

By publishing articles in one of three languages, *JRME* would be accessible to a larger number of researchers and the number of readers would inevitably rise—approximately 10% of current subscriptions are outside the United States and Canada. There also would likely be an increase in the number of reviewers and an expansion of the areas of expertise that they bring to the reviewing process. Having a trilingual publication would also benefit faculty who work with graduate programs that are conducted abroad and who struggle to obtain high-quality articles to use in their current courses. For example, some faculty at Spanish-speaking universities either pay for or personally perform costly and time-consuming translations of articles that are published in *JRME*.

Maintaining the quality of *JRME* is always a challenge, and it would be more complicated when manuscripts can be submitted in a language other than English. *JRME* might require specialized copy editors or an advisory board of bilingual and trilingual researchers with a distinguished research background who could oversee the editing process and assist the editor in the decision-making process. *JRME* could update its reviewer database to include the languages in which reviewers are proficient. Considering the profile of researchers currently in the *JRME* reviewer database, over 25% are from outside the United States and are more likely to speak at least one language in addition to English. In the long term, this percentage would grow, making it easier for us to communicate with each other not only through *JRME* but also through international conferences.

The ideal situation would be to have a growing number of scholars proficient in several languages, capable of engaging in discussions in the language of choice, and interested in listening and continuing debates independently of language barriers. Through *JRME*, we have accomplished much; we should be proud of it and thankful that NCTM has supported this enterprise. However, we are still far from the ideal situation with regard to making *JRME* an international journal. I believe that we, the mathematics education community, could play a bigger role in making this happen. What should guide our decision on this issue is that we have an opportunity to reach a larger and more diverse international community and, therefore, need to reach consensus on whether we are willing to provide the necessary financial resources to make that possible. If we make the journal for us, we should be willing to make sure that the journal be a forum for the worldwide community of mathematics education.

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Mathematical Discourse in Shared Storybook Reading

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The purpose of the study reported in this article was to explore the mathematical discourse in which four dyads engaged while sharing the storybook *One Snowy Night* (Butterworth, 1989) while at home or in other locations (e.g., day care centers). Each dyad consisted of a mother and her four-year-old child. Various discourse patterns were evident, and while there were commonalities across dyads, each pair shared the book in unique ways. In two of the dyads, the mother initiated the mathematical discourse; in the other two, the child did. Size, subitizing, and counting were the most common mathematical concepts that emerged. One dyad attended to a single concept of size, and the other dyads attended to more than one mathematical idea. Some parents scaffolded particular problem-solving strategies; others provided more generic support. Based on our findings, we discuss insights and issues and make suggestions for further research.

Key words: Discourse analysis; Early childhood, K–4; Language and mathematics; Parents' role; Situated cognition

That storybook reading can be a valuable context for learning and teaching mathematics is increasingly recognized by educators. For example, the National Council of Teachers of Mathematics (NCTM) *Curriculum and Evaluation Standards for School Mathematics* (1989) advocates “. . . the use of children's books as a vehicle for communicating mathematical ideas” (p. 5). Suggestions for using children's literature to support mathematics learning in elementary classrooms and descriptions of this learning are a regular feature in the “Links to Literature” section in the journal *Teaching Children Mathematics*. Continued support for this position is implicit in the *Principles and Standards for School Mathematics* (NCTM, 2000). For example, in the discussion of diversity in teaching and learning mathematics (p. 130), a photograph of a teacher reading with a group of children depicts storybook reading as one way in which to support diversity. Moreover, a body of professional literature (e.g., Burns, 1992; Evans, 2001; Whitin & Wilde, 1992) has emerged that suggests how teachers can use children's literature to enhance mathematics learning in classrooms.

We postulate that this emerging interest in storybook reading and early mathematics teaching and learning was precipitated, at least in part, by the centrality

afforded storybook reading in many primary classrooms over the last several decades (Pellegrini, 1991). Indeed, Pellegrini contends, storybook reading has become the literacy event *par excellence* in schools, and is seen as *the way* that children acquire literacy. As we have proposed elsewhere (Anderson, Anderson, Lynch, & Shapiro, 2003), the importance ascribed to storybook reading in early literacy development seems to have roots in some of the early research in early reading acquisition. For example, Durkin (1966) and Clark (1976) found that a factor common to young children who learned to read prior to formal instruction in school was that a parent or significant other had read to them regularly. Research has also shown that middle class parents tended to encourage the use of decontextualized language in storybook reading (Heath, 1982), and researchers (e.g., Snow 1991) have argued that use of decontextualized language is essential for later success in school. In particular, Holdaway (1979) developed the shared-reading experience in which he attempted through the use of enlarged texts or “big books” to emulate in the classroom shared-reading experiences in the home.

However, much of the research in using children’s literature as a context for learning mathematics (e.g., Griffiths & Clyne, 1991; Streefland, 1985) has focused on learning mathematics in classroom settings where children’s literature is used as a springboard for mathematical activity that occurs outside the shared book reading. That is, as Griffiths and Clyne (1991) indicate, “*building on the mathematics which is implicit or explicit in a book . . . can assist children in developing concepts, solving problems and making connections*” (p. 10; emphasis added). Although some researchers (e.g., Kamii & Lewis, 1990) confirm that, as is the case with reading and writing, children enter school possessing much mathematical knowledge, little is known about the qualitative nature of their experiences prior to school. Some researchers (e.g., Saxe, Guberman, & Gearhart, 1987; Walkerdine, 1988; Young Loveridge, 1989) assert that events such as daily conversations, activities, and games in the home contribute to children’s early mathematics knowledge. Furthermore, case studies into children’s early mathematics learning (Anderson, 1991, 1993; Phillips & Anderson, 1993) point to bedtime reading as occasions when mathematics is shared. For example, a case study by Anderson and Anderson (1995) documented how mathematics can constitute an integral part of shared book readings. In an exploratory study with 12 dyads each consisting of a mother and a 4-year-old child, Shapiro, Anderson, and Anderson (1997) reported that while most parents focused on print, illustrations, and the meaning of the story line in shared book reading, some parents and children also engaged in interactions that focused on mathematics while reading two well-known children’s narratives—*Swimmy* and *Mr. McMouse* by Leo Lionni (1991, 1992)—not commonly thought of as having a focus on mathematics.

The study reported here extends our previous research in several ways. We present four cases of mother-child interactions, whereas the other case studies cited were of an individual child whose parents were the researchers. The research here focused on storybook reading, whereas in our other case study research and research into families’ mediation of mathematics in the home (Anderson, 1997,

1998), everyday activity was the focus, of which storybook reading was one feature. In contrast to our research into families’ storybook reading in which *attention to mathematics* was only one of the categories investigated, this study focused on in-depth analysis of mathematical discourse in the shared-reading context. The significance of the research reported here lies in documenting the ways in which mathematical discourse is co-constructed when middle-class parents and children share storybooks at home. Its exploratory and descriptive nature lends itself well to a generation of future research questions while furthering our knowledge of ways in which children come to know mathematics prior to school. Furthermore, a multiple case study design allows for comparisons and contrasts across dyads.

The purpose of this study reported here was to explore mathematical discourse that emerged as parents shared a children’s storybook with their 4-year-old children. The research question that guided the study was: In what ways do parents and children attend to mathematics while sharing a children’s book?

THEORETICAL PERSPECTIVES

Until the last 2 decades or so, the prevailing view informing our conceptions of learning was that cognitive abilities were independent of the context in which they were acquired. However, researchers such as Rogoff (1982) have challenged this notion, arguing that learning is context specific. As Panofsky (1994) proposed, in order to understand cognition, it must be studied simultaneously and in an integrated way with the context. Within this framework, learning is thought to occur within “socially constructed situations” (Rogoff, Gauvain, & Ellis, 1984, p. 557), meaning that people learn as they interact with each other to solve problems in culturally specific ways. Panofsky (1994) contends that to understand young children’s development, the home is obviously an important context to investigate. However, as she also points out, social situations constructed at home are likely to differ markedly from socially constructed situations at school (Panofsky, 1994)—a point that we will return to later in this article.

A similar sociocultural view of cognition is proposed by Gee, Michaels, and O’Connor (1992). Drawing on the foundational work of Vygotsky (1987) and Wertsch (1985), they argue that language and learning are social activities. And as Gee et al. (1992) and Panofsky (1994) point out, social activities have traditions and will vary across cultural groups, as well as between one social context and another.

