Elementary School Teachers' Philosophies of Classroom Instruction: A Thematic Analysis

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Introduction

- During the early elementary school years, exposure to teacher language that is rich in references to metacognition, cognitive processes, and requests for remembering is important for long-lasting gains in academic achievement (Ornstein et al., 2010; Coffman et al., 2019).
- The use of this metacognitively-rich language – termed Cognitive Processing Language (CPL) – during whole-class instruction has been linked to children's developing memory skills, study skills, and acquisition of knowledge in specific content domains, such as mathematics.
- Natural variability exists in teachers' use of CPL, but previous research has demonstrated that factors such as education level and teaching experience do not account for this difference (Coffman et al., 2008; 2019). This work is motivated by an attempt to understand possible sources of the documented differences in teachers' use of this language. Specifically, we seek to understand why some teachers use naturalistically higher levels of CPL, whereas others use lower levels of this language.
- Given the link between teachers' CPL and children's cognitive skills, it is important to understand more about the factors that may underlie these differences.

Aims of the Study

In this exploration of the factors that influence teachers' differing use of CPL, we aim to:

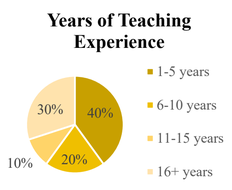
1. Examine teachers' thinking regarding facilitation of learning in the classroom
2. Identify teachers' opinions concerning central ideas about classroom instruction
3. Build a foundation for further exploration of the intersection of teachers' perspectives with their observed classroom instruction to understand factors that contribute to differences in teachers' use of CPL

Methods

- Data for this study were drawn from an ongoing longitudinal study that is designed to examine children's cognitive and academic skills across the elementary school years.
- These teacher-centered interviews were conducted at the conclusion of the child participants' Kindergarten year (Spring 2018) through hour-long qualitative interviews.
- To explore the content of the teacher interviews, we used a thematic analytics approach for systematic investigation of patterns of approaches to instruction (Braun & Clarke, 2006).

Participants

Participants were drawn from 3 schools and included 10 Kindergarten teachers.



- 10 women, 0 men
- Age Range: 23 - 53 years; Mean: 37 years
- The sample was comprised of 80% European American, 10% African American, and 10% Asian American/Pacific Islander
- Mean Years of Teaching Experience: 13.4; Range: 2-30
- Mean Years Kindergarten Instruction: 10.38; Range 1-25

Interview Protocol & Analysis

- Hour-long, open-ended, one-on-one in-person interviews were conducted with 10 Kindergarten teachers using an adapted version of the Teacher Interview Protocol (Weiss et al., 2003).
- We asked teachers to describe their professional training and experience, personal philosophies of instruction, as well as their content knowledge and beliefs about student approaches to problem solving.

Memory	Do you think memory is an important part of your classroom? If so, why, or in what ways?
	Do you think there is a relation between children's memory skills and student achievement? If so, what is it?
Critical Thinking	How much can teachers help students think critically? What do you do to foster this skill?
	How much can you gauge student comprehension of what you have taught?
Varied Instructional Strategies	How much can/do you adjust your lessons to the proper level for individual students?
	How well can you provide appropriate challenges for very capable students?
Math Strategies	What math strategies do you want your students to have when they leave your classroom? Where did you develop these goals and how does this vary by student?

- Each interview was audio-recorded and later transcribed.
- We inductively created a qualitative codebook that includes code names, definitions, and examples.
- 2 trained researchers inductively coded each transcript separately and maintained >80% reliability.

Results & Discussion

- We identified four main themes that teachers shared in the interviews – importance of memory, critical thinking, instructional strategies, and the foundational nature of math skills. Table 1 provides a definition of each theme and examples from teachers.
- In every interview, teachers emphasized the importance and role of memory. In these conversations they specified different instructional techniques they use to foster development. Some teachers made connections to classroom experiences to create meaning behind memory, while others used students' background knowledge or home life to connect experiences.
- 8 of the teachers emphasized that an important role of their position as a Kindergarten teacher was to nurture the development of critical thinking skills – both academic and social. The distinction between the two skills was important because teachers believed that critical thinking in the classroom can also support peer interaction skills.
- Individual modifications for struggling and advanced students were mentioned by every teacher. Varied strategies such as modeling, small- and whole-group instruction, visual aids, and exciting activities allowed teachers to acknowledge and support children of different academic abilities. These teachers set different expectations and adapted classroom instruction to reflect the specific needs of students with different academic, behavioral, and social abilities.
- 7 teachers discussed the ways in which mathematics skills in Kindergarten are foundational skills that are used to build a more advanced understanding of numbers in future grades. The teachers focused on a general number sense – an ability to use and understand numbers and identify number relationships (e.g., greater than and less than).
- These qualitative interviews provided us with a foundation of understanding of teachers' philosophies and opinions about classroom instruction and students' abilities, which may contribute to differences in teachers' use of CPL. Future research should explore the intersection of teachers' perspectives with their observed classroom instruction in order to better understand what factors may contribute to differences in teachers' use of CPL.

