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Influence of a Teacher's Scaffolding Moves During Child-Led Small-Group Discussions

May Jadallah
Illinois State University
Richard C. Anderson
Kim Nguyen-Jahiel
Brian W. Miller
Center for the Study of Reading, University of Illinois at Urbana-Champaign
Il-Hee Kim
Indiana University, Purdue University Fort Wayne
Li-Jen Kuo
Northern Illinois University
Ting Dong
Xiaoying Wu
Center for the Study of Reading, University of Illinois at Urbana-Champaign

The influence of one teacher's scaffolding moves on children's performance in free-flowing child-led small-group discussions was investigated. Three moves were examined: prompting for and praising the use of evidence, asking for clarification, and challenging. Lag sequential analysis was applied to a corpus of over 5,300 speaking turns during 30 discussions to identify recurrent turn-by-turn patterns of teacher-child and child-child talk initiated by the teacher's moves. A complex system of influence among discussion participants was documented in which the teacher's moves had delayed effects as well as immediate effects, indirect as well as direct effects, and reciprocal instead of unidirectional effects. Some children appropriated scaffolding moves of the teacher and began to spontaneously employ the moves in later discussions.

KEYWORDS: small-group discussions, collaborative learning, scaffolding, teacher influence, appropriation, argumentation

A fundamental tenet of Vygotsky's (1981) sociocultural theory is the phase in development in which the child has only partially mastered a task and can carry it out only with the assistance of an adult or more capable peers.

Every child has an *actual* and a *potential* level of development. A problem that a child can independently solve defines his or her actual level of development, whereas a problem that he or she can solve under an adult's guidance or in collaboration with others defines this child's potential level of development (Rogoff & Wertsch, 1984). Thus, the zone of proximal development is "this dynamic region of sensitivity in which cognitive development advances" (p. 1). Within the framework of the zone of proximal development, two concepts will be tied in: scaffolding and appropriation.

Providing assistance is critical to the acquisition of cognitive and social skills within the zone of proximal development. The most widespread term for this assistance is *scaffolding*. Scaffolding, a term advanced by Wood,

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MAY JADALLAH is an assistant professor at Illinois State University, College of Education, Campus Box 5330, Normal, IL 61790; e-mail: *mjadall@ilstu.edu*. Jadallah is interested in examining teachers' influence on students' cognitive and social interaction during collaborative discussions; covering a range of disciplines including nature of science and related topics.

RICHARD C. ANDERSON is a professor of educational psychology and the director of Center for the Study of Reading, 51 Gerty Drive, Champaign, IL 61801; e-mail: *csrrca@illinois.edu*. Anderson is interested in children's reading and language development, including microanalysis of social and cognitive facets of classroom reading lessons, story discussions that promote thinking, and the influence of writing systems on learning to read.

KIM NGUYEN-JAHIEL is the associate director at Center for the Study of Reading, University of Illinois at Urbana-Champaign; e-mail: *knguye@illinois.edu*. Nguyen-Jahiel's research interests include social and cognitive learning processes in collaborative learning.

BRIAN W. MILLER is a research assistant at Center for the Study of Reading, University of Illinois at Urbana-Champaign; e-mail: *bwmiller@illinois.edu*. Miller is interested in studying the effect of motivation, affect, personal beliefs and social factors on learning particularly of science content.

IL-HEE KIM is an assistant professor at Indiana University, Purdue University Fort Wayne; e-mail: *kimi@ipfw.edu*. Kim's research interests are discourse processes and second language writing.

LI-JEN KUO is an assistant professor of educational psychology and a research associate at the Center for the Interdisciplinary Study of Language and Literacy at Northern Illinois University; e-mail: *lijenkuo@niu.edu*. Kuo's research focuses on the language and literacy of children with diverse first and second language backgrounds.

TING DONG is a research assistant at Center for the Study of Reading, University of Illinois at Urbana-Champaign; e-mail: *tingdong@illinois.edu*. Dong is interested in the influence of culture and personality on students' small-group collaborative learning experience.

XIAOYING WU is a postdoctoral researcher at Center for the Study of Reading, University of Illinois at Urbana-Champaign; e-mail: *xwu6@illinois.edu*. Wu's interests include understanding the nature and development of reasoning, motivation, and information processing. She is also interested in children's language development and reading processes.

Bruner, and Ross (1976), describes the "process that enables a child or novice to solve a problem, carry out a task, or achieve a goal which would be beyond his unassisted efforts" (p. 90). The original use of this metaphor had no explicit reference to Vygotsky. The implicit link between Vygotsky's zone of proximal development and scaffolding was first made explicit by Cazden in 1979 (Stone, 1998). Ever since, the scaffolding metaphor has been used to describe how educators can best assist learners within the zone of proximal development to nudge them forward until the learners can independently apply a newly acquired strategy.

Originally used to understand the interaction of one adult and one child in everyday joint activities (Bruner, 1986), the application of the scaffolding metaphor was adapted to examine classroom settings involving larger, more complex systems; teachers with entire classrooms; or with small groups of students (Davis & Miyake, 2004). Furthermore, the metaphor has been used frequently by those who design and assess computer software that aims to provide partially customized help to assist learners' development of knowledge and skill (Quintana et al., 2004). A number of studies have considered aspects of scaffolding. Palincsar (1998) and others considered classroom artifacts as scaffolding factors. Tabak (2004) studied patterns of distributed scaffolding. Davis and Miyake (2004) and Pea (2004) stressed the importance of examining *fading*, that is, gradual withdrawal of a scaffold.

An idea related to scaffolding and the mastery of a task within the zone of proximal development is *appropriation*. Rogoff (1995) defines appropriation as a "process by which individuals transform their understanding of and responsibility for activities through their own participation" (p. 150). She makes the case that children appropriate cultural practices when they take part in joint activities with their parents or other adults. Through guided participation, children gradually master the steps of an activity, until they become capable of performing it by themselves without others' guidance. Cazden (2001) and Pontecorvo (1993) assert that the ability to perform a task independently is not simply a matter of internalization or a mere copying of the behavior presented by others. Rather, the more widely used term *appropriation* describes a process by which children acquire new skills as they take part in one activity, becoming more fluid in using these skills in subsequent activities (Rogoff, 1990). Sociocognitive theories consider social interaction with more capable others a vital component in learning. Vygotsky (1981) has been numerously cited for stating that the higher mental functions first appear in a public space before becoming private and internal.

Although the scaffolding metaphor is widely used, its specific implications for instruction are not always clear. We agree with Quintana and his colleagues (2004), who "argue that advances in the field require an empirically grounded consensus about successful scaffolding methods" (p. 339). Quintana and colleagues developed a taxonomy of specific scaffolding methods employed in computer-assisted science education. Along with

others, such as Palincsar (1986), one of our goals in this study is to provide more specificity and greater empirical grounding for scaffolding methods that can be successfully employed during classroom discussion.

Starting from the early 1980s, researchers have examined scaffolding in classroom settings using qualitative approaches (e.g., Bliss, Askew, & Macare, 1996; Kong & Pearson, 2003; Maloch, 2002; Palincsar, 1986; Rodgers, 2004). Qualitative studies give rich descriptions of teachers' scaffolding strategies and have illuminated several aspects of teacher-student reciprocal influence. To provide an example of scaffolded instruction, here are two segments of teacher-student dialogue from Palincsar (1986). The first took place during the initial phase of the training.

> Teacher: . . . Remember we talked about the weatherman and we said that weatherman does this? What does the weatherman do?
> Student 4: Give a . . .
> Teacher: What does he do when he tells us it's going to be a beautiful weekend?
> Student 4: Prediction!
> Teacher: Right. You remembered that big word. And what do we do when we predict about the story?
> Student 4: We think about what might happen.
> Teacher: Next in the story. Right. (p. 85)

By the end of the reciprocal teaching sessions, children had picked up the strategies their teacher had scaffolded and by then demonstrated a good command of the strategies. The following excerpt from the 18th session illustrates this change. After reading one paragraph on daddy longlegs (spider-like creature), Student 6 led the following segment of the discussion.

> Student 6: [question] what does the daddy longlegs do when something comes around it? J_____?
> Student 1: Use that odor and . . . [not audible]
> Student 6: Yeah. C_____?
> Student 2: When an animal comes along, he puts out his odor and they get too sick to catch him.
> Student 6: Yeah. M_____?
> Student 4: Or too weak.
> Student 3: They feel too weak and too sick.
> Student 6: Everybody gave me good answers.
> Teacher: Very good. (Palincsar, 1986, p. 93)

From deep and thorough analysis of classroom transactions, these studies documented a shift in the teaching-learning responsibility from the teacher to the students when teachers were successful in applying scaffolded instruction. Despite the fact that qualitative studies of scaffolding covered long time periods (up to one academic year), the studies fell short on

a number of features compared to other approaches (Chinn, 2006). The sample size was small in most studies, which did not permit numerical comparisons. Although some studies accumulated huge amounts of data, only selected examples of teacher-student exchange were reported, and it is often unclear whether the examples were representative.

Classroom scaffolding has also been examined using quantitative approaches. Lutz, Guthrie, and Davis (2006) conducted a quantitative analysis to examine the influence of scaffolding on student engagement. In a study encompassing 12 weeks of instruction, Lutz and her colleagues inspected 20 to 30 minutes of one 90- to 120-minute lesson in each of three classrooms. They divided the lessons into 30-second segments to examine teacher scaffolding and student engagement. They found that the two teachers trained to employ scaffolded instruction varied their scaffolding techniques and displayed less "undermining behavior" as compared to the one untrained teacher. They also found that the students in experimental classrooms outperformed students in the control classroom in reading comprehension. However, since findings were aggregated at the classroom level, the study fell short of establishing a connection between teachers' scaffolding techniques and the momentary engagement of students as a response to these scaffolding techniques.