Sociocultural Perspectives of Literacy

Until recently, research in literacy was dominated by the fields of linguistics and psychology, wherein reading and writing were seen as a set of cognitive and linguistic skills. Emerging work in anthropology, cultural studies, and sociolinguistics (e.g., Barton, Hamilton, & Ivanic, 2000; Street, 1995) has led to a reconceptualization of literacy as complex social practices. That is, as Clay (1993)

suggests, different cultural groups engage in different literacy practices, ascribe different meanings to literacy, and mediate literacy learning in different ways.

Research in storybook reading in the home over the last several decades has documented the sociocultural nature of this particular literacy event (Altwerger, Diehl-Faxon, & Dockstader-Anderson, 1985). A foundational study in this regard is Heath's (1982, 1983) ethnography in three contexts in the southeastern United States: Maintown, a white, middle-class community; Roadville, a white, working-class community; and Trackton, an African-American, working-class community. Maintown children were read to regularly by a significant other in an interactive, dialogic manner. Within storybook reading, they learned to decontextualize knowledge and to link old knowledge with new. As Heath (1983) points out, through the highly routinized shared book reading, "[b]efore the age of two the child is socialized into the initiation-reply-evaluation sequences repeatedly described as the central structure of classroom lessons. . ." (p. 51). Parents in Roadville also read regularly to their children, initially focusing children's attention on letters, colors, and shapes. As the preschoolers grew older, parents asked questions about the literal content of stories but they did not help children connect the content of books with their knowledge of the world. As Heath indicates, these ". . . children cannot decontextualize their knowledge . . ." (p. 63). Although these children initially did well in school, unlike their mainstream counterparts they began to encounter difficulty as they moved into fourth grade and were required to use decontextualized knowledge. Trackton adults did not regularly read to their children and rarely provided books specifically for them, although the adults themselves read newspapers, mail, advertising brochures, and other materials. Older siblings sometimes attempted to read to their younger siblings and to ask them questions about books when they played "school." Furthermore, Trackton children were not often drawn into conversation. Heath speculated that because they had not learned many of the routines expected of them—including shared book reading—Trackton children began to experience difficulty upon entering school.

As Heath (1983) and others have noted, the bedtime story has come to be regarded, especially in educational circles, as a natural phenomenon. Heath's work demonstrates that this assumption is clearly not the case and that learning to share storybooks in particular discursive ways differs from one sociocultural context to another, and the Maintown children have learned to share storybooks in ways that are privileged in school. According to Janes and Kermani (2001), ". . . schools have traditionally privileged an elite group by emphasizing language, content, and interactional behavior familiar to this [mainstream] group" (p. 458).

Although not framed within a sociocultural perspective of learning, Golden and Gerber's (1990) description of storybook reading as a semiotic event is congruent with this perspective. As they state, "A picture book narrative . . . has the potential of generating multiple interpretations depending upon what the symbol offers, what the reader brings and how the text is mediated by participants in a social context" (p. 205). In other words, whereas a particular text will influence the transactions and interactions that occur when a significant other and a child share

a storybook, also of importance is the knowledge that the child brings to the text and how the adult guides the shared reading.

Sociocultural Perspectives of Mathematics Learning

Until the last decade or so, constructivist theories of learning (e.g., Kamii & DeClark, 1985) were prominent in mathematics education. Influenced by the work of Piaget, theorists viewed the child as *constructor* of his or her own knowledge through accommodation and assimilation by interacting with the environment. As is the case with literacy, educators and theorists have more recently begun to conceptualize mathematical development within a sociocultural framework (e.g., Cobb, 1995; Joram, Resnick, & Gabrielle, 1995). Cobb (1995) proposes that "an individual's arithmetical activity is profoundly influenced by his or her participation in encompassing cultural practices such as completing worksheets in school, selling candy on the street, and packing crates in a dairy" (p. 364).

Within a sociocultural perspective then, learning is seen as a process of "enculturation into a community of practice" (Cobb, 1994, p. 13) in mathematics. Central to this perspective is the Vygotskian notion that children's enculturation is guided by a more competent other and that discourse is a primary tool that guides the learning or enculturation. For example, Rogoff (1990) theorizes that young children come to understand their world as a result of social interactions with significant others. Similarly, Sfard, Neshet, Streefland, Cobb, and Mason (1998) argue for the centrality of conversation in learning mathematics. Furthermore, as children engage in social practices such as literacy or mathematics, they begin to internalize the processes and rely less on more competent others to support their learning.

Other Considerations

Like Cobb (1995), we see the complimentary nature of sociocultural theory and constructivism in young children's emerging mathematical knowledge. Therefore, although we acknowledge the importance of the social nature of learning, we also recognize that children through processes of accommodation and assimilation construct their own knowledge (Kamii & Lewis, 1990). Although we acknowledge the importance of significant others in supporting children's knowledge construction, we also propose that there will be considerable variation from one context to another in the ways in which learning is supported.

METHOD

The study reported here involved 21 middle-class parents and their 4-year-old children, with the parents audiotaping their shared reading of *One Snowy Night* (Butterworth, 1989). We provided the book so that we could compare interactions across dyads. Parents chose a convenient time and place for the shared-reading activity. The majority of parents read to their child at home, although some chose

the day-care facility that their child attended as the site for the shared reading. Parents were instructed to "Share the book as you normally would with your child."

Our decision to audiotape the shared readings, as opposed to videotaping them, may be viewed as a limitation. Although audiotaping did not provide evidence of gestures, facial expressions, or body language, we did capture pauses and background noises such as page turning, intonation, and so forth. During analysis, we drew upon all contextual components—the child's and mother's words, both what was said and how it was said, the elapsed time, the illustration and text, any peripheral noise—to aid in understanding what was happening. Furthermore, we believe we minimized the intrusiveness of the recording in that there was no need for an additional person to set up equipment or to observe; the tape recorder was less noticeable than a video camera on a tripod. Without the intrusion of this additional equipment, many of the parents chose to read the book at bedtime, which was their normal routine at home.

In each shared-reading episode, the book was read in its entirety. The audiotapes were transcribed in full. We divided the dyad's utterances into *conversational turns* or *discourse turns* so as to identify to what the children or the parents were attending. Sinclair and Coulthard (1975) define the conversational turn as "everything said by one speaker before another began to speak" (p. 251). The descriptive categories of *size*, *number*, *estimation*, *counting*, and *shape* emerged from the analysis of the mathematical discourse. For instance, if a child said "six, it's six mice," this would be coded as an example of a turn in which there was attention to number. We then tabulated the number of turns in each category for each dyad.

Four of the 21 dyads accounted for approximately half of the discourse turns related to mathematics. They became the focus group for this article so that we might document more thoroughly the ways in which parents and children engaged in mathematics while sharing a storybook. We read the entire transcripts of each of these dyads six times. In our first two readings, we made note of all of the interactions including who initiated them, the focus of the interaction, how the other responded, and so forth. In turn, we generated descriptive labels (e.g., makes observations, offers interpretations, calls attention, asks questions, responds to questions, etc.) for the discourse turns found in each transcript. Using constant comparison, we reexamined interactions whenever a different category arose. In subsequent rereadings we focused on their mathematical interactions. We then speculated as to how these interactions might contribute to children's understanding. In the next sections of this article, we share our analysis of how these parent-child dyads engaged in mathematics related interactions in storybook reading.

Participants

The parents who participated in the larger study consisted of 17 mothers and 4 fathers; the 21 children, all of whom were 4 years old, comprised 11 daughters and 10 sons. One mother-daughter dyad and three mother-son dyads constituted the

focus group that we examined for the study reported here. The majority of the 21 children were enrolled in different university and college child-care facilities, and this was the case for the children in the focus group. The parents were well educated and best characterized as middle class. At the time we did the study, in many cases, at least 1 parent was enrolled in postsecondary education.

Storybook

As indicated earlier, we provided the storybook to permit comparisons across dyads. We chose *One Snowy Night* (Butterworth, 1989) as a parent might do—after perusing a selection of children's books available at a local bookstore. On several occasions in the text and in the title, the number words "one" or "two" are used as adjectives (e.g., two shivering rabbits), on two occasions the word "small" is used, and in one illustration the numerals 5 and 9 are shown. However, we did not consider this storybook as a "counting," "shape," or "size" book because it lacks an explicit mathematical focus found in books like *The Cheerios Counting Book* (McGrath, 1998) in which parents and children are explicitly prompted by the text to engage in counting. However, based on the description of the story that follows, the book has a cumulative story structure that has the potential to elicit mathematical discourse.