Table 1: Teachers' Views on Learning in the Classroom Context

Theme	Definition/Theme Explained	Examples
Importance of Memory	Teachers emphasized the importance of memory for school success. They recognized the importance of different types of memory that students may use, as well as ways that they may foster memory development in the classroom through meaningful associations, the use of aids, and building on students' background knowledge.	"The best way to tap into memory…is to have some memory behind it…Each student here will remember certain things because it had meaning for them." "I feel like there's two ways that we hope and expect students who can remember things. There's just rote memorization…there's nothing there you can connect an experience to, you just have to remember what it is."
Critical Thinking	Teachers felt that the development of critical thinking during the Kindergarten year was important from an academic stance, as well as a social stance. This included critical thinking skills that were centered around understanding math and reading problems, as well as critical thinking skills that were integral to peer interactions.	"Kids, they're going to hear things, see things from their peers, from their teachers, from the media, and they have to know how to look at that critically with their own mind, form their own opinion, and also have this awareness of 'that might sound interesting, but how do I find out if it is factual'...That's the very beginning foundations of teaching…you have to look in the right places if you want to find facts." "We try to teach them [critical thinking] a lot and I feel like that can be done through different ways: it can be done in academic ways as well as…social and emotional ways."
Teachers' use of Varied Instructional Strategies	Teachers saw it necessary to use various strategies during instruction in order to support all students' learning. These strategies included modeling, small- and whole-group instruction, using visual aids, and completing activities in which students were eagerly engaged.	"Just working with a variety of students you realize…you have to set different expectations for them." "We give that slow release where we do all of it first and then they practice with us and we model for them…and they do it independently." "I make sure that kids with different diverse background with different cultural backgrounds…they're seeing some of that pulled into what they have."
Mathematics Skills as Foundational	Teachers viewed the mathematics skills that students learned during the Kindergarten school year as foundational to mathematics skills and concepts that would be taught during future grades. These skills included understanding not only how to count, but what numbers mean (number sense).	"…In a quantity and why ten is more than five on your fingers showing why ten is more than five, um, because then that applies as they get to first grade and second grade when you get to word problems, as you solve it, being able to see your answer and think, that doesn't make sense." "I guess an of idea number sense. So understanding that numbers represent groups or a collection of items or objects or things like that."

Thank you to the children, families, teachers, and research assistants who make this work possible. The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A170637 to the University of North Carolina at Greensboro. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

The Development of Kindergartners' Deliberate Memory Skills: The Moderating Role of Metamnemonic Knowledge

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INTRODUCTION

- A rich literature has documented how the use and effectiveness of appropriate strategies for remembering improve across the elementary school years (Ornstein, Haden, & San Souci, 2008).
- Given that the link between strategy use and recall is not as clear in early childhood, it is necessary to examine individual-level factors that may account for variability in strategy use and effectiveness.
- It has been suggested that in order to appropriately use strategies in service of a memory goal, children require an existing knowledge of strategies and an understanding of how their memory works—or metamemory (Schneider, 1985; Wellman, 1983).
- However, limited research has examined the role of metamemory, and more specifically metamnemonic knowledge, on children's effective strategy use and recall over time. Especially important is understanding the contribution of metamemory when it is conceptualized across different measures.
- Despite the acknowledged variability in children's metacognitive skills at school entry, there are almost no short-term longitudinal studies examining children's emergent metacognitive skills (Roebers, 2017).

AIMS OF THE STUDY

In this exploration of the connections between children's strategy use, metamemory, and recall we aim to:

1. **Characterize children's emergent deliberate strategy use and metamnemonic knowledge using two metamemory measures at two time points in kindergarten.**
1. **Explore the moderating effect of metamnemonic knowledge on the link between children's strategy use and recall performance.**

METHODS

- Preliminary data are presented from an ongoing longitudinal study memory and cognitive skills as children transition into elementary school.
- Child-, home- and school-level measures were collected across the kindergarten year.
- Continuing data collection will allow for multi-level assessments through the beginning of the second grade.

