CHARACTERISTICS OF PRESCHOOL TEACHERS' LANGUAGE INPUT DURING A NOVEL, SPATIALLY FOCUSED TASK

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Abigail Dillaha

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This thesis was presented

by

Abigail Dillaha

It was defended on

April 13, 2018

and approved by

Jana Iverson, Professor, Department of Psychology

Elizabeth Votruba-Drzal, Associate Professor, Department of Psychology

Susan Levine, Professor, University of Chicago, Department of Psychology

Thesis Director: Melissa Libertus, Assistant Professor, Department of Psychology

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Language input is critically important for the development of children's skills in many domains as the speech children hear shapes the way they think about the world. The goals of this study were to investigate how teachers spoke to their preschool students when presented with a novel, spatially related task and to analyze the relationships between qualitative aspects of the teachers' speech and their own spatial skills and vocabulary. Thirty-four preschool teachers were recorded while playing with small groups of students with the materials to build a ball maze. Transcripts of teachers' speech were coded using a coding scheme adapted from the Dyadic Parent-Child Interaction Coding System. Results revealed a substantial individual variation in the way teachers spoke during the ball maze task. Results also indicated that teachers with better vocabulary skills used more Praise and Problem Solving talk and teachers with better spatial skills used more Problem Solving talk. This suggests that teachers' own cognitive abilities are related to the amount of certain types of speech that they use while engaging in a novel task with a small group of students. Future studies are suggested to examine these relationships more thoroughly.

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PREFACE

I would like to express my extreme gratitude to Dr. Melissa Libertus of the Department of Psychology for all of her support during the past four years, and to Ph.D. candidate Emily Braham for her constant guidance throughout every step of this project. Without their encouragement and inspiration, none of this would be possible.

1.0 INTRODUCTION

The speech that children hear as they grow up is critically influential for how they come to think about the world around them. Language input leading up to and during preschool years is particularly important because this is a time period of enormous cognitive and interpersonal growth. A seminal study by Hart and Risley (2003) documented what has become commonly known as the "30 million word gap." In following a set of children longitudinally up until 3 years of age, the researchers discovered that 86-98 percent of the words in each child's vocabulary came from their parents' vocabularies. They also found that children of lower socioeconomic status had substantially smaller, slower growing vocabularies by the age of 3 than children of higher socioeconomic status, and that this gap in language skill was still apparent when the children were tested at the end of elementary school. Thus, it is critically important to understand the language input children are exposed to in early childhood, as it can have long-lasting impacts.

One way in which language input influences children is through the development of private speech. Private speech is spoken out loud to oneself for the purpose of self-regulation. Children internalize what they hear adults saying during tasks and this influences the development of their own private speech (Berk & Spuhl, 1995). Private speech is then predictive of children's performance on independent tasks, as this process of internalizing language input and developing private speech is representative of a transition from collaborative to independent problem solving (Winsler, Diaz, & Montero, 1997). Children learn to perform the actions of adults during collaborative problem solving for themselves (e.g., focusing attention, making plans for task completion, and providing praise upon success), so it is imperative that we understand the language input that is being presented to children when they are engaged in play with adults.

Different parenting/teaching styles result in a wide variety in the speech children hear from adults. Some noticeable, qualitative differences in adults' speaking styles include whether they focus more on negative attributes and discipline or on praising children, whether they ask many questions to elicit engagement or spend more time talking at children, and whether they give children more explicit directions or speak in a way that allows children to make their own decisions. These qualitative variations in language input have varied consequences for children, one example of which is the use of management language and its impact on executive function. Management language is language parents use to provide structure and guide children's behavior. Executive functions (i.e., working memory, cognitive flexibility, and behavioral inhibition) are critically important in the development of children's social and academic abilities (McClelland, Acock, Morrison, 2006; Blair & Razza, 2007; McClelland, Acock, Piccinin, Rhea, & Stallings, 2012). Bindman and colleagues (2013) investigated the variations in the types of management language parents use and how this language is related to children's levels and growth of executive functions (EF). They looked at the difference between suggestive language (i.e., questions and statements that invite children to provide opinions or make choices on courses of action) and directive language (i.e., comments that instruct children on what to do without soliciting their input), and found that suggestive language was positively correlated with children's EF at age 3, while directive language was negatively correlated with children's EF at age 3. They also found that suggestive language was negatively correlated with the rate of children's EF growth, while directive language had no influence on the rate of growth. This qualitative difference in language input clearly has a complex relationship with executive function, which is important for children's success in many domains, including academics.

