"Quarters Are What You Put into the Bubble Gum Machine": Numeracy Interactions during Parent-Child Play

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Abstract

Literacy has been studied extensively in the context of children's play, but few studies exist of numeracy development through play. The purpose of this study was to investigate the frequency and type of numeracy exchanges that occurred spontaneously during parent-child play. Twenty-six 4-year-olds and their mothers played with a variety of toys, including a cash register and play money, for 15 minutes. Three types of numeracy interactions were examined, including cultural, procedural, and mathematical exchanges. Results indicated that approximately one-half of the numeracy interactions related to mathematical concepts, one-third to cultural exchanges, and one-sixth to procedural information. The majority of parents provided conceptual information through implicit teaching rather than direct, didactic teaching of number skills during play. Parents initiated significantly more numeracy interactions than children, but the 4-year-olds initiated about one-fifth of the exchanges. The present study has implications for preschool and kindergarten programs, parent education, and home-school partnerships. Connections between the home and literacy development are often studied, but numeracy connections and home environments have been ignored. Teachers can capitalize on the opportunity to reinforce numeracy concepts being taught more formally at school by including informal, home-based play activities as well as structured number activities with parental involvement. Parents and children in this study demonstrated that numeracy-related interactions occur naturally in discourse during play, and that play is an important social context for guidance of numeracy development.

Introduction

In a free play session, a 4-year-old child and his mother are playing with a set of toys that include a cash register and a pretend credit card. Their dialogue illustrates several types of exchanges related to numeracy, or the development of knowledge about numbers:

> *Child:* (looking at the cash register) What's this for?
> *Mother:* (grabbing the credit card) I think that's where you scan this. It goes through there. It's where you put your credit card.
> *Child:* (takes the card and tries to swipe it)
> *Mother:* With the magnetic strip down. (takes the card and shows him the correct side) See, this thing is back. Usually you got to click that part through the reader.
> *Cash Register:* "Two dollars and 50 cents" (aloud)
> *Mother:* A bargain!
> *Child:* Bargain?
> *Mother:* Bargain.
> *Child:* What's a bargain?
> *Mother:* Inexpensive, doesn't cost much money. We love bargains.
> *Child:* Bargain, yeah yeah yeah!

In this brief exchange, the mother explained procedural information such as how to use a pretend credit card. She also provided value-laden information about the worth of the goods, and, finally, offered cultural information to the child about the importance of spending little money in purchasing goods, with shared enthusiasm for the concept of a bargain. In their 15-minute play session, she never helped the child count the play money in the drawer. She did not focus on the fact that the cash register adds and counts, functioning as a real calculator. The majority of her numeracy-related interactions were focused on sharing cultural information about buying and selling goods and on procedural information related to the use of the toys for buying and selling; only a few comments were related to properties of mathematics such as comparison of size or quantity.

Another mother in the study interacted in a different manner with her preschooler during their play session with the same toys. In the following exchange, the mother and child had been

looking at the play money.

> *Mother:* Remember what these are called? These are what you always have to have to put into the bubble gum machine. What are those?
> *Child:* (whispers) "Quarters."
> *Mother:* Say it! Quarters. What are these? (Holds up dimes)—dimes. (They continue looking at the money together and talking about the coins; after a few minutes, they play with the cash register, and the child is learning to push the buttons to add.)
> *Mother:* 3 (child pushes 3) plus (child pushes plus) 7 (child pushes 7) equals (child looks at button, then at mother) mmmhmm (child pushes equals).
> *Cash Register:* $10 (aloud)
> *Mother:* Because 7 and 3 equal 10.

Subsequently they went through a counting sequence on the machine but found the answer by counting on the child's fingers first. They spent the rest of the play session adding on the machine. In this dyad, the majority of numeracy interactions were related to mathematical properties such as recognition of money, recognition of number, quantity, and adding and counting. Despite differences in their focus, each mother provided her child with conceptual knowledge about numbers, within the social context of play.