On most pages in *One Snowy Night*, there are several lines of text and an illustration. In five instances (i.e., every fourth page) a full-page illustration is accompanied by text only on the adjacent page. There are 23 pages of text and illustrations, and on average, 9 lines of text per page. Because of space limitations and copyright considerations, it is not possible to provide a reproduction of the book here. To help the reader understand the book, we provide the first page of text and then a summary of the rest of the narrative.

It's cold in the park in winter.
 But Percy the park-keeper doesn't mind.
 He puts on his warm coat and
 his big scarf and wears two pairs of woolly
 socks inside his Wellington boots.
 Percy likes to be out in the fresh air. (Butterworth, 1989, p. 1)

The story then unfolds as paraphrased below:

One cold, snowy winter's night as Percy prepares for bed, he answers a knock on his door and it is a squirrel seeking shelter. This first visitor is welcomed into Percy's bed. Two rabbits arrive next and they settle into bed with Percy and the squirrel. A fox comes knocking. A little while later, a group of animals – a badger, two ducks, a hedgehog and a family of mice – arrive, all wanting a bed for the night. With so many in the bed, turmoil results and all of the animals fall out. Upon hearing a strange noise, they each find hiding places throughout the room. Percy laughs to discover that a mole who is poking his way in through the floorboards is making the noise. After settling the mole, Percy invites the other animals to come out of hiding, but no one moves, as they are

content to remain where they are for the night. Thus, the story ends with only Percy and the mole sharing the bed.

RESULTS

To understand the diverse ways in which parents and children engaged in mathematics through shared reading, we examine storybook reading episodes in each of four dyads. To conserve space within the article, we do not report the verbatim reading of the entire text. Instead, we provide only those portions necessary for the reader to understand the context in which the interactions occur. The **bold print** in the transcripts indicates the dialogue between adult and child, with each turn numbered. The regular type denotes the words in the storybook. In parentheses, we provide page references, relevant descriptions of illustrations, and any additional comments that are necessary for the reader to understand the interactions. To present the findings, we refer to *sequences involving mathematical discourse*. We define such a sequence as two or more conversational turns related to the same mathematical concept or topic bounded by the shared reading of the text. Although we focus only on mathematical discourse in this article, in a later section we provide a synopsis of the joint construction (cf. Ninio & Bruner, 1978) of the shared-reading events to give the reader a sense of the broader context in which the mathematical dialogues occurred.

Winters¹ Dyad: Mother (M) and Daughter (D)

[: or . . . used to represent omitted dialogue or reading]

- 1 M: **Ok. One Snowy Night.** (turns page; reads p. 1) It's cold . . . the fresh air.
 2 D: **Look, that's his breath.** (adjacent page, p. 2 shows Percy standing near a bird perched on a branch)
 3 M: **Yes, 'cause it's cold.** (turns page; reads pp. 3–4) . . . shares his lunch with them.
 4 D: **He's nice.**
 5 M: **Yeah.** (begins to read p. 5) One winter's night it was so cold.
 (At this point, there is some extraneous discussion about the research project.)
 6 M: . . . (reads pp. 5–7) One winter's night . . . room for two. **Who would the two be?**
 7 D: **Squirrel and Percy.**
 8 M: **Yeah, right.**
 9 D: **Mama look.**
 10 M: **He's sleeping with his hat on, funny Percy.** (begins to read p. 8) The squirrel . . . feels warm.
 11 D: **Maybe he forgot.**
 12 M: **Maybe he's so comfortable with that hat on he just decided to leave it on.** (reads p. 8 to middle of p. 9) Knock, Knock, . . . and warm up.

- 13 D: **Mama why do we put this?** (apparently referring to the PZM microphone).
 14 M: (reads next sentence on p. 9) The rabbits squeezed into bed next to Percy and the squirrel. There wasn't much room. **How many were in the bed, do you think?** (Five sentences remain on p. 9; two shivering rabbits are pictured in a doorway on p. 10.)
 15 D: **Let me count.**
 16 M: **Well, you know how many there were before.**
 17 D: **No I don't. 1, 2, 3, 4.**
 18 M: **Right.** (reads, remaining text on p. 9, p. 11, first two sentences p. 12) . . . a fox! . . . "Well, if you promise to behave", he said. **Why do you think he was saying that to the fox?**
 19 D: **'Cause then he won't be acting funny, they didn't say that.**
 20 M: **Yes, foxes can be a little bit nasty sometimes so he wanted to make sure the fox was going to behave himself.** (reads next sentence, p. 12) . . . he squeezed . . . next to all the other animals. **I wonder how many there are there now?**
 21 D: **Um, I'll count. Remember there were 1, 2, 3, 4 and then 5.**
 22 M: **Right you are. Great!** (reads to middle of p. 13) . . . quite a surprise.
 23 D: **Mom, why can't I do this?**
 24 M: **Ok.**
 25 D: **A whole family of mice and a hedgehog, 2 ducks and a badger; they all wanting a bed for the night.** (The text, p. 13: There on the step was a badger, two ducks, a hedgehog and a whole family of mice! They all wanted a bed for the night.)
 26 M: **Right; now how many animals are there on the steps?**
 27 D: **1, 2, 3, 4, 5, 6, 7, 8, 9, 10.**
 28 M: **Ah, 10 and there're already 5 in the bed. Do you know how many 10 and 5 makes?**
 29 D: **What?**
 30 M: **A big number; 15.** (a younger sibling joins them; M reads three quarters of p. 15; describes a small illustration in lower corner of p. 15) **A little mouse on Percy's hat.** (reads remainder of p. 15; pp. 17, 19, 20, up to first line p. 21) . . . Nobody stirred.
 31 D: **Mommy what kind of stir?**
 32 M: **When somebody stirs, they move around . . . So when nobody stirred, it means they were perfectly still.**
 33 D: **How would a fox come jump down there?** (p. 22 shows fox on top of a cupboard).
 34 M: **He's a pretty good jumper, that's how he got on top of the cupboard.** (omits next sentence; reads rest of p. 21) The squirrel . . . The mice . . . into Percy's slippers! . . . "Well I never!", said Percy. (mice in slippers can be seen in lower left hand corner, p. 21) **How many mice can you see in those slippers?**
 35 D: **1, 2, 3, 4, 5, 6.**
 36 M: **Great.**
 37 D: **Six mice.**
 38 M: **Six mice.**
 39 D: **There's a lot of mice.**
 40 M: **Yes.** (reads last page, p. 23) . . . for a mole! (Percy and mole shown in bed.)
 41 D: **Now can we?**
 42 M: **So how many are in the bed in the end?**

¹ All family names in this article are pseudonyms.

43 D: Two.

44 M: That's right. That's a cute story.

As can be seen from the transcript, the mother and daughter in the Winters dyad engaged in dialogue throughout the storybook reading. Counting, addition problems, and subitizing were part of their mathematical discourse, and the mother wove the concept of *accumulating totals*² throughout the shared reading.

Six sequences involving mathematical discourse [6–8; 14–18; 20–22; 26–30; 34–40; 42–44]³ occur with this dyad.⁴ Four sequences [6, 14, 20, and 26] involve the mother asking clarification questions, and in the others [34 and 42] she asks knowledge questions. The child responds to the questions by providing the anticipated answer [7, 27, 35, and 43] and by suggesting a problem solving strategy [15 and 21].

In the first sequence [6–8] and sixth sequence [42–44] when the child provides the anticipated answer, the mother confirms the response, thus enacting an initiation-reply-evaluation (Heath, 1983) sequence. In the first sequence, the mother draws attention to number by asking her daughter to name the “two” characters for which there is room in the bed, the daughter responds by saying “Squirrel and Percy,” and the mother evaluates this response as being correct. In the sixth sequence, when the mother returns to an earlier line of questioning, “How many in the bed . . . ?” the child subitizes, responding immediately by saying “two” [43]. The immediacy of the child’s response on the audiotape suggests that the child did not count the objects.

