus-response mappings must be retained during the task. Other measures, like the Stroop task (Stroop, 1935) and Flanker task (Eriksen &Eriksen, 1974) do not require working memory. The Stroop task takes advantage of the fact that reading is an automated behavior in adults, and therefore is not appropriate for use in pre-literate children. Versions of the flanker paradigm employing spatial cues mapped to spatially distinct responses are advantageous in that they do not load on working memory and have been successfully tested with children as young as 4 years of age (Rueda, Posner, Rothbart, & Davis-Stober, 2004).

In the version of the flanker task involving task-relevant directional cues, participants must indicate as quickly as possible whether a centrally presented stimulus points to the left or to the right while ignoring proximate left- or right-pointing flanker stimuli. When the flanking stimuli are pointing in the same direction as central stimulus (i.e. spatially congruent), there is no cognitive conflict. However, when flanking stimuli are pointing in the opposite direction (i.e. spatially incongruent), conflict must be resolved prior to responding. The extra time needed to resolve this conflict (to inhibit responding on the basis of the flankers) provides a measure of the efficiency of conflict resolution. Longer reaction times and more errors indicate less efficiency (Rueda, Fan, McCandliss, Halparin, Gruber, Lercari, & Posner, 2003). Typically, conflict processing is measured as the difference between reaction times or error rates on incongruent trials and congruent trials.

Previous studies using flanker paradigms have found that incongruent flankers produce interference at all ages. These effects decline with age in early to middle childhood and reach close to adult levels in late childhood. Ridderinkhof, van der Molen, Band, & Bashore (1997) showed no improvement in conflict processing after age 10. Using the child-adapted version of the Attention Network Test (A.N.T.), a combination of the Flanker and Posner cuing paradigm, Rueda et al. (2004) found conflict scores and error rates decrease until the age of 7 after which little change was observed. Six-year-old children had high error rates (11.8% for congruent, 25% for incongruent) potentially indicating that they may have had difficulty understanding the instructions. With such high error rates, these findings must be interpreted with caution.

The current studies examine the effects of age and formal schooling on EF in two cross-sectional samples of kindergarteners and first graders. Study 1 examines conflict processing in a private school sample, whereas Study 2 addresses isolates the effects of schooling apart from age by using a variant of the school cutoff design within a public school sample.

CHAPTER II

STUDY 1

For Study 1, we adapted the Flanker component of the child-friendly A.N.T. (Rueda et al., 2004) for use on a touchscreen computer. Previous research indicates that children perform best when they have a strong goal representation (i.e. a context) and when there is clear feedback on their performance (Berger, Jones, Rothbart, & Posner, 2000). For this reason, we have modified the task to be even more goal-oriented by adding onscreen “nets” to “catch” fish and by providing animated feedback that reinforces the contingencies in the task. When children respond by selecting a net, they see the net move towards the fish, and when they select the correct net, they see the fish swim into the net along with auditory feedback. These additions make our flanker task experience more game-like and engaging, thus increasing accuracy and providing more interpretable reaction time data.

Based on the previous literature, we hypothesize that we will observe an improvement in reaction times and accuracy between kindergarteners and first graders. Once we control for age in Study 2 by employing a school cutoff design, we expect to find effects of schooling on conflict processing with first graders showing better reaction times and accuracy due to their prior year of experience with kindergarten.

Participants

Participants were 112 children in kindergarten (N = 51) and first-grade (N = 61) (see Table 1 for summary). The kindergarten group had an average age of 6.15 years (*Range* = 5.33 –

7.07, *SD* = .37). The first grade group had an average age of 6.97 years (*Range* = 4.87 – 7.95, *SD* =.48). Participants were recruited from private schools in the metropolitan Nashville-area.

Table 1. Study 1: Participants.

	Grade Level	N	Mean Age (years)	Age SD	Age Range
Study 1	Kindergarten	51	6.15	.37	5.33 - 7.07
	1st Grade	61	6.97	.48	4.87 - 7.95
Study 2	Kindergarten	39	5.98	.09	5.81 – 6.12
	1st Grade	24	6.24	.08	6.08 - 6.36

Two kindergarteners were excluded from the reaction time analyses for having congruent or incongruent median reaction times that exceeded 3 standard deviations from the mean of that child's grade.