Experimental designs in which interventions are simply assumed to mediate outcomes do not illuminate the process of learning and development. The focus is the final result rather than the process itself. Understanding the process is the goal of the microgenetic method, a research approach that explores events moment by moment to capture the factors that induce change in behavior or shape learning and growth (Siegler & Crowley, 1991). The method focuses on the process *as* it takes place rather than only *after* it takes place; it examines the process as well as the product.

According to Chinn (2006), the microgenetic method has several key features: (a) all or most learning events are recorded, (b) observations of performances are dense relative to the rate of change of the phenomenon, (c) periods of observations are long enough to include major changes, (d) every learning event is analyzed, (e) a large number of participants are recruited to permit numerical analysis, and (f) every participant encounters similar tasks repeatedly to permit systematic comparisons across and within individuals. The microgenetic method helps researchers infer the "processes that give rise to both qualitative and quantitative aspects of change" (Siegler & Crowley, 1991, p. 606).

In a pioneering study, Orsolini and Pontecorvo (1992) applied the microgenetic method to classroom transactions, using lag sequential analysis to examine recurrent patterns in teacher-child interactions. They found that children's extended talk was more likely to occur when it was preceded by the teacher's repeating or rephrasing children's talk or when other children picked up the issue. To go beyond most previous studies, the microgenetic

approach fused with statistical methods suitable for identifying patterns in event sequences were employed in the present study to investigate detailed turn-by-turn teacher-child interactions in the context of Collaborative Reasoning discussions.

Collaborative Reasoning discussions are small-group peer-led discussions that aim to promote children's critical thinking, engagement, and social participation skills (Anderson, Chinn, Waggoner, & Nguyen, 1998; Li et al., 2007). In Collaborative Reasoning, children read a story about a dilemma faced by the story's main character. Children gather in small groups. Then the teacher poses a "big question" about the moral dilemma or policy issue raised by the story. As the children interact with one another, they reflect on the story, give their positions, reasons, and evidence, and also challenge each other when they disagree.

Collaborative Reasoning discussions are carried out by children themselves. Despite the fact that the teacher does not lead these discussions, he or she is assumed to have an important role to play. The teacher has a role at three different times: (a) introductory remarks before the discussion, (b) scaffolding moves during the course of the discussion, and (c) debriefing after the discussion ends. While the teacher's rate of talk is on average less than his or her rate of talk during conventional classroom discussions (Chinn, Anderson, & Waggoner, 2001), the teacher is nonetheless assumed to have a critical impact on children's learning and development.

The teacher intervenes only infrequently during Collaborative Reasoning discussions. While children share ideas about the big question, the teacher facilitates the discussion "from the side" and scaffolds their cognitive and social skills using several moves. These moves are designed to assist children's performance by helping them clarify and elaborate their ideas, construct their arguments, respond to other children's claims, and consider alternative perspectives. Once the discussion is over, the teacher debriefs the children and provides them with feedback about the group's social interaction and the quality of their argumentation. During the debriefing, the teacher gives the children the chance to take part in evaluating the discussion.

Collaborative Reasoning discussions provide a classroom environment during which a teacher's scaffolding moves can be gradually appropriated by the children. As the children become more skilled in constructing arguments and fulfilling new roles, the teacher gradually relinquishes control. However, the teacher's role does not end; he or she continues to provide scaffolding when needed. It is reasonable to assume that an environment in which teacher and student control is equalized amplifies reciprocal influences between the teacher and the students and among the students themselves. A child's response affects the teacher's reaction, just as the teacher's input affects the child's response; the same applies to interactions among the children themselves (Orsolini & Pontecorvo, 1992). As interactions

presumably take place within the zone of proximal development, it is to be expected that children will appropriate the moves practiced within their groups, reaching increasingly higher levels of performance.

Previous studies have shown that student rate of talking almost doubles during Collaborative Reasoning, as compared to baseline discussions in the same classrooms, and that the talk during Collaborative Reasoning more frequently embodies cognitive processes known to be associated with improved learning and problem solving, including a significantly higher rate of providing explanations, elaborating ideas by linking them to prior knowledge, drawing inferences that connect different parts of texts, and supporting ideas with text evidence (Chinn et al., 2001; Murphy, Wilkinson, Soter, Hennessey, & Alexander, 2009). Previous studies involving nearly 60 classes of fourth and fifth graders have established that students who have participated in Collaborative Reasoning write reflective essays (about a story they have *not* previously read or discussed) that contain significantly more acceptable arguments, counterarguments, rebuttals, and uses of text evidence than comparable students who have not participated in Collaborative Reasoning (Kim, Anderson, Miller, Jeong, & Swim, 2009; Reznitskaya et al., 2001, 2008; Zhang, Anderson, & Nguyen-Jahiel, 2009). The present study adds no new evidence about the outcomes of Collaborative Reasoning as compared to other approaches. Instead, the study examines the process, especially the influence of the teacher on the process, that may give rise to the outcomes documented in previous research.

The present study uses the microgenetic approach and employs statistical techniques appropriate for analyzing events sequenced in time to investigate the role of the teacher in Collaborative Reasoning discussions, seeking to identify scaffolding moves that are part of chains of influence on children's talking and thinking. Reciprocally, the study explores the impact of children's reactions on a teacher's use of scaffolding moves.

Method

Participants

This study focuses on 30 discussions within one fourth-grade classroom located in a small city in east central Illinois. Children attending the school were from a mix of working-class and middle-class families; 56% were European Americans, 40% were African Americans, 6% were Asian Americans, and 3% were Latino Americans. About half the children (49.5%) qualified for free or reduced-price lunch.

The teacher, Ms. Jackson (pseudonym), had taught for 36 years at the elementary school level. She had a master's degree in elementary education. She had been in charge of the science literacy committee in her school for 12 years and had participated in a writing program for children for 3 to 4 years.

Ms. Jackson's room had a bank of windows on one side and blackboards across another side. Handmade and purchased posters hung all around the room. Movable desks were arranged traditionally in rows. Most Collaborative Reasoning discussions were held at a round table at the back of the room. The children sat in a semicircle so that the camcorder could capture their faces. Ms. Jackson sat off to the side of the group to discourage speech directed to her.

The classroom included 16 girls and 7 boys; 12 were European American and 11 were African American. Children were assigned pseudonyms that preserved clues to gender and ethnicity. Children's assent forms and parental consent forms were obtained for all children. Children completed the Reading Comprehension subtest of the Metropolitan Achievement Test (Farr, Prescott, Balow, & Hogan, 1986). They also responded to a questionnaire in which they rated each child in their class on several characteristics. One item asked the children to judge whether each classmate was too quiet; another asked about classmates who talk too much.

Procedures

Ms. Jackson was one of a group of teachers participating in a larger study who attended a 1-day workshop on Collaborative Reasoning. Teachers learned the framework of the Collaborative Reasoning approach and were introduced to scaffolding moves designed to facilitate the discussions and promote children's thinking. They watched video clips demonstrating how other teachers implemented the moves. Teachers practiced facilitating Collaborative Reasoning discussions in role-play.

In the workshop, teachers learned the Collaborative Reasoning ground rules, which they were then to encourage their children to follow: (a) talking freely without being nominated by the teacher, (b) not interrupting other children who are talking, (c) encouraging everyone to participate in the discussion, (d) listening respectfully to everyone's ideas, (e) considering all sides of an issue, and (f) thinking critically about the ideas and not about people.

Teachers were recommended to use a set of scaffolding moves to promote children's argumentation skills. These moves include (a) prompting children to use text evidence to support their arguments (a teacher might ask, "Is there evidence in the story that supports what you are saying?"); (b) asking children for clarification when their utterances contained ambiguous pronouns, hidden premises, implicit warrants, or were otherwise unclear (a teacher might ask, "Who do you mean by 'he,' the father or the coach?" or "Are you assuming that the princess was poor?"); (c) challenging children when they considered only one side of an argument or based conclusions on unsupported assumptions (a teacher might say, "Some people might say the goose was well enough to fly" or "If you were Stone Fox, will you give up your dream to help your tribe for Little Willy?"); (d) ratifying

children when they spontaneously advanced a challenge or encouraged other children to state their ideas (a teacher might say, "That's a thoughtful idea" or "I liked the way you asked Cecily to state her opinion"); (e) providing adequate wait time to give children time and space to reflect, think, and independently manage their discussion; (f) summarizing children's arguments to help them keep track of the discussion (a teacher might intervene when children go off topic and say, "Let's stop for a minute and summarize your main ideas"); and (g) debriefing children and encouraging them to reflect on how well their discussion went (a teacher might start the debriefing saying, "How do you think the discussion went today?").

Ms. Jackson was asked to divide the children into three heterogeneous groups balancing reading ability, gender, ethnicity, and talkativeness (Table 1). Later, we verified that the groups were indeed similar on these factors. Groups were labeled with color names as a child-friendly approach to help the teacher manage the groups. Each group had 7 to 8 children and discussed 10 stories, 2 stories a week over a period of 5 weeks. The discussions averaged 16.3 minutes in length. While Ms. Jackson met one discussion group, the rest of the children did individual work at their desks.

Videotapes of the discussions were digitized and then transcribed using Transtool (Kumar & Miller, 2003), software that marks digital video with time stamps indicating the starting point of any turn of speech or classroom event that can be synchronically transcribed. Once the first round of transcription was completed, a second round was done to review the accuracy of the transcription and the time stamps. The transcripts detailed not only participants' talk but also overlapping speech and nonverbal behavior. Transcripts were exported to Microsoft Word for coding.

