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Supporting Multiple Literacies: Parents' and Children's Mathematical Talk within Storybook Reading[1]

Ann Anderson, Jim Anderson, and Jon Shapiro
University of British Columbia

The purpose of this study was to explore how parents and their young children attended to mathematical concepts as they engaged in shared book reading. Thirty-nine parents and their 4-year-old children from a culturally diverse metropolitan area were videotaped as they read *Mr. McMouse* (Lionni, 1992) and *Swimmy* (Lionni, 1963). Shared reading episodes were transcribed in their entirety and the data were coded according to a scheme developed by the authors (Anderson, Anderson, & Shapiro, 2004). All families except one engaged in mathematical talk although there was considerable diversity in terms of the amount of talk and the ways in which mathematical concepts were shared. The concept of size arose most frequently, next was different aspects of number, while shape occurred relatively infrequently. Results suggest that shared book reading holds considerable potential for parents to draw attention to mathematical vocabulary and concepts.

In this article, we explore how parents and young children attended to mathematical concepts as they engaged in shared book reading. Over the past couple of decades, educators have promoted the use of children's books to support children's mathematical learning; there is a burgeoning literature on how to do this. (e.g., Evans, Leija, & Falkner, 2001; Griffiths & Clyne, 1991). In North America, the National Council of Teachers of Mathematics (2000) affirms the role of storybook reading in mathematics and regularly features Links to Literature in the journal, *Teaching Children Mathematics*.

Several factors underpin this interest in using children's literature to promote children's mathematical learning. First, there is increasing emphasis on integration in curriculum and instruction. For example, integration underscores the New Basics initiative in Queensland, Australia; *connectedness* and *knowledge integration* are prominent in the Productive Pedagogies component of that framework (Education Queensland, 2004). Second, while literacy has traditionally referred to the ability to encode and decode print, more recent work in multiple literacies (e.g., Cope & Kalantzis, 2000) points to the various ways that meaning is coded through different sign systems (including mathematics). Finally, storybook reading has been afforded unprecedented importance in many early childhood and primary years classrooms (Pellegrini, 1991), and we speculate that the centrality uncritically ascribed to it in literacy learning (Anderson, Anderson, Lynch, & Shapiro, 2003) transcends curriculum boundaries.

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The importance ascribed to storybook reading in children's literacy development can be traced to the work of researchers such as Clark (1976) and Durkin (1966). They found that a common attribute of most precocious readers was that they had been read to regularly by a parent and significant others. Educators (e.g., Holdaway, 1979) began to promote shared book reading pedagogy in classrooms, attempting to emulate the book reading that occurred in the homes of these successful early readers. A significant body of research subsequently confirmed that parent/child storybook reading indeed contributes to children's language and literacy development, although meta-analyses of the research studies (Scarborough & Dobrich, 1994) suggest a much weaker relationship than is commonly believed and is promoted in the professional literature (Anderson et al., 2003), especially in terms of children's facility with print literacy.

There is consensus among researchers, however, that shared book reading contributes to children's language development. Through being read to, children acquire the grammatical structures of written text or "book language", which is very different from oral language. Furthermore, a body of research (e.g., Dickinson & Smith, 1994; Dickinson & Tabors, 2001) suggests that book reading contributes significantly to children's vocabulary and concept development. This research indicates children acquire new words and their meanings by being exposed to them in context. Parents and caregivers contribute to this learning by drawing attention to words and concepts in various ways, by elaborating on them and by helping children associate new words and concepts with their existing knowledge (Shapiro, Anderson, & Anderson, 1997).

However, as children's literature and shared reading continue to be embraced as a context for learning mathematics, it is important to reiterate that shared book reading is not a facet of all cultures (e.g., Anderson, Anderson, & Shapiro, 2004). Educators must realise that in some cultures, story telling is preferred to storybook reading and we need to be sensitive to and inclusive of the literacy practices of all cultural groups.

While literacy pedagogy has been informed by studies of parents reading with their children at home, only a limited number of studies have examined storybook reading and children's mathematics.

Using case study research to investigate different ways that families mediated mathematics to their young children through daily experiences and routines, Anderson (1997, 1998) identified storybook reading as one such context. In a longitudinal case study, Anderson and Anderson (1995) documented how mathematics played an integral role in storybook reading with their pre-school child. They described how the illustrations and the story line prompted mathematical discourse as parent and child constructed meaning and documented the spontaneity of the mathematical discourse often initiated by the child.

Shapiro et al. (1997) videotaped 12 parents as they shared two high quality children's books with their 4-year-old children either at home or in

the child's day care centre. Interestingly, one of the categories that emerged from the data analysis was "attention to mathematics" as parents and children co-constructed meaning of the texts. The authors highlighted the considerable diversity in the shared reading experiences including attention to mathematics among this relatively homogeneous group.

Using a multiple case study design, Anderson et al. (2004) documented the mathematical discourse of four mother-child pairs as they shared *One Snowy Night* (Butterworth, 1989). Different families focused on different mathematical concepts. For example, one family focused exclusively on size while two of the families engaged in counting, subitising, and rudimentary problem solving. The initiation of mathematical discourse also differed across families. The mothers in two of the families initiated all of the discourse whereas in another dyad, it was the child who did so. Again, the authors point to variability in the ways that each of these families shared the book and engaged in mathematical discourse.