Parents completed questionnaires that detailed years of parental education, number of members in household, total income in household, number of hours in preschool and number of hours in daycare between the ages of 2 and 5. Individual t-tests confirmed that groups did not differ in terms of years of average parental education, SES (income-to-needs ratio), average time in preschool or daycare (see Table 2 for summary).

Table 2. Study 1: Parental Questionnaire (with Standard Deviations in Parentheses).

Grade Level	Parental Education (years)	Income-to-Needs Ratio	Average # of Hours in Pre-K per Week	Average # of Hours in Daycare per Week
Kindergarten	17.53 (1.67)	11.96 (15.44)	15.44 (7.92)	7.93 (12.33)
1st Grade	17.19 (1.37)	8.52 (7.88)	19.62 (12.32)	4.72 (9.89)

Methods

Stimuli

Stimuli were displayed using EPrime 2.0.8.74 on a HP EliteBook 2750p Tablet PC laptop computer featuring a 12.1” touchscreen display and stylus. The screen was pivoted so that children viewed only the screen while the experimenter could access the keyboard behind the monitor. The experimenter controlled the onset of each trial when the child seemed attentive and ready. Each trial began with a central fixation cross. The target array was a horizontal row of three yellow-colored drawings of fish with a cyan-colored background. Two nets, one on both the lower left and right corners of the screen, served as response areas. The participant was instructed to respond based on whether the central fish was pointing to the left or right by using a stylus to tap on the corresponding net. On congruent trials, the flanking fish pointed in the same direction as the central fish, and on incongruent trials, the flankers pointed in the opposite direction.

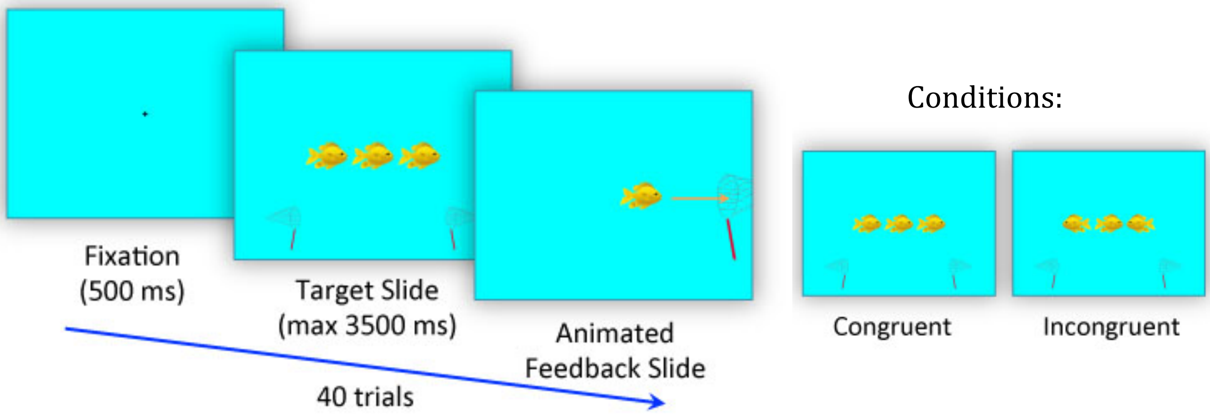

Figure 1. Schematic representation of flanker task.

Procedure

Each child completed the computerized flanker as well as other computerized tasks and paper-and-pencil standardized assessments. The Flanker task took approximately four minutes to administer and was part of a 30- to 45-minute testing session.

Participants were instructed to catch a fish by using one of the nets on the lower left and right corners of the screen. They were told that the fish would have other fish on his left and right sides, but that the goal was to catch the middle fish. Children were also instructed to rest the tip of the stylus on a 2”x2” photograph of a bucket placed 6 centimeters from the edge of the screen before each trial commenced and after making a response. This ensured that reaction times were not influenced by proximity from the screen. Finally, children were told to respond as quickly and accurately as possible.