Data Corpus and Coding

Thirty discussion transcripts comprising 5,342 discussion turns were analyzed in this study. The unit of analysis was the single turn for talking. A discussion turn is a time segment during which a speaker shares an idea with his or her group and includes one or more lines of discussion transcript. Lines of discussion transcript also contained transcribers' comments about children's nonverbal behavior (such as raising hands to indicate a position, flipping through story pages, etc.), notations of nonparticipation (such as pauses during discussions that exceeded 3 seconds), and descriptions of events outside the main flow of discussion (such as inaudible side conversations between two children, intercom announcements, etc.). For the analyses described in this article, talking turns were operationally defined as lines of discussion transcript demarcated as distinct events by the transcriber; this included overlapping turns, interjections, and speech fragments that did not gain or hold the floor as well as "full turns" (Chinn et al., 2001)—utterances that held the discussion floor while participants expressed ideas.

Table 1
Gender, Ethnicity, Talkativeness, and Metropolitan Achievement Test Score for Children Within Discussion Groups

Group and Name	Gender	Ethnicity	Talks Too Much[a]	Too Quiet[a]	MAT Score
Blue					
Alfahah	Male	African American	7	3	22
Angela	Female	African American	8	4	30
Chris	Male	European American	9	2	43
Emma	Female	European American	0	14	48
Lakeshia	Female	African American	6	1	13
Linda	Female	European American	1	7	60
Nora	Female	European American	1	5	38
Tyron	Male	African American	4	3	26
Red					
Jesse	Male	African American	14	0	27
Joe	Male	European American	1	4	51
Liz	Female	European American	13	1	30
Mary Anne	Female	European American	0	2	56
Monica	Female	European American	3	2	50
Naquella	Female	African American	2	2	34
Tracy	Female	European American	1	4	52
Tyson	Male	African American	10	1	37
Yellow					
Cicely	Female	European American	0	11	53
Grace	Female	African American	3	2	40
Jazline	Female	African American	6	2	55
Lucy	Female	European American	4	1	41
Major	Male	African American	16	0	30
Mark	Male	African American	8	0	52
Shannon	Female	European American	0	12	54

Note. MAT = Metropolitan Achievement Test (Farr, Prescott, Balow, & Hogan, 1986).
[a]Number of peer nominations, maximum score = 22.

Every single turn by Ms. Jackson during the 30 discussions was examined and coded. First, Ms. Jackson's turns were categorized based on the scaffolding moves recommended during the Collaborative Reasoning workshop. New categories were constructed for moves that Ms. Jackson used that had not been recommended at the workshop. The next step was to identify her most frequently used moves, defined as those that constituted more than 10% of her total turns during the discussions. The children's turns that were responses to specific scaffolding moves were next inspected and coded. The remaining turns were assigned a miscellaneous code. This process was repeated for each scaffolding move that met the 10% criterion: prompting

Table 2
Frequency and Percentage of Ms. Jackson's Scaffolding Moves During 30 Collaborative Reasoning Discussions

Scaffolding Moves	Blue Group	Red Group	Yellow Group	All Groups	%
Asking for clarification	35	20	26	81	21.1
Praising the use of evidence	26	20	31	77	20.1
Prompting for evidence	10	20	14	44	11.5
Challenging	23	9	10	42	10.9
Asking children to sum up	15	16	1	32	8.3
Checking assumptions and restating ideas	13	4	12	29	7.6
Prompting for positions or reasons	11	2	4	17	4.4
Summing up (by teacher)	6	8	0	14	3.6
Praising children' ideas	3	1	5	9	2.3
Other moves	19	13	7	39	10.2
Total	161	113	110	384	

and praising children's use of evidence, asking children for clarification, and challenging, as indicated in Table 2.

Coding prompts for and praises of the use of evidence. The use of textual evidence is a strong tool for building persuasive arguments. One of Ms. Jackson's principal objectives was to have children support their arguments with story evidence. If children did not spontaneously use story evidence, she would eagerly prompt for it. Three codes were assigned to this category, two teacher codes and one student code. Ms. Jackson's explicit request for textual evidence was given a code to highlight turns during which she prompted the direct use of story information, for instance, "Where in the story does it say that the princess did not like the prince?" Another teacher code was assigned to turns during which Ms. Jackson praised the use of evidence, for example, "That is good story information." Children's discussion turns containing one of the following or similar phrases—"In the story, it said [evidence]"; "On page [*x*], it said [evidence]"; "Chang Li said [evidence]"; or direct oral reading from the story—were assigned the third code in this category.

Coding the prompts for clarification. At times, children's utterances contain pronouns whose reference is hard to identify. For example, the story *Stone Fox* (Gardiner, 1980) included two male protagonists, Stone Fox and Little Willy, and two other male characters, Willy's grandfather and Dr. Smith. If a child used two pronouns and said, "He should win, because he started feeling better," the listener has to infer that the second *he* refers to Willy's grandfather, whose health started improving near the end of the

story. Because it was contested who should win the race, the first *he* is even more ambiguous. When children overused pronouns, Ms. Jackson had to prompt the child who was talking to clarify whom he or she meant, for instance, "Do you mean Willy or Stone Fox should win?" Ms. Jackson also asked children to elucidate their statements by asking, "Can you clarify what you mean by . . . ?" or by restating what the children said: "Do you mean to say . . ." Three codes were also assigned to this category, one teacher code and two child codes. The two types of teacher prompts for clarification just mentioned were assigned one code. A child who responded to the teacher's prompt was given a code, and all other children who elaborated beyond the given clarification were assigned the third code.

Coding challenges. Challenging is an essential component of argument construction. Ms. Jackson used three approaches to challenge children: (a) presenting a general challenge, whereby Ms. Jackson might comment, "It sounds to me as if no one's trying to look at things from the Prince's point of view"; (b) asking children to place themselves in a story character's place, when Ms. Jackson might ask, "If you were Stone Fox, what would you think?" and (c) expressing the challenge as a possible alternative some people might think of, in which case she might ask, "Some people might say computers are expensive. What do you think about that?" During the workshop, teachers were encouraged to use the third approach to lessen their authoritative voice while raising a challenge. This approach to challenging was thought to give children the chance to address a challenge from their teacher with less reticence. The teacher's talking turns were assigned one code. Children's talking turns were assigned two codes: the first was to the child responding to the teacher's challenge; the other was to all other children who expanded that response.

Statistical Analysis

To analyze the clusters of talking turns associated with scaffolding moves, two methods of sequential categorical data analysis were employed, lag sequential analysis (Bakeman & Gottman, 1997) and bidirectional dependence analysis (Wampold & Margolin, 1982). For these methods to yield sensible results, several assumptions addressed by Chiu and Khoo (2005) must be satisfied: (a) coding reliability, (b) dependence as opposed to independence (or randomness) of events, (c) stability in sequential dependencies among events when participants are observed over time (stationarity), and (d) stability in sequential dependencies when participants are clustered in groups (homogeneity).

To increase interrater reliability, we coded the cluster of talking turns for each instructional move separately. That is, each of the 30 discussions was coded three times, once for each instructional-move cluster. A second trained rater independently coded 30% of the discussion transcripts,

Table 3
Likelihood Ratio Tests for Independence, Nonstationarity, and Heterogeneity

		Independence			Nonstationarity			Heterogeneity		
Scaffolding Move	Group	LRχ^2	*df*	*p*	LRχ^2	*df*	*p*	LRχ^2	*df*	*p*
Prompting and praising use of evidence	Blue	68.71	9	.000	80.07	108	.980	11.13	24	.988
	Red	51.25	9	.000	75.12	108	.993			
	Yellow	75.47	9	.000	74.11	108	.995			
Asking for clarification	Blue	364.06	9	.000	85.00	108	.950	32.75	24	.120
	Red	348.57	9	.000	91.02	108	.880			
	Yellow	272.71	9	.000	76.79	108	.990			
Challenging	Blue	175.98	4	.000	62.00	54	.212	12.84	12	.381
	Red	88.12	4	.000	39.05	54	.930			
	Yellow	124.75	4	.000	61.63	54	.222			

resulting in interrater coding reliability (Cohen's kappa) as follows: prompting and praising the use of evidence, $k = .95$; asking for clarification, $k = .91$; and challenging, $k = .81$.

Unlike traditional statistical methods, observations in event sequence data are by their nature dependent. In fact, "we want to *detect dependence* in the observations. . . . Thus, dependence is not a problem" (emphasis in original; Bakeman & Gottman, 1997, p. 136). Dependence is tested against randomness or lack of patterns (Wampold, 1995). A likelihood ratio chi-square test was employed to detect whether the events were independent. As Table 3 indicates, all tests were significant; thus the null hypothesis of independence was rejected.

The SEQGROUPS-2 program (O'Connor, 1999) was used to test the assumptions of stationarity (stability across different time segments) and homogeneity (stability across different groups). In the case of stationarity, the discussions were examined for stability across the 10 discussions. For example, this test examined whether Ms. Jackson's prompt for evidence had the same likelihood of being followed by children's use of evidence in each of the 10 discussions. In the case of homogeneity, the sequential dependencies among clusters of talking turns were compared across groups to examine group stability. Using the same example, this test examined, for instance, whether the transitional probability between Ms. Jackson's prompt for evidence followed by children's use of evidence was the same in the three groups. For each of the groups listed in Table 3, the likelihood ratio chi-square test for the rival hypothesis of nonstationarity was not significant. This indicates that discussion dynamics were stable from one discussion to the next. Likewise, the likelihood ratio chi-square tests for the rival

hypothesis of heterogeneity were nonsignificant. This indicates that sequential dependencies among the teacher's and children's turns were the same across groups. Hence, it is possible to get sensible results from a classroom-level analysis with data pooled across the 10 discussions of the three groups.