The present study, with a larger number of participants representing different linguistic and sociocultural groups, builds upon this previous research.

Theoretical perspectives

This study is framed within a sociocultural theory of learning based on the foundational work of Vygotsky (1987) and his followers (e.g., Wertsch, 1985). From a sociocultural perspective, learning is viewed as being highly social with language playing a central role (Gee, Michaels, & O'Connor, 1992). Vygotsky theorised a *zone of proximal development* wherein a more proficient other supports learning that one could not achieve on one's own. In other words, learning is thought to occur within "socially constructed situations" (Rogoff, Gauvain, & Ellis, 1984, p. 557), meaning that people learn from each other to solve problems in culturally specific ways. But as Panofsky (1994) posits, social activities have traditions and vary across contexts and groups.

Until fairly recently, literacy was viewed as a set of linguistic and cognitive skills, transferable from one context to another. However, anthropological and socio-linguistic work has led to a reconceptualisation of literacy as a set of complex social practices (e.g., Barton, Hamilton & Ivanic, 2000). Foundational work in this regard was Heath's ethnography conducted in the south eastern United States (Heath, 1983). She documented the literacy practices in three community contexts: Maintown, a white, middle class community; Roadville, a working class white community; and Trackton, a working class African-American community. Analysing storybook reading practices, Heath found that the Maintown children were read to at an early age in an interactive, dialogic manner. They learned decontextualised knowledge and how to link their existing knowledge with new knowledge. In essence, these children were learning the discourse routines favoured by (and necessary for, success in) schools. While Roadville parents read regularly to their children, they tended to ask literal level

questions and did not help their children learn to link new knowledge with that which they already knew. Heath contended that because they had not learned how to decontextualise knowledge, these children encountered difficulty as they progressed through school. Parents and caregivers in Trackton did not read regularly to children and did not provide them with books, although the adults read newspapers, brochures and so forth. Furthermore, the children were not frequently drawn into conversation. Heath speculated that many of these children experienced difficulty in school from the beginning because they had not learned the interactional routines or the discourse practices favoured by schools (Janes & Kermani, 2001).

Recently, a similar shift has occurred in conceptualising the learning and teaching of mathematics. As with literacy, mathematics educators have begun to embrace sociocultural perspectives of mathematics learning. Again, mathematics is seen as social practices embedded in, and influenced by, particular social and cultural practices. Cobb (1994), a leading proponent of a sociocultural perspective, argued that learning mathematics is a process of "enculturation into a community of practice" (p. 13). Discourse or conversation is seen as central in this enculturation (Sfard, Nesher, Streefland, Cobb, & Mason, 1998) as a more proficient other, such as a parent, guides the learning until, in a Vygotskian sense, the knowledge is internalised.

Method

Thirty-nine parents and their 4-year-old children were recruited from day care centres in a culturally diverse metropolitan area of Canada. The participants came from socio-economically diverse neighbourhoods and a variety of linguistic groups including Cantonese, Danish, English, Mandarin, and Slovene. Although we sought to have a gender-balanced group, the dyads broke down as follows: 9 mother-son; 7 father-son; 7 father-daughter; 16 mother-daughter. Some of the children spoke a language other than English as their first language. However, English was the language of instruction in the day care centres and all of the parents indicated that they normally shared books with their children in English. All of the parents had graduated from high school, some had no post-secondary education, some were in 2-year college technical programs, others were enrolled in baccalaureate programs in university, and still others were professionals holding undergraduate and graduate degrees.

Parents were asked to "Share this book with your child as you normally would", either at day care or at home, according to their preference. Each dyad was videotaped sharing *Swimmy* (Lionni, 1963) and *Mr. McMouse* (Lionni, 1992). These were two books selected in our previous research (Shapiro et al., 1997) in consultation with two experts in children's literature as being appropriate for children of this age group. They were used in the present study to allow comparisons and contrasts across our work with different groups of participants. We decided to provide the books, as opposed to having parents and children select the books to read, because we

wanted to be able to make cross-dyad comparisons. We also confirmed with the managers of two large, local children's book stores that these books were being purchased by parents and children and thus had currency and relevancy. Copyright restrictions preclude us from reproducing the books, but a description of each is provided in Appendix A for readers not familiar with these texts. The order in which the books were read was alternated across dyads. The researcher or the research assistant, while being as inconspicuous as possible during the taping, kept field notes of any information that would aid in understanding and interpreting the data. A mirror mounted on tripods was placed behind the participants as they read so the video camera would capture any gestures otherwise hidden by the books.

The videotapes were transcribed in their entirety. All talk was transcribed verbatim and all gestures / actions were described in detail. The data were divided into conversational turns or discourse turns, defined by Sinclair and Coulthard (1975) as "everything said by one speaker before another began to speak" (p. 251). The utterances were coded according to a system developed by Shapiro et al. (1997). All of the utterances pertaining to mathematics were then identified and we did a second order analysis using the coding scheme described in Appendix B. A second person then independently coded 20% of the data and any discrepancies identified were reconciled through discussion.