After hearing the instructions, children watched an experimenter demonstrate the procedure with four trials: three correct responses followed by an incorrect response. Then, children completed as many practice blocks as needed to reach a criterion of four consecutive correct trials. After the practice trials, children completed 40 experimental trials. Each trial represented one of four conditions presented in equal proportions: 2 target types (congruent, incongruent) x 2 response sides (left, right). Participants responded by using the stylus to tap either the left or right net on the screen. Accuracy and reaction time were recorded. During the practice and experimental trials, children were given occasional feedback ("Good job") and encouragement from the experimenter. When children were too slow, children were encouraged to respond faster "so that the fish doesn't get away." When children, selected the wrong net, they were encouraged to "be careful" and reminded of the instructions.

Each trial began with a fixation period of a random duration between 500 and 900 milliseconds (see Figure 1). Subsequently, the target display consisting of the central fish, flanking fish, and response nets appeared until a response was detected, to a maximum of 3500 milliseconds. After responding, the participant received auditory and visual feedback from the computer. The animated visual feedback featured the selected net moving toward the fish accompanied by a "swoosh" sound. For correct trials, the animation featured the central fish swimming into the net accompanied by a recorded exclamation of "Woohoo!" For incorrect trials, the central fish swam in the direction it was pointing accompanied by a single tone. The experimenter initiated the next trial with a key press.

Results

Scores for the paper-and-pencil standardized assessments are listed in Table 3.

Table 3. Study 1: Standardized Assessment Scores (with Standard Deviations in Parentheses).

Grade Level	LW-ID	CALC	MF	AWM	PC
Kindergarten	106.77 (14.16)	91.79 (41.13)	92.62 (26.18)	111.23 (27.00)	103.02 (15.85)
1st Grade	110.20 (11.64)	108.44 (14.83)	104 (11.20)	116.03 (18.77)	102.98 (5.95)

Note. MR refers to WASI Matrix Reasoning; Woodcock-Johnson III subtests: LW-ID refers to Letter-Word Identification, CALC to Calculation, MF to Math Fluency, AWM to Auditory Working Memory, PC to Pair Cancellation.

For the flanker task, percent error was calculated by dividing number of incorrect responses by the total number of valid trials. Trials were considered invalid if the laptop touchscreen did not register the child's first attempt to select a net or if the child was inattentive. These trials were marked by the experimenter and excluded from analyses. Median reaction times (RTs) using only correct responses were calculated for each participant. Medians rather than means were used to reduce the effect of outlying RTs.

In order to analyze the effect of flanker congruency on reaction times across grade levels, we conducted an ANOVA with Congruency (2 levels: congruent, incongruent) as a within-subjects factor and Grade (2 levels: K, 1) as a between-subjects factor. As expected, a significant main effect of grade indicated that first-graders were faster than kindergarteners, $F(1,110) = 7.22$, $p < .05$, and children were faster when responding to congruent trials than incongruent trials, $F(1,110) = 51.08$, $p < .01$ (see Figure 2). Conflict processing improved as a function of grade, as indicated by a significant interaction, $F(1,110) = 7.43$, $p < .05$. Pairwise comparisons revealed that the flanker congruency was significant for both grade levels, $p < .01$. Kindergarteners and first graders differed on incongruent trials with kindergarteners having longer reaction times ($p < .01$). The same effect was only marginal on congruent trials ($p = .07$).