Lag sequential analysis tests the probability of a systematic sequence of events as compared to an unsystematic sequence or randomness. For example, if a teacher asks for evidence (*criterion* event), lag sequential analysis evaluates the transitional probability that this event will be followed by a child's use of evidence (*target* event). When the transitional probability significantly exceeds the expected value, there is justification for the conclusion that after a teacher asks for evidence in one turn, a child is more likely to provide evidence in a following turn. A series of transitional probabilities can be evaluated for the target's occurring immediately after the criterion (Lag 1), after one intervening event (Lag 2), after two intervening events (Lag 3), and so on (Bakeman & Gottman, 1997, p. 112). We computed and evaluated transitional probabilities using the SEQUENTIAL program (O'Connor, 1999).

Lag sequential analysis requires a large number of observations. When K categories representing different types of talking turns are used and when L lags are examined, the number of talking turns should exceed $5K^{L+1}$ (Bakeman & Gottman, 1997, p. 145). When the number of categories is limited to $K \leq 4$, and the effects of one turn on the immediately following turn (lag = 1) are examined, 80 turns ($5 \times 4^{1+1} = 5 \times 4^2$) of talking for one group in one discussion will be sufficient. This criterion is met for every discussion in each of the three groups in the present study. However, each turn can influence not only the immediately following turn but also subsequent turns. To examine the effects of one event on events at longer lags (lag = 2 and beyond), 320 turns ($5 \times 4^{2+1} = 5 \times 4^3$) of talking are required. This criterion is met in the present study when the 10 discussions of a group are pooled.

In the present study, bidirectional dependence is concerned with whether in small-group discussions teacher talk influences the children and whether, as well, children's talk influences their teacher and other children. Wampold and Margolin (1982) proposed a statistic termed kappa to examine the reciprocity between sequences of talking turns. Wampold (1995) described several desirable features of kappa: (a) Kappa is independent of the length of sequences. (b) Kappa is sensitive to the difference between the observed number of transitions and the expected number of transitions. When the number of transitions equals the expected value, kappa is zero; when the number of transitions is larger than the expected value, kappa is positive; otherwise, it is negative. (c) Transformed kappas range from −1 to 1, in which a larger transformed kappa means that the reciprocal pattern takes place more frequently. Wampold-Margolin bidirectional *k*s for this study were obtained using the BIDIRECTIONAL program (O'Connor, 1999).

Results

Shown in Table 2 are the nine main scaffolding moves Ms. Jackson used during the discussions. Four moves each accounted for more than 10% of her total moves: (a) asking for clarification, (b) prompting for evidence, (c) praising the use of evidence, and (d) challenging. Because prompting for evidence and praising the use of evidence target the same argument move—the use of evidence—the impact of these two scaffolding moves is presented jointly. Together, these two categories constitute 32% of Ms. Jackson's total turns and, hence, are the moves most frequently used to target the same aspect of argumentation.

The overall rate of teacher's and children's talk changes drastically in Collaborative Reasoning discussions. A previous study found that while teachers talk less, children's rate of talk almost doubles during Collaborative Reasoning discussions compared to conventional classroom discourse (Chinn et al., 2001). Findings are similar in the present study. Figure 1 shows that Ms. Jackson's rate of talk dropped sharply after the first discussion and remained lower than the average of any one child's rate of talk for all but one of the remaining discussions.

Effects of Prompting and Praising the Use of Evidence

Ms. Jackson both prompted for and praised the use of story evidence in order to help her children learn to support their arguments with textual information. As Table 2 indicates, she prompted children to use evidence 44 times (12% of scaffolding moves), whereas she praised the use of evidence 77 times (20% of moves). Together, the two moves compose one third of her total input during the discussions. Following Anderson and his colleagues (1998, 2001), we took the position that whereas most statements during the discussion of a story contain information from the story, it is only when a child *explicitly labels* information as coming from a story that the rhetorical function of providing evidence is fulfilled. For a statement to be coded as providing evidence, children had to mark the statement with a phrase such as "In the story, it said [evidence]"; "On page [*x*], it says [evidence]"; or "The picture shows [evidence]." To maintain coding consistency, we preserved this strict criterion even when Ms. Jackson failed to meet the criterion when judging a child's contribution. If Ms. Jackson praised a child who used story information, but the child did not mark the information explicitly as coming from the text, the child was not credited with use of text evidence.

The lag sequential analysis (lag = 1) of the cluster of teacher and child moves involving the use of evidence are depicted in Figure 2. When Ms. Jackson prompted children to use evidence, there was 26.3% probability ($p < .001$) that her request would be fulfilled by a child in the following turn. Once a child used evidence, there was 16.7% probability ($p < .001$)

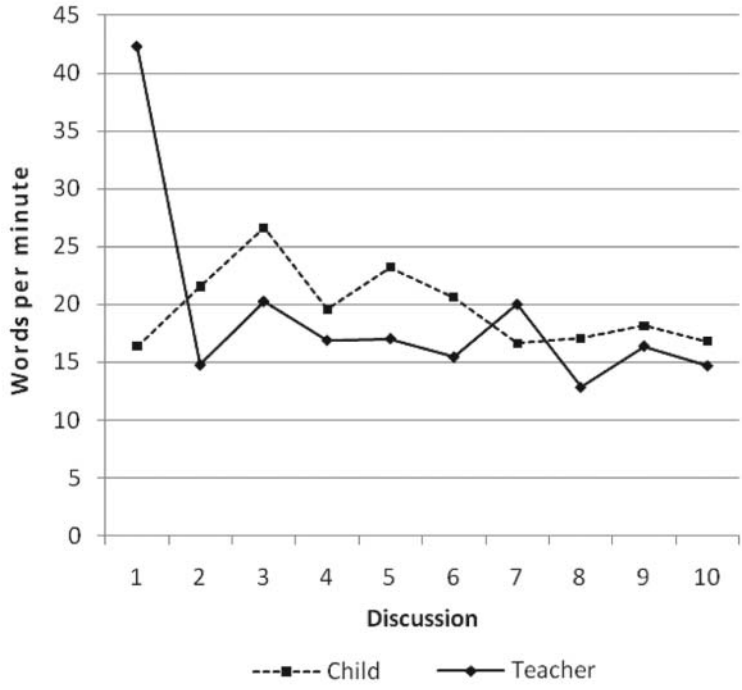

Figure 1. **Rate of teacher talk and average of child talk in words per minute for each Collaborative Reasoning discussion.**

that she or he would be praised by Ms. Jackson immediately. While these two event sequences are direct and expected, we detected two additional event sequences that are indirect and less expected. Once Ms. Jackson praised the use of evidence, there was 13.0% probability ($p < .001$) that another child would also provide evidence right after the praise. Once evidence was used a second time, there was 7.9% probability ($p < .001$) this would be followed by another child who once again used evidence. Anderson and colleagues (2001) called this child-child influence the "snowball" phenomenon. They found that once a useful argument move is employed by a child, it spreads among the rest of the children and occurs with increasing frequency.

The third discussion contains a representative example of sequences of teacher and child moves involving evidence. Children read *A Trip to the Zoo* (Reznitskaya & Clark, 2001). In the story, Lily is excited about the upcoming field trip to the zoo, whereas Anna decides not to make the trip because she is worried that zoos are not good places for wild animals to live. During the

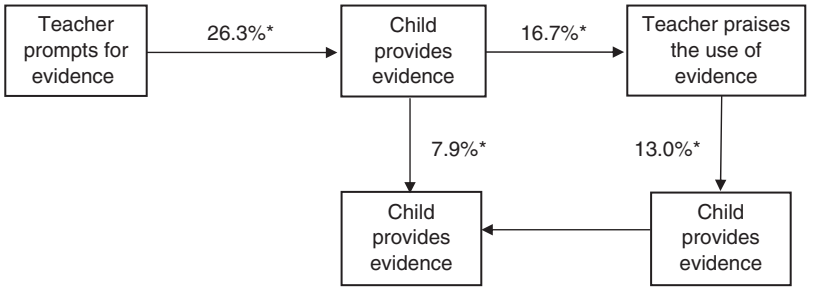

Figure 2. **Transitional probabilities for teacher and child moves involving evidence.**
Note. Lag = 1; *$p < .001$.

discussion, the children considered the big question, "Are zoos good places for animals?"[1]

Ms. Jackson: Can you use evidence from the story? |1| Two girls? |1|
Cicely: |1| Anna said how would you |1| Anna said [reading from story] "How would you feel if somebody put you in a cage and you had to stay there for the rest of your life."
Ms. Jackson: Good point. |2| Glad to see you use an example |2|
Grace: |2| Yah and and in the story |2| it said "you don't have to go to the zoo you can just go on the road and see different animals."
Mark: They said um they said in the story there, "they'll lose their instinct to hunt and look for their food" [turns to teacher]
Ms. Jackson: Good Point. Good, good example |1| from the story |1|

The transitional probabilities depicted in Figure 2 are relatively low. The strict criterion used to code the use of evidence might contribute to these low probabilities. However, there are at least two other contributing factors. When prompted, a child may need time to sift through the story to find evidence. In this case, the child is likely to provide evidence in the second turn or later turns. The other factor is that interjected turns, overlapping turns, "empty" turns ("uh, I think . . ."), and the transcriber's notations of nonverbal behavior sometimes intervene before the child has the opportunity to respond. We treated simultaneous speech, overlapping speech, and transcribers' comments as separate lines in the transcript. Because of the necessarily mechanical rules for defining turns in a large corpus, this often resulted in several apparent turns intervening between a teacher's prompt for evidence and a child's use of evidence. The following excerpt is a typical example of a delay in responding. The aforementioned two explanations account for the majority of Tyron's delay in responding to Ms. Jackson's prompt. Part of the delay is due to Tyron's difficulty in locating evidence in the story. The

other part of the apparent, if not real, delay is due to Lakeshia's interjected turn and the transcriber's notation that Alfahah is raising his hand.