PARTICIPANTS

Participants were drawn from 6 schools and included 94 kindergarteners:

- 42 Males, 52 Females
- Age Range: 4.93 to 6.43 years
- 58% Caucasian, 31% students of color

MEASURES

The Metamemory Task: MET (Schlagmueller et al., 2001)

- Children were presented with various questions and scenarios to assess their metamnemonic knowledge.
- They were first asked to rank the difficulty of specific memory strategies and scenarios in which strategies could be used on a scale from 1 to 3 (easiest to hardest) and then later were asked to do the same using medals (1st, 2nd, and 3rd place).
- Each response was scored on a scale of 0 to 3, with 3 indicating all stimuli were properly ranked and 0 indicating none of the stimuli were properly ranked, and were summed into a composite score.

The Object Memory Task: OBJ (Baker-Ward et al. 1984)

- Children were asked to "work to remember" as many objects as possible, and given a 2 minute study period prior to a recall trial.
- Spontaneous verbal and behavioral strategic efforts were coded.
- Children were then asked what they did to remember these objects; responses were coded on a 4-point likert scale for metamnemonic understanding.

Fall and Winter Strategy Use Descriptive Findings

Variable	Time	Min	Max	Mean	SD
Verbal Strategies	Fall	0	65	11.40	14.38
Naming					
Associations					
Object Talk	Winter	0	66	12.79	16.65
Categorizing					
Behavioral Strategies	Fall	26	124	96.40	21.88
Manipulations					
Pointing	Winter	39	124	98.57	20.47
Visual Scanning					
Composite Strategy Score	Fall	34	234	109.35	30.80
Verbal Strategies					
Behavioral Strategies					
Overt Mnemonic Activity	Winter	39	235	115.06	33.76
Covert Mnemonic Activity					

Within-Task Concurrent and Longitudinal Associations

	1.	2.	3.	4.	5.
1. Fall Composite Strategy Use	.				
2. Fall Recall	.45**	.			
3. Fall Metamnemonic Knowledge	.12	.22*	.		
4. Winter Composite Strategy Use	.36**	.24*	.08	.	
5. Winter Recall	.13	.40**	.05	.32**	.
6. Winter Metamnemonic Knowledge	.27**	.23*	.34**	.06	.09

- Children's strategy use and metamnemonic knowledge were both related with recall in the fall (R=.45; R=.22), but only strategy use was associated with recall in the winter (R =.32).

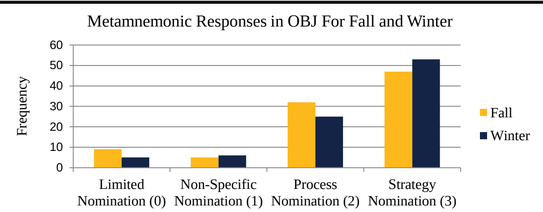
*p<.05, **p<.01

WITHIN AND ACROSS TASK RESULTS

Characterizing Children's Metamnemonic Knowledge in OBJ

"What did you do to help you remember all those things?"

Code	Definition	Example
(0) Limited Nomination	The absence of a clear nomination.	"*I don't know.*" no answer/shakes head.
(1) Non-Specific Nomination	Focused on the task demands; a lack of metacognitive awareness.	"*I'm smart.*" "*I remembered!*"
(2) Process Nomination	Acknowledgement of deliberate behavior to remember.	*"I played with them." "I focused." "Used my brain."*
(3) Strategy Nomination	Nominated a strategic behavior	*"I put them in order." "I said them over and over."*



- Approximately half of the children in Fall (50.5%) and Winter (59.6%) referenced strategic behavior when asked what they did to help them remember.