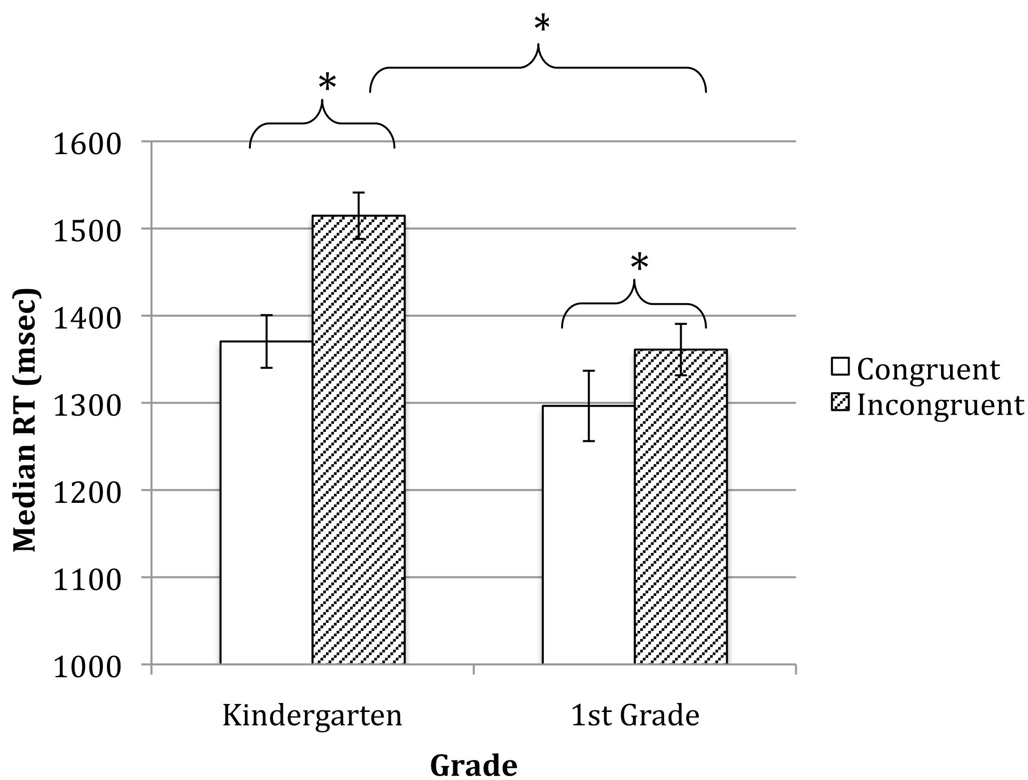

Figure 2. Study 1: Mean of Median Reaction Times (in Milliseconds) by Grade

The same analysis was conducted with error rates and yielded a main effect of flanker congruency, $F(1,112) = 6.63$, $p < .05$ (see Figure 3). Pairwise comparisons revealed that only kindergarteners committed more errors on incongruent trials compared to congruent trials ($p < .05$). Overall, the results suggest that reaction time on flanker task was a sensitive measure of conflict processing and that this process gained efficiency between kindergarten and first grade.

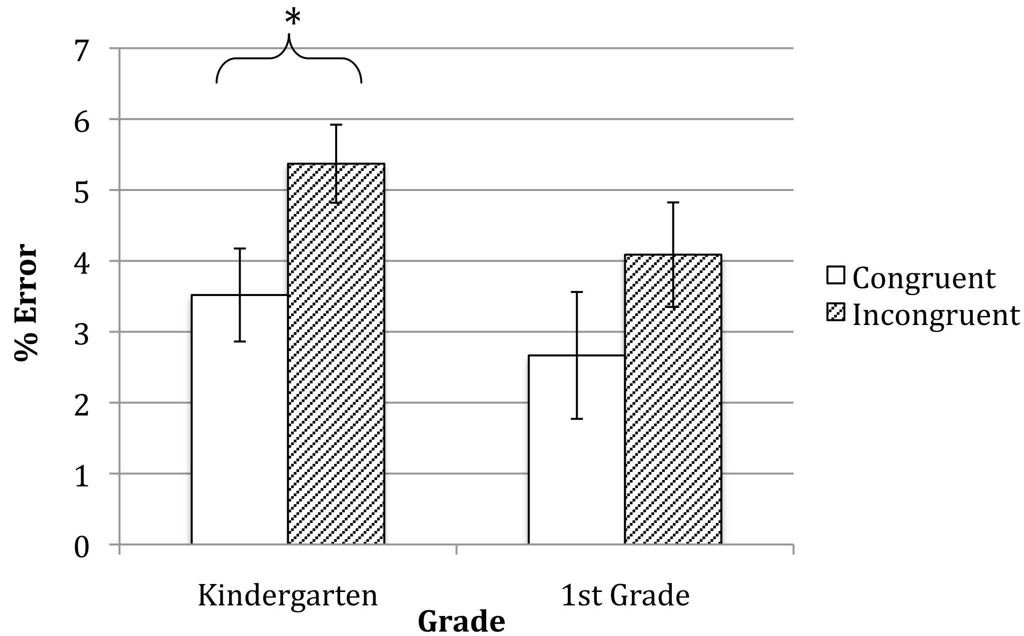

Figure 3. Study 1: Mean of Error Rates by Grade

Since accuracy was high, and the distribution of scores was not normal, we arcsine transformed the error rates. Conducting the accuracy analysis with arcsine-transformed error rates yielded the same main effect of flanker congruency, and pairwise comparisons showed that kindergarteners committed marginally more errors on incongruent trials than congruent trials ($p < .09$).