Tyron: Um, well, um, it's more safe for them [animals] to stay in the zoo cuz if they're not in the zoo things that dangerous can happen to them or they probably can't find their food and they can die.
Ms. Jackson: Could you use some evidence from the story for that Tyron?
Tyron: Um, [pause for 8 seconds] [looks at the story] um, [pause for 10 seconds]
Lakeshia: |1| Try . . . Just look in the story.|1|
Alfahah: |1| [Raises left hand]|1|
Tyron: Um, on page 14 animals should be free, because in the story right here it says, "Well some of those animals need more space than they have here in the zoo. How could a jaguar feel it's at home if it can't run over miles and miles of land like it does in Africa?"

Occasionally, children did not respond to Ms. Jackson's prompt because they were preoccupied with another issue. The following excerpt is from a discussion of *Marcos' Vote* (Nguyen-Jahiel, 1996), in which the children are trying to decide whether a school should replace its worn-out math textbooks with new textbooks or with computers and computer software that teach math. Ms. Jackson asked if there was evidence in the story to support Tyson's idea that parents would be willing to donate money to the school to buy computers. However, the children did not respond to Ms. Jackson's request to provide evidence. Instead, Jesse went back to a previous idea about the number of computers the school needs to buy.

Tyson: Look if you buy that thing, if you buy, whatever if you buy that box or that kinda stuff for people to put their money in. I guarantee you if that person's son school or daughter school sometimes they going to put in $20.00 or something.
Naquella: |1| Yeah, they like, just like |1|at church they bring offering.
Ms. Jackson: |1|Some people say that|1|
Tyson: Yeah.
Ms. Jackson: Some people might say that they look at the evidence to support their decision.
Jesse: Who—who said um something about the computers?
Tyson: |1| Yeah, why they just buy two computers? |1|
Naquella: |1| I think they should try to get the computers |1| and the rest of them should try to help get textbooks.

Table 4 shows the transitional probabilities of event sequences involving the use of evidence when the lag is set to 1, 2, 3, and 4. Although the transitional probability decreased at Lags 2 and 3, it went up again to almost 20% at Lag 4. This means that children's direct responses to Ms. Jackson's prompting were captured up to Lag 4. We also inspected the children's use of evidence independently of Ms. Jackson's prompting or praising and/or the use

Table 4
Transitional Probabilities at Different Lag Positions for Moves Involving the Use of Evidence

	Lag Position			
Event Sequence	1	2	3	4
Teacher prompts for evidence → Child uses evidence	.263**	.105	.080	.184**
Child uses evidence → Teacher praises child	.167**	.106**	.044**	.026
Teacher praises child → Child uses evidence	.130**	.104*	.026	.104*
Child uses evidence → Child uses evidence	.079**	.075*	.079*	.057

*$p < .01$. **$p < .001$.

of evidence by other children. The transitional probabilities were not higher than 4.1% for any lag position ranging from 1 to 4 following a neutral turn in which the use of evidence was not prompted, praised, or utilized by another child. The lag sequential analysis indicates that Ms. Jackson's prompting and praising influenced children's use of evidence more than did the use of evidence by other children.

The bidirectional dependence analysis revealed teacher-child and child-child reciprocal influence regarding the use of evidence. For the sequence in which Ms. Jackson prompts for evidence followed by a child's use of evidence, Wampold-Margolin k was equal to 0.106 ($p < .001$); this result indicates that Ms. Jackson was more likely to prompt children for evidence again when her request for evidence was responded to. The result is of interest, as it documents not only the teacher's influence on children but also children's influence on their teacher. For the use of evidence by a child followed by the teacher's praise of the use of evidence, $k = .281 (p < .001)$. This result indicates that children were more likely to use evidence again after receiving praise from the teacher. Finally, for a child's use of evidence followed by another child's use of evidence, $k = .038$ ($p < .001$); this result indicates that while significant, children had a weaker reciprocal impact on each other. It is likely that the kappa values were underestimated due to transcription conventions, as discussed above, and other challenges that increased the distance between events in a sequence.

Ms. Jackson prompted for evidence mostly when it existed in the story; however, she also requested it when she presumably knew that it did not exist. Asking for evidence was a move appropriated by the children, especially those who experienced a request for evidence when none existed. Children gradually learned to question the validity of a claim by pointing to the lack of evidence, using phrases such as "But it doesn't say that in the story." Eventually, they started requesting evidence or requesting the

location of evidence in the story as a condition for accepting the validity of a claim, using phrases such as "*Where* does it say that in the story?"

Ms. Jackson requested text evidence even when none existed as early as the first discussion. Children were discussing the story *What Should Kelly Do?* (Weiner, 1980). Kelly wants to win an art contest, but it is hard for her to beat Evelyn, the best artist in the school. On the day the paintings are due, Evelyn forgets about her painting while playing on the swings. Kelly notices Evelyn's painting outside as it is about to rain. Kelly contemplates whether to save Evelyn's painting or let it be destroyed by the rain. The big question is, "Should Kelly save Evelyn's picture?" Mrs. Jackson asked Mary Anne to support her idea with evidence in spite of the fact that there was no evidence in the story to support Mary Anne's claim:

Mary Anne: She probly [*sic*] just put it up against the side where the stairs were. |3| That way |3| when she went to— \\
Joe: |3| Probably. |3|
Ms. Jackson: \\ Does it say in |4| the story |4|?
Jesse: |4| No. |4| |5| They don't |5| say how big the school was, or how it is.

By the second discussion, Mary Anne showed an improved understanding of the value of evidence. The children were discussing *Ronald Morgan Goes to Bat* (Giff, 1990). The story is about Ronald, who does not know how to play baseball but shows great spirit cheering his team. Ronald got better when his father started practicing with him. The big question was, "Should the coach let Ronald play on the team?" The following episode shows how children used story information to debate whether Ronald's father could teach him how to play. Mary Anne, who previously had not paid close attention to evidence to back her claims, asserts (in the underlined section) that the absence of text evidence makes further speculation fruitless.

Liz: Um, I think that his dad should um, teach him how to play baseball.
Tyson: But his dad said he don't know how to play either.
Liz: No.
Monica: Right here at the end of the story, Tyson, |1| it says— |1|
Mary Anne: |1| He [Ronald's father] said |1| ' He USED to close his eyes too.
Monica: Yeah, he used to close his eyes, but |2| he |2| quit, |3| it says— |3|
Mary Anne: |2| But |2|
Mary Anne: |3| But he quit |3| Now he quit and can probably play great. But it never says that in the story, so you can't be sure.
Jesse: When you get older, you not gonna be, you not gonna be as worse as your son, I'm sure.
Monica: Yeah, it says right here, "I saw my father and ran up to catch to him, and said 'see you Michael, my father asked, 'how's the champ?' I'm the worst, I said. I was the worst too, said my father, but then. What? My father laughed. I stopped closing my eyes when I swung. Maybe that's what I'd do."

To instill in the children the importance of using evidence to strengthen their arguments, Ms. Jackson used queries such as "Is there any evidence in the story?" and "Can you use evidence from the story?" Children gradually acquired an appreciation for the use of evidence not only to support their own arguments or to challenge other children's arguments but also to raise doubts about the validity of arguments because of lack of evidence. In the yellow group, for example, during the 10 discussions, there were 11 instances in which children challenged each other using phrases such as "But it doesn't say that in the story."

Starting from the fifth discussion, children began to ask each other to locate story evidence by saying, "Where does it say that in the story?" In the excerpt below, the children were discussing *Marco's Vote* (Nguyen-Jahiel, 1996). Jazline asks Cicely to support her opinion with evidence. When Cicely fails to do so, Jazline asserts that it is important to have evidence from the story to support claims.

Ms. Jackson: |1| Cicely, |1| what was your—can you clarify your comment about, the, computers only to teach math?
Cicely: The— they only . . . well, like [computers] only teach math, they don't teach reading or science, or anything, |1| anything else like that.
Jazline: Where does it say that in the story?
Grace: |1| [looks over shoulder away from the group, into the classroom; continues through Jazline's turn] |1|
Cicely: [starts to look through the story]
Grace: |1| [looks through story] |1|
Mark: |1| Grace, what do you think about what, um, um, Cicely said?
Grace: I agree with her because five hun—, five hun—, I mean fifty hundred dollars, is too much to save, they can save ten thousand dollars, and that's not much.
Jazline: Um, I think, I think that um, we should find out where it—, it says that computers only teach math. Because if the—, if the computers only teach math, then they can like, each day you have to do math for like, after the day is over, or not the day's over, but like the last subject is social studies, after social studies, you still have like, an hour left and you could do the computers like, the end of the day with your math done so can, have |1| it done. |1|

The rhetorical function of prompting for evidence changes depending on who is using it. While the teacher implicitly aims to help children construct text-based arguments, a child might request evidence to challenge another child. In the previous episode, Jazline's request for evidence was more teacherly than oppositional. She asked Cicely to provide evidence, but she did not seek to raise doubts about Cicely's position. In fact, Jazline was an emergent child leader who gradually assumed a number of functions normally performed by teachers and often did so in a teacherlike way (Li et al., 2007).

Children also appropriated praising the use of evidence; however, this was less widely disseminated among the children compared to requests for evidence. During the debriefing following the fifth discussion, Naquella, of the red group, expressed admiration for the way Monica had used evidence. When Ms. Jackson asked children to evaluate who had the strongest arguments, Naquella stated succinctly, "I think Monica [did] because she was using examples out of the story . . . very good." However, the independent use of this scaffolding move by children *during* the discussions was not observed until later. Monica, of the red group, and Lakeshia, of the blue group, praised others in their groups when they used evidence. Monica used this move three times, once during the eighth discussion and twice in the tenth discussion, whereas Lakeshia used it once in the ninth discussion. The fact that appropriation of this instructional move did not take place before the eighth discussion suggests that the children were not sure that it was a suitable move to emulate and only gradually became comfortable doing so.