The aforementioned studies provide insight regarding the language input provided by parents, but preschoolers also receive another substantial source of adult language input from their teachers. One explanation Bindman and colleagues (2013) postulated for their findings is that parents respond to the levels of executive functions of their children, and this response accounts for the differences in the types of speech they use. Teachers, on the other hand, most often interact with multiple children at one time, so it is less likely that their speech is tailored to the abilities of one child. Teachers too exhibit qualitative variations in the language input they provide to children, but instead of responding to the cognitive capabilities of one child, this variation has been shown to be related to the changing roles teachers take in the classroom (Kontos, 1999). One unique aspect of the language environment in school is that teachers are able to carefully craft lessons and prepare themselves to provide children with certain information. In the present study, we are interested in the language input children receive from teachers during a novel task, as the input children receive in this situation may influence how they think about responding to new and unexpected challenges.

Language input influences children in a broad sense, but we also know that exposure to certain language can be beneficial to children in specific domains. One example of a relationship between domain-specific language exposure and development of skills is spatial language and spatial skills. Spatial skills are of particular interest in pedagogical settings because of their relationship with math performance (Assel, Landry, Swank, Smith, & Steelman, 2003; Casey, Nuttall, & Pezaris, 1997; Gallagher et al., 2000) and propensity to succeed in STEM fields (Shea, Lubinski, & Benbow, 2001; Wai, Lubinski, & Benbow, 2009). For example, more than any other factor, mental rotation skills have been shown to mediate the gender differences observed on the math section of the SAT (Casey et al., 1997). Individual and sex differences in spatial skills emerge early in childhood and persist throughout the lifespan (Levine, Huttenlocher, Taylor, & Langrock, 1999; Lewin, Wolgers, & Herlitz, 2001; Linn & Petersen, 1985). These differences can be seen as early as preschool; therefore, it is important to understand how the early language environment impacts the development of spatial abilities.

We know that spatial language input children receive is related to their performance on spatial tasks. In a study by Szechter and Liben (2004), 5-year-old children whose parents used more language to describe spatial relationships presented in a picture book performed better on subsequent tests of spatial-graphic representations. Subsequently, Lowenstein and Gentner (2005) showed that children who heard specific location words (e.g., on, in, under) performed better on a spatial mapping task than those who heard a general reference to location (e.g., here). This was true when the location words were presented during or before the spatial mapping task. These studies show that exposure to spatial language immediately before completing spatial tasks benefits performance, but perhaps more interesting is how children's long-term language environment relates to their spatial skills. Pruden, Levine, and Huttenlocher (2011) assessed this long-term exposure to spatial language in a study where they recorded parent and child speech over several visits when children were between 14 and 46 months of age, then assessed children's spatial abilities at 54 months of age. They found that parents who used more spatial language had children who performed better on two nonverbal spatial tasks, and that this effect was mediated by the children themselves using more spatial language. This suggests that the long-term language environment is important in the development of spatial skills insofar as the language children are exposed to influences how they think and speak about spatial relationships. These skills in turn impact their performance on tests of spatial abilities.

In addition to being influenced by language input, spatial understanding is acquired through physical interaction with the world. Children who play with puzzles at home have higher spatial skills than children who don't, and more frequent puzzle play is associated with better performance on tasks involving mental transformation, even after controlling for language input (Levine, Ratliff, Huttenlocher, & Cannon, 2012). Because of the physical nature of spatial skill acquisition, it is important to consider the impact of language in the context of interaction with toys that may require spatial skills. Levine et al. (2012) showed that higher quality of parent-child interactions during puzzle play, one component of which is a greater number of spatially relevant words used by parents, predicted an increase in girls' performance on tasks involving mental transformation. In the present study, we also look at language in the context of play with a toy that requires spatial skills, specifically a three-dimensional ball maze that is constructed from blocks and a variety of other pieces.