Results

As shown in Table 1, the number and type of interactions varied from family to family even when they shared the same book. For example, there were 21 mathematical discourse turns as the Johansen's shared both books while there were none in the Ling family. Nine of the families accounted for slightly more than one half of the mathematical discourse while there were few such interactions in some families. It is beyond the scope of this article to present full transcripts of the interactions across the different families; rather, we attempt to share the various ways that families engaged with mathematics. The reader might wish to refer to our earlier work (Anderson et al., 2004) for a "thick description" of shared reading events in which parents and children engage in sustained mathematical discourse.

Of note here (Table 1) is the comparative frequency of mathematical discourse turns that occurred in each of the two books. Interestingly, there were more than three times as many instances of such discourse turns in *Swimmy* than in *Mr. McMouse* (180 versus 53 respectively). Notwithstanding this trend, the Buchanan, Simmt, and Richards families attended to mathematics more in *Mr. McMouse* than they did in *Swimmy* and the same number of mathematical interactions occurred in each of the texts with the Ladson family. It is also important to point out that most of the mathematical discourse that occurred in both books centred on the illustrations.

Table 1
Summary of Mathematics Discourse Turns for Each Family in Each Shared Book Reading

	Swimmy						Mr. McMouse					
Family	Size-Child	Size-Parent	Number-Child	Number-Parent	Shape-Child	Shape-Parent	Size-Child	Size-Parent	Number-Child	Number-Parent	Shape-Child	Shape-Parent
Johansen-M/D	0	9	1	4	0	0	1	3	1	2	0	0
Ladson-F/D	2	4	1	1	0	0	1	3	2	2	0	0
Howe-M/D	4	6	1	2	0	0	0	0	0	0	0	1
Gobel-F/S	0	2	3	7	0	0	0	1	0	0	0	0
Du Roy-M/D	0	2	3	2	0	0	0	1	0	4	0	0
Richards-M/D	0	2	0	1	0	0	2	2	3	2	0	0
Tang-M/D	0	7	0	4	0	0	0	0	0	0	0	0
Cohen-M/D	1	4	1	2	0	0	0	2	0	0	0	1
Lockwood-M/D	1	4	1	1	1	1	0	0	0	0	0	0
Sigurdson-M/S	0	5	0	0	0	3	0	0	0	0	0	0
Buchanan-M/S	0	2	0	0	0	0	1	1	4	0	0	0
Smith-F/S	0	2	0	4	0	0	0	1	0	0	0	0
Dudley-Janes-M/S	3	4	0	0	0	0	0	0	0	0	0	0
Simmt-F/D	0	1	0	1	0	0	0	0	1	3	0	0
Acreman-M/D	0	5	0	1	0	0	0	0	0	0	0	0
Gauthier-M/D	1	1	1	1	0	0	0	0	0	1	0	0
Hasting-F/S	1	1	1	2	0	0	0	0	0	0	0	0
Froebel-M/S	3	2	0	0	0	0	0	0	0	0	0	0
Prentice-M/D	5	0	0	0	0	0	0	0	0	0	0	0

Swimmy							Mr. McMouse					
Family	Size-Child	Size-Parent	Number-Child	Number-Parent	Shape-Child	Shape-Parent	Size-Child	Size-Parent	Number-Child	Number-Parent	Shape-Child	Shape-Parent
Conrad-M/S	0	3	0	0	0	1	0	0	0	0	0	0
Johnson-M/S	1	2	0	0	0	0	0	1	0	0	0	0
Becker-F/D	0	3	0	0	0	0	0	1	0	0	0	0
Jackman-F/D	1	2	0	0	0	0	0	1	0	0	0	0
Manning-M/D	1	2	0	0	0	0	0	0	0	0	0	1
Goyette-M/D	0	3	0	1	0	0	0	0	0	0	0	0
Keifer-F/S	0	3	0	0	0	0	0	0	0	0	0	0
Ping-F/S	0	2	0	0	0	0	0	0	0	1	0	0
Carvan-M/S	1	1	1	0	0	0	0	0	0	0	0	0
Browne-M/S	0	3	0	0	0	0	0	0	0	0	0	0
Wareham-F/D	1	1	0	0	0	0	0	0	0	0	0	0
Colbourn-F/D	0	2	0	0	0	0	0	0	0	0	0	0
Carpenter-F/S	0	2	0	0	0	0	0	0	0	0	0	0
Pilgrim-M/D	0	2	0	0	0	0	0	0	0	0	0	0
Jones-M/D	0	0	0	0	0	0	1	1	0	0	0	0
O'Hare-F/S	0	1	0	0	0	0	0	0	0	0	0	0
Shi-M/D	0	1	0	0	0	0	0	0	0	0	0	0
Smythe-F/D	0	1	0	0	0	0	0	0	0	0	0	0
Janes-Winsor-M/S	0	1	0	0	0	0	0	0	0	0	0	0
Ling-M/D	0	0	0	0	0	0	0	0	0	0	0	0

Three mathematical foci or concepts emerged from the discourse: number, shape and size. Across families, size was most common, number was next while shape was relatively infrequent. Each of these concepts arose at least once in each of the books, although in keeping with the overall trend noted earlier, each was more frequent in *Swimmy*. As in our previous work (e.g., Anderson et al., 2004), these broad categories or foci do not adequately capture the nuanced manner in which parents and children engaged in mathematical discourse as they co-constructed meaning within shared reading. We now share examples of the different ways in which families engaged in discourse around these different foci.