Predicting Recall Performance: Metamemory as a Moderator

Fall Multiple Regression Results

Variable	*t*	*SE B*	*β*	*F*	*df*	adj. R^2
Overall Model				10.64	3, 89	.24**
Strategy Composite Score	4.51	.01	.41**			
General Metamemory (MET)	2.22	.05	.20*			
Strategy Composite* MET	1.62	.00	-.15			
Overall Model				9.06	3, 89	.21**
Strategy Composite Score	.91	.02	.29			
Task-Specific Metamemory(OBJ)	1.89	.23	.19+			
Strategy Comp.* Meta_OBJ	.47	.01	.15			

Winter Multiple Regression Results

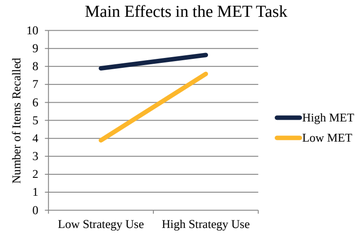
Variable	*t*	*SE B*	*β*	*F*	*df*	adj. R^2
Overall Model				5.18	3, 80	.13*
Strategy Composite Score	2.25	.01	.24*			
General Metamemory (MET)	-1.05	.04	-.11			
Strategy Composite* MET	-2.36	.00	-.26*			
Overall Model				3.63	3, 80	.09*
Strategy Composite Score	1.95	.02	.72+			
Task-Specific Metamemory(OBJ)	.56	.19	.06			
Strategy Comp.* Meta_OBJ	-1.14	.01	-.42			

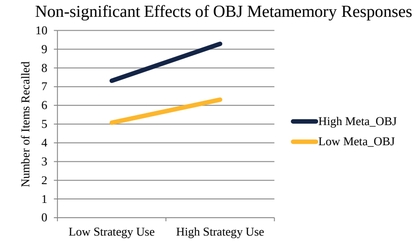
Note: Continuous predictor variables were mean-centered before entered into the model

+p<.10, *p<.05, **p<.01

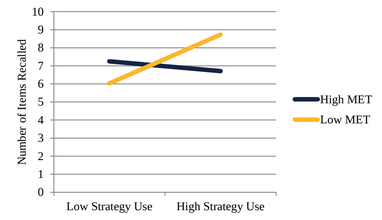
MAIN AND MODERATING EFFECTS

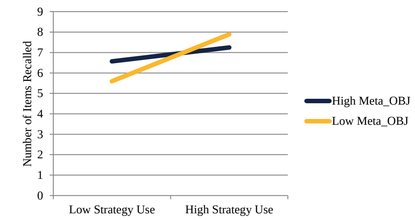
Fall Regression Results





Winter Regression Results





- In Fall, there were significant main effects of strategy use and scores on the metamemory task on children's recall (β=.41; β=.20), and a marginal main effect of metamnemonic responses in the OBJ task (β=.19).
- In Winter, there was a significant interaction effect of children's scores on the metamemory task and strategy use on recall (β=-.26), and a marginal main effect of metamnemonic responses in the OBJ task (β=.72).

DISCUSSION AND FUTURE DIRECTIONS

- Findings from this study highlight the differential role of two measures of children's metamnemonic knowledge. Specifically, children's general knowledge about successful memory strategies, rather than reflective processing after recall, played a role in the effective use of strategies. Children who exhibited fewer strategies, but higher levels of metamnemonic knowledge, were better able to take advantage of these strategies in service of a memory goal than their peers of low metamemory skills.
- These findings provide insight regarding the role of metamemory as it serves children's self-regulated learning behaviors (Roebers & Feurer, 2016) which are thought to later serve more advanced techniques for remembering information, such as integrating material and study skills (Coffman et al., 2019).
- Future research would benefit from the examination of additional individual- and context-level factors that may play a role in children's emergent metacognitive skills as they serve deliberate remembering, such as parents' and teachers' metacognitive language (Lockl & Schneider, 2006; Coffman & Ornstein, 2020).

ACKNOWLEDGEMENTS

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Exploring the Interplay of Metamemory and Teacher Language on Mathematics and Memory Performance

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INTRODUCTION

- Research documents links between adult-child conversations and children's emerging memory and mathematics skills (e.g., Fivush et al., 2006; Klibanoff et al., 2006).
- Teachers' use of metacognitive-rich language (termed Cognitive Processing Language; CPL) has been associated with students' performance on deliberate memory and mathematics tasks (Coffman et al., 2008; 2019; Hudson et al., 2018). Children in classrooms with higher levels of CPL evidenced more strategic behaviors on memory tasks and greater mathematical fluency scores.
- Results from a number of studies suggest CPL may be particularly beneficial for subgroups of students – lower-regulated and lower-achieving (Ornstein et al., 2009; Ornstein & Coffman, 2020).
- Mathematics and memory performance have also been associated with metacognition (Bellon et al., 2019; Schneider et al., 1998).
- However, little is known about the interplay of the classroom context and children's metamemory (knowledge of memory processes) on developing cognitive abilities.