Block play is a particularly interesting situation to consider in the discussion of spatial skills, because block play has been shown to naturally increase parents' use of spatial language (Ferrara, Hirsh-Pasek, Newcombe, Golinkoff, & Lam, 2011). Caldera et al. (1999) showed that the complexity of children's block play when they were not given any instructions was related to their performance on two assessments of spatial ability (i.e., Block Design, which involves recreating a design in a photo with blocks, and Embedded Figures, which involves finding a figure within a more complex design). Additionally, children's preference for art activities and their ability to accurately reproduce a block structure were related to their spatial skills (i.e., Block Design and Copying Blocks, which is a measure of visual motor ability that involves mental rotation and spatial visualization). Children's interest in the unstructured block play was also predictive of their performance on the Embedded Figures test. A possible common thread connecting these relationships is that creativity positively influences the acquisition of spatial skills. If this is the case, maybe language input that promotes children's interest in spatially relevant toys or encourages creative thinking could predict children's performance on tests of spatial abilities.

While the spatial language assessed in previous work may vary from study to study, it ultimately amounts to a fixed set of vocabulary words. One interest of the current study is to examine the broader language environment surrounding spatial tasks, especially since we know that qualitative differences in language input can have widespread effects on children's growth and achievement in other domains. In addition, none of the previous studies have considered which characteristics of the teachers may affect the frequency and type of language input they provide. We do know that parent characteristics may influence their speech in ways that are meaningful for children's abilities. Elliott, Braham, and Libertus (2017) found that parents' number comparison abilities as well as their subjective ratings of their own math abilities were related to their large number talk (i.e., how frequently they talked about numbers greater than 10) in a laboratory play session. The frequency of parents' large number talk in turn was related to their children's math abilities. In the present study, we aim to expand on this knowledge by looking at possible relationships between teacher characteristics and the frequency with which they use different types of speech while building a ball maze with a small group of students.

The present study aims to investigate the language input preschoolers receive from their teachers when presented with a novel task focused on spatial skills. We presented teachers with a ball maze activity to build with small groups of students and recorded the teachers' speech as they played with the children. We coded the teachers' speech using a coding scheme adapted from the Dyadic Parent-Child Interaction Coding System (DPICS-IV; Eyberg et al., 2013), looking for qualitative aspects of speech such as commands, questions, and praise. We assessed the teachers' spatial skills using the Block Design subtest of the Wechsler Abbreviated Scale of Intelligence (WASI-II; Wechsler, 2011), as spatial skills provide teachers with the tools they need to complete the task (i.e., build a successful ball maze). We also assessed their vocabulary skills using the Reading Vocabulary subtest of the Woodcock Johnson III Tests of Achievement (Woodcock, McGrew, & Mather, 2001), as vocabulary skills provide teachers with the tools necessary to effectively communicate with children about the task. In sum, we aimed to address the following questions:

(1) What kind of speech do teachers use during a novel task that requires problem solving within the context of a spatial task? How do teachers approach a new problem with their students?

(2) How do teachers who are seemingly the best prepared for this particular novel task (i.e., those who have high spatial skills and/or high vocabulary skills) speak to children about it?

2.0 METHOD

2.1 PARTICIPANTS

Preschool teachers from the Pittsburgh area were recruited by calling and mailing letters to preschool directors. Teachers were eligible to participate if their students were between 3 and 5 years of age. Teachers in the study were the lead instructors in their classrooms or, if they were assistant teachers, took a leading role on the day of the observation. Co-teachers were never observed on the same day. The final sample consisted of 34 teachers, all of whom were female. Thirty-one teachers identified themselves as White, two as Black, and one as Asian. On average, the teachers were 44.26 years of age (*SD* = 13.16, range = 23 to 67 years), and had 15.59 years of experience working with children under the age of 6 in childcare or education (*SD* = 9.79, range = 1 to 41 years). One teacher reported completing some college but no degree, two teachers had an associate degree, 15 teachers had a bachelor's degree, five teachers had completed at least one year of work toward a master's degree, 10 teachers had a master's degree, and one teacher chose not to report information about her education. Twenty-six teachers reported having a degree in early childhood education other than a Child Development Associate (CDA) credential.

Teachers were asked to report details about their classrooms. The teachers in our sample represented 25 different classrooms, as there were nine sets of co-teachers. Classrooms ranged from having 4 to 27 students (*M* = 16.84, *SD* = 5.44). The average age of children in the classrooms was 3.89 years. Eleven classrooms had children between 3 and 4 years of age, nine had children between 4 and 5 years of age, and four had a mixture of 3-, 4-, and 5-year olds. Eleven teachers described their classrooms as full day preschool, nine as having a mixture of children who stayed for the full day and those who stayed for only half of the day, four as morning half day, and three as afternoon half day.

