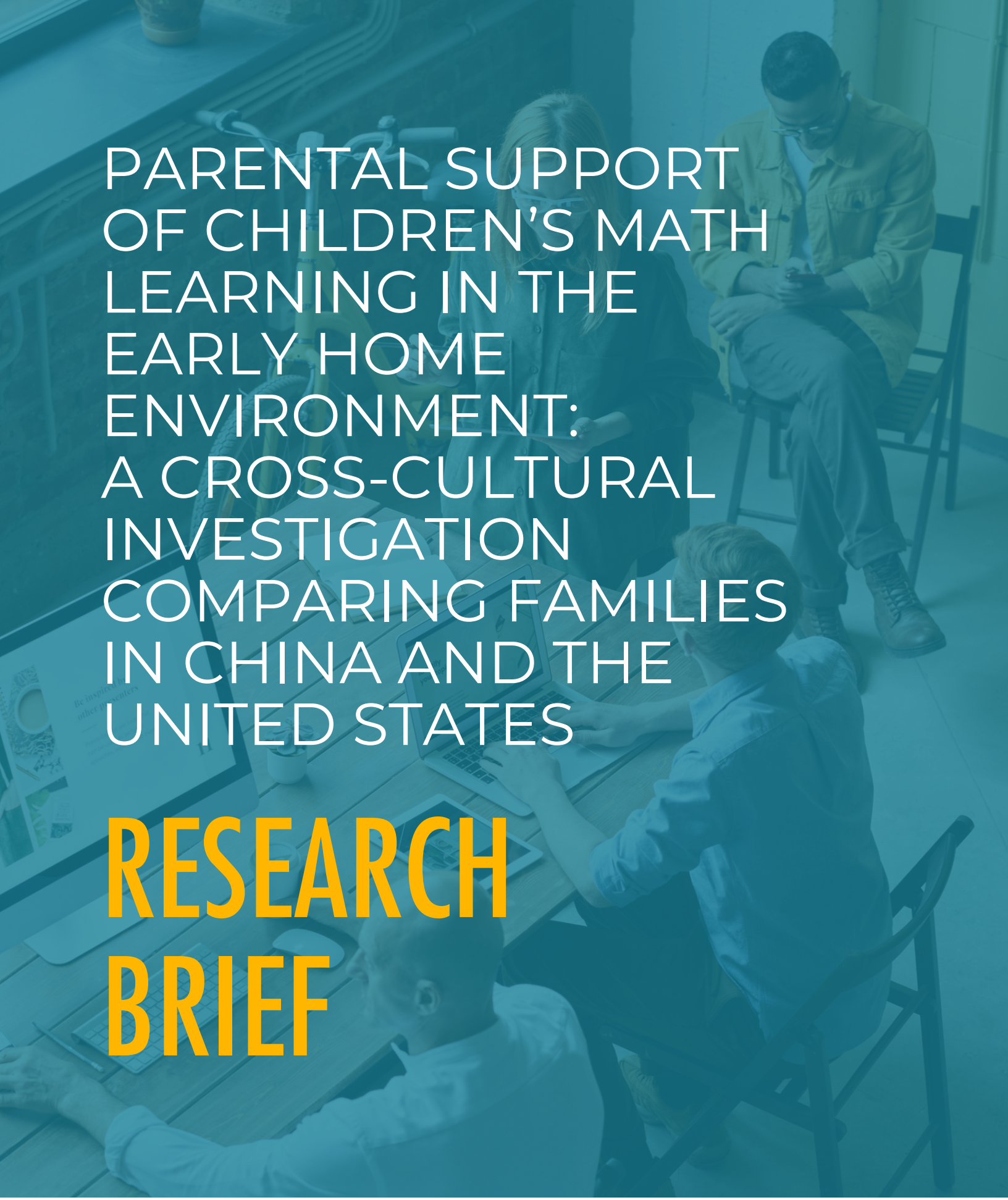

PARENTAL SUPPORT OF CHILDREN'S MATH LEARNING IN THE EARLY HOME ENVIRONMENT: A CROSS-CULTURAL INVESTIGATION COMPARING FAMILIES IN CHINA AND THE UNITED STATES

