Relationships between home numeracy activities, parental numeracy guidance, and young children's numeracy interest and competence

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Introduction

- At home, parents may adopt various guidance strategies to help children learn math. As proposed by Firestone et al. (2004) and Ricco et al. (2003), for instance, parents may draw children's attention to the various steps involved in solving different math problems. They may also help children become familiar with a certain type of math problems through problem re-representation and practice. However, few existing studies have examined the relative contributions of the frequencies of home numeracy activities and different types of parental numeracy guidance to children's numeracy development.
- Cheung et al. (2018) found that the more frequent children participated in home numeracy activities, the more they liked numeracy activities. Fisher et al. (2012), on the other hand, showed that children's early math interest was a predictor of their math skills in later school years. To date, the role of children's numeracy interest in the relationship between the home numeracy environment and children's numeracy competence remains unexplored.
- This study thus sought to answer two research questions:
  - Are the frequencies of home numeracy activities, parental guidance regarding problem-solving steps and problem familiarization related to children's numeracy competence?
  - Does children's numeracy interest mediate the relationships of the frequencies of home numeracy activities and parental numeracy guidance to children's numeracy competence?

Methods

- Participants:
  - Recruited from 10 kindergartens in Hong Kong
  - 327 Hong Kong second- and third-year kindergarten children *(50.2% girls; 53.8% second-year kindergarten children; mean age = 4.95 years, SD = .65 years)* and their parents *(81.7% mothers)*
- Procedures and measures:
  - Parents completed a questionnaire which assessed the following variables.

Variables	Descriptions	Examples
Frequency of home numeracy activities (HNA)@	7 items (α = .81)	Reading children's books related to numbers *(1 = never; 6 = several times a day)*
Parental guidance - Problem-solving steps (P-PS)^	3 items (α = .73)	Provide detailed steps to keep my child focused *(1 = never; 5 = always/almost always)*
Parental guidance - Problem familiarization (P-PF)^	3 items (α = .78)	Restate the problem in terms of a situation that is familiar to my child from his/her daily life *(1 = never; 5 = always/almost always)*
Children's numeracy interest (C-NI)@	6 items (α = .87)	Participating in numeracy games *(1 = strongly dislike; 6 = strongly like)*

Note: @ Cheung et al., 2008; ^ Firestone et al. (2004) and Ricco et al. (2003)

Methods (cont'd)

- Procedures and measures:
  - To assess children's numeracy competence (C-NC), 11 tasks were administered.
    - The tasks were adapted from related past studies (e.g., Cheung et al., 2018).
    - The tasks included rote forward counting *(3 items)*, backward counting *(3 items)*, skip counting *(3 items)*, counting fluency *(1 item)*, identification of the missing number in sequences *(21 items)*, numeral identification *(15 items)*, numeral writing *(15 items)*, numerical magnitude comparison *(16 items)*, addition number facts *(9 items)*, addition fluency *(26 items)*, and addition story problem-solving *(9 items)*.
    - The tasks demonstrated good reliabilities (Spearman-Brown *r*s = .80 - .98).

Approach for statistical analysis

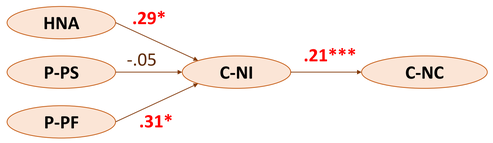
- To examine how often, on average, parents engaged children in home numeracy activities and provided different types of numeracy guidance, and obtain an initial picture of their relationships with children's outcomes, the **means**, **standard deviations** and **zero-order correlations** among variables under investigation were first computed.
- Next, **structural equation modelling** was used to explore the relationships between the frequencies of home numeracy activities, parental numeracy guidance, and young children's numeracy interest and competence.

Results

- The following table shows the means, standard deviations and zero-order correlations among variables under investigation.

	M	SD	1	2	3	4	5
1. HNA	2.93	0.68	-	-	-	-	-
2. P-PS	2.94	0.71	.40***	-	-	-	-
3. P-PF	3.27	0.74	.45***	.53***	-	-	-
4. C-NI	4.59	0.73	.33***	.28***	.39***	-	-
5. C-NC	103.20	58.40	-.06	.07	.08	.11	-

- The following figure shows our final structural equation model, whereas the following table shows the results of indirect effects tests.



Model fit indices:
$\chi^2(316) = 618.162$, *RMSEA = .059, CFI = .921, TLI = .913, SRMR = .061*

*Note: * p < .05, *** p < .001. Children's gender and grade (not shown) are covariates. Standardized estimates are shown in this model.*

Indirect Effect	Estimate	95% bias-corrected bootstrap confidence interval	Std. Est.
HNA → C-NI → C-NC	**0.34**	(0.08, 0.82)	.06
P-PS → C-NI → C-NC	-0.14	(-1.61, 0.59)	-.01
P-PF → C-NI → C-NC	**0.80**	(0.13, 1.84)	.80

Conclusions

- Different from the results of some prior studies (e.g., Napoli, & Purpura, 2018), we could not find any direct relationship between the frequency of home numeracy activities and children's numeracy competence.
- The frequencies of home numeracy activities and parental guidance regarding problem familiarization were indirectly associated with children's numeracy competence via interest. Nonetheless, parental guidance regarding problem-solving steps was not related to children's numeracy interest nor competence. These findings may imply that:
  - both the frequency of home numeracy activities and the way parents interact with children matter for children's numeracy outcomes;
  - some parental numeracy guidance strategies have stronger links with children's numeracy outcomes than others do;
  - it is important to include parental scaffolding types and children's affective attitudes in home numeracy model.
- This study had at least two limitations. First, all data were collected at the same time point; thus, no causal relationships between the variables can be drawn. Second, we only relied on parents' self-report to assess their frequencies of using various numeracy guidance strategies.
- In the future, direct observations of parent-child interactions during home numeracy activities can be conducted to identify a wider range of parental numeracy guidance strategies. Researchers can also collect data from both parents of each child, so as to examine whether mothers and fathers adopt similar numeracy guidance strategies and exert similar influences on children's numeracy interest and competence.

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