However, in the two other sequences [fourth: 26–30 and fifth: 34–40] that open with a question-response, different patterns emerge. For example, at the point in the story when a group of animals arrives on the park-keeper’s steps seeking shelter (in contrast to the one or two animals that have been arriving prior to this), the mother seems to suggest *object-counting* when she asks, “how many animals are there on the steps?” [26]. In response, the daughter counts each of the animals in the illustration, “1, 2, . . . , 9, 10” [27]. The mother then incorporates her daughter’s response into a follow-up question, which returns to the previous “How many in the bed?” line of questioning, but she restructures it in an interesting way. She now explicitly structures her request to encourage a *count-on* strategy, saying “. . . 10 and there are already 5 in the bed,” thereby soliciting a combination of two known values [28]. Indeed, she poses an explicit addition question, “Do you know how many 10 and 5 makes?” Rather than see the mother’s encouragement for the child to object-count the large group of animals as a departure from the *accumulating totals* line of questioning, we interpret this intervening move as a scaffolding

² With each knock on the park-keeper’s door, a certain number of animals join the ones that have already arrived. Thus, the number of animals in the bed accumulates.

³ Throughout the article, the numbers in brackets correspond to the line numbers in the transcript.

⁴ We do not consider the child’s use of numerical determiners such as “2 ducks” [25] during reading of the text as mathematical discourse. That children are able to recall in a nearly verbatim manner large portions of text with correct prosody is well-documented by researchers in emergent literacy.

strategy. That is, the mother guides the child first to determine the number of animals in the large group so that she can then use that total to count-on. The child’s clarification question redirects the conversation, wherein the mother provides the solution [30]. We can only speculate as to whether this change in the mother’s discourse is because the problem involves 15, a 2-digit number. Also, that the child sought clarification and did not produce an answer to this question seems consistent with Hughes (1986) findings that preschool children have difficulty interpreting *decontextualized* questions, such as “What does 3 and 4 make? What is 3 plus 2?”

Interestingly, the child extends the initiation-reply-evaluation pattern in the fourth sequence of this type [34–36] when she observes that there are “six mice” in total. That is, the mother’s knowledge question, “How many mice can you see in the slippers?” [34], prompts the child to object count as before, and the mother confirms the answer. However, this time the child follows with her observation in which she explicitly states the cardinal number, “6.” When the mother repeats the child’s comment [38], the child interprets “there’s a lot of mice” [39] and the mother confirms her response [40].

In the second [14–18] and third sequences [20–22] where the child responds by suggesting a problem-solving strategy, different patterns emerge. After reading there wasn’t much room [in the bed], this mother asks, “How many were in the bed . . . ?” [14]. Rather than provide an immediate answer, the daughter suggests a problem-solving strategy she might use, “Let me count.” [15]. In turn, the mother’s response, “Well, you know how many there were before.” [16] seems to point toward an alternative strategy that the child could use. That is, she cues her daughter to recall that there were two characters—Percy and the squirrel—already in the bed and then to count-on the two new visitors—two shivering rabbits—to find a total. However, the daughter indicates that she does not recall how many characters were previously in the bed and proceeds to use a count-all strategy. Thus, the child follows through on her own intended strategy and provides an answer. It is important to remember that when the child counts “. . . 1, 2, 3, 4” [17], the illustration does not show all four characters in the bed. The mother confirms her daughter’s answer and returns to the reading. On the next occasion [20–22], the child again verbalizes the same strategy and yet the dialogue does not unfold as before. That is, when only one more visitor (a fox) gets in the bed, the mother asks for a total [20]. Again, the daughter suggests a problem-solving strategy, “Um, I’ll count,” but then immediately proceeds to count-all. Here, the mother does not interject with an alternative as before. However, since the child prefaces the counting with “remember there were” [21], she seems to heed her mother’s earlier suggestion, recalls the number sequence (1, 2, 3, 4) quickly, and then states “5” as the next number in the sequence (and thus gives the answer to “How many now?”). As before, the mother confirms her daughter’s solution, thereby reinforcing the child’s count-all strategy. In both instances, the child uses “verbal counting procedures” (Baroody, 2000, p. 63) to determine a sum.

Nardini Dyad: Mother (M) and Son (S)

[: or . . . used to represent omitted dialogue or reading]

- 1 M: (assumed to be looking at cover) **This story is called *One Snowy Night* and the author's name is Butterfield. Do you remember the other stories of the Butterfield, the picture story and the god-fairy. It's the same person; it's a good story.**
- 2 S: **Who is the name?**
- 3 M: **I don't know the names; there are lots of them. Do you think that's a mole?**
- 4 S: **No a rat.**
- 5 M: **No.**
- 6 S: **It's a rat.**
- 7 M: **Do you think so?**
- 8 S: **Yes it's a rat.**
- 9 M: **I think we could read. I think it's a badger.**
- 10 S: **No, I think it's a badger.**
- 11 M: (reads first two sentences, p. 1) **It's cold. . . . Look at his rosy cheek.** (reads to end, p. 1) . . . wears two pairs of woolly socks. . . . **Two pairs of socks is a pretty good idea because, is the book up to look? It was nice.** (reads first two sentences, p. 3) . . . where Percy lives. **It's a dear little house.** (reads final sentence p. 3, two sentences on p. 4) . . . lunch with them. **What's he doing?** (on p. 4 Percy is tossing crumbs to three birds hovering nearby).
- 12 S: **I don't know.**
- 13 M: **He is feeding the bird. How many squirrel are there?** (p. 4, a squirrel runs down a tree; another sits on a stump).
- 14 S: **Two.**
- 15 M: **How many birds?**
- 16 S: **Three.**
- 17 M: **This one has a red breast.**
- 18 S: **Yeah.**
- 19 M: (reads first sentence, p. 5) . . . began to snow. **Do you remember in Calgary, it snowed all the time.** (reads rest of p. 5) . . . somebody at the door. . . . **Who do you think it was?** (p. 6 shows Percy's face looking out his window).
- 20 S: **I don't know.**
- 21 M: (reads, p. 7) . . . room for two." (p. 8, shows Percy and a squirrel in bed) **There's Percy and the squirrel.** (reads p. 8) . . . "Now who could that be?" thought Percy.
- 22 S: **I know.**
- 23 M: **Who do you think it would be?**
- 24 S: **Turn the page. I know that it was going to be rabbit.**
- 25 M: **Do you?**
- 26 S: **Two rabbits.**
- 27 M: (reads first 7 sentences on p. 9) . . . wasn't much room. (p. 10 shows two rabbits in a doorway) **Now how many are there in bed with Percy? Percy and squirrel and the two rabbits, how many are there?**
- 28 S: **Percy and**
- 29 M: **and by two rabbits.**

- 30 S: **That will be four.**
- 31 M: **Oh I think you are probably right.** (reads remaining text on p. 9, pp. 11–12) . . . It was a fox! . . . The squirrel fell out. . . . **Now how many did they have once the fox got in?**
- 32 S: **Percy, squirrel, 2 rabbits and the, that, that fox, 5.**
- 33 M: **And the squirrel has fallen out. How many are left?** (p. 11 shows a fox; p. 12, shows a squirrel on the floor next to a bed).
- 34 S: **Three, four.**
- 35 M: **Four, that's right.**
- 36 S: **Is the squirrel dead?**
- 37 M: **Oh no he's not dead. Does he look dead?**
- 38 S: **Yes.**
- 39 M: (reads 5 of 6 sentences on p. 13) . . . a badger, two ducks, a hedgehog, and a whole family of mice! **Let's count them.** (p. 14 shows animals as described).
- 40 S: **1, 2, 3, 4, 5, 6.**
- 41 M: (reads final sentence on p. 13; then pp. 15–16) . . . moving under the floor," . . .
- 42 S: **Floor.**
- 43 M: (turns page; animals in front of and behind one another are shown on the right hand side of p. 18 and the text is on p. 17.) **All these animals are listening. Let's count all the mice.** (The mice are scattered, one in the middle, one at the top, one to the far right, one to the far left and two at the bottom of the picture.)
- 44 S: **1, 2, 3, 4, 5, 6.**
- 45 M: **6 mice. Do you, how many ducks are there?**
- 46 S: **2.**
- 47 M: **Ah, they're still there. How many rabbits?**
- 48 S: **2.**
- 49 M: **They still are then. How many squirrel are there?**
- 50 S: **1.**
- 51 M: **He still then. How many hedgehogs are there?**
- 52 S: **1.**
- 53 M: **How many fox were there?**
- 54 S: **1.**
- 55 M: **He, there. How many persons were there?**
- 56 S: **None.**
- 57 M: **Where's Percy?**
- 58 S: **I don't know.**
- 59 M: (reads p. 17, p. 19, first two sentences p. 20) . . . "It's a mole!"
- 60 S: **It's a mole!**
- 61 M: (reads rest of p. 20) . . . sat him on his hot water bottle. . . . **It looks cozy on the water bottle.** (A mole sitting on a hot water bottle near a pillow is shown at bottom, p. 20.)
- 62 S: **Yes.**
- 63 M: **He is warming up.** (reads to middle p. 21) . . . The fox, the rabbits, the badger, and the ducks were all safely hidden away. (p. 22 shows animals hidden in different places, badger is in a bottom drawer) **Where's the badger? Oh look at the fox, he's upon the cupboard and the duck in the hat with a stripe and the rabbits**

are snug in the drawer as well. Happy, they're all very happy. (reads rest of p. 21) . . . "Well I never!" said Percy. They seem very happy don't they? (reads last page, p. 23) . . . for a mole.