Controlling for grade level, conflict score and error rates in the congruent condition were not correlated, whereas conflict score and error rates in the incongruent condition were correlated, $r = .34$, $p < .01$. Controlling for grade level, overall reaction time and error rates in the congruent and incongruent conditions were correlated, $r = .29$ and $r = .30$ respectively, both p's < .01.

Discussion

This study provides an analysis of conflict processing in the early school years. Our task was sensitive to capturing development in conflict processing, and the modifications we made to make the flanker task to incorporate more game-like features resulted in high accuracy rates for both groups. The results indicate that conflict processing is significantly more efficient in first graders than in kindergarteners. Kindergarteners showed a greater decrement in performance between incongruent and congruent trials that manifested primarily in between-group differences in incongruent trial reaction times. This suggests that the processing demands incurred by incongruent trials were greater for the younger group.

These above group differences could be attributed to age, schooling, or a combination of both; the study design does not allow for dissociating these effects clearly. The private schools from which we recruited our participants did not impose a strict cutoff. Instead, children were admitted into kindergarten based on interviews and observations. It is likely that children displaying better self-regulation and EF skills were accelerated whereas children with poorer EFs were held back. Therefore, dissociating age and schooling effects is not possible in this experiment.

To address is question, we employed a school cutoff design in Study 2. We assume that the effects of schooling can be interpreted because grade level is determined by age only and no other selection criteria. In the public school system from which we recruited participants for Study 2, grade retention and acceleration were less frequent than in private schools, and prospective participants with atypical age/grade matching were not recruited.

CHAPTER III

STUDY 2

Participants

Participants were 63 children in kindergarten (*N* = 39) and first-grade (*N* = 24) (see Table 1 for summary). The Kindergarten group had an average age of 5.98 years (*Range* = 5.81 – 6.12, *SD* = .09). The first grade group had an average age of 6.24 years (*Range* = 6.08 – 6.36, *SD* = .08). Participants were recruited through the afterschool programs of public schools in the metropolitan Nashville-area. Since the school cutoff date was approximately September 30, only kindergartners born in July, August, or September were recruited. Only first-graders born in October, November, or December were recruited.

Two first-graders were excluded from the reaction time analyses for having congruent or incongruent median reaction times that exceeded 3 standard deviations from the mean of that child's grade. Four children (3 kindergarteners, 1 first-grader) were excluded from the accuracy analyses for having greater than 40% overall error rates.

Methods

Stimuli

Stimuli were the same as Study 1, except experiment trials automatically self-advanced after child responded instead of being experimenter-initiated.

Procedure

The procedure was identical to Study 1.

Results

Scores for the paper-and-pencil standardized assessments are listed in Table 4.

Table 4. Study 2: Standardized Assessment Scores (with Standard Deviations in Parentheses).

Grade Level	LW-ID	CALC	MF	AWM	PC
Kindergarten	107.49 (9.92)	83.08 (46.74)	87.95 (23.52)	102.69 (5.12)	107.21 (30.87)
1^{st} Grade	120.65 (11.98)	110.73 (13.91)	107.62 (10.71)	107.73 (5.72)	116.70 (19.60)

Note. MR refers to WASI Matrix Reasoning; Woodcock-Johnson III subtests: LW-ID refers to Letter-Word Identification, CALC to Calculation, MF to Math Fluency, AWM to Auditory Working Memory, PC to Pair Cancellation.