AIMS OF THE STUDY

In this examination of the interplay between children's metamemory and teachers' instructional language on cognitive skills we aim to:

1. Examine associations between metamemory, deliberate memory skills, and mathematical fluency.

2. Explore the moderating effect of children's metamemory on the association between teachers' metacognitively-rich instructional language and two child outcomes – strategic sorting and mathematical fluency.

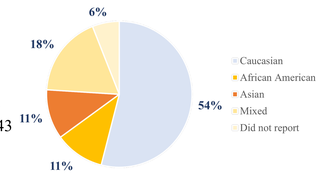
METHODS

- Data for this study were drawn from the first cohort of an ongoing longitudinal study of children's memory and cognitive skills as they transition into elementary school.
- Child- and school-level measures were collected across the Kindergarten year.
- Continuing data collection will allow for multi-level assessments through the beginning of the second grade.

PARTICIPANTS

Participants included a subgroup of 72 Kindergarteners:

- 38 Female, 34 Male
- Age Range: 4.93-6.43 years



MEASURES

Mathematical Fluency: MF (Woodcock et al., 2001)

- Children were presented with addition and subtraction problems.
- Children were given three minutes to solve as many problems as possible.

Metamemory Scale: MET (Schlagmueller et al., 2001)

- Children were presented with various questions and scenarios to assess their metamemory knowledge.
- During the first part of the assessment, children were asked to rank specific scenarios, memory strategies, or people on a scale from 1 to 3 (easiest to hardest to remember).
- During the second part of the assessment, children were asked to rank specific scenarios, memory strategies, or people using medals (1st, 2nd, and 3rd place). Scores range from 0 to 18.

Free Recall with Training: FRT (Moley et al., 1992)

- Children were asked to remember 16 line drawings (from four categorical groups) in the fall and spring of the Kindergarten year.
- During fall, children completed a baseline trial (measuring spontaneous sorting), a training trial (receiving instructions on categorical organization), and a generalization trial (assessing their ability to utilize this strategic instruction with new materials).
- Children completed a single trial with new drawings at the spring timepoint.
- As children worked to remember, their strategic sorting was measured (Roenker et al., 1971). Strategic sorting (ARC) scores range from –1 (below chance) to 0 (chance sorting) to +1 (perfect sorting).

Cognitive Processing Language: CPL (Coffman et al., 2008)

- A cumulative total of 60 minutes of whole-group mathematics lessons were videotaped and coded for each classroom.
- Teachers' language was coded every 30 seconds during lessons using a coding scheme characterized by 26 codes from four main categories: (1) *instructional activities* (2) *cognitive structuring activities* (3) *memory requests* (4) *metacognitive information*.
- A composite index of Cognitive Processing Language (CPL) is based on a subset of codes:

Code	Definition
Strategy Suggestions	Recommending that a child adopt a procedure for remembering or processing information
Metacognitive Questions	Requesting that a child provide a potential strategy, a utilized strategy, or rationale for a utilized strategy
Co-occurrence of Memory Requests and Instructional Activities	Requesting information from children's memory while also presenting instructional information
Co-occurrence of Memory Requests and Cognitive Structuring Activities	Requesting information from children's memory while simultaneously facilitating encoding and processing by focusing attention or organizing materials
Co-occurrence of Memory Requests and Metacognitive Information	Requesting information from children's memory while providing or soliciting metacognitive information

DESCRIPTIVE STATISTICS

Child-Level Tasks

Descriptive Statistics Across Kindergarten for MET, MF, and FRT

Task	Mean	Standard Deviation	Range
Fall Metamemory	8.86	3.93	0 - 16
Fall Mathematical Fluency	4.97	5.05	0 - 24
Spring Mathematical Fluency	12.54	8.89	0 - 45
Fall Baseline Sorting (FRT)	-0.21	0.12	-0.23 - 0.78
Fall Generalization Sorting (FRT)	0.02	0.47	-0.23 - 1
Spring Generalization Sorting (FRT)	0.11	0.53	-0.23 - 1

- Over the Kindergarten year, children increased in their mathematical fluency and use of strategic sorting behaviors.