64 S: For a mole.

65 M: That's a good story isn't it.

66 S: Yeah.

67 M: I like this picture of the duck, all the animals tuck into strange little places.

:

68 M: Do you know which I like? I like the one all coming up the stairs. They look like, please let us in.

69 S: Yeah that's the one I like too.

:

70 M: These ones are bigger aren't they? Do this little ones? The brother is helping this little guy is not he?

71 S: Yeah, this guy, they small too.

72 M: Hmm, how many pairs are there in the book.

73 S: What's pairs?

74 M: Pairs, 2 things. There's the squirrel, there's one pair rabbits, one fox, are these pairs of mice? (The tape recorder clicks off.)

The Nardini mother-son dyad, similar to the Winters mother-daughter dyad, engage in discourse throughout the storybook reading. Both dyads talk about the number of animals present on different occasions. However, the nature of these interactions and the ways in which the Nardini mother sustains mathematical discourse differ from the Winters in interesting ways.

Seven sequences involving mathematical discourse [13–16; 27–31; 31–35; 39–40; 43–45; 45–56; 70–74] occur in this shared reading. The mother initiates all of them: five sequences by asking knowledge questions [13, 45, and 70] or clarification questions [27 and 31] and two by suggesting action [39 and 43]. The child responds to the knowledge questions with the anticipated answer [14, 46, and 71]; in responding to the clarification questions, he first names the characters and then provides a numerical answer [28 and 32]. The child also carries out his mother's suggestions [40 and 44].

There is one occasion where the child makes an observation "two rabbits" [26] and the mother does not respond to it, but instead resumes reading [27]. This reference to number is brief, and it is not clear from the data whether his mother has turned the page and thus reveals an illustration in which two rabbits are depicted. Thus, either he is refining his prediction [24] or confirming the number of rabbits that he sees in the illustration.

In three of the five instances when she poses a question and the child responds, the mother follows with a second question [13–16; 31–35; 70–74]. However, all three sequences unfold somewhat differently after the second question is posed. In the first sequence, the mother's knowledge question draws attention to number by asking her son, "How many squirrels are there?" [13], and he subitizes [14]. She follows with another knowledge question about the number of birds [15], and her

son again subitizes [16]. Again, the immediacy of the child's response on the audio-tape suggests that the child did not count the objects. Interestingly, the mother had just previously asked a clarification question about what Percy is doing [11], drawing a noncommittal, "I don't know" from her son. Whether the mother adjusts the type of questions as a means to engage her son in the shared reading can only be speculated. Of note here is that the mother does not resort to simple labeling (e.g., What animal is this?) but instead incorporates number as a way to examine the illustration.

The next example of the question-response-question pattern begins with the mother's clarification question, "Now, how many did they have once the fox got in?" [31]. We interpreted this as an indirect prompt to *add-one*, somewhat reminiscent of when the Winters mother alluded to a count-on strategy. However, the son responds by naming the animals in succession "Percy, squirrel, two rabbits, and the . . . fox," paralleling what his mother had done in an earlier example [27] and stating the cardinal number, "5" [32]. Since he does not enumerate and since the 5 animals are not shown in the illustration, the child seems to have tallied as he labeled each animal. Whether he tallied with or without the aid of fingers cannot be ascertained from the audio tape. Regardless, this incident seems to support Kamii's (1982) claim that children ". . . build these [number] concepts by reflective abstraction as they act (mentally) on objects." (p. 38). Next, by recalling the fact that the squirrel has fallen from the bed, the mother follows with a subtraction or a *one-less* question [33] that her son answers, "three, four," apparently self-correcting his answer. This time, the mother brings closure and confirms the answer "four" [35].

The final example of the question-response-question pattern occurs after the text has been read. Here, *size* and the concept of *pairs* that did not arise during the reading of the text are mentioned. In reviewing a favorite illustration, the mother draws attention to the size of the mice (i.e., "These ones are bigger, aren't they. . . the brother is helping this little guy, is not he?" [70]). The child responds by calling attention to the size of another one of the mice [71]. The mother's follow-up question, "How many pairs in the book?" [72] is unlike the follow-up questions in the earlier examples in that it does not seem directly related to her opening question in that sequence, "These ones are bigger, aren't they?" [70]. Here, the child's clarification question, "What's pairs?" [73] serves to extend the dialogue since the mother provides an explanation ("pair, 2 things") illustrates the concept (" . . . one pair of rabbits"), and then asks "Are these pairs of mice?" [74]. Unfortunately, the audiotape terminated before the child answers. From the data available, it is not possible to discern the mother's motivation for raising the concept of pairs. We wonder if she noticed, as we did, that her son consistently recognizes groups of two (cf. two ducks [45–46]) and is therefore reinforcing and extending this concept.

In a fourth instance initiated by the mother [27–31], a initiation-reply-evaluation sequence unfolds. As the animals begin to gather in Percy's bed, the mother, as in the Winters dyad, asks a clarification question, "Now, how many are there in bed with Percy?" [27]. But unlike the Winters mother, she proceeds to list each

of the characters to be counted. Here, we interpret her verbal recall of the characters as lending support so that her son can provide an answer, since the animals are not shown in the illustration. Unlike the daughter in the Winters dyad, the son here does not enumerate, but in conjunction with his mother, repeats the characters names [28–29]. He then states the corresponding cardinal number, “That will be four” [30], and the mother confirms the child’s answer. Again, it is plausible that he used his fingers to assist in tracking the number of characters as he named them or he was able to keep track mentally. Given that the quantity “four” is relatively small, the amount of scaffolding the mother provides is interesting. However, this is the first instance during the shared reading where some of the characters being counted are not shown in the illustration. Yet another pattern emerges [45–56] where six initiation-reply-evaluation turns occur. That is, the mother repeatedly asks her son how many of each type of animal is in the illustration (e.g., “How many ducks are there?” [45]). It is important to remember that the illustration in the book shows the animals in front of and behind one another, with the mice scattered and pairs of animals appearing separately in different locations. Since she regularly confirms her son’s subitizing with “. . . they’re still there then” [45, 49], the mother seems to encourage quantifying as a way to confirm that all of the animals are still in the room. That is, rather than pose the question “Is everyone still here?” she breaks the task into manageable parts by asking the child “How many ducks?” [45], “How many rabbits?” [47], and so on until all characters are accounted for. Heath (1982) indicates that mainstream parents use such a strategy that helps initiate children into ways of thinking that will be expected of them in school.

As noted previously, the mother suggests action that encourages the child to count on two occasions. In the first sequence [39–40], the mother reads, “There on the step was a badger, two ducks, a hedgehog, and a whole family of mice,” and says, “Let’s count them” [39], apparently drawing her son’s attention to the illustration. The child appears to interpret “them” as referring to the mice and proceeds to enumerate aloud for the first time [40]. Although the mother does not confirm the child’s answer, she appears to accept his interpretation (6 animals, but with 4 animals left to count) since she does not encourage him to count the remaining animals illustrated. In a subsequent illustration, the mother explicitly asks her son to count “all the mice” [43] and as before, he does so, counting 1 through 6 [44]. This time, she confirms his count by making the observation “6 mice,” modeling the use of cardinal number to describe the set [45].