For the flanker task, in order to analyze the effect of flanker congruency on reaction times across grade levels, we conducted an ANOVA with Congruency (2 levels: congruent, incongruent) as a within-subjects factor and Grade (2 levels: K, 1) as a between-subjects factor. A significant main effect of grade indicated that first-graders were faster, $F(1,61) = 5.34$, $p < .05$, and children were faster when responding to congruent trials than incongruent trials, $F(1,61) = 16.70$, $p < .01$ (see Figure 4). In contrast to Study 1, there was no significant interaction of grade and flanker congruency.

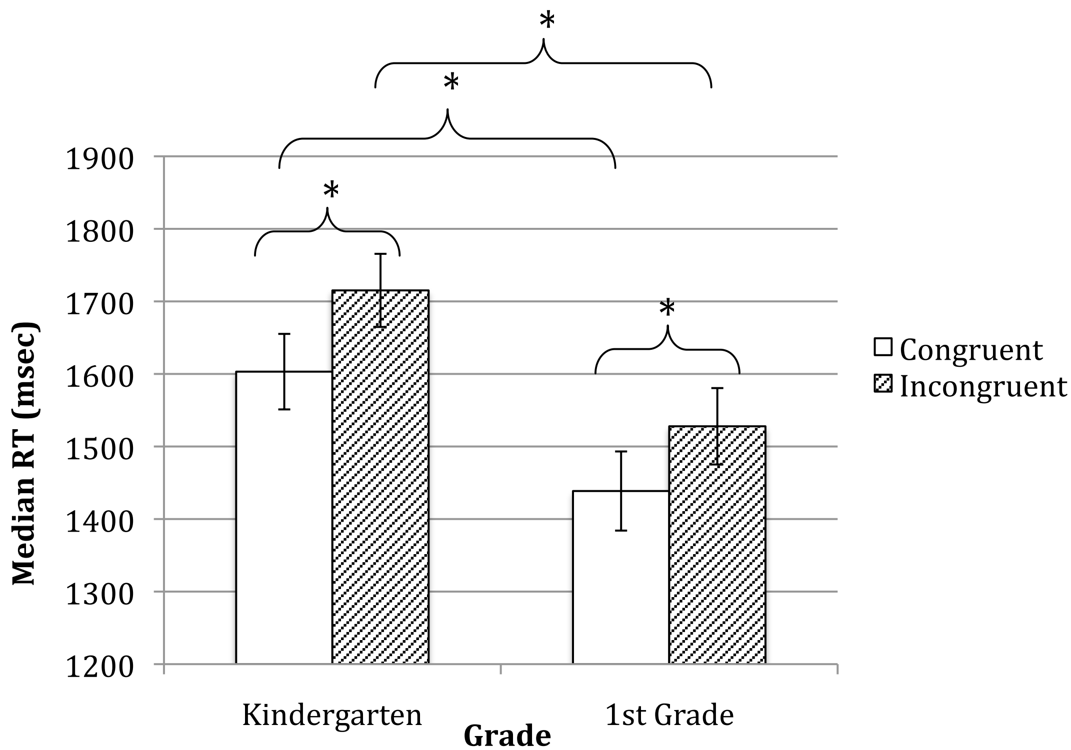

Figure 4. Study 2: Mean of Median Reaction Times (in Milliseconds) by Grade

The same analysis was conducted with error rates and yielded a main effect of grade level, $F(1,59) = 8.55$, $p < .01$ (see Figure 5). Moreover, there was a significant interaction between grade level and flanker congruency, $F(1,59) = 4.60$, $p < .05$ indicating that conflict processing accuracy improved across grade levels. Pairwise comparisons revealed that groups differed on incongruent trials, with kindergarteners committing more errors ($p < .01$). Also, kindergarteners committed more errors on incongruent compared to congruent trials ($p < .01$), whereas first graders committed a similar number across trial conditions.