To conserve space, we provide only those portions of verbatim transcripts of the shared reading necessary for the reader to understand the context in which the interactions occur. The regular print indicates the dialogue between adult and child and the capital letter that precedes it identifies the speaker according to family role (M: Mother; F: Father; D: Daughter; and S: Son). Inside parentheses, each transcript opens with a description of the illustration identified by page number and if text was read prior to the dialogue, it is included in *italics*. The **bold print** signals the key words that capture the category being discussed. If dialogue preceded or followed the excerpt, a colon is used to alert the reader that the excerpt is a subset of a larger conversation. If no colon is present, the excerpt is complete and was bounded by reading of the text.

Size

The concept of size arose at least once in all of the families (with the exception, of course, of the Ling Family) and, in the case of 11 families, this was true in both books.

Adjectives. Many of the families used adjectives or descriptors of size as they commented on aspects of the illustration. On many occasions, as with the Jackman father, this was not a simple reiteration or rewording of the text just read. Also, the children used size to describe what they saw; interestingly, when the Johansen child pointed to the size of the cat, her mother pointed to its colour in response, reminding us again of the unelaborated way in which these comments arose.

Jackman Family *(Swimmy)*
[p. 21 a school of tiny red fish, p. 22 Swimmy and four red fish; *swim all together like the biggest fish in the sea!]*
F: Where's Swimmy?
D: (Points to picture) That's my guy.
F: And it looks like the **little** red fish are following him.
D: Yep, they're following him.

Johansen Family *(Mr. McMouse)*
[p. 21 Spinny and Timothy inside a trap, p. 22 the front portion of a cat.]
:

M: Ohhhh.
D: A **big** cat!
M: A black cat.
:

Interestingly, some parents further emphasised the size of an object through the use of additional adjectives or descriptors. The Brown and Johansen families' use of *sure* and *very* are examples. The exclamation, "Look at that!" by the Johansen mother seemed to add even more emphasis. Although the elaboration is not extensive, we speculate it serves to draw additional attention to size.

Brown Family *(Mr. McMouse)*
[… *the cat a few feet behind.* p. 19. Turns to p. 21, Spinny and Timothy inside a trap, p. 22 the front portion of a cat.]
M: There's that cat (points to it). He is **sure big**!

Johansen Family *(Mr. McMouse)*
[pp. 3–4 Four brick structures of varying height, p. 4 Timothy runs from building(s).]
M: Let's turn the page (gasps). Oh! Here's a **very big** house! Look at that!!
D: Look at that!!

Comparisons. Families also engaged in what we term *indirect comparisons* to attend to the concept of size. As in the following examples, the families used similes or metaphors to compare objects from the illustrations with objects with which the child was familiar. Here, the parents seemed to intuitively encourage the children to draw from their schemata to comprehend the size of a particular object. Interestingly, the Cohen mother helped her child associate the anemones in the illustration with a specific, previous experience with anemones.

Du Roy Family *(Mr. McMouse)*
[p. 12 Near the middle bottom of a mound of rocks in a cave-like opening, a mouse sits with eyes closed holding a stick which touches an oval rock above his head; … *As they went, Spinny explained all the things* …
D: (points to mouse underneath rock) And he's sleeping.
M: I think so. It looks **like he is under a big umbrella**.
:

Ladson Family *(Mr. McMouse)*
[p. 7 Timothy hides partially behind a group of large rocks, p. 8 five field mice hide behind blades of grass and circular / oval rocks; … *from behind the large boulders*.]
D: From behind the large bolduhs [boulders]
F: Boulders
D: Boulders
F: Boulder is like this (pointing to the illustration). **It's a big, big rock**.

D: **And heavy**
F: **And heavy**. Yeah, you are right.

Cohen Family *(Swimmy)*
[p. 18 three red anemones of varied height attached to rocks, a starfish and a sea urchin; *and sea anemones who looked like palm trees swaying in the wind.*]
:

M: Yes, and that's how they pull in food. Remember, **the big white ones** we saw at the wharf at Bamfield?
D: Yeah!

On some occasions, families directly compared the size of two or more objects in the illustrations. While these examples are somewhat similar to the indirect comparisons just discussed, an important difference is that here the child could visually compare the objects in the illustrations. The Ladson father also modelled the use of comparative language (bigger) to describe the relationship between the size of the objects. Interestingly, the Johnson mother introduced the concept of scale by implying that to the mice, the grass is comparable in size as trees are to humans.

Ladson Family *(Swimmy)*
[p. 15–16 Swimmy (1.5 cm long) near tail of an eel (45 cm long); … *an eel whose tail was almost too far away to remember* …]
F: **He's a lot bigger than Swimmy**, isn't he?
D: Huh, huh.
:

Johnson Family *(Mr. McMouse)*
[p. 25 six blades of grass (tallest: 22 cm), with 10 flower shapes at the top, p. 26 Timothy (10 cm tall) and Spinny (7.5 cm tall), run on two legs toward the grass; *They tiptoed out of the trap, and off they ran.*]

M: Look, they're [the mice] running off. Look at those pieces of grass. What do they look like? (pauses) **trees because they're [the mice] so small**.