Correlations Among MET, MF, and FRT

Task	1	2	3	4	5	6
1. Fall Metamemory	--					
2. Fall Mathematical Fluency	.28*	--				
3. Spring Mathematical Fluency	.28*	.60**	--			
4. Fall Baseline FRT	.19	-.02	-.03	--		
5. Fall Generalization FRT	-.01	.05	.09	-.01	--	
6. Spring Generalization FRT	.19	.17	.26*	.18	.42**	--

*p <.05 **p <.01

- Within-task correlations were observed for mathematical fluency and sorting generalization scores.
- Children's metamemory at school entry was correlated with mathematical fluency at the beginning and end of Kindergarten.
- Spring sorting scores and mathematical fluency were significantly correlated.

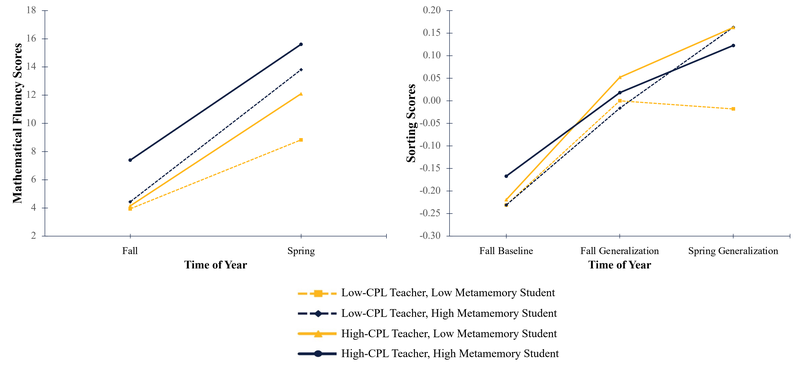
Classroom-Level Factors

Taxonomy Codes	Overall Mean *(Range)*	Low CPL Mean *(Range)*	High CPL Mean *(Range)*
Strategy Suggestions	11.5% *(2.5%-22.5%)*	8.8% *(2.5%-20.8%)*	14.2% *(6.7%-22.5%)*
Metacognitive Questions	13.8% *(3.3%-38.3%)*	9.0% *(3.3%-19.2%)*	18.7% *(7.5%-38.3%)*
Co-occurrence of Memory Requests with:			
Instructional Activities	60.0% *(44.2%-65.9%)*	58.2% *(44.2%-65.0%)*	61.8% *(56.7%-65.8%)*
Cognitive Structuring Activities	35.4% *(20.8%-55.0%)*	32.2% *(22.5%-55.0%)*	38.5% *(20.8%-55.0%)*
Metacognitive Information	16.1% *(7.5%-28.3%)*	12.3% *(7.5%-14.2%)*	19.8% *(11.7%-28.3%)*

- Standardized scores were generated for each component of CPL.
- Each of the resulting *T* scores was averaged to create a composite index of CPL. The mean *T* score was 50 (*SD* = 5.22) with a range of 41.19 to 58.60.
- Teachers were divided into high and low groups based on a median split for comparison. The table displayed above shows the percentage of intervals in which teachers used each type of language (mean scores and ranges are displayed).

RESULTS

Interplay of Children's Metamemory and Teachers' Instructional Language on Cognitive Skills



- Four groups were created based on median splits of children's initial metamemory level and teachers' use of CPL during mathematics lessons.
- At the end of the year, there were significant differences (p=.04) in mathematical fluency performance between children with lower levels of metamemory who were placed in low-CPL classrooms (Mean=8.83) when compared to peers with higher metamemory and/or in high-CPL classrooms (Mean=12.1 to15.61).
- Similar patterns were found for performance on a free recall with training deliberate memory task. However, these differences were not statistically significant.

DISCUSSION AND FUTURE DIRECTIONS

- Findings revealed the importance of examining the role of both child- and classroom-level factors in children's developing cognitive skills.
- The interplay of children's metamemory knowledge and teachers' instructional language suggests that classrooms with metacognitively rich dialogue may be particularly beneficial for subgroups of students. Mirroring findings from past studies (see Ornstein & Coffman, 2020), teachers' use of higher levels of Cognitive Processing Language appears more important for students with lower levels of ability.
- Future research should expand these findings to further test for between-group differences and the potential moderating effect of children's metamemory. Moreover, expanded longitudinal studies will help determine if these findings persist across the early elementary school years.
- Moreover, additional experimental studies are needed to determine causality between higher levels of CPL and increases in students' growing cognitive skills.