Guided Participation and Parental Scaffolding

In Western middle-class families, parents often use play with young children as a context for teaching (e.g., Farver, 1993; Rogoff, 2003; Vandermaas-Peeler et al., 2002). Although parental teaching during play has been the focus of much research, little is known about the development of preschoolers' numeracy skills and concepts in the context of parent-child interactions during play.

The shared play vignettes illustrate several important aspects of a process known as guided participation (Rogoff, 1990; 2003), in which parents and children exchange culturally relevant information during informal interactions in ongoing activities in their daily routines. Parents and others with more expertise provide young children with important cues about both knowledge and behavior in social contexts. For example, one strategy, known as "building bridges," helps the child make connections between prior and new experiences (Neuman, 1997; Rogoff, 1990). The mother in the second dyad above "built bridges" when she reminded the child that quarters are the coins they usually put in bubble gum machines. Intersubjectivity, or shared engagement and goals, in the activity is an important component of guided participation, as seen in the shared enthusiasm for "bargains" in the first dyad and in the mutual goals of adding numbers together in the second dyad. Scaffolding is a process of intervention and provision of support in order to help children solve problems beyond their current capabilities, with the eventual goal of self-regulation or independent activity (Neuman, 1997; Rogoff, 1990; Wood, Bruner, & Ross, 1976). Scaffolding can be observed in both dyads. The first mother showed the child, with verbal and nonverbal support, how to use the credit card scanner. The second mother pointed to the correct numbers and the "plus" or "equals" sign, when the child was uncertain of which buttons to push. She encouraged and provided sensitive assistance, preventing frustration and maintaining interest in the activity. Both mothers provided help within their children's zone of proximal development (Vygotsky, 1978), or at a level just beyond what they could do unassisted. Sensitive scaffolding also supports the child's learning by gradually lessening the level of support and encouraging ownership of the task. The second mother and child dyad went through four counting sequences in their play. In the first two sequences, the mother asked questions and gave directives like "Where's the 4? Push it." In the last two sequences, she asked the child to calculate the answer independently (e.g., "Now before you hit equal, what is 4 plus 2?").

Review of the Literature on Early Numeracy Development

Numeracy has been defined as knowledge and mastery of mathematics, and as the use of mathematics to meet various challenges in the individual's environment (Botha, Maree, & de Witt, 2005). In early childhood, emergent numeracy encompasses concept acquisition and development, particularly with a focus on number, measurement, space, and shape (Botha et al., 2005). Many researchers have commented on the dearth of research on numeracy development relative to the interest in literacy (e.g., Aubrey & Godfrey, 2003; Botha et al., 2005). Literacy has been studied extensively in the context of children's play (see Roskos & Christie, 2001), but very few studies of numeracy development through play activities exist.

In one of the only known studies examining children's talk about mathematical concepts during play episodes, Macmillan (1998) focused on preschool children's abilities to interpret and integrate cultural roles within the social context of play and on children's use of mathematical concepts in their talk during social, constructive play with peers. In her analysis of the transcripts, she found that children showed an understanding of mathematical meanings related to procedural and conceptual knowledge of counting and measuring (e.g., *full to the top* and *almost all bottles are full*). The children demonstrated an understanding of time and physical space in their play with trucks in the sandpit, and of cause and effect, and size, in an episode of constructive play in building sand castles. Macmillan's qualitative findings provide support for the importance of linguistic communication during peer play for children to practice and develop concepts related to numeracy in the context of everyday activities in the preschool environment.