Representation. On occasion, the participants represented size through gesture. Typically, they did so by extending their arms (Johnson family) or positioning their hands or fingers (Smith family) to illustrate their interpretation of an object's size. The Johnson child initiated the gesture in a speculative manner that was continued by the parent. As well, several families traced the length of the eel in an illustration, with a finger to emphasise, and kinaesthetically demonstrate, its size. Interestingly, the Prentice child used tone of voice to signal the concept of size para-linguistically (Golden & Gerber, 1990).

Johnson Family *(Swimmy)*
[pp. 15–16 Swimmy near the tail of an eel (45 cm long); *an eel whose tail … too far away to remember*]
S: The tail could be this long? **(Extending both arms fully**)
M: Do you think it could be this long? **(Extending both arms fully)**

Smith Family *(Mr. McMouse)*
[p. 7 Timothy partially hides in a mound of boulders, p. 8 five field mice partially hide among rocks and grass (4 cm tall); … *nothing but an ordinary, innocent city mouse?*]
M: We've seen little mice like that before. They're really small. **(Mother holds up thumb and forefinger about 2.5 cm apart.)**

Prentice Family *(Swimmy)*
[p. 11 Swimmy (1.5 cm long) just below a large fish (16 cm long; 10 cm wide), p. 12 two other large fish, one under the other; *A strange fish pulled by an invisible thread.*]
D: (pointing to each fish) These are big fish.
M: (points to Swimmy in the i llustration) What is this little fish?
D: **(squeaky voice)**. It's a little **tiny, teeny-weeny** fish?
M: It is small isn't it? And these ones are this big. **(Holds both hands touching page spaced apart to depict the size of the larger fish shown in the illustration)**. This big!
:

Measure. The Cohen child informally used units to describe the length of the eel demonstrating the concept that a numerical value can be used to measure an object's size. While we do not know the actual unit the child used, she captured the essence of measurement, assigning a number to a size attribute. It should be noted that there are vertical lines painted at intervals for most of the eel's body, most distinct in the wider portion of the body; coincidentally, these markings form 23 spaces along the length of the eel.

Cohen Family *(Swimmy)*
[pp. 15–16 Swimmy near the tail of an eel (45 cm long); *an eel whose tail … too far away to remember*]
M: that means he's sooo lonnng. Want to trace him?
D: (Indicating with her finger along the page) **I'll see how long he is? One, two, three, four, five, … twenty-one, twenty-two, twenty-three** (looks at her mother)
M: Twenty-three minutes long? (laughs) That's a very long eel.

Number

Number arose at least once in 18 of the families, and for six of the families this occurred in both books. Again, much of this discourse centred on the illustrations.

Adjectives/subitising. One common aspect of number that arose was subitising. That parents subitise—as with the Cohen family—is perhaps to be expected. However by doing so, they demonstrated to the child that one can name "how many" in a small cluster of objects without counting. Indeed, the children in these families (e.g., Richards family) typically subitised for sets of two, whereas the parents modeled the concept with slightly larger sets. It should be noted that these instances of subitising could also be labeled as using number as an adjective, similar to this use with size.

Cohen Family *(Swimmy)*
[pp. 9–10 A lobster (3 legs and 2 pincers visible) spreads across the pages with Swimmy in the upper left corner in front of it; *a lobster, who walked like a water-moving machine.*]
M: They walk on their **six** legs
:

Richards Family *(Mr. McMouse)*
[pp. 1–2, two identical mice facing each other with a grey thin rectangle (a mirror) between them, on p. 2, the mice are wearing a coat and hat.]
:
D: **Two** (of) the same man and **two** (of) the same mouse. (points first to mouse on both sides of the mirror on p. 2; then points to mouse on both sides of the mirror on p. 1)
M: Oh! I see! (Daughter and Mother laugh) That's right!

One as a descriptor. Some of the families used one (a numerical attribute) as opposed to more general descriptors such as a or the to refer to, or to identify, a single object. Hence, the sense of one as a number (a word that denotes how many when a single item is present) is reinforced.

Du Roy Family *(Swimmy)*
[pp. 1–2 more than a hundred red fish are stamped randomly with a black fish (Swimmy) among them near the middle; *A happy school of little fish … sea somewhere.*]
:
D: **one** here and **one** here

Acreman Family *(Swimmy)*
[pp. 23–24 Twenty-four red fish swim behind Swimmy and about 40 red fish swim very close together forming a "fish head" shape in front of him; *He taught them … each in his own place.*]
M: (tracing the shape of the red fish formation with her finger) See! This is all the red fish in **one** big pile.
D: Yeh! (points to the fish shape and smiles)

Approximation. Many of the families used global descriptors such as *lots* and *tons* to approximate large numbers of objects. This resonates with Resnick's (1989) proto-quantitative schemas of number wherein young children "express quantity judgements in the form of absolute size labels such as *big, small, lots and little*" (p. 162). However, the Du Roy mother used *lots* to describe a relatively small set. Also of note here is that the parents modelled this sense of number in this context with 4-year-olds who are thought to have this ability. In contrast, the Johansen mother described the school of fish by naming a large number (1000) as an approximation. When her daughter used a less specific referent (all), she reiterated her numerical approximation. Interestingly, the father in the Hasting family not only referenced a numerical approximation but also invoked the language of estimation (almost) in describing when the book was published.