The following example occurred during the course of the eighth discussion after reading *Stone Fox* (Gardner, 1984). In the story, Little Willy enters a dogsled race hoping to win a prize to pay the taxes on his grandfather's farm. Willy is racing against Stone Fox, a Native American, who had won the race several times before and used the money to buy back his tribe's land. Willy is about to win the race when his dog dies just 10 feet before the finish line. The big question was, "Should Stone Fox let Willy win the race?"

Tracy: See everybody thought Stone Fox was really mean and everything, but he wasn't, because it says, "Stone Fox's dream was for his people to return to their homeland. Stone Fox was using the money he won from each race to simply buy the land back. He had already purchased four farms and over 200 acres." And Stone Fox was all right.
Monica: Good example from the story Tracy.

During the sixth discussion, four children in the blue group criticized Chris for what they regarded as his excessive reading from the story; they thought that he was supposed to think for himself and not just read from the story. However, one girl in the group defended Chris's use of evidence, saying, "He is using proof from the story; that's what we're supposed to do." In the following excerpt from the seventh discussion, the children again talk about using story evidence. In this excerpt, children used the word *advice* in place of *evidence*. Angela expresses how she and her peers are supposed to balance arguments expressed in their own words with story evidence to make final decisions about the big question.

Chris: What do you think Alfahah?
Linda: Yeah, Alfahah.
Alfahah: About what?
Lakeshia: About yeah about more advice from the story.

Chris: Should he, I mean, should he, we should start using advice from the story, not just . . .

Students: [All talking at once.]

Angela: Sometimes we do have to use some words from our own though, and from the story to use advice see what's going on in the story, about what he should do, about changing his mind or not changing his mind.

Figure 3 shows that as the discussions progressed, Ms. Jackson prompted less for evidence as children began to spontaneously provide evidence to support their claims. She in turn increased praising children for providing evidence to help them sustain this argument move. Ms. Jackson's moves of requesting evidence and praising the use of evidence were appropriated by the children without any direct instruction or suggestion from her. Although these child-initiated moves occurred late in the series of discussions and there were too few instances to undertake an informative analysis, it would be interesting to investigate whether these child-initiated moves would, over time, have the same impact as the teacher's moves.

In conclusion, Ms. Jackson's prompting for evidence was likely to be followed by children's use of evidence, and children's use of evidence was likely to be followed by Ms. Jackson's praising the use of evidence. Ms. Jackson's praising the use of evidence reciprocated children's use of evidence. Starting from the first discussion, Ms. Jackson asked children to back their claims with text evidence, especially when there was no evidence in the stories to support their claims. In later discussions, as Ms. Jackson's use of these scaffolding moves decreased, a few children picked up the moves and began using them spontaneously.

Effects of Asking for Clarification

Ms. Jackson asked for clarification 81 times throughout the 30 discussions; this constituted 21% of her talking turns (Table 2). Ms. Jackson asked children to clarify statements on two types of occasions. The first was when children used pronouns whose reference was unclear. The second was when children stated reasons that she judged needed further elaboration. In spite of the fact that Ms. Jackson would direct only one particular child to clarify his or her statement, this move indirectly affected other children in the group, leading them to expand their conversation about the designated topic. As later examples show, requests for clarification often led children to increase their use of text evidence as they sought it to make their reasoning clear.

Figure 4 displays the lag sequential analysis of talking turns involved in clarification. Pooling over all discussions, when Ms. Jackson asked for clarification, there was 60.6% probability ($p < .001$) that in the following turn, a child would provide clarification. When a child responded with an attempt at clarification, another child would comment on this attempt. This

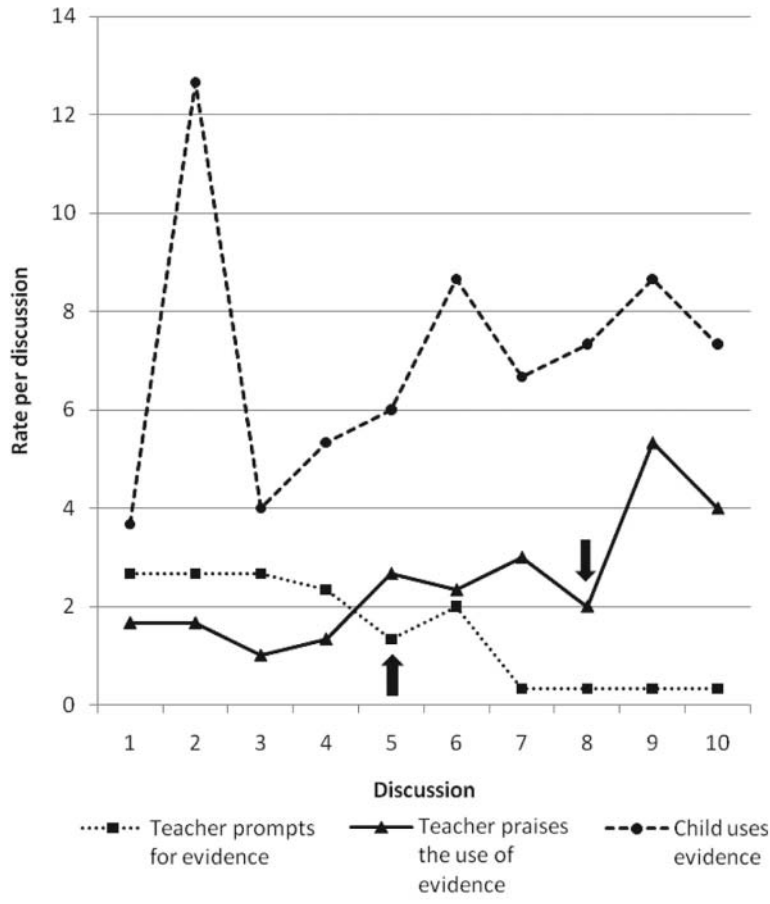

Figure 3. **Rate of teacher and children moves per discussion involving evidence.** *Note.* The upward arrow in the graph indicates the discussion (Number 5) during which children first appropriated prompting for evidence. The downward arrow indicates the discussion (Number 8) during which children first appropriated praising the use of evidence.

child-child sequence occurred with 41.9% probability ($p < .001$). Furthermore, there was a high probability that in the following turn, a third child (or the first child) would further comment on the same topic (49.1%, $p < .001$).

Table 5 indicates that at Lag 1, the likelihood that children would continue commenting on the issue raised in a child's clarification stays relatively high, 44.5% ($p < .001$). This result further supports the notion that when the

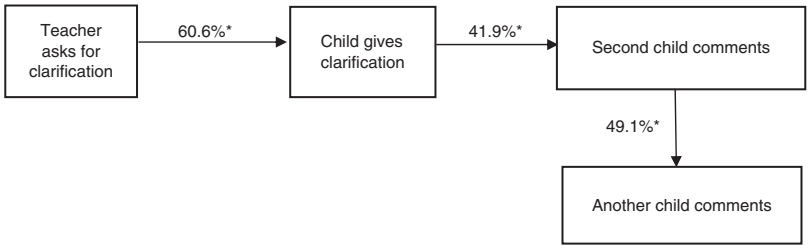

Figure 4. **Transitional probabilities for teacher and child moves involving clarification.**
Note. Lag =1; *$p < .001$.

Table 5
Transitional Probabilities at Different Lag Positions for Moves Involving Clarification

	Lag Position			
Event Sequences	1	2	3	4
Teacher asks for clarification → Child gives clarification	.606**	.101**	.061**	.061**
Child gives clarification → Second child comments	.419**	.259**	.235**	.161**
Second child comments → Another child comments	.491**	.313**	.205**	.161**

*$p < .01$. **$p < .001$.

teacher asks even one child to clarify his or her statement, the influence of the teacher's targeted request goes beyond that one child to other children in the group. However, when farther lags are examined (Lag 2 and beyond), it should be noted that there is a sharp decline in children's response to clarification. One explanation for this decline is that unlike the two other scaffolding moves, asking for clarification targeted a particular child, whereas the other two moves, especially challenging, were usually open to all children.

Bidirectional dependence analysis indicated that all the event sequences involved in clarification reciprocated each other ($p < .001$). That is, children's providing clarification reciprocally influenced Ms. Jackson's requests for clarification ($k = .397$), children's comments on a clarification reciprocated the children's providing clarification ($k = .228$), and children's comments reciprocated the comments of other children ($k = .509$). The strongest reciprocal influence was observed when children commented on the contributions of other children.

In the first discussion, Ms. Jackson used clarifying moves to help children state clearer positions and refer to story characters by name rather than with imprecise pronouns. In the discussion of *What Should Kelly Do?* (Weiner, 1980), excerpted below, the children were talking about Evelyn. The pronoun *she* had been employed in previous turns and was understood to refer to Evelyn. However, Ms. Jackson wanted Alfahah to clarify whom he thought Evelyn would be angry at. Ms. Jackson's request for clarification triggered a contribution from Linda as well as from Alfahah. It also encouraged Marry Anne and Lakeshia to express their ideas about the designated issue.

Alfahah: |2| She would, she would get |2| mad or angry that her picture was ruined and she wouldn't get first prize.
Ms. Jackson: Who would she be angry at?
Linda: Maybe Kelly, or she could even be mad //
Alfahah: // She could be angry at the person who won first prize or something. Cuz she ruined her own picture that she left it outside.
Mary Anne: Or um, she could be upset at herself because she didn't turn in her picture, she just left it outside.
Lakeshia: She and um, she didn't know that um, she was gonna leave it outside and that she was on the swings and stuff. And um, and, [pause 7 seconds] and, and um, Kelly might have told her that it had gotten ruined for . . .