The directors of the preschools were asked to report details about the schools overall. The teachers in our sample represented fifteen different preschools, of which eight were private pre-kindergarten programs, three were university-based preschool programs, three were church-based preschool programs, and one was a non-profit childcare center. Ten of the preschools had primarily White students, three had students who were primarily White or Black, and two had students who were primarily White or Asian.

2.2 PROCEDURE

Prior to participation in the study, all teachers provided written consent. Teachers were informed that the purpose of the study was to learn what factors influence how they teach and interact with their students. They were observed over the course of several hours doing their daily classroom routines. They were also asked if they would be willing to participate in a task with their students involving a novel toy (i.e., a ball maze) brought by the experimenter for at least 10 minutes. All teachers in the final sample agreed to complete this task. After the observations, teachers completed an assessment session lasting between 1 and 1.5 hours. During this session, teachers completed a variety of tests assessing basic cognitive skills and academic achievement. In the present study, we focus on measures of teachers' spatial skills and vocabulary. They were also given a link to complete an online questionnaire about their demographic information. Once teachers completed the study, the preschool directors were asked to complete an online questionnaire about demographic information of their center. Teachers were compensated $10 per hour for all activities completed as part of the study. Directors were compensated $30 for each teacher from their center who completed the study.

2.3 MEASURES

2.3.1 Observation of ball maze activity

Teachers wore ZOOM H1 audio recorders with lapel microphones as they moved about their classroom. An observer set up the audio recorder and remained present in the classroom for the observation to take notes that would help to determine the context of teachers' speech later on. The observer presented the teachers with a wooden ball maze toy by Wonderworld (see Figure 1) which included wooden track pieces, 85 interlocking orange blocks, five balls, and special trick pieces (e.g., ramps, a staircase, a funnel, flip pieces).

Figure 1. Ball maze pieces presented to teachers

The observer explained to the teacher that the track and trick pieces could be used to create a path for the balls to roll, and that the orange blocks could be used to support the path at different heights. Teachers were presented with a photo that showed a completed example maze (see Figure 2), but they were encouraged to guide the students in playing with the maze however they saw fit. Teachers were asked to work with a group of less than seven students on the maze for at least 10 minutes, and they were told that they could rotate groups if they had time.