Jones Dyad: Mother (M) and Son (S)

[: or . . . used to represent omitted dialogue or reading]

- 1 M: **One Snowy Night. Do you know this story?** (reads p. 1) . . . fresh air. **What’s that?** (adjacent page, p. 2, shows Percy standing near a bird perched on branch).
- 2 S: **A robin.**
- 3 M: (reads pp. 3 and 4) . . . his lunch with them. **What else can you see?**

- 4 S: **A squirrel, a robin, a bird, a squirrel** (naming animals illustrated, p. 4).
- 5 M: (reads p. 5; turns page; begins to read first sentence on p. 7) . . . There on the step was a
- 6 S: (chimes in) **a cold squirrel.**
- 7 M: (reads rest of pp. 7 and 8, and on p. 9) . . . Standing outside were two shivering
- 8 S: **bunnies.**
- 9 M: (reads pp. 9, 11, 12, and midway on p. 13) . . . There on the step was one badger
- 10 S: **2 ducks, 1 porcupine**
- 11 M: **a hedgehog**
- 12 S: **a hedgehog.**
- 13 M: (reads) A whole family of mice.
- 14 S: **1, 2, 3, 4, 5, 6, six mice.**
- 15 M: (turns page; reads first sentence p. 15) . . . not enough room for them all.
- 16 S: **Something is going to happen.**
- 17 M: (reads rest of p. 15, pp. 16, 17, 19, and beginning of p. 20) . . . said Percy. “It’s a
- 18 S: **a mole**
- 19 M: (reads midway on p. 21) . . . all safely hidden away.
- 20 S: **The fox was up there, the bunny there, the badger, the porcupine there and the mole**
- 21 M: **and the squirrel.**
- 22 S: **Oh, where is the**
- 23 M: **the mice had tucked themselves. There they are.**
- 24 S: **There’s one squirrel.**
- 25 M: **The squirrel’s tucked away in the pocket.** (reads, p. 23) . . . for a mole. **What does this remind you? Does this remind you of that song we know falling out of the bed?**
- 26 S: **No.**
- 27 M: **Does me; there’s 10 in bed.**
- 28 S: (sings) **10 in the bed, roll over, roll over. I fell out and hit the floor, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.**
- 29 M: **This was just like that song.**
- 30 S: **Now let me try, what’s it called.**
- 31 M: **One Snowy Night- Percy**
- 32 S: **One Snowy Night, Percy.**
- :
[After echo reading a line or two, the mother suggests that her son “look at the picture and tell me a story.”]
- 33 S: **He was feeding the bird, and the squirrel. It was so cold he had some cocoa and cookies . . . then another knocking, 1 badger, 1 hedgehog, 2 ducks and a whole family of mice.** (On p. 14 we see these animals standing on the steps outside the hut, with several mice on the bottom step.)
- 34 M: **Can you count them?**
- 35 S: **1, 2, 3, 4, 5, 6, and 6 mice, that was a family . . .** (he continues to tell the story).
- :
36 S: **I wish I could sleep up there. Look, 1, 2, 3, 4, 5, 6, 7, . . ., 13, 14, 15, 16; sixteen.**

(p. 22 shows animals hiding in different places; a fox is on top of a cupboard, a duck is in a hanging planter, and so on).

- 37 *M*: **Sixteen what?**
 38 *S*: **Sixteen mice; you count them and see . . .** (Six mice are squeezed into slippers on the right hand page, p. 21.)
 39 *M*: **1, 2, 3, . . . 13, 14, 15. Did you say 15 or 16?**
 40 *S*: **Sixteen, 1, 2, 3, 4, . . . , 13, 14, 15, 16.**
 41 *M*: **Let's do it again.**
 42 *S*: **1, 2, . . . , 15, 16.**
 43 *M*: **Let's do it again. 1, 2, 3, . . . , 15, 16, 17.**
 44 *S*: **No.**
 45 *M*: **You're counting Percy as well? Oh, sorry.**
 46 *S*: **Yeah, 1, 2, 3, . . . , 15, 16.**
 47 *M*: **Well we're both right. I didn't realize you were counting Percy.**

Unlike the two previous dyads where mathematics related interactions were interspersed throughout the shared reading, for the Jones dyad, most of the mathematical discourse occurs in the postreading discussion. With this mother-son dyad, interactions involve counting only. Unlike the Winters and Nardini dyads where only the child counts, the mother and child both count aloud. Also, worthy of note is that the son usually initiates counting, unlike the two children discussed previously who counted in response to their mothers' questions.

Three sequences of mathematical discourse [25–29; 34–35; 36–47] emerge as the Jones dyad shared the storybook. The mother initiates the first pair of sequences by asking an association question [25] and a knowledge question [34] and in both cases, the child responds to the questions. However, when the child initiates the third sequence by offering an interpretation [36], the mother follows up and an extended dialogue ensues [36–47]. On two occasions, the child makes an observation about there being “six mice” [14] and “one squirrel” [24], but there is no follow-up or elaboration.

Noteworthy here is the fact that there are only two instances of mathematical discourse that occur while the book is being read. On the first occasion, the child spontaneously enumerates and states the cardinal set, “1, 2, 3, 4, 5, 6, six mice” [14] after his mother reads “a whole family of mice” [13]. On the second occasion, the child makes the observation, “There's one squirrel!” [24], incidentally including a mathematical referent as he and his mother locate the characters in the illustration.

The sequence that the child initiates [36–47] occurs near the end of his retelling of the story and after the text is read. In this sequence, the mother asks a clarification question after the child offers his interpretation of the illustration. In turn, the child answers his mother's question and immediately makes a suggestion (i.e., a problem-solving strategy) that his mother follows. Next, a series of repeated counting occurs and so the dialogue unfolds. That is, the child spontaneously enumerates but this time states only the cardinal number without identifying the set that has been counted, “1, 2, 3, . . . , 15, 16, sixteen.” [36]. When the mother seeks to clarify “Sixteen, what?” [37], the child responds, “Sixteen mice . . .” [38]

and asks his mother to count in order to check his total. (It is important to recall here that there are 6 mice and a total of 16 characters in all when everyone is in the park-keeper's house.) In turn, his mother counts all of the animals illustrated and asks, “Did you say 15 or 16?” [39]. Because the totals differ (i.e., son 16, mother 15), a series of *recounting* ensues as they check each other's results. When the mother's counting [43] reaches a third possibility (i.e., 17), little is said of it. Instead, the inquiry turns to what is being counted [45], rather than recount again. When the mother realizes that her son is counting the character Percy along with the animals [45–46], 16 is readily accepted by the mother, and she concludes that both answers are right, implying that a count of 15 (total number of animals) or 16 (total number of animals plus Percy) are both acceptable. The child does not seem confused by the fact the mother does not clearly indicate which of the totals (15, 16, or 17) she is referring to by the term “both” [47]. Although the conclusion is not entirely clear, it is noteworthy that this mother models two strategies (i.e. count-recount and logical reasoning) as ways to check discrepancies.

The first sequence initiated by the mother occurs after the text has been read when she asks an association question, “Does this remind you of a song . . .” [25]. Although the child does not concur, the mother, by confirming that the story reminds her of the song, “10 in the bed” [27], prompts the child to sing his version of the song, ending with what appears to be rote counting, 1 through 10 [28]. Her response, where she reiterates, “This was just like that song” [29], seems to imply a connection between the subtractive structure of the song and the cumulative structure of the story.

The second sequence that the mother initiates occurs during the child's retelling. After the child gives his own version of the story, “. . . and a whole family of mice” [33], his mother asks a knowledge question, “Can you count them?” [34] to which he responds by counting all of the mice and naming the cardinal set [35], as he had done spontaneously when his mother read the same text earlier [13–14]. We can only speculate if this mother's encouragement to count here was precipitated by the earlier episode.