Studies of parental scaffolding of numeracy activities in early childhood are relatively scarce (Benigno & Ellis, 2004). One of the first and most comprehensive studies of parent-child interactions related to the development of number was conducted by Saxe, Guberman, and Gearhart (1987). Saxe et al. examined the social context of numeracy development by considering ways in which children's numerical goals developed through everyday number-related activities and how these processes were influenced by social interactions with adults. Seventy-eight middle-class and working-class mothers and their 2- and 4-year-olds participated in interviews related to maternal aspirations for their children. Observations were also made of the dyads' interactions during number activities and games. Saxe et al. found that mothers provided sensitive assistance to their children, adjusting support according to the child's successes or failures on the tasks. Social class did have an influence on the findings, in that working-class children's number achievements were lower in the independent tasks, working-class mothers reported lower expectations than middle-class mothers, and working-class mothers and their children engaged in less-complex number activities at home. Age of the child also affected the interactions, in that younger children were less competent, and they had engaged in less-complex number activities at home. Saxe et al. concluded that children's everyday number experiences were socially organized, and emergent, or negotiated through dyadic interactions.

Recent research by Bjorklund, Hubertz, and Reubens (2004) on mathematics learning in the context of games and children's use of mathematics strategies supported the findings of Saxe et al. (1987)—that parents provide sensitive and contingent instruction of numeracy development. Bjorklund et al. (2004) conducted a microgenetic study of 5-year-olds playing a board game with a parent over a 3-week span. Children's and parents' behaviors during the game were compared to a math context in which children solved arithmetic problems. Bjorklund et al. found that parents engaged their children more in the math context than in the board game, with most of the cognitive directives they provided being related to counting in that context.

In another study that examined the nature of parent-child interactions during activities at home, Anderson (1997) conducted four 15-minute play sessions with parents and 4-year-olds interacting with different sets of materials, including a book, blocks, paper, and a mathematics workbook for preschoolers. She found that most of the mathematics events were parent

initiated, with parents supporting math by asking questions and making comments during the activities. There were a variety of parent-child interaction styles, with some parents focusing on math for nearly the entire time and others interjecting it into the context of other activities periodically. Anderson concluded that parents were important mediators of children's early mathematics learning, and that more research on parent-child interactions in everyday activities is needed to understand the importance of the home context for children's numeracy.

Purpose of this Study

The present study investigated the frequency and type of numeracy interactions that occurred spontaneously during parent-child play in order to gain an understanding of numeracy development in ongoing naturalistic interactions between parents and their preschoolers. In this study, play materials relevant for both literacy and numeracy development were provided, but no explicit instructions were given about either. The following questions were addressed: (1) If not directed to engage in numeracy play, how often will parents and their 4-year-olds spontaneously engage in numeracy-related interactions? (2) How often do children initiate those exchanges? (3) To what extent will the numeracy interactions involve the three following components: cultural exchanges about buying, selling, and the value of goods; procedural information about how to use toys related to numeracy development; and mathematical concepts? Given the lack of data on naturalistic interactions related to numeracy in parent-child play, the study was descriptive in nature, and no specific predictions were made.

Method

Participants

Twenty-six 4-year-old children and their mothers participated in the study. Families were recruited through local preschools and the community. There were 14 boys and 12 girls, with a mean age of 51.85 months (*SD* = 6.84). The mothers' mean age was 35.28 years (*SD* = 4.16). Mothers were highly educated, with 80% having college or graduate degrees. The majority worked part time or as homemakers (12% full time out of the home, 46% part time, 42% full-time homemakers). One dyad was African American and the rest were Caucasian. The families lived in a small city in the southeast.

Materials

The play materials employed in the study were related to the theme of a post office and included the following: a standard black mailbox; a mail carrier bag; a postal shirt; a large stuffed bear; a cash register that functioned as a calculator, with a scanner; play money; a plastic credit card; note cards and paper; envelopes of many sizes; stickers; stamps; and markers.

Procedure

As part of a larger study examining literacy and play, the mothers were contacted by a researcher to schedule a home-based interview lasting approximately one hour. Parent-child dyads were videotaped at home as they read a story and then completed the 15-minute play activity. During the play activity, parents were told, "we would like for you to play with (child's name) with these toys related to the post office however it is most comfortable and natural for you." If siblings were present, a second interviewer played with them in another room. After the play activity was completed, the parent was asked to complete several surveys related to demographics and the home environment.