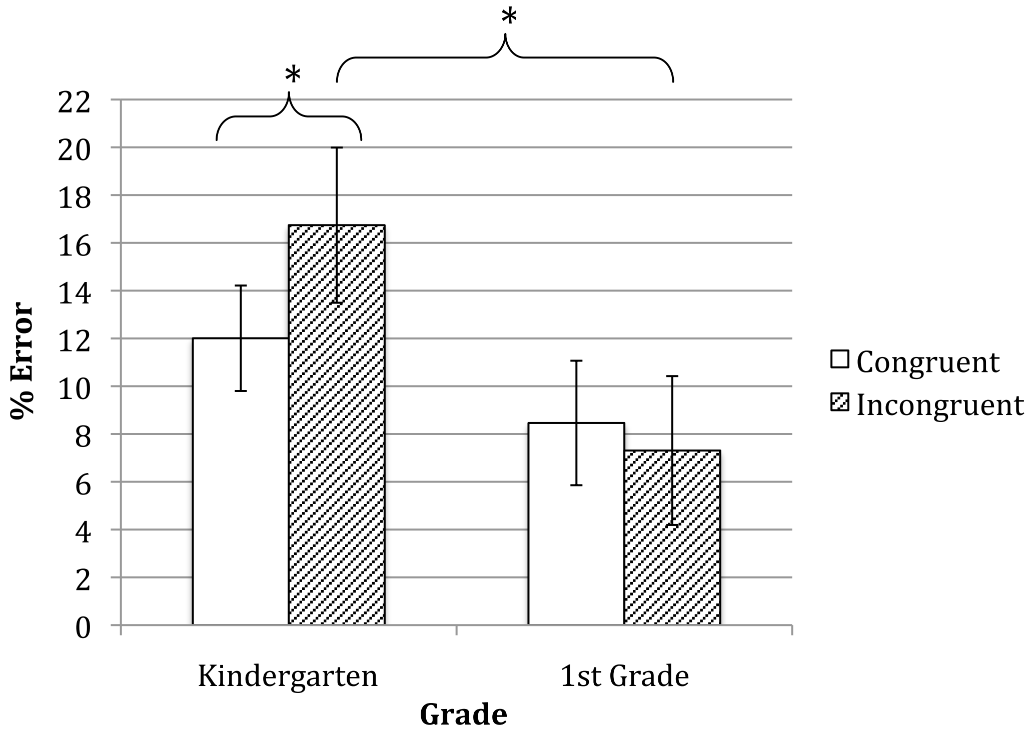

Figure 5. Study 2: Mean of Error Rates by Grade

Conducting the same analysis with arc-sine transformed error rates yielded a main effect of grade level, $F(1,59) = 11.42$, $p < .01$. The grade level X flanker congruency interaction was marginal, $F(1,59) = 3.35$, $p = .07$. Pairwise comparisons revealed results similar to those in the previous analysis, but additionally, there was a marginally significant difference between grade levels on congruent trials ($p = .06$).

Controlling for grade level, conflict score and error rates in both congruent and incongruent conditions were not correlated. Controlling for grade level, overall reaction time and error rates in the congruent and incongruent conditions were correlated, $r = .35$ and $r = .39$ respectively, both p's < .01.

Discussion

This study captured a developmental change in conflict processing with a much smaller, younger sample of children compared to Study 1. Unlike Study 1 in which the change was observed in reaction times, the developmental change in Study 2 was present in the accuracy domain. Kindergarteners committed significantly more errors on incongruent trials compared to congruent trials, whereas first graders committed an equal number in both trial types.

CHAPTER IV

GENERAL DISCUSSION

These studies aimed to explore the relative contributions of maturation and schooling on EF as measured by conflict processing in a flanker task. Study 1 was conducted with a sample of kindergarten and first graders enrolled in private schools. Study 2 employed a school cutoff design to isolate the effects of schooling in a sample of kindergarten and first graders enrolled in public schools. Overall, the results suggest that our version of the flanker task was sensitive to capturing development in conflict processing in kindergarteners and first graders, and this process was more efficient in first graders.

In Study 1, improvement in conflict processing was observed in reaction time. In Study 2, improvement was captured in accuracy rates in a much smaller sample among children much closer in age. This difference manifests differently across samples due to a number of potential factors. Generally, children in Study 2 were slower (average of 230 msec for kindergarteners, 150 msec for 1^{st} graders) and less accurate than children in Study 1.

So far, the results only provide an entry point for further investigations into the effects of schooling on EF development. Longitudinal follow-up testing at the end of the school year will allow us to examine changes in reaction time and accuracy after a year of kindergarten or first grade. If we find that conflict processing improves significantly in first graders versus kindergartners, we can attribute this to a schooling effect of first grade. If we find that conflict processing improves equally in both groups, we can attribute this mostly to a maturational effect.