RESEARCH BRIEF

Center for Family Math

ABOUT AUTHOR

Tiffany is currently an Assistant Professor in the School of Education at Shanghai Jiao Tong University. She received her Ph.D. in Education from the Harvard Graduate School of Education in 2024, concentrating in Human Development, Learning, and Teaching, along with a secondary field in Data Science from Harvard's School of Engineering and Applied Sciences. From 2024 to 2025, she was a postdoctoral fellow at Stanford's Graduate School of Education through the Stanford Impact Labs Postdoctoral Fellowship Program. Tiffany's research examines how early experiences influence children's cognitive development and learning, with a particular focus on the role of the home environment and family interactions. This work aims to identify culturally situated factors that support the development of foundational cognitive skills in early to middle childhood.

Qianru Tiffany Yang

Shanghai Jiao Tong University,
School of Education
Website: Google Scholar

OVERVIEW

Young children vary in their ability to count objects, identify and compare numbers, and perform simple arithmetic, all of which are early mathematics skills that are predictive of later math achievement.[1,2] This project examines how the home environment and parent-child interactions support early math learning in China and the United States, focusing on cultural and family influences on numeracy and spatial skills. Findings offer strategies to bridge early math gaps and support children from diverse cultural backgrounds.

Key takeaway(s)

- Encourage parents to use a diverse range of mathematical language – not just talk more, but talk in varied ways about math concepts.
- Recognize and respond to cultural differences in how families approach math talk, beliefs, and expectations to better support children's learning.
- Promote everyday conversations about spatial relationships and support children's autonomy during spatial activities, as these practices help children develop stronger spatial reasoning skills.

[1] Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., & Japel, C. (2007). School readiness and later achievement. Developmental Psychology, 43(6), 1428–1446. https://doi.org/10.1037/0012-1649.43.6.1428

[2] Silver, A. M., & Libertus, M. E. (2022). Environmental influences on mathematics performance in early childhood. Nature Reviews Psychology, 1(7), 407–418. https://doi.org/10.1038/s44159-022-00061-z

ABOUT THE PROJECT

Key Research Questions
The project consists of three studies that aim to answer the following research questions:

Study 1 examines the variability of Chinese parents' engagement in math-related home activities and language, as well as its relation to Chinese children's numeracy skills (e.g., the ability to count sets and label quantities, identify and compare numbers, and perform simple addition and subtraction).

- RQ1: What is the nature and variability of Chinese parents' engagement in math-related home activities and language with their preschoolers?
- RQ2. Are math-related home activities and language related to children's numeracy skills?

Study 2 aims to understand individual and cultural differences in parents' use of mathematical language (i.e., math talk) when interacting with their child by studying both American and Chinese families. The study also explores parental math beliefs (e.g., expectations for children to reach math benchmarks and parents' own attitudes toward math) as potential sources of individual differences in math talk within each culture.

- RQ1: What are the cultural commonalities and differences in parental math talk during number book reading and pretend play in American and Chinese families with 4-year-old children?
- RQ2: What is the cultural variability in parental math beliefs among American and Chinese parents?
- RQ3: Do parents' math beliefs relate to their math talk, and if so, how do these associations differ across cultures?

Study 3 delves into parental support in the spatial domain of math learning by examining associations between parent-child interactive features during block play and children's spatial abilities in Chinese and American families. The interactive features under investigation include parents' use of language incorporating spatial concepts such as shapes, spatial dimensions, and properties and parental support for child autonomy (i.e., parenting practices that encourage independent exploration, allow children to set task goals, and provide scaffolding only when necessary without over-intervening). Children's spatial ability includes both a verbal aspect–children's use of spatial language during play–and a non-verbal aspect–children's mental transformation skills.