Coding

Numeracy. Transcripts of the videotaped interactions were used to code all the numeracy exchanges that occurred during the play activity. The coding scheme was developed by the authors for this study, based on mathematical concepts (e.g., Jennings, Jennings, Richey, & Dixon-Krauss, 1992) and on the theoretical framework related to guided participation (Rogoff, 1990, 2003). Inter-rater reliability on the coding scheme was established at 80% agreement across all categories. Nine types of numeracy interactions were coded, as explained in detail below, including two codes related to cultural themes relevant to the play materials (exchange and value), one code that was procedural (tools), and six codes related to numbers and mathematical properties (number recognition, money recognition, quantity, comparison, counting, and adding/subtracting). Each numeracy interaction was counted, and the total number of numeracy-related events was obtained by adding all the codes. Each interaction was also coded as parent initiated or child initiated, depending on who began the interaction. For example, if a child asked a question that prompted the parent explanation, the code would be assigned as child initiated. Given that all dyads engaged in 15 minutes of play, frequencies were employed as the basis of measurement.

The codes are defined as follows. "Cultural exchange" referred to concepts related to the buying and selling of goods for money. Cultural exchange was coded when parents explained the use of the credit card to buy goods (e.g., "You can give me that card instead of money to buy these envelopes"), explained the concept of the worth of the goods ("This costs one dollar, so you give me one dollar"), or the exchange of goods for money (e.g., "Okay, I paid you one dollar, now give me my stamps"). Cultural exchange was also coded when a parent explained the roles of buyer and seller. For example, "I need to buy some stamps. Can you ring me up? How much do I owe you?"

"Value" was the second cultural code, used to characterize value-laden judgments about the exchanges of money and how much things cost. This would include comments about how expensive or cheap something was (e.g., "I don't have that much. Can't it be $10 on sale?"), or judgments about the merit of using credit cards to buy goods.

A procedural code was included because it was a popular springboard to numeracy play with the cash register. "Tools" categorized interactions related to the use of the cash register, the scanner, and the credit card. Typically this included talk about how to swipe the card, use the scanner, or push buttons on the register to get the numbers.

The remaining codes referred to properties of mathematics and numbers more generally, including number recognition (e.g., "What's that? A one?"); money recognition (e.g., "That is a penny"); quantity (e.g., "How many letters do you have?"); comparison (using terms that imply comparisons such as big and little, heavy and light, etc.), counting, and adding/subtracting.

Engagement. The parent-child play session was also coded for engagement during the play activity. Engagement was defined as active participation and interest in the ongoing activity, through direct action (e.g., verbal interest expressed) or indirectly (e.g., attentive listening). Each member of the dyad was rated separately, and the dyad was also rated jointly for engagement in the play. Level of engagement was measured on a scale of 1 (low engagement; i.e., lack of verbal or nonverbal contact between the child and mother or between an individual and the ongoing activity) to 3 (high engagement; i.e., high verbal and/or nonverbal participation and interest in each other and the activity).

Results

The means and standard deviations of the numeracy interactions are presented in Table 1. The total number of events, by each category and each code, is presented, as well as the total

parent-initiated and child-initiated events. The average number of numeracy interactions was 21.12 (*SD* = 8.77), but this varied widely across dyads, with a range from 6 to 41 interactions per 15 minutes of play.