Ladson Family *(Swimmy)*
[pp. 1–2 more than 100 red fish are scattered across and Swimmy in the middle, p. 2]
F: Uh, oh, there's **lots of things** swimming here (points to picture). What do we call a whole pile of?
D: Oh, I saw a video about this (points to page).
F: Oh, what happened?
D: There were **all tons** of red fish and one black fish (points to page).
:

Du Roy Family *(Mr. McMouse)*
[p. 8, five field mice partially concealed among rocks and grass.]
D: (turns to p. 8 when M paused from reading on p. 5) Oh, look it (points to picture), there's a mommy and a daddy.
M: (looking at picture) Oh, **lots** of mice.
[turns back and finishes reading on p. 5 and returns to pp. 7–8]
:

Johansen Family *(Swimmy)*
[Title pages, Swimmy and five red fish, and a school of about 35 red fish.]
M: Here's a **thousand** fish.
D: Yeah. (looking intently at illustration)
:
[pp. 1–2: both pages are covered with (>150) red fish and Swimmy in among them.]
D: (pointing to illustration) Look at all these fish!
M: **Thousands** of fish!

Hasting Family *(Swimmy)*
[Last page, "Copyright @ 1963 by Leo Lionni".]
F: It's from nineteen sixty-three.
S: Nineteen sixty-three,
F: That's a long time ago. It's **almost forty** years.

Counting. Some families occasionally counted. As in the case of the Howe family, when parents asked "How many?" in reference to a small set of objects, the children object-counted and did not subitise. We speculate that for these particular children, the prompt "How many?" was associated with counting, although possibly these particular children were unable to subitise for sets of three or more. Interestingly, the Howe mother confirmed her daughter's counting with the cardinal number three, which was not always the case with these families. In the Gobel family, the child prompted the counting. When the father complied, it is interesting that while he probably did not count each individual fish, 86 was a reasonable approximation to the actual number of fish, and is a large number to model for this age group. Interestingly, when the Simmt child miscounted the number of objects in response to the prompt, her father modelled accurate one-to-one counting but in a supportive and encouraging ("Let's try again") manner. That the Cohen child initiated a multi-digit count is noteworthy in that her pace did

not suggest she was rote counting. Interestingly, the mother in the Johansen family used a counting routine to signal when to turn the page.

Howe Family *(Swimmy)*
[p. 11 Swimmy swims below a large fish, p. 12 two other large fish swim one under the other; *strange fish pulled by an invisible thread*]
M: (points to picture) How many fish are there?
D: **One, two, three** (pointing to each fish)
M: **Three** big fish (hand is on page) and one little one.
:

Gobel Family *(Swimmy)*
[p. 1 about 80 red fish, p. 2 Swimmy is shown in the middle of more than 100 red fish; *A happy school of little fish*]
S: I can't count that many fish.
F: You can't count that many?
S: No.
F: Is there too many to count?
S: You count.
F: I could count them but it would take a long time.
S: Count them.
F: I'd rather read than count.
C: No, please [count].
F: OK, shall I count really fast? **One, two, three four, …** [then speeds up running numbers together]. I think there are **86** fish on that page. Do you agree? Good. Okay.

Simmt Family, *(Mr. McMouse)*
[p. 7 Timothy hides near three large rocks, looking toward five field mice partially hidden among rocks and grass (15 distinct blades in a line), p. 8.]
F: … (referring to illustration) What do you see in the forest?
D: Mouse (pointing).
F: Yeah, a whole bunch of mice. How many mice?
D: (pointing to individual mice). **One-two-three-four-five-six-seven-eight-nine.**
F: Well, I don't know if there's nine. Let's try again. (pointing to each mouse) **One-two-three-four-five**. Okay!

Cohen Family *(Swimmy)*
[pp. 15–16 Swimmy near the tail end of an eel (45 cm long); *an eel whose tail … too far to remember*]
M: That means he's soooo looong. Want to trace him?
D: (indicating with her finger along the page) I'll see how long he is. **One, two, three, four…twenty-three.** (looks at Mom)
M: Twenty-three minutes long? (laughs) That's a very long eel.

Johansen Family *(Swimmy)*
[p. 22 Swimmy is at bottom middle and 4 red fish are in the bottom left-hand corner, while more than 60 red fish are scattered on p. 21; *We are going to swim all together like the biggest fish in the sea!*]

M: So they will swim together (makes a swishing sound and runs hand down page over the fish) like a very big fish. Yes! **One, two, three** – turn the page.
D: Ohh!
M: Look at that.

Shape

The concept of shape was less prevalent in that it arose in only six families, and in only one or the other of the books in each case.

General reference. As in the Sigurdson and Manning families, reference to shape was general and unelaborated.