- RQ1: What are the cultural differences and/or similarities in parent spatial language and support for child autonomy during block play when comparing families of 4- and 5-year-olds in China and the US?
- RQ2: How do American and Chinese children differ or resemble each other in their verbal and non-verbal spatial skills?
- RQ3: Are parents' spatial language and autonomy support related to children's spatial skills? Do these relationships differ or remain similar across the two cultures?

METHODOLOGY

This project investigates the role of the early home environment and parent-child interaction in supporting children's math learning in two cultural contexts: China and the United States. Researchers collected data from 176 families of 4- and 5-year-old children in both China and the U.S. (90 Chinese families; 98 American families). These data provided evidence about four things: (1) home numeracy activities, including formal numeracy activities such as counting objects and solving simple sums, and informal numeracy activities such as playing board games and puzzles; (2) parental math beliefs, such as expectations for children to reach math benchmarks and parents' attitudes toward math; (3) parent-child interactions during both math-related activities (e.g., number storybooks) and routine activities (e.g., pretend play); and (4) children's mathematics skills (e.g., the ability to count sets and label quantities, identify and compare numbers, and perform simple addition and subtraction). To gather information, we used survey data, observational data of parent-child interactions with provided activity materials, and children's assessment data.

Survey data: Parents were invited to complete a survey that asked about the frequency with which they engage their children in home numeracy activities, including both formal and informal ones. The survey also included items about parental math beliefs.

Observational data of parent-child interactions: Families were first invited to have snacks and instructed to chat informally as they normally would at home. After snack time, families were provided with multiple activities to play with. These activities included numeracy activities such as number storybooks and routine activities such as pretend play. Parent-child interactions were audio- and video-recorded for further analysis.

Child assessment data: Children were invited to play a battery of computerized tasks with the researcher to measure their early math skills. Assessment sessions were conducted one-on-one following the observations of parent-child interactions.

Analyses use a variety of statistical methods to examine which factors in the home environment and features of parent-child interactions support children's mathematical development, while also considering culture as a potential moderator of these relationships where applicable.

FINDINGS: STUDY 1

Among Chinese parents, the diversity of mathematical language is a strong predictor of children's numeracy development.[3]

- When parents engage in a greater **diversity** of math talk – that is, talking with children about a variety of topics such as counting, labeling quantities, identifying numbers, discussing number magnitudes, and basic arithmetic – it corresponds with higher math performance.
- However, the **quantity** of math talk, often identified in previous research with Western families as a significant factor,[4] does not play a significant role in Chinese children's mathematical skills. In Chinese families, only including a variety of different math concepts in math talk appears to influence child performance.
- Since the study identifies the diversity of parents' math talk – a previously less documented factor in supporting children's early math learning – as a key feature of parent-child interactions that fosters children's mathematical development, its findings underscore the importance of identifying culturally specific factors in the early home environment that support math development in children from diverse cultural backgrounds.

[3] Yang, Q. T., Star, J. R., Harris, P. L., & Rowe, M. L. (2023). Chinese parents' support of preschoolers' mathematical development. Journal of Experimental Child Psychology, 236, 105753. https://doi.org/10.1016/j.jecp.2023.105753

[4] Eason, S. H., Scalise, N. R., Berkowitz, T., Ramani, G. B., & Levine, S. C. (2022). Widening the lens of family math engagement: A conceptual framework and systematic review. Developmental Review, 66, 1–26. https://doi.org/10.1016/j.dr.2022.101046

FINDINGS: STUDY 2

Although American and Chinese parents are similar in how they prompt their children for mathematical talk and the expectations they hold for them, key differences exist.[5]