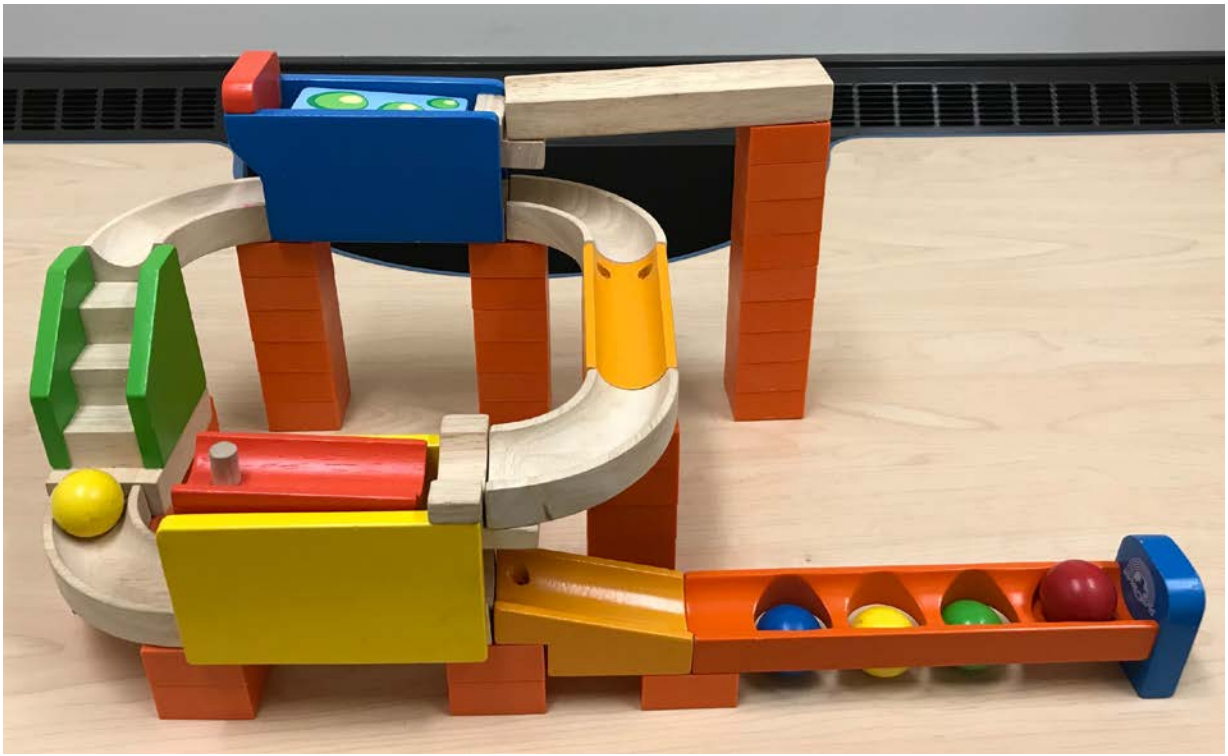

Figure 2. Example of completed ball maze shown to teachers

2.3.1.1 Transcription

The teachers' recorded speech was transcribed and verified by trained research assistants. The transcribers segmented teachers' speech into utterances. An utterance was defined as talk by one speaker that was bound by a transition in the speaker, a pause of more than two seconds, or grammatical closure (Pan, Rowe, Spier, & Tamis-Lemonda, 2004).

2.3.1.2 Coding

To code the teachers' speech, we first determined whether or not each utterance was relevant to the ball maze task. Utterances first started being considered part of the ball maze when the children were all gathered around the toy and the teacher started to describe it. Utterances were no longer considered part of the ball maze once clean-up of the ball maze was over. Utterances during the ball maze task were deemed irrelevant if they fell into one of three major categories: transitions, other activities, and administrative duties/emergencies. Transitions occurred when a teacher worked with multiple groups of students on the ball maze. We considered teachers' discussion of when/who would switch and anything they said while children were in the process of switching groups irrelevant. Discussion of other activities included a teacher talking to a group of students not working on the ball maze, talking to children about things outside of school, disciplining children, or talk about anything else that was unrelated to the ball maze. Administrative duties/emergencies involved discussion with children about toileting or injuries, or any time a teacher left to speak to another adult. Since we only recorded the teachers' speech, we needed enough context to determine whether something was irrelevant to the ball maze. Because of this, anything that we suspected to be irrelevant but was only one or two utterances was marked as relevant. Bigger chunks of irrelevant speech (i.e., three or more utterances) were marked as irrelevant.

We coded the transcripts of the utterances relevant to the ball maze using a modified version of the Dyadic Parent-Child Interaction Coding System (DPICS-IV; Eyberg et al., 2013). This manual is designed to assess both sides of an interaction with one child and one adult, so we modified the coding scheme to focus on the adult (i.e., the teacher) in an interaction with one adult and multiple children. Categories that were used as described in the manual are Negative Talk (i.e., telling a child not to do something or expressing disapproval), Direct Command (i.e., explicitly instructing a child to complete a behavior), Indirect Command (i.e., suggesting that a child complete a behavior in question form or in a way that makes it unclear whether the child has to complete that behavior), Information Question (i.e., a question that requests a response from the child beyond a “yes” or “no”), and Descriptive Question (i.e., a question that only requests a “yes” or “no” response from the child). We also combined Labeled and Unlabeled Praise into one Praise category (i.e., a positive evaluation of the child), since neither was particularly common. We eliminated the Reflection category (i.e., a statement that has the same meaning as a child’s prior statement), since we didn’t have the children’s side of the conversation to be sure when a teacher was repeating something a child said. We took Behavior Description (i.e., non-evaluative description of a child’s current or most recent behavior) and Neutral Talk (i.e., statements presenting information or acknowledging something about the current activity) together to be the rest of the “filler” in the transcripts, so we did not assess either one specifically. We also added a Problem Solving category, which was taken from an earlier draft of the DPICS. Problem Solving occurs when a teacher prompts students in an open-ended way to solve problems by generating ideas, solutions, or consequences. Problem Solving is a specific type of question, statement, or command, so it was always coded in addition to another category. Examples of each talk category can be seen in Table 1. As instructed in the manual, when an utterance had qualities of more than one talk category, we coded the highest category on the Priority Order. The Priority Order was established in the manual to state which categories are the most influential in shaping the quality of interactions. The Priority Order, from highest to lowest, is Negative Talk, Direct Command, Indirect Command, Praise, Information Question, then Descriptive Question. If it was unclear which category an utterance belonged to and we could not choose between two categories, we coded whichever was lowest on the Priority Order. Since the Priority Order provides a ranking of categories in order of their impact on the quality of interactions, the goal was to account for the highest quality component of the interaction when possible, but not overstate the quality of the interaction when we were unsure.