Sigurdson Family *(Swimmy)*
[pp 11–12 Swimmy and three large fish; the same stamp but different colour paint has been used for each of the three fish. *strange fish, pulled by an invisible thread*]
:
S: They all look the same as him.
M: Do they all look the same?
S: Yeh?
M: How do you mean? The **same shape**?
S: 'Cause they all have their mouth open. (looks closely at the big fish)
:
[p. 13–14 elliptically shaped leaf patterns attached to rectangular stems (i.e. seaweed) among circular and oval rocks scattered across the bottom with Swimmy near the left hand bottom corner; … *a forest of seaweeds growing from sugar candy rocks*…]
:
M: There's all different colours and **shapes**.
:

Manning Family *(Mr. McMouse)*
[p. 9 Two mice, Timothy (right profile) and Spinny (back on) stand near each other … *a tail like yours?" said Spinny.*]
M: … I see. They have the same tail! (points to Timothy's tail)
D: (Looks closely at picture) But his is gold (points at Timothy)
M: … This one's darker, this one's lighter (pointing to the mice), but they're a **similar shape**, aren't they? The same colour as his ears.
:

Specific attribute. For the Lockwood and Howe families, the references to shape are more specific. For example, the Lockwood mother referenced a specific attribute (curvature) in describing the shape of the eel. Both the Howe parent and the child associated a known shape (a basketball) with an object in an illustration, thereby indirectly referencing the attribute of a sphere (or a circle).

Lockwood Family *(Swimmy)*
[p. 15–16 An eel whose tail is somewhat like a backward S, with Swimmy near the tail's end; *An eel whose tail … to remember*]

:
D: He broke his tail.
M: His tail is broken? No, I think it's just a **curve; it's curving**.
:

Howe Family *(Mr. McMouse)*
[p. 11 Spinny stands on a marbled rock, Timothy and three other mice stand to his left, p. 12. at the bottom of a mound are two orange marbled / speckled rocks. … *I'll arrange everything."*]
:
D: What does a basketball …
Parent: Do you see a basketball there?
D: Yes.
Parent: That is right-it is in the **shape of a basketball**.
:

Discussion

The results of this study suggest that shared book reading is a context for parents and children to engage in mathematical talk. It is important to note that none of this talk appeared contrived and indeed occurred as parents and children co-constructed meaning of the book. For example, none of the participants simply counted objects for the sake of counting. Indeed, based on our experiences working with 4-year-olds, we speculate that they simply would not remain engaged, unless the mathematical talk was meaningful within the context of the shared reading event.

That the amount of mathematical talk differed widely across families is consistent with our previous research (Anderson et al., 2004; Shapiro et al., 1997). It is also consistent with a *literacy as social practices* perspective, in that individual families will engage in literacy differently, including the ways that they share books. This point is important because the ways that these families would share other books would not necessarily be the same as the ways in which they shared these particular texts. Indeed, it would be imprudent to conclude that because the Ling family did not engage in mathematical talk sharing these two books, that they would not do so when sharing others.

The results of this study are consistent with a sociocultural theory of learning, in that talk or discourse was central. Further, the diversity as to the amount of mathematical talk that occurred, and the differences in the mathematical concepts that arose across the families, also reflect a sociocultural perspective.

That the two books, *Mr. McMouse* and *Swimmy* generated different amounts of mathematical talk is also interesting. When we selected these books, we believed that each held similar potential in terms of the amount and types of mathematical conversation they would engender. That more than three times as much mathematical talk arose as families shared *Swimmy* compared to *Mr. McMouse* was unexpected, although as noted previously,

this trend did not hold for four families. While it is beyond the scope of this study to explain this occurrence, further research is needed to ascertain why mathematical talk is so much more prevalent in one text than in another. For example, having parents "think aloud" as they reflect while watching a video recording of their shared reading should provide interesting insights.

While much of the mathematical talk within the storybook reading was unelaborated, we still see it as being significant in children's mathematical development. As was indicated earlier, there is a body of research (e.g., Dickinson & Tabors, 2001) that demonstrates that shared reading is a rich site for vocabulary and concept development as children are exposed to words in different contexts and with nuanced meanings. The attention to mathematical concepts and vocabulary evident in this study is consistent with this research. That is, by being exposed to words such as *bigger*, *small*, *six*, *lots*, and *shape* in the rich context of storybook reading, children were acquiring the vocabulary of mathematics and the associated meanings. It is important to remember that each book here took about 5 or 6 minutes on average to share. Adams (1990) estimates that some children experience more than 1000 hours of shared reading prior to formal schooling, pointing, we think, to the potential that shared reading holds as a context for children to engage with mathematical vocabulary and concepts.

The focus on size that was apparent in these readings is quite interesting. Our interpretation of the research literature is that number, and in particular counting, receives a great deal of attention in studies with preschool children. Indeed, some of our earlier work (Anderson, 1996) suggests that parents of young children tend to equate mathematics with number and/or counting. The relative dearth of attention to shape in the shared reading of these two books, we believe is expected given that meaning making seems to be paramount in this context. Shape is not a central concept necessary to make meaning of these two texts and thus it arose with such infrequency. Size on the other hand is important, especially in *Swimmy* and thus the relative frequency with which it arose there. Although number arose less frequently than size, it also served to help make meaning of the story.