ACKNOWLEDGEMENTS

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Working to Remember: An Exploration of Spontaneous Strategic Study Behaviors in Elementary School Students

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INTRODUCTION

- The use of strategic study skills by elementary school students is a predictor of long-term academic success (Moreira et al., 2013).
- Past research documents that children in the fourth and fifth grades are capable of spontaneously employing study strategies (Brown & Smiley, 1978; Coffman et al., 2019). However, little is known about strategic study behaviors in younger elementary school students.
- Additionally, limited research has focused on early cognitive abilities that may predict later study skills.
- Diamond (2013) reports linkages between three executive functions (working memory, inhibitory control, and cognitive flexibility) and numerous cognitive outcomes. These skills may predict students' use of spontaneous study strategies during elementary school.

AIMS OF THE STUDY

In this exploration of the spontaneous strategic study behaviors of elementary school students we aim to:

1. Adapt a task that had previously been used with fourth and fifth graders for use with younger students.
2. Examine links between the use of study strategies and recall performance.
3. Explore three executive functions as possible predictors of strategic study behaviors.

METHODS

- Data for this study were drawn from the first cohort of an ongoing longitudinal study of children's memory and cognitive skills across the early elementary school years.
- Child- and school-level measures were collected from Kindergarten entry through the beginning of the third-grade year.
- Due to the COVID-19 pandemic, the study skills task was conducted via Zoom. Previous assessments (including those that yielded the Kindergarten predictors) were performed in person.

PARTICIPANTS

Participants were drawn from 3 schools and included 49 third-grade students.

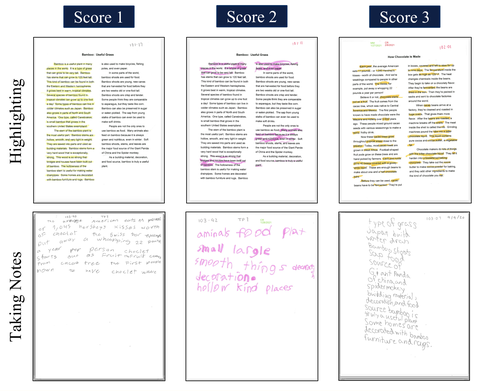
- 21 Males, 28 Females
- Age Range: 7.77 to 9.46 years (Mean: 8.50)
- The sample was comprised of 59% European American, 6% African American, 10% Asian American/Pacific Islander, 22% Multiracial, and 2% unreported.

MEASURES

Study Skills (adapted from Brown & Smiley 1977; 1978)

- Children were given a non-fiction text, paper, pencil, and highlighter.
- The examiner read the passage aloud, then gave the children 4 minutes to work to remember with no explicit study instructions. Afterwards, the children were asked to recall as much as possible.
- Recall for each fact from the passage was scored on a scale from 0 to 2 (0=no recall, 1=partial recall, 2=full recall). Recall scores reflect the sum of scores across all facts (51 in total).
- For each of the study behaviors defined below, strategy use was scored from 0 to 3 (0=non-use to 3=strategic use). A composite score was created using the average of the observed strategies.

Study Strategy	Definition
Underlining	Degree to which students strategically underlined key facts
Highlighting	Degree to which students strategically highlighted key facts
Taking Notes	Degree to which students strategically took notes on key facts or summarized important details in their own words
Reviewing Notes	Degree to which students reviewed notes in a strategic manner
Drawing a Picture	Degree to which students drew an organized picture of key facts
Verbalization	Degree to which students rehearsed or reread specific facts aloud
Self-Testing	Degree to which students strategically self-tested, focusing on key facts
Rereading	Degree to which students strategically and systematically reread (e.g., in the service of taking notes)



Executive Functions (McCarthy, 1972; Gerson et al., 2013)

Working Memory: The ability to maintain and manipulate information in the mind. This was assessed with a *Backwards Digit Span Task.* Children must recall numbers in reverse order of the sequence presented.

Inhibitory Control: The ability to disregard mental, attentional, and behavioral impulses. This was measured using the *NIH Flanker Inhibitory Control and Attention Task.* Children must focus on a given stimulus while ignoring distractor stimuli.

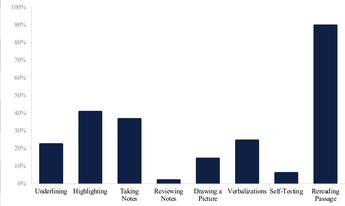
Cognitive Flexibility: The ability to switch between tasks. This was measured using the *NIH Dimensional Change Card Sort Task (DCCS).* Children are shown a series of bivalent cards. They must sort along one dimension and then according to the other.