The results of Study 2 suggest that kindergarten experiences may have a crucial role in shaping EFs. It is possible that the year of kindergarten experienced by first graders was instrumental in honing attention skills and staying on task, as indicated by lower error rates. The kindergarten group was only exposed to pre-kindergarten experiences, which may have not taxed EFs as heavily. It is also possible that home practices changed as a result of entering kindergarten. Some previous research shows that parents increase literacy practices in anticipation of children entering kindergarten (Son & Morrison, 2005, April). Thus, the additional exposure to reading could benefit EFs. These questions are beyond the scope of the present investigation, but are worth further exploration.

There are several aspects of the studies that must be considered when comparing reaction times and accuracy. Most importantly, the flanker tasks used in the studies were slightly different; Study 1 featured experimenter-initiated trials whereas Study 2 had trials that self-advanced. Therefore, experimenters in Study 1 did not initiate the next trial until children demonstrated that they were attentive and on-task. If children were not attending, experimenters could direct their attention to screen. In Study 2, experimenter did not control trial onset. Although experimenters tried to prompt child to attend to the display, it is possible that children were not focusing on the display as the trial initiated. Experimenters marked trials in which children were clearly not on-task, and we attempted to remove these trials from analyses; however, it is still possible that Study 2 included more "contaminated" trials.

In addition to differences in age range restrictions between Study 1 and Study 2, there were further differences in participant samples between the studies. The children in Study 1 were recruited from private schools, whereas Study 2 primarily recruited from public schools. Due to this, it is likely that there is a difference in SES levels between the two participant samples. We do not have enough parental questionnaire data collected from Study 2 participants to compare, but this merits future investigation (see Table 2 for Study 1 questionnaire data). A substantial literature indicates that SES is associated with EFs (i.e. Sarsour, Sheridan, Jutte, Nuru-Jeter, Hinshaw, & Boyce, 2011; Noble, McCandliss, & Farah, 2007). Noble et al. (2007) found that the association of SES and working memory was mediated by home literacy environment, preschool attendance, and elementary school quality. On the other hand, the association between SES and cognitive control was explained by language abilities. Taken together, it seems that SES influences EF component processes with a combination of home and school-related variables mediating this relationship.

In addition to SES, it is relevant to consider the discrepancy in standardized assessment scores between participant samples. T-tests reveal that kindergarteners in Study 1 and 2 differed on Math Fluency scores, whereas first graders differed in Calculation and Math Fluency (see Table 5). This difference could be partially attributed to the younger age of children in Study 2. The entire sample of children in Study 2 fell within the age range of kindergarteners in Study 1.

Table 5. Study 1 & Study 2: Standardized Assessment Scores (with Standard Deviations in Parentheses).

Grade Level		LW-ID	CALC	MF	AWM	PC
Kindergarten	Study 1	106.77 (14.16)	91.79 (41.13)	92.62** (26.18)	111.23 (27.00)	103.02 (15.85)
	Study 2	107.49 (9.92)	83.08 (46.74)	87.95 (23.52)	102.69 (5.12)	107.21 (30.87)
1st Grade	Study 1	110.20 (11.64)	108.44* (14.83)	104** (11.20)	116.03 (18.77)	102.98 (5.95)
	Study 2	120.65 (11.98)	110.73 (13.91)	107.62 (10.71)	107.73 (5.72)	116.70 (19.60)

Note. MR refers to WASI Matrix Reasoning; Woodcock-Johnson III subtests: LW-ID refers to Letter-Word Identification, CALC to Calculation, MF to Math Fluency, AWM to Auditory Working Memory, PC to Pair Cancellation.

**p<.05 *p<.01 indicates significant difference between Study 1 & 2

The present study goes beyond previous research by capturing a developmental shift in conflict processing in the early school years with partial insight into how these changes are related to maturational versus schooling effects. Schooling effects will be addressed more clearly in the longitudinal component of this project, when changes in conflict processing efficiency will be assessed after a year of kindergarten or first grade.

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