King Dyad: Mother (M) and Son (S)

[: or . . . used to represent omitted dialogue or reading]

- 1 *M*: (reads text, pp. 1 and 3, uninterrupted) It's cold . . . it's cosy and warm. **When it gets too cold, you (pause) go inside.**
 2 *S*: **It's hot.** (The book reading is happening in summer.)
 3 *M*: **The animals live in the park.** (Text on p. 4: The animals who live in the park all know Percy's hut. Every day he shares his lunch with them.) (turns to p. 5, rephrases third sentence : “Brr,” said Percy. “I think I'll need an extra blanket tonight.”) **Brr, we need extra blankets.**
 :
 [Extraneous conversation.]
 4 *M*: (rephrases the next sentence on p. 5 : He made himself some hot cocoa and got ready

- for bed.) **It was so cold. He poured some hot cocoa, he was not ready for bed.** (last four sentences on p. 5 are omitted).
- 5 *M*: (turns page; reads pp. 7, 8, and most of p. 9 without interruption) There on the steps . . . "Your tail is tickling my nose."
- 6 *S*: **Who said that?**
- 7 *M*: **Percy did.**
- 8 *S*: **The squirrel? Who did that?**
- 9 *M*: (finishes reading p. 9) Knock, Knock . . . someone else at the door. (The illustration on p. 10 shows two rabbits, one slightly behind the other, seemingly shorter than the other.)
- 10 *S*: **Which one is biggest?**
- 11 *M*: **You tell me.**
- 12 *S*: **Which one is smallest?**
- 13 *M*: **Which one do you think is biggest?**
- 14 *S*: **No, you say which one.**
- 15 *M*: **Your teasing me, which one? There, you're right.** (turns to p. 13, missing pp. 11 and 12) **One step was a badger.**
- 16 *S*: **What does a badger do?**
- 17 *M*: **He lives in the forest.** (reads text on pp. 13, 15, 16, and 17 without interruption) Knock, Knock, . . . they all ran to hide.
- 18 *S*: **Where is the keeper?** (illustration on the adjacent p. 18 shows all the animals in front of and behind one another, listening. Percy is not in the illustration.)
- 19 *M*: (reads text on pp. 19, 20, and 21 without interruption) But Percy . . . "Well I never!" said Percy.
- 20 *S*: **Mom, in the reading, everyone found the claws.**
- 21 *M*: (reads last page, p. 23) Percy yawned . . . for a mole. (On the adjacent page, publication information is printed in small font.)
- 22 *S*: **Small word.**
- 23 *M*: **Very small.**
- 24 *S*: **Smaller, what if it was that small?**
- 25 *M*: **That small, pretty small. Do you think you would be able to put it there?**
- 26 *S*: **Yes, what if it was this big?**
- 27 *M*: **Well, it's pretty big there.**
- 28 *S*: **Bigger than that. . .**
- 29 *M*: **Do you think you would have trouble, if it was that big?**
- 30 *S*: **That big? Yes.**
- 31 *M*: **That big? That big?**
- 32 *S*: **Yes.**
- 33 *M*: **That big? How big do you think it is in real life?**
- 34 *S*: **I think that big.**
- 35 *M*: **Show me with your hands how big. That big do you think?**
- 36 *S*: **How big is that?**
- 37 *M*: **Pretty big.**

Unlike the previous three dyads, the King dyad's interactions involve only the mathematical concept of size. The child initiates both sequences of mathematical

discourse [10–15; 22–37], first with a knowledge question, "Which [of the two rabbits] is biggest?" [10] and then with an observation, "Small word" [22]. In the first instance, the mother responds by redirecting the question, and in the second, she confirms his observation. The child follows with a second knowledge question, "Which one [rabbit] is smallest?" [12]. We attribute the child's questions here to the illustrator's use of perspective in positioning two rabbits such that one appears to be shorter than the other. The interactions continue as a playful give-and-take ("Which one do you think is biggest? No, you say which one? Your teasing me.") as the mother turns the question back to the child and he reciprocates. Finally, since his mother confirms with, "There, you're right" [15], it is assumed he points to the rabbit in the foreground. We believe that the mother's playful encouragement for the child to find a solution demonstrates another way parents use to support learning, in contrast to asking questions or suggesting strategies like the other mothers demonstrated. That is, by avoiding answering the child directly and by insisting that he state the answer, she encourages perseverance and confidence that leads to the child's demonstration of a solution.

The second sequence [22–37] occurs after the book is read when the child makes the observation, "Small word" [22]. We assume this is in reference to the last word, "mole," in the text. Interestingly, the mother's confirmation, rather than end the discussion, is followed by the child's speculative question, "What if it was that small?" [24]. In turn, when the mother follows with a speculative question of her own, a confirmation-question pattern unfolds [25–32]. Note that the child and mother go beyond simply using the terminology (i.e., bigger, smaller) to comparing size [22–32]. Indeed, since they use and accept terms like ". . . *this* big" and ". . . *that* small," we believe that they accompany such statements with pointing or finger/hand gestures to illustrate the sizes to which they refer. Next, the conversation takes an interesting twist when the mother asks the speculative question, "How big do you think it [a mole] is in real life?" [33]. The child's response, "I think that big" appears to be ambiguous, since the mother suggests, "Show me with your hands how big" [35] for clarification. Such an explicit request at this point and not earlier adds strength to our assumption that visible indicators were used in conjunction with those previous descriptions. In addition, we posit that in making this request here, the mother reinforces the need to visually demonstrate size, especially when general descriptors (e.g., "that big," "this small," "bigger") are used. Based on the mother's final statement, "Pretty big" [37], we believe that the child does not interpret the size of the mole to be the same as depicted (3 cm in height) in the illustration. Instead, the child appears to engage in some basic proportional thinking, using his background knowledge about animals to provide a more realistic estimation of the actual size of a mole.

DISCUSSION

From a literacy-as-social-practice perspective, we would expect that each of the families would differ in how they shared the book, and this was the case in our study.

These differences are depicted in Table 1. For example, in the Winters and Jones dyads, the interactions were fairly evenly distributed between mother and child. On the other hand, the Nardini mother tended to dominate the interactions, whereas the King child accounted for slightly more of the interactions than his mother. Whereas the Nardini mother tended to ask different types of questions (e.g., clarification, knowledge, interpretive, prediction), knowledge questions predominated in the other dyads. The Nardini and Jones children asked relatively few questions, whereas the King child asked the same number of questions as did all of the other children combined. Whereas all of the families asked clarification and knowledge questions, the Kings were the only dyad to engage in speculative (i.e., "What if?") questions.

The dyads also differed in the initiation of mathematical discourse. The Winters mother initiated all six sequences of mathematical discourse and the Nardini mother initiated all seven sequences. However, in the Jones dyad, the child initiated one of the three sequences and the child in the King dyad initiated both sequences that occurred. In addition, the mathematical discourse had different foci across families. For example, with the King dyad, size was the only mathematical concept that arose. The other three families all engaged in counting and the Winters and Nardini families also engaged in subitizing and some rudimentary addition and subtraction problems. The Nardinis also discussed size and the concept of pair. On the surface, the concepts covered seem typical for 4-year-olds, as do their responses. However, at times the children were not merely object counting as they recalled characters previously encountered but not visible in the illustration they were looking at, in order to arrive at a total. Furthermore, the characters were not always arrayed in neat rows or groups, yet the children were able to track their counting and avoid double counting or missing characters. In addition, counting was used successfully as a problem-solving strategy. And interestingly, characters' size were compared as illustrated and with respect to their real-world counterparts.

The mothers in both the Nardini and Winters dyads posed problems about the cumulative structure of the story, drawing attention to the total number of animals as additional characters entered the story line. Questions such as "How many in the bed now [after two more animals entered]?" while helping the child follow the story line, parallel a type of word problem typically posed to kindergarten and first-grade children: Two rabbits get in bed with Percy and the squirrel. How many were in the bed? Such questions go beyond requiring the child to merely count objects using the illustration at hand (e.g., "Let's count the mice."). Instead, in the shared-reading context, information necessary for the child to solve the problem is presented over several pages of the storybook, intertwined with other aspects of the story. When the Winters' mother posed the problem, she did not repeat or summarize this information. Thus, her daughter had to recall and extract the requisite information from other extraneous details to solve the problem. In the supportive context of shared reading, then, this 4-year-old child was able to solve a problem containing extraneous information. The Nardini mother engaged her son in similar problem solving, although in a more limited way, in that she posed such a problem