Table 1
Means and Standard Deviations for the Total Number, Number of Child-Initiated, and Number of Parent-Initiated Numeracy Interactions, by Type of Interaction

Code	Mean	Standard Deviation
Total Numeracy Interactions	21.12	8.77
Child-Initiated	4.42	3.71
Parent-Initiated	16.69	8.72
Cultural/Social Codes	6.46	3.57
Cultural Exchange	5.50	3.14
Child-Initiated	0.46	0.76
Parent-Initiated	5.04	3.04
Value	<1	
Procedural Code	3.50	3.49
Tools	3.50	3.49
Child-Initiated	0.62	0.85
Parent-Initiated	2.73	3.22
Mathematical Codes	11.19	6.99
Comparison	4.23	2.50
Child-Initiated	1.35	1.65
Parent-Initiated	2.88	1.88
Quantity	3.38	2.95
Child-Initiated	1.19	1.50
Parent-Initiated	2.19	2.04
Money Recognition	1.77	2.92
Child-Initiated	0.42	0.90
Parent-Initiated	1.35	2.68
Number Recognition	1.12	1.70
Child-Initiated	0.27	0.45
Parent-Initiated	0.85	1.49
Counting	<1	
Adding/Subtracting	<1	

Gender

Possible differences related to child gender on the frequency and type of numeracy interactions

were tested in a series of one-way analyses of variance (ANOVA). There were no significant differences in child gender on any of the numeracy-related dependent variables. Thus, the gender of the child did not appear to influence parent-child interactions related to early numeracy in this study.

Types of Numeracy Interactions

In order to examine the nature of the numeracy interactions by the three types of codes—cultural, procedural, and mathematical—a repeated measures ANOVA was conducted. There was a significant difference in the frequency of each type of numeracy, F (2, 25) = 16.37, $p < .0001$. Post-hoc tests indicated that mathematical codes were the most frequent (M = 11.19, SD = 6.99), accounting for nearly half of all numeracy interactions. Cultural exchanges were the next most frequent (M = 6.46, SD = 3.57) with 34% of interactions. Finally, procedural exchanges accounted for 16% of interactions related to numeracy (M = 3.5, SD = 3.49).

The nine individual codes were examined separately as well to investigate differences across the categories. The results of a one-way repeated measures ANOVA yielded a significant difference in the nine types of numeracy interactions, and post-hoc comparisons of the means indicated that cultural exchanges were by far the most frequent code, F (8, 25) = 16.29, $p < .0001$, with nearly six instances per 15 minutes of play. The next most frequent types of numeracy interactions were related to tools, quantity, and comparison, with 3 to 4 interactions of each type on average per 15 minutes of play. These were all significantly more frequent than interactions related to value codes, recognition of number, and money—all with means at or slightly over 1 interaction per play session. The least common types of numeracy interactions, with means of less than one each, were counting and adding. These results suggest that parent-child interactions related to numeracy in free play focused on supporting a cultural, conceptual, and procedural understanding, rather than direct teaching of number skills such as adding and counting.

Parents initiated nearly 17 numeracy events, or about 1 per minute (M = 16.69, SD = 8.72) compared to children's mean initiation of 4.4 events (SD = 3.71). However, it is noteworthy that children as young as 4 years of age initiated nearly one-fifth of the interactions. The analyses of parent-initiated events indicated that, as described above for the total number of numeracy interactions, the cultural exchanges were by far the most frequently observed, F (8, 25) = 14.85, $p < .0001$. As indicated by the pattern of means (see Table 1) and post-hoc comparisons, the next most frequent parent-initiated numeracy interactions were comparison, tools, quantity, and recognition of money, with no significant differences between these means. Value and recognition of number were significantly less frequent, with means less than 1, and adding and subtracting and counting were all less than .5 per 15 minutes of play.

The child-initiated events, however, focused most often on comparisons and quantity of the play materials, F(5, 25) = 3.61, $p < .02$, with means at or slightly above 1 interaction per session for each type (see Table 1). All other means were well below 1 per 15 minutes of play. Children often spontaneously declared "how many" of something they had or wanted (quantity), for example, or noted when a letter was too big to fit into the small envelope (comparison). The following example shows a child's focus on quantity, even though the mother does not initiate a discussion of number or any mathematical properties because she is focused on literacy activities.