In the first discussion by the yellow group, asking for clarification was also used to elucidate pronouns. In the following episode, Major attempted to answer the big question, "Should Kelly save Evelyn's picture?" As it was not clear whether Major meant Kelly or Evelyn, Ms. Jackson asked Major to clarify which of the two girls he was talking about. Although Major stated that he meant Kelly, according to the story, he should have said Evelyn. Ms. Jackson did not follow up on this. However, three girls in the group attempted to correct him.

Major: I think she should, she should, she should not forget that she had uh a painting test, she should have kept her painting in her book bag so that when she got to school and the bell rang, she could take it to the office.
Ms. Jackson: And who is she, would that be Evelyn or Kelly?
Major: Kelly.
Ms. Jackson: All right, would you, now would you repeat that again, I'm not sure I heard you clearly.
Major: She should, she should //
Ms. Jackson: // Kelly should . . . [emphasizing the use of Kelly's name instead of the pronoun *she*]
Major: Kelly should, she knew she had a painting test so she should of kept her own test, and not leave it and put it in her book bag, and when the bell rings, she could take it to the office. And not lose it.
Ms. Jackson: Ok.
Shannon: |1| That wasn't |1| Kelly. [looking at Major]

Jazline: |1| [raise hand] Um |1|
Lucy: That was |2| Evelyn |2| [looking at Major]
Jazline: |2| That was |2| Evelyn. [looking at Major]

Anderson, Chinn, Chang, Waggoner, and Yi (1997) found that children's naturally occurring arguments are often elliptical and filled with unclear referring expressions, such as *it*, *that*, *these*, *she*, and so on. However, they maintained that unclear referring expressions are common in everyday talk, stressing that children in discussions seem generally to understand what is being said despite vagueness. Although there were exceptions, such as the glaring example involving Major excerpted above, the children in the present study also seemed to understand each other most of the time despite frequent vagueness.

In the following episode of the third discussion about *A Trip to the Zoo* (Reznitskaya & Clark, 2001), the big question was whether zoos are good places for animals. When Monica responded to Mary Anne's challenge regarding whether young animals will be able to learn how to hunt if they are kept in a zoo, Ms. Jackson asked Monica to clarify what she meant. After Ms. Jackson requested that Monica elaborate her idea, 27 consecutive turns were devoted to this issue (of which 15 are presented here).

Monica: |2| But they can teach them |2| how to do it at the |3| zoo.|3|
Tyson: |3| Yeah. |3|
Mary Anne: |4| What are they going |4| to chase |5| a rubber ducky?|5|
Tracy: |4| They could like— |4|
Tyson: |5| Yeah you |5| you could, you could get \\
Ms. Jackson: \\ Could you make that a little clearer Monica?=
Tyson: = Yeah, if you if you, if the babies get fed up in the, uh, up in the, uh, zoo. The mummy and daddy already still know how to hunt. They they probably won't forget |1| how to hunt and stuff. That way when they get back |1| they know how to teach them survive in the wild.
Monica: |1| What . . . what I'm trying to say is |1|
Monica: What I'm trying to say is they can make a little jungle—like they would |2| have back home.|2|
Tyson: |2| Yeah that's what I'm talking about |2|
Jesse: |3| Yeah so they so they can start getting used to |3| it. They said yeah have a little jung— \\
Mary Anne: |3| But still they wouldn't feel like animals |3|
Monica: Jesse, you're trying to—, Okay then can make a little thing at the zoo, because it's not really going to be out in the wild and they [zoo keepers] can like train them [animals], they can take them out like two hours a day and |4| um, they can like,|4| they can give them a piece of meat and then like, they can bring like dead zebras back so they can learn how ta—
Tracy: |4| give them a piece of meat |4|
Mary Anne: It's not the same they have to chase the animals not find |5| it laying down |5| on the ground.

Requesting clarification often stimulated children to challenge each other's ideas. In the second discussion, for which the children read *Ronald Morgan Goes to Bat* (Giff, 1990), the big question was, "Should the coach let Ronald play on the team?" A typical example occurred when Ms. Jackson asked Tyron, from the blue group, to clarify his statement. Following Tyron's response, Alfahah referred to the story to oppose Tyron's argument. The topic was further discussed after a second request for clarification by Ms. Jackson. The following is the first of these requests for clarification.

Ms. Jackson: Oh, can you clarify that for me, uh, the dad thought—why, why are you thinking that the dad thought he [Ronald] was the champion of the team?
Tyron: Because, the boy, every time, every time he probly [*sic*] came home, from the baseball team, he probly [*sic*] tell his daddy, "I was the champ, I was the champ" or he got on the phone with him or something. |1| He called him— |1|
Alfahah: |1| I don't think,|1| I don't think he said that, cuz in the story, it says, "My father asked how's it coming. I'm the worst I said." So I don't think he said that to his dad.

Children's appropriation of this scaffolding move started almost the same time as their adoption of prompting and praising the use of evidence. By the seventh discussion, children began to ask other group members to explain or clarify their positions. The move was first used by one boy in each group but quickly diffused to girls, four of whom immediately picked it up and used it successfully. The following excerpt from the eighth discussion of the story, *Stone Fox* (Gardiner, 1980), illustrates an appropriation of this move.

Lucy: I agree with her.
Mark: Could you clarify that?
Jazline: I mean, persuade us to think that you really, really agree with you. You got to persuade us.
Lucy: I agree because Willie should get the money, because it's not Willie's fault that his dog died.

In conclusion, Ms. Jackson's requests for clarification helped children identify the reference of pronouns, elaborate their ideas, and critically extend each other's contributions. For each pair of events in the sequence, a strong reciprocal influence was detected. That is, not only did Ms. Jackson's requests for clarification cause children to try to improve the clarity of their statement, but also children's attempts to provide clarification influenced Ms. Jackson to request clarification again. Providing clarification increased the frequency of commenting on attempts at clarification, and this also worked in a reciprocal manner, as did comments on clarification. Some children picked up the move of requesting clarification and used it successfully with other children.

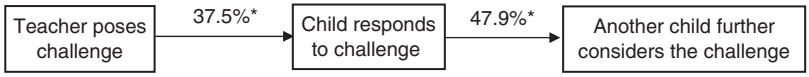

Figure 5. **Transitional probabilities for teacher and children moves involving challenging.**
Note. Lag = 1; *$p < .001$.

Effects of Challenging

The third-most-used scaffolding move by Ms. Jackson was challenging. Challenging constituted 11% of her turns (Table 2). The challenging approach she used most often was posing the challenge as a possible alternative suggested by others (19 times in all 10 discussions). The other two approaches, placing oneself in place of a story character and the general challenge, were used less often (13 and 10 times, respectively). Lag sequential results in Figure 5 indicate that when Ms. Jackson posed a challenge, there was a likelihood of 37.5% ($p < .001$) that a child in the following turn would respond to her challenge. Following a response to the challenge, there was a 47.9% probability that another child would also address the challenge.

The following example from the fifth discussion, about *Marcos' Vote* (Nguyen-Jahiel, 1996), illustrates a typical episode in which Ms. Jackson posed a challenge. The children were debating who should be in charge of making the final decision about getting new math textbooks or buying a computer program. To help the children consider an important third party, Ms. Jackson asked the children to pretend to be parents and to think about what they would choose for their children. After considering this perspective, Tyson changed his position.

Ms. Jackson: If you were a parent, what would you be, what do you think that you would want |1|, |1| |2| for your children? |2|
Monica: |1| I think they will |1|
Jesse: |2| I would ask my kids |2|
Tyson: I would ask my son, "Do you want a computer, do you?" I, I aks [*sic*] my son or my daughter aks [*sic*] all your friends if they want a computers [*sic*] or something. And then if they say "yeah, yeah." I say "pick a choice textbooks or computers," and then if they pick computers, I 'ma [*sic*] just get the money that I 'ma [*sic*] go have, like that momma and daddy have. Me and her, me and the |3| momma and daddy gonna have |3|.
Monica: |3| So you changing your mind Tyson? |3|
Tyson: Yeah.

Children often spontaneously challenged each other when they disagreed about an issue; therefore, Ms. Jackson did not need to pose

Table 6
Transitional Probabilities at Different Lag Positions for Moves Involving Challenging

	Lag Position			
Event Sequence	1	2	3	4
Teacher poses a challenge → Child responds to challenge	.375**	.304**	.321**	.196**
Child responds to challenge → Child responds to challenge	.479**	.340**	.223**	.159**

*$p < .01$. **$p < .001$.

challenges unless she felt there was a valuable point of view they were missing. Children's responses indicated that challenging was a successful scaffolding move.

With further lags, the likelihood that children would continue exploring their teacher's challenges ranged from 30.4% ($p < .001$) at Lag 2 to 19.6% ($p < .001$) at Lag 4 (Table 6). The fact that the teacher effect persists across four turns further supports the idea that teachers have not only an immediate influence but also a delayed one. Unlike the two other teacher moves, the influence of challenging remained relatively stable at farther turns. This might be due to the fact that usually the entire group is addressed with the teacher's challenge rather than individual children. As soon as a child responds to the teacher's challenge, other children carry the line of thinking on for a series of turns. Bidirectional dependence results indicate that children's responses to their teacher's challenges prompted the teachers to challenge them again ($k = .173$, $p < .001$). However, children's reciprocal influence on each other was much stronger ($k = .472$, $p < .001$).