Table 1. Examples of talk categories

Talk Category	Examples
Negative Talk	"Stop, stop, stop, that's not nice."
	"You do not throw pieces like that."
	"Don't yell."
	"You're being very rude today."
	"No, no, no." (in response to child's behavior)
Direct Command	"Try to put a marble now."
	"Look closely at that piece."
	"Put it down on the floor so we can all see it."
	"Listen."
	"I need you to stop playing and go to the bathroom."
Indirect Command	"Let's try that."
	"Can you try to use some of these blocks?"
	"Can I have that block?"
	"What if you use this one instead?"
	"You have to put the blocks together like this, okay?"
Praise	"That's very interesting, what you're doing over there."
	"Great idea."
	"You're right, there are directions on the side."
	"Very good James."
	"Thank you."

Table 1 (continued).

Talk Category	Examples
Information Question	“How many blocks do we need there?”
	“After it comes out here, where does it go?”
	“Do you want the red one or the blue one?”
	“What do you need?”
	“What?” (as in, “What did you say?”)
Descriptive Question	“Should I build another piece?”
	“Do you want to use more of these blocks?”
	“Don’t we have to build it up before we can put the ball down?”
	“Do you know where that piece went?”
	“Are you going to use these pieces first?”
Problem Solving	“How do you think we should get our track up high in the air?”
	“If you put a support there, what’s going to happen?”
	“What’s your idea?”
	“What do you need to finish that?”
	“Let’s think about how we can fix that.”

2.3.2 Teacher cognitive measures

During the assessment session, teachers completed a variety of tests of their basic cognitive skills and academic achievement. Two were of particular interest to the current study: the Reading Vocabulary subtest of the Woodcock Johnson III Tests of Achievement (Woodcock, McGrew, & Mather, 2001) and the Block Design subtest from the second edition of the Wechsler Abbreviated Scale of Intelligence (WASI-II; Wechsler, 2011).

2.3.2.1 Reading vocabulary

We assessed teachers' vocabulary skills as a proxy for their spoken language abilities. This measure assesses a person's ability to supply appropriate meanings to written words and involves three separate tasks. The synonym portion involves reading a word and providing a synonym, the antonym portion involves reading a word and providing an antonym, and the analogy portion involves completing an analogy with three words provided (i.e., A is to B as C is to __). Teachers were tested on each task until a ceiling was reached (i.e., four consecutive incorrect responses). Since Reading Vocabulary is a composite measure of several tests, we used age-normed standardized scores to compile this number.

2.3.2.2 Block design

The Block Design subtest was administered to assess teachers' spatial skills. In the task, teachers were presented with nine identical blocks whose sides were either all red, all white, or half red and half white and asked to replicate designs shown in pictures. Teachers were given a specific amount of time to complete each design and were scored by their speed and accuracy. Trials were administered until teachers completed all trials or received two consecutive scores of zero. Scores were calculated as the total number of points earned on the assessment.

3.0 RESULTS

All descriptive statistics and correlations can be seen in Table 2. In all analyses, we controlled for the amount of time each teacher spent working with children on the ball maze by using rates of each kind of talk divided by the number of minutes the teacher spent with the ball maze. All categories were used at least once by each teacher, with the exception of Negative Talk. On average, the most frequently used category was Descriptive Questions (DQ; $M = 2.22$, $SD = 1.01$), followed by Indirect Commands (IC; $M = 1.72$, $SD = .72$), Direct Commands (DC; $M = 1.64$, $SD = 1.05$), Information Questions (IQ; $M = 1.41$, $SD = .60$), Problem Solving (PS; $M = .47$, $SD = .34$), and Praise (P; $M = .37$, $SD = .27$). The least frequently used talk category was Negative Talk (NTA; $M = .13$, $SD = .11$). The category with the largest range in use was Information Questions, with a range of 4.95 (.50-5.45), and the category with the lowest range in use was Negative Talk, with a range of .42 (.00-.42).