The illustrations served an important function in the shared reading in that a considerable amount of the mathematical talk centred on them. We interpret this finding as parents intuitively utilising pictorial representations to support the talk involving mathematical concepts. We see this finding as being significant in several ways. First, comparing and discussing shape, number and size of pictorial representations of objects is cognitively different from comparing and discussing the shape, number and size of two or more actual objects. Second, some parents encouraged comparison of the pictorial representations of objects with objects from children's everyday experiences thereby prototypically modelling the concept of scale in a foundational way. As with the Maintown parents in Heath's (1983) classic study who enculturated their children into the discourse patterns privileged in school, some of these parents, we believe, are laying the groundwork for these

children to be able to deal successfully with pictorial representation that they may encounter in mathematics classrooms at school.

The present study shows that some children are familiar with engaging in mathematical talk within shared book reading. The manner in which families here shared mathematics is not entirely consistent with the ways that some educators suggest storybook reading should be conducted in mathematics classrooms. That is, while parents tended to integrate mathematical talk almost seamlessly into the storybook reading, many educators advocate using the storybook reading as a springboard to mathematical activities. As Panofsky (1994) reminds us, there are fundamental differences between learning at home and learning at school and we are not advocating that teachers try to emulate what parents do or that parents employ school-like activities at home. It seems prudent though that educators be aware of and consider these differences.

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Authors

Ann Anderson, Department of Curriculum Studies, University of British Columbia, 2125 Main Mall, Vancouver, British Columbia, Canada V6T 1Z4.
Email: <ann.anderson@ubc.ca>

Jim Anderson, Department of Language and Literacy Education, The University of British Columbia, 2125 Main Mall, Vancouver, British Columbia, Canada V6T 1Z4.
Email: <james.anderson@ubc.ca>

Jon Shapiro, Department of Language and Literacy Education, The University of British Columbia, 2125 Main Mall, Vancouver, British Columbia, Canada V6T 1Z4.
Email: <jon.shapiro@ubc.ca>

Appendix A

Illustrations in *Swimmy* and *Mr. McMouse* spread across two adjacent pages, and the text is written on every second page. On those pages, there is an average of 1.5 lines of text in *Swimmy* and 7 lines of text in *Mr. McMouse*. Lionni uses watercolours and stamping techniques in *Swimmy* and a paper collage technique in *Mr. McMouse*. Multiple characters and objects of varied number, size and shape appear in both books. Neither book could be considered to have explicit mathematical foci as in the case of books such as *The Cheerios Counting Book* (McGrath, 1998) in which parents and children are explicitly prompted by the text to count.

Next, we provide the first page of the text and then a summary of each narrative.

Mr. McMouse

"Whenever Timothy saw himself in the mirror, he felt happy.

"What a good-looking city-mouse I am !" he thought."

One day Timothy, a city mouse discovers he looks more like a man than a mouse and runs away from his city home. When he stops to rest, a country mouse named Spinny introduces herself, recognises him as a mouse, names him Mr. McMouse, and invites him to stay with them. Spinny then explains that he needs to pass a Tickleberry eating test , a running test and a tree climbing test to become a licensed field mouse. After failing the first two tests, his third test is interrupted when a cat approaches the tree he is climbing and the mice run away. After Spinny and Timothy run into a trap, the cat lies outside. When Timothy sings a lullaby, the cat falls asleep, and he and Spinny escape. Because of this, Spinny is awarded a bravery medal and Timothy receives an honorary license and they are very happy.

Swimmy

"A happy school of little fish lived in a corner of the sea somewhere.

They were all red. Only one of them was black as a mussel shell.

He swam faster than his brothers and sisters. His name was Swimmy."

Swimmy, a small black fish lives with a school of small red fish until one day a tuna swallows all the red fish, leaving Swimmy alone. After feeling sad and scared, Swimmy swims the sea discovering one marvel after another, namely, a medusa, a lobster, strange fish, seaweeds, an eel, and anemones. Finally he comes across another school of little red fish who are hiding because they are afraid of being eaten. Swimmy teaches the school of fish to swim close together so they look like a large fish with Swimmy as the eye. By doing so, they scare away the big fish.

Appendix B

Attention to Mathematics

SIZE [38 dyads]: talk associated with the size of objects

Adjective / descriptor [24 dyads]: A big eel.

Indirect Comparison [16 dyads]: Like big rocks.

Direct Comparison: [10 dyads]: There's the big tuna and there's Swimmy.

Representation [8 dyads]: A whale! (child extends both hands to show how big)

Measure [1 dyad]: I'll see how long he is, one, two three, …

NUMBER [18 dyads]: any talk in which a number word is used.

Adjective / Subitising [11 dyads]: Three daddies.

One as descriptor [5 dyads]: One big fish.

Approximation [13 dyads]: There are lots of fish. Thousands of them.

Counting [6 dyads]: One, two, three, four, five.

SHAPE [6 dyads]: any talk that refers to or describes the shape of an object.

General reference [3 dyads]: All shapes and colours.

Generic attribute [3 dyads]: The shape of a big fish.

Specific attribute [2 dyads]: It's curving.