STRATEGY USE

Descriptive Statistics of Strategy Use

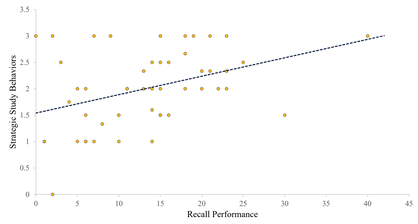
Study Strategy	Mean *(SD)*
Underlining	1.91 (0.83)
Highlighting	1.60 (0.75)
Taking Notes	2.00 (0.84)
Reviewing Notes	1.00 (0.00)
Drawing a Picture	1.71 (0.95)
Verbalization	1.75 (0.75)
Self-Testing	1.33 (0.58)
Rereading	2.57 (0.70)

Percentage of Students Who Used Each Study Strategy



- Students used a range of study strategies. Rereading (89.8%) and highlighting (40.8%) were the most common and reviewing notes (2.0%) was the least.
- Children used a mean of 2.37 different strategies.
- The overall composite of strategic behaviors ranged from 0 to 3 with a mean of 2.00 and standard deviation of 0.73.

Strategy Use and Recall Performance



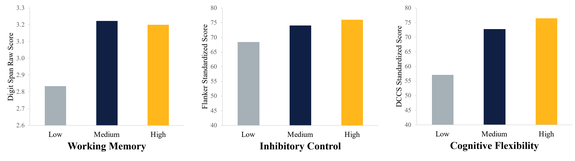
The overall composite of strategic study behaviors was correlated with recall performance (.389, p =.006).

Regression Predicting Recall Using Strategic Study Behaviors

	B	*SE B*	*β*	R^2
Strategic Study Behaviors	4.326	1.497	.389**	.151

*p <.05 **p <.01

EXPLORING EXECUTIVE FUNCTIONS



- Students were divided into three groups based on their overall strategy score – low (0-1.9), medium (2-2.9), and high (3).
- Using these groups, we explored mean scores on the three executive functions (working memory, inhibitory control, and cognitive flexibility) measures as a function of study skills scores.

RESULTS

Linking Early Cognitive Predictors to Strategy Use

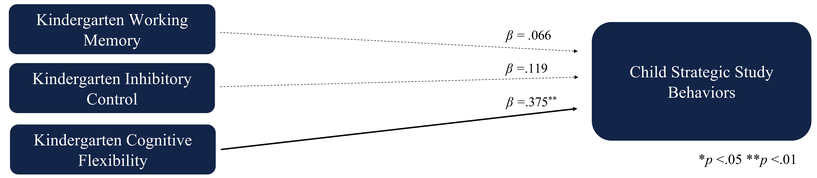
Correlations Between Study Skills and Kindergarten Executive Functions Measures

	1	2	3	4
1. Strategic Study Behaviors	--			
2. Working Memory (Digit Span)	.166	--		
3. Inhibitory Control (Flanker)	.218	.185	--	
4. Cognitive Flexibility (DCCS)	.417**	.210	.233	--

*p <.05 **p <.01

- The use of strategic study behaviors in third grade was correlated with children's performance on a cognitive flexibility task in Kindergarten.

Regression Predicting Study Skills Using Kindergarten Executive Functions Measures



*p <.05 **p <.01

- Children with higher levels of cognitive flexibility during Kindergarten used more strategic study behaviors in later elementary school.

DISCUSSION AND FUTURE DIRECTIONS

The findings from this study expand the current body of research in several meaningful ways:

- It is one of the first studies designed to examine the use of strategic study skills in third-grade students. As indicated by the descriptive statistics, children at this age are capable of employing strategic behaviors spontaneously while working to remember a non-fiction passage.
- The results indicate a correlation between students' use of study strategies and their recall performance.
- Early cognitive skills may predict later strategic behaviors. Specifically, these findings suggest that cognitive flexibility may be important for emerging study skills.

The results also provide a groundwork for future research directions:

- Researchers may explore other skills (e.g., metacognition, reading fluency) at school entry that may predict later strategic studying.
- Numerous classroom and home contextual factors may influence the development of these skills and should be examined.
- There is a need to explore different profiles of learners and what child- and context-level factors may be associated with students' developing strategic study skills.

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