Next, we examined how the talk categories related to one another. We used Spearman's correlations because not all of the variables were normally distributed. As can be seen in Table 2, Indirect Commands were positively correlated with Negative Talk ($\rho(32) = .342$, $p = .048$) and Direct Commands ($\rho(32) = .554$, $p = .001$). Information Questions were positively correlated with Descriptive Questions ($\rho(32) = .513$, $p = .002$) and Problem Solving ($\rho(32) = .661$, $p < .001$). None of the other correlations reached significance.

The two measures of teachers' cognitive skills, Reading Vocabulary and Block Design, were positively correlated with one another (ρ (32) = .653, $p < .001$). Reading Vocabulary was positively correlated with Praise (ρ (32) = .468, $p = .005$) and Problem Solving (ρ (32) = .435, $p = .010$). Block Design was also positively correlated with Problem Solving (ρ (32) = .385, $p = .024$), but none of the other talk categories (see Table 2). Even though both teacher skills measures were correlated with Problem Solving, neither Reading Vocabulary nor Block Design were significantly correlated with Information Questions, which is notable since most cases of Problem Solving are Information Questions and are therefore coded as both. Neither Reading Vocabulary nor Block Design was correlated with Negative Talk or either type of questions or commands.

Table 2. Descriptive statistics and spearman's correlations between talk categories and teacher abilities

Measure	1	2	3	4	5	6	7	8	*M*	*SD*	Min	Max
1. Negative Talk	-								.13	.11	.00	.42
2. Direct Command	.194	-							1.64	1.05	.16	4.82
3. Indirect Command	.342*	.554**	-						1.72	.72	.36	3.62
4. Praise	.254	.380*	.316	-					.37	.27	.11	1.41
5. Information Question	.027	.083	.123	.262	-				1.41	.60	.28	2.63
6. Descriptive Question	-.009	.264	.216	.303	.513**	-			2.22	1.01	.50	5.45
7. Problem Solving	.116	.034	.097	.205	.661**	.314	-		.47	.34	.04	1.35
8. Reading Vocabulary	.004	-.070	-.133	.468**	.269	.249	.435*	-	93.24	9.28	71	110
9. Block Design	.143	-.154	-.218	.099	.222	.150	.385*	.653**	38.50	14.40	8	67

*$\rho < .05$

**$\rho < .01$

4.0 DISCUSSION

The main goals of this study were to investigate how teachers spoke to children during a novel task that required spatial skills and to see if the way the teachers spoke was related to their own cognitive abilities (i.e., vocabulary skills, which may be related to teachers' abilities to communicate with children about the ball maze; and spatial skills, which may be related to teachers' abilities to build a successful ball maze). We found substantial individual variation in the way teachers spoke to children. We also saw correlations between the command talk categories and the question talk categories. Finally, we found that Praise and Problem Solving talk were correlated with teachers' performance on a vocabulary assessment, and that Problem Solving talk was also correlated with teachers' performance on a test of their spatial abilities. These correlations between talk categories and teacher abilities suggest that teachers who were better equipped to perform well on the ball maze task used speech types that may be beneficial to children.

The command and question categories were used by teachers most frequently on average, which makes sense since these categories were so widespread in the types of utterances they covered. Even though there were more questions and commands on average, we still saw a great deal of variation between teachers in their use of Direct Commands (range = .16-4.82), Indirect Commands (range = .36-3.62), Descriptive Questions (range = .50-5.45), and, to a somewhat lesser extent, Information Questions (range = .28-2.63). Interestingly, a greater use of Indirect Commands was predictive of more frequent use of Direct Commands and Negative Talk, and all three of these fall under a broader category of commands (most instances of Negative Talk in this data set were “don’t” or “stop” commands). We also saw a similar pattern with questions, as Information Questions were positively correlated with Descriptive Questions and Problem Solving, and most instances of Problem Solving in this data set were questions. In answering our first question (i.e., what kind of speech do teachers use during a novel task?) we saw that while there was a great deal of individual variation in how teachers approached this new problem, teachers who used more commands used more of all types of commands, while teachers who used more questions used more of all types of questions. This could prove useful in future studies that may want to train teachers to change something about the language input they provide to children. Perhaps more generalized interventions could prove useful since similar categories of speech are correlated with one another.