> *Child:* We got *one more*. (quantity)
> *Mother:* Did you want to send anything to...
> *Child:* Hey there's a blue paper one! *One more!* Blue paper. (reaches in the mailbag) (quantity)
> *Mother:* Did you want to make a letter to Goldilocks?
> *Child:* No. There's something in there. Paper. (reaching in the bag)

Mother: No writing on that one?
Child: This is for my letter. *Two!* (has found two sheets of paper) (quantity)
Mother: Uh huh.
Child: I want to write *two, two letters.* I can write *two letters!* (quantity)

Low- and High-Frequency Numeracy Interactions

In order to compare parent-child dyads with a low frequency of numeracy interactions to dyads engaging in a high frequency of numeracy interactions, a median split was used to divide the sample into "low-" or "high"-frequency groups. The median number of numeracy interactions was 19.5, so 13 families had 19 or fewer interactions and 13 families had 20 or more interactions (range = 6 to 41). The first analysis was a *t*-test to check for differences in the groups on child initiations of numeracy, and there were no significant differences. Parents in the high-frequency group obviously initiated more numeracy interactions (M = 22.54, SD = 8.04) than parents in the low-frequency group (M = 10.85, SD = 4.45).

A series of *t*-tests were conducted to compare the low- and high-frequency dyads on the types of numeracy interactions. Adding, subtracting, and counting were not included given that the means were less than 1. Interestingly, although it was the most frequent type of interaction, there were no significant differences in low- and high-frequency dyads on the number of cultural exchanges (M low = 5.0 and M high = 6.0), t (24) = -.81, p> .10. The procedural interactions varied significantly, with M = 5.31 in the high group compared to 1.69 in the low group. All of the number-related concepts were significantly more frequent in the high-frequency group as well.

Engagement

Finally, the ratings of the engagement of the parent in the play activity, the child in the play activity, and the dyadic engagement with each other were examined. The parents' mean rated engagement was 2.73 (SD = .60), the children's average rating was a 2.5 (SD =.71), and the dyadic engagement rating averaged 2.31 (SD = .84). Given that engagement was rated on a 3-point scale, there was relatively high engagement in the activity and with each other, with no significant differences in parents' or children's engagement in the play activity overall. Although the effects were only marginally significant, boys were rated as more engaged in play than girls, t (24) = -1.74, p < .10, M for boys = 2.71 and for girls = 2.25. Mothers and boys were rated higher on engagement with each other than mothers and daughters, t (24) = -1.81, p < .08, M for mothers and sons = 2.57 and for daughters = 2.0. Engagement was not correlated with any of the numeracy interaction codes.

Discussion

The results of this investigation suggest that parent-child interactions related to numeracy in free play focused on supporting a cultural, conceptual, and procedural understanding of numeracy, rather than direct teaching of number skills such as adding and counting. Approximately half of the numeracy interactions related to a conceptual understanding of mathematical properties, such as quantity and comparison of size, and one-third were related to cultural information about buying and selling and the market value of goods. Parents of 4-year-olds were much more likely to engage in a conversation about the value of money, or rules about spending it, than they were to spend time counting the money, for example. We found that parents initiated most of the numeracy interactions, supporting prior research by Anderson (1997). However, children in this study initiated approximately one-fifth of the numeracy exchanges and discussed number-related concepts such as quantity and comparison of the play materials with their parents during play in ways similar to Macmillan's (1998) reports of

discourse during peer play in a preschool classroom.

Analyses of the nine numeracy codes revealed that the single most frequent type of numeracy interaction was a cultural exchange, in which the parent provided information about buying and selling. This finding supports prior research on guided participation and demonstrates that play can be an important social context for teaching children general information about the world. Most parents in the study initiated relatively high rates of cultural exchanges during play, regardless of whether they had a low or high frequency of initiating mathematical concepts.

