Parents' interactive behaviors during joint play with children: What matters for children's early mathematics ability?

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Introduction

- As posited by social constructivism, children construct knowledge through interacting with more competent societal members, and the scaffolding provided by these societal members can greatly facilitate children's knowledge construction process (Wood et al., 1976).
- Some scaffolding behaviors involve cognitive support (e.g., engaging children in tasks within their zone of proximal development), whereas some other scaffolding behaviors involve emotional support (e.g., providing encouragement) (Mermelshtine, 2017).
- Existing studies show that parents vary greatly in their interactive behaviors during joint numeracy activities with children (Cheung & McBride, 2017; Ramani et al., 2015).
- To date, relatively little is known about parents' interactive behaviors during joint mathematical play and their relationships with young children's mathematics ability. This study therefore aimed at:
  - exploring the frequency of different interactive behaviors displayed by parents during joint mathematical play with children;
  - investigating the roles of different parents' interactive behaviors during joint play in children's early mathematics ability.

Methods

- Participants were recruited from 7 kindergartens in Hong Kong.
- The final sample consisted of 94 parent-child dyads.
  - Parents: 12 fathers and 82 mothers
  - Children: 53 boys and 41 girls; all were first-year kindergarteners; mean age = 4.07 years, SD = .37 years
- The Raven's Colored Progressive Matrices was used to measure children's non-verbal reasoning (C-NR) (as control variable).
- The Test of Early Mathematics Ability – Third Edition (TEMA-3) (Ginsburg & Baroody, 2018) was used to measure children's early mathematics ability.
  - Contained 72 items
  - Tapped on informal as well as formal mathematical concepts/skills
  - Showed good split-half reliability (Spearman-Brown $r = .95$)
- Parents were provided with some number cards and tokens and were asked to play a shopping game with children for 10 minutes. The whole process was video-recorded and transcribed.
- Based on the work of Hennessy et al. (2016), a coding scheme was developed, and the frequency of four behaviours were counted:
  - Explaining mathematical reasoning (P-Explain)
  - Adjusting interactions according to children's mathematics level (P-Adjust)
  - Providing encouragement for doing mathematics (P-Encourage)
  - Criticizing children's mathematics ability (P-Criticize)

Approach for Statistical Analysis & Results

- The percentage of parents displaying different types of interactive behaviors, the means and standard deviations of the frequency of different interactive behaviors are displayed in the following table.

Interactive behavior	% of parents displaying the behavior	*M*	*SD*
P-Explain	8.5%	.16	.61
P-Adjust	7.4%	.21	.93
P-Encourage	58.5%	1.60	2.06
P-Criticize	84.0%	3.84	4.48

- As seen from the above table, when parents played with children, only a small number of them explained mathematical reasoning and adjusted their interactions according to children's mathematics level. Therefore, in subsequent analyses, we examined the relationships of parents' tendency to display such behaviors (i.e., displayed versus did not display) (instead of the frequencies of displaying such behaviors) to children's early mathematics ability.
- To examine the relative contributions of different parents' interactive behaviors during joint play to children's early mathematics ability, a linear hierarchical regression was conducted, and the results are displayed in the following table.

Step	Predictor variable	*B*	*SE B*	*β*	R^2	ΔR^2
1	C-NR	.72	.23	.31**	.10	.10**
2	C-NR	.54	.21	.24*	.29	.20***
	P-Explain	2.91	2.25	.12		
	P-Adjust	6.93	2.35	.27**		
	P-Encourage	.25	.31	.08		
	P-Criticize	-.49	.14	-.32**		

Note. * $p < .05$, ** $p < .01$, *** $p < .000$.

- As seen from the above table, after controlling for children's non-verbal reasoning, children's early mathematics ability:
  - was positively associated with parents' tendency to adjust their interactions according to children's mathematics level;
  - was negatively associated with parents' frequency of criticizing children's mathematics ability; and
  - had no significant relationship with parents' tendency to explain mathematical reasoning and frequency of providing encouragement for doing mathematics.

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Conclusion

- Our findings provide empirical support for the notion of social constructivism that parental scaffolding plays a critical role in children's learning process. However, not all scaffolding behaviors shared the same strength of relationship with children's early mathematics ability.
- Criticism on children's mathematics abilities may lower children's interest and confidence in doing mathematics and thus lead to poorer mathematics ability.
- In view of the low frequency of parental scaffolding behaviors observed in this study, it is worthwhile to coach parents on how to interact with children during home mathematics activities.
- When interpreting the results of this study, several limitations should be noted. First, the sample size of this study was rather small. Moreover, this study was correlational in nature. Lastly, only four types of parents' interactive behaviors were included in the statistical analyses.
- Future researchers can examine whether parents' interactive behaviors vary across different types of home numeracy activities. This can help us know in what scenarios parents require more support for scaffolding children's mathematics learning. Longitudinal studies can also be conducted to explore how different types of parents' interactive behaviors during joint play are related to children's mathematics abilities over time.

References

- Cheung, S. K., & McBride, C. (2017). Effectiveness of parent-child number board game playing in promoting Chinese kindergarteners' numeracy skills and mathematics interest. *Early Education and Development*, *28*, 572-589. doi: 10.1080/10409289.2016.1258932
- Ginsburg, H. P., & Baroody, A. J. (2003). *Test of Early Mathematics Ability – Third Edition*. Austin, TX: Pro-Ed.
- Hennessy, S., Rojas-Drummond, S., Highama, R., Márquez, A. M., Maine, F., Ríos, R. M., García-Carrión, R., Torreblanca, O., Barreraa, M. J. (2016). Developing a coding scheme for analysing classroom dialogue across educational contexts. *Learning, Culture and Social Interaction*, *9*, 16-44. doi: 10.1016/j.lcsi.2015.12.001
- Mermelshtine, R. (2017). Parent-child learning interactions: A review of the literature on scaffolding. *British Journal of Educational Psychology*, *87*, 241-254. doi: 10.1111/bjep.12147
- Ramani, G. B., Rowe, M. L., Eason, S. H., & Leech, K. A. (2015). Math talk during informal learning activities in Head Start families. *Cognitive Development*, *35*, 15-33. doi: 10.1016/j.cogdev.2014.11.002
- Raven, J. C., Court, J. H., & Raven, J. (1995). *Raven's Colored Progressive Matrices*. Oxford, UK: Oxford Psychologists Press.
- Wood, D., Bruner, J., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Child Psychiatry*, 17, 89-100.

Further Information

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