We also observed a positive correlation between teachers’ vocabulary skills and how frequently they used praise. Praise is an interesting type of talk in this case because of its possible implications for children’s interest in the task. In addition, Caldera et al. (1999) found that children’s interest in block play was related to their performance on a test of spatial ability. The impact of praise on children has been debated for some time. The idea that praise decreases intrinsic motivation was generally accepted for a long time. It was argued that rewarding children for completing tasks leads to children’s expectations of continuous rewards for good performance because they have come to associate an external reward with the task rather than being independently motivated. Schwartz (1996) suggests that praise is not effective as part of a teaching strategy because it may portray the idea that teachers are constantly judging children’s work and ideas to determine what is good and bad, and that teachers are ultimately the ones to decide whether something is good or bad. However, some studies have called the idea that praise is detrimental to intrinsic motivation into question. A meta-analysis by Cameron, Banko, and Pierce (2001) concluded that verbal rewards (i.e., praise) improve self-reported interest in a task. Looking at this specifically in preschool children, Anderson, Manoogian, and Reznick (1976) found that positive verbal reinforcement increases intrinsic motivation while other rewards, like money and awards, tend to decrease intrinsic motivation. The researchers' explanation proposes that money and awards provide a sufficient justification for task performance, providing children with an extrinsic motivation to associate with the task. Verbal praise, on the other hand, is seen as an insufficient justification for task performance, so while it has a positive impact on children, its impact is too small to become an external motivator and decrease intrinsic motivation. Studies like these suggest that praise given by teachers during the ball maze task may be related to children's interest in the task, which, according to Caldera et al. (1999), should benefit their spatial skills since the ball maze is an example of block play. Further studies are warranted to examine whether or not these relationships hold true.

Additionally, we saw an increase in the use of Problem Solving talk in teachers who scored higher on both the measure of vocabulary and the measure of spatial skills. Schwartz (1996) suggested that engaging children in meaningful conversation about their work (e.g., asking them about their thought process or prompting them to make new discoveries) may be more of a substantial reward for children than just telling them, "good job." Problem Solving seems like a good candidate for this "meaningful conversation" as it is a type of speech that requests that children generate ideas to solve new problems and asks that they talk through their reasoning out loud. This request to generate new ideas could also be a way of fostering children’s creativity. Caldera et al. (1999) suggested that the explanation for the positive influence of art preference, complexity of block play, and interest in the free block play on spatial skills could be that these all provide some indication of children’s creativity, and this creativity scaffolds the acquisition of spatial skills. If Problem Solving talk does in fact have a positive influence on children’s creativity, it may be true that this is a type of language input that promotes the development of spatial skills. Again, further studies would be necessary to examine these relationships.

One notable limitation of the current study is that we do not have any data on the children. Information about children’s speech and children’s spatial skills would be necessary in order to get a broad picture of the influence of teacher language input on children during this ball maze task. Future studies should examine these factors as they relate to teacher language input. Specifically, future experiments should assess whether Praise and Problem Solving during novel tasks requiring spatial skills lead to better spatial skills in children. If these causal relationships can be shown in an experiment, researchers should also examine whether the influence of Praise is mediated through increasing children’s interest in the activity and whether the influence of Problem Solving is mediated through promoting children’s creativity.

Another limitation of the present study is that our tests of teachers’ cognitive abilities are limited. We only used the Reading Vocabulary subtest as our measure of teachers’ language abilities and therefore their ability to communicate with children about the ball maze task, but there are many other aspects of language/communication skills that could be considered. We also only used the Block Design task, even though spatial skills include many different abilities, many of which could influence how skilled the teachers are at building a functional ball maze.

Further studies are needed to see if our results could be replicated when teachers' language and spatial abilities are measured through different tasks.

This study is the first to assess teacher characteristics as they relate to qualities of teachers' language input to preschoolers. We have also looked at teacher speech in a broad, qualitative sense that reaches beyond a set of vocabulary words. This is an early step toward a full understanding of how teacher characteristics influence their language input, which is ultimately important when we understand how this language input impacts children. If we understand what teacher abilities or beliefs influence their language input, we can create targeted interventions to make their speech more beneficial to children.

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