To our surprise, parents in this study seldom engaged their children in counting or adding activities. This result may be caused by the free play context of the present study rather than a structured activity clearly designed to investigate numeracy as in most prior research (e.g., Anderson, 1997; Bjorklund et al., 2004; Saxe et al., 1987). Unlike parents in this study, parents in prior research were aware that the research focused on mathematical events. Perhaps parents automatically turn to counting when asked to engage their child in mathematical learning, because this is a rudimentary skill within preschoolers' zone of proximal development, or because of the influence of the school context on rote learning of number facts (Warren & Young, 2002). Further studies are needed to compare explicit and implicit teaching of numeracy-related skills in early childhood.

The generalizability of the study findings is limited to a highly educated, middle-class sample in the United States, and to the social context of a free play activity in which parents highly value teaching within play (Vandermaas-Peeler, 2002). We expect that both the nature of the activity, and the types of toys provided, influenced the findings. One of the primary purposes of the study was to investigate numeracy in a free play setting. However, the mothers had just completed a storybook reading activity with their children, and some of the play materials focused on literacy. Some mother-child dyads had a clear preference for literacy-related activities, and we noticed that dyads with a very low frequency of numeracy interactions typically engaged in more literacy-related play, such as writing a letter or coloring a picture. Blevins-Knabe, Austin, Musun, Eddy, and Jones (2000) examined the frequency and type of mathematical activities provided by parents and family day care providers. Their findings indicated that mathematical activities were ranked as less important than social skills, reading, and language, and they occurred relatively infrequently. However, Blevins-Knabe et al. found that parents and providers who provided the most literacy activities also provided the most math activities.The social context of any activity is important to consider, and this one may have been constrained by the types of materials and a parental focus on literacy. Nonetheless, the study contributes important information about numeracy exchanges during parental play with a preschooler. Further research with diverse economic and cultural groups is needed.

In this study, we applied a methodology that is often employed in studies examining parental guidance of children's activities such as literacy and play but that is seldom utilized in studies of numeracy development. The use of similar methods in future research has promise for a wide range of topics and settings related to children's participation in numeracy-related activities, both in home and school contexts.

It would be interesting, for example, to consider the effects of the child's age on parent-child talk related to numeracy. Saxe et al. (1987) found that age was significantly associated with the findings related to complexity of interactions, although the older children in that study were 4½ years old. Parental guidance of numeracy interactions is related not only to age but also to the child's comprehension and number-related abilities, and future research on parent-child interactions could include an independent measure of the child's understanding of mathematical and number-related properties. Very few parents focused on counting, for example, perhaps because the children already knew how to count and had a conceptual understanding of sequencing by age 4 (Griffin, 2004; Macmillan, 1998). The mother in the second example depicted in the introduction taught her son to count using the machine and supported his learning in this context with an already familiar skill—using his fingers to count. Theories of

scaffolding and prior research suggest that parental intervention and discourse are related to the child's zone of proximal development. More research is needed on guided participation of early numeracy development in naturally occurring interactions, and with children of different ages and abilities.

In summary, the present study has implications for preschool and kindergarten programs, parent education, and especially for home-school partnerships. As noted by Warren and Young (2002), the connections between home environments and literacy development have been emphasized by educators, but the home and numeracy connections are seldom discussed or reinforced. Early childhood teachers can capitalize on the opportunity to reinforce numeracy concepts being taught more formally at school by including informal, home-based play activities as well as structured number activities with parental involvement. Many such activities exist for literacy (e.g., reading together, dramatizing stories through play, finding words in various print media or around town, rhyming and singing games, etc.). Similar activities could be suggested for numeracy, using parent-child language and play in creative ways. For example, teachers could suggest that parents engage in counting and number-related talk during play (e.g., using a cash register or a calculator and play money to "go shopping") as well as in everyday home-based activities (e.g., preparing food or doing laundry). Parents and children in this study demonstrated that numeracy-related interactions occurred naturally in discourse during play and that play is an important social context for guidance of numeracy development.

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