Table 1
Discourse Turns in Shared Storybook Reading Episodes

Discourse turns	Winters dyad	Nardini dyad	Jones dyad	King dyad
Makes observations	C: [2, 37] M: [10, 30]	C: [6, 24, 26] M: [1, 11, 13, 17, 21, 29, 43, 45, 47, 40, 51, 63, 68, 70, 74]	C: [14, 20, 24] M: [11, 13, 21, 23, 25]	C: [2, 20, 22] M: [3, 15]
Offers interpretations	C: [4, 11, 39] M: [3, 12, 20]	C: none M: [9, 61, 63]	C: [36] M: [27, 29]	C: none M: [1]
Calls attention	C: [9] M: none	C: [71] M: [11, 43, 67, 68]	C: [36] M: none	C: none M: none
Asks questions	C: [13, 23, 29, 32, 33, 41] M: [6, 14, 18, 20, 26, 28, 34, 42]	C: [2, 36, 73] M: [1, 3, 7, 11, 13, 15, 19, 23, 25, 27, 31, 33, 37, 45, 47, 49, 51, 53, 55, 57, 63, 65, 68, 70, 72, 74]	C: [22, 30] M: [1, 3, 25, 34, 37, 39, 45]	C: [6, 8, 10, 12, 16, 18, 24, 26, 28, 30, 36] M: [13, 15, 25, 29, 31, 33, 35]
Responds to questions	C: [7, 17, 19, 27, 35, 43] M: [30, 32, 34]	C: [4, 12, 14, 16, 18, 20, 30, 32, 34, 38, 46, 48, 50, 52, 54] M: [3, 37, 74]	C: [2, 4, 26, 35, 38, 40, 46] M: [31]	C: [14, 26, 30, 32, 34] M: [7, 11, 13, 17, 25, 27, 37]
Suggests action or strategy	C: [15, 21] M: [16]	C: none M: [39, 43]	C: [38] M: [41, 43]	C: none M: [35]
Follows suggestion	C: none M: none	C: [40, 44] M: none	C: [42] M: [39]	C: none M: none
Confirms	C: none M: [5, 8, 18, 20, 22, 24, 26, 36, 40, 44]	C: none M: [5, 31, 35]	C: none M: [47]	C: none M: [15, 23]
Repeats statement	C: none M: [38]	C: none M: none	C: none M: none	C: none M: none
Child reads	C: [25]	C: [60, 64]	C: [12, 32]	C: none
Child retells story	C: none	C: none	C: [33]	C: none
Child predicts	C: none	C: none	C: [16]	C: none
Child sings	C: none	C: none	C: [28]	C: none

Note. M = mother; C = child; transcript line numbers appear in brackets.

at one juncture only (i.e., a fox joins the group, and the squirrel falls out of the bed). Yet, if we were to paraphrase these interactions into a typical word problem, it might read, "There were 4 characters in the bed. Once the fox got in, how many are in the bed? The squirrel fell out. How many are left [in the bed]?" Essentially then, the Nardini's also illustrate that within shared reading, multistep problems with extraneous information can be posed and solved. In response, the Winters child enumerates and the Nardini child states a cardinal number, after naming each character. Both these children seem to use the *count-all strategy* (Ginsburg & Baron, 1993). We speculate that in this context, the children mentally picture the group of visitors as a whole and count-all accordingly. We speculate this because the children did not turn back the pages to count nor did they pause in their counting as we predict they would if they were counting-on. Although the situation was not posed explicitly as a problem, the Jones mother also drew her child's attention to the cumulative structure of the story by referring to the song, "Ten in the bed."

In the Nardini and Winters dyads, school-like language was used. That is, when the Winters' mother asked, "Do you know how many 10 and 5 makes?" and the Nardini mother asked, "How many are left?" they paralleled the phrasing that many teachers and textbooks use to pose addition and subtraction questions. Similarly, when the Nardini mother suggested, "Let's count them" or the Jones mother asked, "Can you count them?" they echoed common requests that teachers make of young children.

Through their mathematical questioning, the Winters, Nardini, and Jones parents were also socializing their children into the initiation-reply-evaluation discourse pattern that is so dominant in classrooms (e.g., Heath, 1983). Heath found that this pattern was a feature of shared storybook reading with middle-class families, and she claimed that children from middle-class homes enter school already intuitively knowing the discourse rules privileged in many classrooms. This pattern was not evident in the King dyad where the child initiated the mathematical discourse. Of course, the King mother and child might engage in this particular discourse pattern when they share other books. Furthermore, we would argue that the conversation here is more elaborate than is the case of the typical school-like recitation pattern. On occasion, each of the other families extended the simple recitation pattern, building upon the child's responses by redirecting or rephrasing the question or by elaborating or clarifying the child's response. Indeed, we believe that this elaborated discourse through which parents and children co-construct meaning might be a goal that we work toward in our classrooms.

CONCLUSION AND IMPLICATIONS

The results of this study are not meant to be generalized. Rather, we present this study as a way to begin to examine the possibilities of shared book reading as a site for mathematical discourse and to stimulate further exploration in this area, especially with more diverse populations, different age groups, and with different text genres. Our study shows that storybook reading can be a site for mathemat-

ical discourse. It is important to remember that when parents and children share books and attend to mathematics, they do so in the context of meaning making. That is, the mathematical discourse appears not to be contrived; it is connected with the story and illustrations.

Much of the professional and research literature regarding mathematics and storybook reading in classrooms focuses on using children's literature as a *springboard* from which follow-up activities can be generated. The findings we report here suggest that for young children and parents in the home, mathematical concepts are co-constructed within the shared reading, including postreading discussions. Jenner (1999) demonstrates that mathematical discourse similar to that found here can occur in a classroom setting when a teacher reads to a group of children. It seems fitting then, that teachers, researchers, and curriculum developers continue to explore ways of embedding mathematical discourse into storybook reading in integral ways.

Notwithstanding this recommendation, we want to again acknowledge Panofsky's (1994) point that "a socially assembled situation at home is likely to differ significantly from the socially assembled situations typical in other settings such as school" (p. 224). Although we may be able to use insights from shared-reading experiences in the home to inform what we do in classrooms, attempting to directly transpose what happens at home to the school, or vice versa, may be difficult and not always desirable.

There is a propensity on the part of educators to be prescriptive in advising parents how to read to their children in the "correct way." Although the findings from our study demonstrate that shared storybook reading is a potential site for supporting mathematics learning in functional ways and in a highly contextualized manner, we see a need for caution in terms of training parents how to do this. As we have argued previously (Shapiro, Anderson, & Anderson, 1997), there is considerable diversity in the ways in which parents and children share storybooks. The study we described here shows that there is also considerable diversity as to how mathematical discourse unfolds in shared reading. Our sense is that parents and children develop routines with which they are comfortable, and disrupting these routines could conceivably detract from storybook reading as a pleasurable experience (e.g., Rosenblatt, 1978) and detract from its learning potential. We advise great caution in this regard.

As was indicated, these four dyads varied considerably in terms of the type of mathematical discourse engaged in and when it occurred. Thus, results from our study support Golden and Gerber's (1990) notion that picture books permit the generation of multiple interpretations depending on "what the symbol offered, what the reader brought and how the text was mediated by participants in the social context" (p. 205) of a single shared-reading episode. This finding is also consistent with current literacy-as-social-practice perspectives.

The results of the study reported here are also consistent with sociocultural theories of learning. For example, discourse was central in each of the storybook sessions and through conversation and dialogue, the children's mathematical

learning was encouraged and supported as the parents provided strategies, asked questions, or provided information. The diversity evidenced in the manner in which these four families shared the storybook epitomizes the notion of a socially constructed situation in that each dyad was unique in how the book was shared. Given this diversity in a homogeneous group of parents, we can only speculate as to the diversity that would occur in a group where different cultural, linguistic, and socioeconomic groups were represented.

That two of the children in this study initiated mathematics related dialogue is also noteworthy. We sometimes infer from the professional and research literature that it is the parent or caregiver or teacher who initiates conversation through which learning occurs. As educators, we acknowledge the importance of listening to children in ways that value their understanding and inquiries of mathematics. Furthermore, it should be noted that at times mothers sustained and extended the child-initiated conversation and at times, it was the child who extended a parent-initiated dialogue.

The results also suggest that a particular book tends to elicit different kinds of mathematical interactions in different families. Although the prevalence of subitizing and counting aligns with what we know of parents' (and schools') tendency to emphasize arithmetic, it was heartening that references to other concepts such as size were present. Further research with different types of books including nonnarrative books and storybooks with an explicit focus on mathematics such as *The Greedy Triangle* (Burns, 1994) seems warranted.

That three of the four dyads involved a mother and a son may also be worthy of note since there were approximately the same number of boys and girls in the 21 families from which we chose the most interactive dyads. It is beyond the scope of this article to explore this issue but we are beginning to examine possible gender differences in storybook reading in our ongoing research (Shapiro, Anderson, Anderson, & Lynch, 2000). This might also be a fruitful area for other researchers to pursue.

The parents involved in this study were middle class, well educated, and spoke English as their first language. Research with parents from diverse sociocultural and linguistic groups is also needed. As well, studies involving children of different ages would be informative. In addition, examining parent-child shared reading over repeated episodes or with favorite books would provide insights into how the mathematical discourse might change over time, as the book becomes more familiar.

Perhaps as might be expected from an exploratory study of a small number of cases, additional questions and issues have arisen. We are excited by what these parents and children were able to demonstrate. However, we believe we have only begun to understand the role that storybook reading can and does play in early mathematics development.

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