General Discussion

The overarching conclusion from the present study is that a teacher's scaffolding moves can initiate long chains of influence on children's talking and thinking. Within discussions, a teacher's and children's moves have indirect as well as direct effects, delayed as well as immediate effects, and reciprocal as well as unidirectional effects. Across discussions, children progress from responding to teacher prompts to unprompted responding and may eventually progress to prompting other children. Teacher and child talk during the discussions examined in this study formed a complex system of influence, but this complexity was not unbounded: Sequential dependencies in teacher-child talk remained stable across all 10 discussions and were also stable across the three discussion groups.

According to Cazden (2001), teachers utter 50% to 70% of all the words spoken during a typical classroom "discussion." Ms. Jackson's rate of talk fell

well below this range, lower even than the average child's rate of talk during Collaborative Reasoning. Despite her comparatively low rate of talk, Ms. Jackson's scaffolding moves had a far-reaching impact on children's argumentation. During the discussions, Ms. Jackson's scaffolding moves focused on three facets of argumentation: (a) supporting positions with text evidence, (b) articulating clear ideas, and (c) challenging to introduce alternative points of view. These moves altogether constituted 63.5% of her turns for talking during the discussions.

The most prominent goal Ms. Jackson set for the children was to construct arguments based on text evidence. To help the children achieve this goal, she employed two moves, asking children to provide textual evidence and praising children's use of evidence. The lag sequential analysis for this move (Figure 2) indicated a chain of teacher influence on children's further use of evidence. The teacher's prompting for evidence increased the likelihood that one child, followed by another, would use textual evidence either to support or to counter a proposed argument. The lag sequential analysis indicated that the teacher's prompting for evidence is more influential on children's use of evidence than is praising children for the use of evidence. Over the 10 discussions, the changes in the teacher's use of these two scaffolding moves paralleled the changes in children's use of evidence. Figure 4 shows two opposite but complementary trends: a decrease in Ms. Jackson's prompting for evidence and an increase in her praise for the use evidence. As children became more spontaneous in using evidence, Ms. Jackson's requests for evidence declined; however, she continued to provide support by praising children when they used evidence. Praising was also expected to fade in later discussions, because it was obvious that children had mastered this aspect of argumentation, and it was time for Ms. Jackson to focus on another element of argumentation or another social skill.

The use of evidence by children during Collaborative Reasoning discussions was also explored in a previous study by Anderson et al. (1998). They found that teachers prompted for story information twice per discussion. This is close to Ms. Jackson's rate; on average, she prompted her children 1.5 times per discussion. In the present study, children made on average 7.5 explicit references to story information per discussion compared to 8.8 in Anderson et al.'s study. There are probably a number of situational, teacher, child, and story factors that affect children's rate of providing text evidence. One factor may be the frequency with which the teacher prompts for and praises the use of evidence. Anderson and colleagues found that teachers in their study seldom praised the use of story evidence. In contrast, Ms. Jackson praised her children for use of evidence 2.5 times per discussion. The lag sequential analysis suggests that her rate of praise may have been excessive, because it was not that influential.

One noteworthy result was that children appropriated prompting and praising the use of evidence. Four children asked other group members

for text evidence to support their claims. The appropriation of this teacherly move was noticed in the last few discussions. This suggests that a child moves from the state of being able to provide evidence to the state of being able to ask for evidence after he or she has had plentiful opportunities to provide evidence.

Ms. Jackson asked children for evidence even when she was aware that the evidence was not available in the story. This strategy turned out to be successful because children appropriated the strategy to problematize other children's arguments that were not supported by story evidence. Although Ms. Jackson praised the use of evidence 1.7 times more than she requested evidence, this move was appropriated by only 2 children. Characteristics of teachers and children and features of situations that might encourage the appropriation of a teacher's moves should be investigated further. In the meantime, the present results suggest that a large number of repetitions of a move by the teacher is not necessarily productive.

The second goal Ms. Jackson set for the children was to formulate clearly stated arguments. Ms. Jackson's requests for clarification constituted one fifth of her turns for talking during the discussions. The lag sequential analysis (Figure 5) suggests a chain of teacher influence on children's argument construction. A request for clarification increases the likelihood that the child who gives the clarification will be followed by another child's commenting on the clarification, whether in agreement or disagreement. The lag sequential analysis further indicates that it is even more likely that a third child will further comment on the designated issue. These results support the idea that minimal input from the teacher affects the targeted child and also spreads and affects other children in the group. This particular scaffolding move not only helps children elaborate their ideas but also encourages them to collaborate and respond to each other.

Six children from two of the three groups appropriated asking for clarification in later discussions. Spontaneous use of the move by children first appeared in the seventh discussion. These children moved from listening to the teacher's request to giving clarifications to commenting on other children's clarification to asking for clarification. This suggests that a teacher's moves can have a cascade of long-term effects.

The third scaffolding move examined in this article was challenging. Children spontaneously challenged each other when they disagreed; therefore, Ms. Jackson did not challenge children very frequently. On average, she posed 1.4 challenges per discussion. Mainly, Ms. Jackson used challenges when children failed to address an issue that she felt was critical. The lag sequential analysis indicates that when the teacher posed a challenge, there was a strong likelihood that a child would respond and a strong likelihood that this would be followed by another child's commenting on the issue raised by the challenge. This result further verifies that teacher moves initiate chains of influence on children's talking and thinking.

This study examined three scaffolding moves of one teacher. Any conclusion drawn from this analysis is limited for now to this particular classroom. Although Ms. Jackson used the scaffolding moves suggested in the Collaborative Reasoning workshop, these moves could be implemented differently by different teachers. There is a need to examine how other teachers use these moves to discover if a common pattern emerges. A comprehensive analysis of all the scaffolding moves implemented by a larger sample of teachers will give a better understanding of the effects of these moves on children's learning and development. Another study limitation was the handling of interjections and other speech fragments that did not gain or hold the floor. Counting these as talking turns sometimes gave the appearance that the response to teacher prompts was delayed. To increase the precision of lag sequential calculations, which are sensitive to the number of talking turns in a direct succession of turns, interjections and the like should be set aside or otherwise controlled in future studies.

A question that will vex many researchers is whether the present study provides a warrant for saying that teacher moves *caused* changes in student ways of talking and thinking. The basis for an affirmative answer is that there would seem to be a vanishingly small likelihood that without the teacher's influence, children would say to each other such things as "Good example from the story" or "Could you clarify that?" The basis for a negative answer is that the evidence from the present study is correlational—that in such instances as "Good example from the story" or "Could you clarify that?" all the study shows is that the teacher's use of the rhetorical moves in early discussions was associated with a few children's use of the same moves in later discussions. We take the position that the case that there are causal links between the teacher and student moves is highly plausible, because three entailments of a causal argument are satisfied by the data: (a) If *X*, then *Y* is probable. (b) *X* precedes *Y* in time. (c) If not *X*, *Y* is improbable. We concede, however, that the evidence is not decisive.

The present study sought to shed light on the *process* of teacher-child influence, not the *product*—that is, child outcomes measured in a postinstruction assessment. Of course, we assume there is a link between process and product. The clearest case for a link from the present study is the use of explicit text evidence. Previous research shows that after experiencing Collaborative Reasoning, children write reflective essays that include explicit reference to text information, incorporating phrases such as "In the story, it says [evidence]," while comparable control children almost never do (Kim et al., 2009; Reznitskaya et al., 2001). The present analysis establishes that teacher prompting for and praising the use of text evidence led immediately to children's use of evidence, later unprompted use of evidence, and later still, prompting other children for evidence. It seems very likely that this chain of influence carries over to the writing of reflective essays; however, again, the case for a causal link is not decisive. A more compelling case

for a causal link could come from a quasi experiment or from studying natural variation among classrooms and teachers, comparing the essays of children whose teachers often prompt for text evidence with those of teachers who seldom or never do.

A more complicated case of probable teacher influence on postinstruction outcomes is the argument move "Some people might say [counterargument]" to introduce an alternative point of view. This move is used fairly often by teachers—Ms. Jackson used it 10 times—but children rarely use the move during discussions; in fact, there were no instances of child use of the move in this set of 30 discussions. In contrast, children who have experienced Collaborative Reasoning sometimes use "Some people might say [counterargument]" when writing reflective essays, while control children never do (Reznitskaya et al., 2001, 2008). What is the explanation for why children do not use the move during discussions but seem to have appropriated it because they use it in essays? A possible answer is that during a discussion, children face challenges from specific classmates who cannot be addressed as "some people," whereas when writing an essay, possible challenges from disembodied others need to be considered, and "some people" is a handy way of referring to them.

This study provides quantitative evidence that in most respects conforms to expectations about the role of scaffolding within the zone of proximal development. A teacher's scaffolding, even if it seems modest in terms of her rate of talk, can have a huge impact on children's thinking. The Collaborative Reasoning approach assumes that children have the initial skills to launch an argumentative discussion; however, children need opportunities to sustain and extend these skills. The initial skills fit Vygotsky's concept of *embryonic function*. As explained by Pontecorvo (1993), "Social interactions within supportive environments bring to life a child's *embryonic* functions. Those functions need ample opportunities to be practiced *unconsciously and spontaneously* within a social context before they reach the level of *consciousness and internal control*" (italics added; p. 190). Collaborative Reasoning appears to provide a social context in which children are able to repeatedly and spontaneously use of tools for thinking and appropriate new tools from one another and from their teacher. As children improve in argumentation, they reach a level of independence and consciousness in using these tools.

Notes

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[1]The following conventions apply to all transcribed teacher and child talk. The double forward slashes // mean an interrupted turn, the numbers surrounded with bangs (e.g., |1|) indicate simultaneous turns, and the words enclosed in square brackets are the transcriber's comments or descriptions of nonverbal behavior. The underlined text in the extracted transcripts highlight the discussion moves being utilized.

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