- Cultural variations were found in parents' cardinality talk (i.e., the quantity of items in a set) during a number book reading activity and a pretend play activity, with Chinese parents engaging in more such talk than American parents. In other words, Chinese parents engaged in more cardinality talk than American parents during a number book reading activity and during a pretend play activity
- Both American and Chinese families engaged in similar patterns of math prompts (e.g., inviting children to discuss math concepts) and various types of math talk (e.g., counting, labeling set quantities, identifying numbers, discussing numerical magnitude, basic arithmetic, etc.).
- American and Chinese parents held similar levels of expectations for their children to reach the surveyed math benchmarks before entering elementary school, such as counting to 100 or knowing simple sums. These parents also expressed similar degrees of positive attitudes toward math.
- For Chinese parents, their child-specific math beliefs – namely, their expectations for children to reach certain math benchmarks – corresponded with more discussions about arithmetic concepts. For American parents, on the other hand, it was parent-specific math beliefs – namely, their own attitudes toward math – that were related to their arithmetic talk.
- These findings deepen our understanding of cultural commonalities and differences in parents' use of math talk during everyday interactions with their children. For example, parents in both cultures discuss similar math concepts with largely comparable frequency. That said, cardinality talk is a key exception, as Chinese parents more frequently talk about the quantities of sets of items with their children during both numeracy and non-numeracy activities. Although differences exist in both cultural contexts, the findings emphasize the importance of fostering positive math beliefs in parents to create a constructive learning environment for children that can engage more advanced mathematical concepts.

[5] Yang, Q. T., Jeffries, I., Xie, Z., Star, J. R., Harris, P. L., & Rowe, M. L. (2025). American and Chinese parents' math talk during numeracy and routine activities: Do parental beliefs matter? Early Childhood Research Quarterly, 72, 284–294. https://doi.org/10.1016/j.ecresq.2025.04.002

FINDINGS: STUDY 3[6]

Chinese parents use more spatial language than American parents, but both cultures show similar autonomy-supportive behaviors. Greater parental spatial language and autonomy support are associated with positive outcomes in children's spatial abilities.

- Chinese parents used more language incorporating spatial concepts such as shapes, spatial dimensions, and other spatial properties than their American counterparts during block play.
- American and Chinese parents displayed similar patterns of parenting practices that encouraged independent exploration, allowed children to set task goals, and provided scaffolding only when necessary without over-intervening.
- In both cultures, parents who used more spatial language, on average, had children who also used more spatial language during block play. Moreover, parents who supported their child's autonomy by jointly setting goals with them were more likely to use spatial language.
- Among Chinese families only, higher parental support for child autonomy – specifically their encouragement of independent exploration – corresponded with better mental transformation skills.
- This study advances research on children's spatial development by: (1) highlighting how parenting practices in different cultural contexts shape children's verbal spatial ability, such as parents' frequent use of spatial language during interactions and engagement in collaborative rather than directive play, and (2) identifying strategies parents can use to support spatial development specifically in Chinese culture, such as allowing space for independent exploration.

[6] Yang, Q. T., Di Sante, M., Jin, Y., Star, J. R., Harris, P. L., & Rowe, M. L. (2025). Block play by American and Chinese families: Associations with children's spatial ability. Journal of Applied Developmental Psychology, 97, 101742. https://doi.org/10.1016/j.appdev.2024.101742

MAIN TAKEAWAYS

These findings across the three studies are important because they offer parents the following insights on how to better support their children's early math learning:

From	To
• Undervaluing your role in facilitating your child's math learning in the early home context.	• Engaging your child in home math activities that teach math concepts directly.
• Treating math solely as formal, academic skills that occur only in structured settings.	• Incorporating informal, game-like activities that include elements of math concepts.
• Overlooking opportunities for natural math discussions during everyday conversations with your child.	• Embedding natural discussions about numbers, shapes, and other math concepts in your everyday conversations with your child.
• Holding negative beliefs or fears about math, as this can undermine your child's confidence and interest in learning.	• Valuing the importance of math and seeing math in the environment around your child.
• Being overly directive at playtime with your child, as this can limit your child's opportunities for self-exploration, independent inquiry, and discovery.	• Granting your child autonomy during play, allowing them to explore, initiate, and inquire about the numerical and spatial aspects of activities.