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Children's Early Mathematical Skills: The Role of Formal and Informal Home Numeracy Practices

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BACKGROUND

There has been extensive research that highlights the benefits of home literacy activities for children's language outcomes; however, a gap in research remains regarding the ways in which home numeracy practices may support children's math achievement (LeFevre et al., 2009). Home numeracy practices are activities involving math concepts that parents do with their children. Researchers have identified two categories of activities, formal and informal, that parents engage in that are important for children's math knowledge acquisition. Formal activities involve directly teaching children math skills (e.g., counting objects), whereas informal activities include playing games and performing everyday tasks that involve the application of math principles (e.g., cooking; Zhang et al., 2020). Given the distinction between these two types of numeracy activities there is a need to understand how each uniquely contribute to children's mathematical skills at kindergarten entry.

MEASURES

Home Numeracy Experiences (LeFevre et al., 2009)

- Primary caregivers were asked to report on the frequency of home-based math activities.
- Frequency was rated 0 (did not occur), 1 (a few times a month), 2 (once a week), 3 (a few times a week), or 4 (almost daily).
- The math activities were divided into four categories: *number skills*, *math books*, *math games*, and *application activities*. These activities were categorized as either formal or informal. Number skills and math books were classified as formal while math games and application activities were considered informal practices.

Number Skills	Counting objects, sorting objects, counting down, identifying written numbers
Math Books	Using count the dot activities, using number activity books, reading number storybooks
Games	Playing card games, making collections, playing board games (with dice or spinners), being timed
Application Activities	Wearing a watch, measuring ingredients, using calendars or dates, talking about money, playing with calculators

Math Problem-Solving Task (MPS; Siegler & Jenkins, 1989)

- Children were verbally given a series of 10 single-digit addition problems. They were asked to provide the solution and then explain how they solved it. Their answers were coded for strategy type (e.g., counting on, decomposition).
- Responses were coded for *accuracy* (i.e., problems solved correctly) and *strategy effectiveness* (i.e., the percentage of the 10 problems on which children employed a strategy and it resulted in the correct answer).

Woodcock Johnson (WJ; Woodcock et al., 2001)

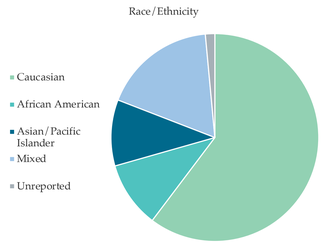
- **WJ Calculation:** Children solved increasingly difficult math problems, starting with writing single digit numbers and progressing to addition and subtraction problems. The task concluded once a child received six incorrect answers. Scores reflect the total number of correct answers.
- **WJ Fluency:** Children were given 3 minutes to solve as many addition and subtraction problems as possible. Scores reflect the total number of correct answers.

METHODS

- Data for this study were drawn from a longitudinal investigation of children's memory and cognitive skills during early elementary school.
- The home-level self-report measure (Home Numeracy Experiences) was completed by parents during the kindergarten year.
- All child-level mathematical measures were carried out during individual assessments with children at kindergarten entry.

PARTICIPANTS

- 68 children total
- 32 girls, 36 boys
- Average age at assessment: 5 years 9 months (Range: 4y11m - 6y5m)
- 12% qualified for free or reduced lunch
- 21% speak another language at home
- 87% of primary caregivers held a bachelor's degree or higher



DESCRIPTIVE STATISTICS

	Mean	Min	Max	Standard Deviation
Home Numeracy Experiences				
Number Skills	2.31	0.00	4.00	1.12
Math Books	1.23	0.00	3.33	0.87
Games	1.82	0.25	4.00	0.95
Application Activities	1.48	0.00	3.40	0.85
Children's Math Outcomes				
MPS Accuracy	4.16	0.00	10.00	3.04
MPS Strategy Effectiveness	0.54	0.00	1.00	0.37
WJ Calculation	7.09	0.00	17.00	5.09
WJ Fluency	5.19	0.00	24.00	5.10

- Number skills was the most frequently reported type of home numeracy activity (mean frequency = 2.31), occurring more than once a week on average. Math games (1.82) occurred approximately once a week. Application activities (1.48) occurred multiple times a month. The least frequently reported type of activity was math books (1.23), which only occurred a few times a month.
- On average, children solved 4.16 addition problems correctly and were able to use a strategy to achieve the correct answer on 54% of problems during MPS.
- The mean number of correct answers was 7.09 for WJ math calculation and 5.19 for WJ math fluency at kindergarten entry.

RESULTS

Correlations Between Home Numeracy Experiences and Math Outcomes

	1	2	3	4	5	6	7	8
1. Number Skills	—							
2. Math Books	.59**	—						
3. Games	.43**	.42**	—					
4. Application Activities	.51**	.47**	.64**	—				
5. MPS Accuracy	-.07	-.03	.29*	.17	—			
6. MPS Strategy Effectiveness	.09	- .01	.28*	.22	.68**	—		
7. WJ Calculation	-.07	.01	.32**	.22	.82**	.51**	—	
8. WJ Fluency	-.05	.12	.34**	.23	.73**	.39**	.76**	—

Note: $^{*}p < .05$, $^{**}p < .01$

- As can be seen in the correlation table above, all four categories of home numeracy experiences were significantly correlated with one another (*p*s < .05). The two highest correlations were between the two formal activities (number skills and math books; $r = .59$, $p < .01$) and the two informal activities (math games and application activities; $r = .64$, $p < .01$).
- Parents' use of math games was significantly and positively correlated with children's performance on all math measures at kindergarten entry (*p*s <. 05). Interestingly, children's performance on the WJ calculation ($r = .32$) and fluency($r = .34$) measures most strongly correlated with playing math games.
- No other types of home numeracy experiences were significantly correlated with children's kindergarten entry math scores.

DISCUSSION

- Parents in this study engaged their children in a variety of different home numeracy experiences. They used a combination of both formal and informal activities. One type of formal math activity — number skills — was the most common numeracy experience used by parents.
- Notably, not all categories of home numeracy activities were significantly correlated with children's math performance at the beginning of kindergarten. Only the frequency of math games was correlated with children's math skills (problem-solving accuracy, strategy effectiveness, calculation, and fluency).
- These findings indicate that the use of informal, rather than formal, numeracy practices may better support children's early math skills as they transition into kindergarten. Specifically, playing math games may be a meaningful way that parents can help children develop mathematical school readiness skills.
- Future work should be directed at exploring these findings further. For example, there is a need to investigate whether using informal practices predicts children's math performance across the kindergarten school year.

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