

What Types of Maternal Math Supports During Card Play Predict First-Graders’ Addition Skills?

BOSTON
COLLEGE

Lindsey Caola, Dr. Beth Casey, and Dr. Eric Dearing

Background

- Parents’ support of their children’s education and learning is a key predictor of academic success. There is evidence that frequency of early home math experiences is predictive of math skills in preschoolers, kindergartners, and early elementary students
- Girls, on average, use lower level arithmetic strategies than boys. Girls depend more on the use of concrete manipulatives such as counters or fingers whereas boys are more likely to use the more advanced strategies of retrieval and decomposition.
- The well-documented link between higher-level mental strategies and later mathematics performance suggests that girls’ early preference for counting strategies may put them at risk for poorer mathematics achievement in later grades.

Objectives

- The present study uses an observational approach to examine maternal support strategies by focusing on a card game, which is one type of informal family experience that lends itself easily to numeric learning.
- The goal was to examine which types of maternal support behaviors during the card game predicted the first-grade girls’ independent addition accuracy at the end of the academic year.

Research Questions

- When examining the rate of different types of maternal support behaviors provided during mother-daughter card game play, which behaviors are predictive of their first-grade daughters’ later addition performance at the end of first grade?
- Does rate of use of any maternal supports during the mother-daughter joint card game still predict their daughters’ later addition accuracy, when also controlling for the girls’ rates of using different types of card game strategies?

Maternal Support Categories		
Specific Strategy for Solving the Problem		
Count-all	Mother suggested child count by ones using their fingers or the symbols on the cards (e.g., concrete manipulatives).	“Use your fingers” “Count the hearts on the card”
Count-on	Mother suggested child count out the sum by stating the first addend and then counting onward from there.	To add 5+4 mother says “You have 5, so count 4 more starting from 6”
Estimation	Mother suggested comparing the numbers in her hand to the child’s hand and asking the child to estimate which hand had the larger total.	“Who has more” “Whose total is bigger?”
Use of Math Fact Hints		
Math Hints Relating to the Numbers on the Cards	Mother stated a math rule, gave a math fact, or asked a question that was designed to scaffold the child’s ability to get to the correct sum.	To add 6+6 mother says “You are 6 years old. How old will you be in 6 years? Or “Do you know your doubles? What is 6+6?”
Novel Math Facts for Decomposition	Mother introduced an easier, novel addition problem that was not found on the cards to scaffold decomposition.	To add 6+5 mother asks “What is 5+5?” The child knows this equals 10 and realizes that 6 is 1 more than 5 so 6+5 equals 11.

Table 1. Coding examples of mother support categories.

Methodology

- Participants:** 162 first-grade girls and their mothers participated in this study. Girls were recruited from two Northeastern public school districts. Data were collected over two years of assessments for two cohorts of students from the same school districts
- Procedure and Measures:** This study included two in-school individual assessments and one home-visit.
 - During the first in-school assessment, girls completed the WISC-IV Block Design subtest and the Peabody Picture Vocabulary Test. During the second testing session the girls attempted to solve a series of addition tasks, which were coded for accuracy.
 - The home visit included a five-minute card game played by each mother-child dyad. In the card game a player received three number cards from a traditional deck of cards. The players needed to identify the player with the highest sum, based on the numbers on their three cards. Card game play was video recorded.
- Data Coding:** Videos were transcribed and child and mother behaviors during card game play were coded by 3 coders (Spearman-Brown reliability coefficient =.94).

Results

Validity of child card game behavior

- There was a significant positive correlation ($r = .32, p < .01$) between frequency of home math activities and children’s rate of using an advanced retrieval strategy during the card game.
- There was a significant negative correlation between child use of the count-all strategy on the card game and frequency of home math activities ($r = -.38, p < .001$).

Descriptive statistics about the card game

- Dyads played an average of 4.93 hands during the allotted time.
- Across these hands the children attempted an average of 15.35 addition problems, and, on average, girls solved 8.5 problems on their own.
- Ten girls solved all addition problems on their own and 7 girls did not solve any of the addition tasks on their own.

Rate Variables	Mean (SD)
Maternal Support	
Suggests count-all	0.07 (0.13)
Suggests count-on	0.04 (0.09)
Suggests estimation	0.03 (0.04)
Math fact hints	0.05 (0.09)
Math hints relating to cards	0.03 (0.07)
Novel math facts: decomposition	0.02 (0.05)
Child Addition Strategies	
Count-all	0.39 (0.28)
Count-on	0.11 (0.14)
Estimation	0.15 (0.20)
Retrieval	0.41 (0.32)
Decomposition	0.01 (0.02)

Table 2. Rates of mother and child behaviors during the card game.

Regression Analyses

- Maternal support in the form of math fact hints significantly and positively predicted child’s later addition accuracy ($p=0.004, d=0.46$), even when controlling for child strategy use in the game ($p=0.01, d=0.44$).
- When examined separately, introducing a math fact hint related to the numbers on the cards ($b=.64, SE=.25, p=0.009, d=0.42$), and introducing a novel math fact not on the cards to scaffold decomposition strategies in their child ($b=.68, SE=.34, p=0.048, d=0.32$), both were significant predictors of addition performance at the end of the year.

Variable	Model 1 b (SE)	Model 2 b (SE)
Maternal Support		
Suggests count-all	-0.27(0.14)	-0.21(0.15)
Suggests count-on	-0.16 (0.18)	-0.25 (0.19)
Suggests estimation	-0.27 (0.39)	-0.65 (0.43)
Math fact hints	0.57**(0.20)	0.53**(0.20)
Child Strategies		
Count-all		-0.07 (0.15)
Count-on		0.16 (0.17)
Estimation		-0.18 (0.18)
Adds in head		0.03 (0.13)
Decomposition		0.67 (0.73)
Covariates		
Cohort	0.04 (0.03)	0.04 (0.03)
Community	-0.06 (0.04)	-0.06 (0.04)
PPVT	-0.00 (0.00)	-0.00 (0.00)
WISC	0.01* (0.01)	0.01*(0.01)
Mother’s Education	0.01 (0.01)	0.01 (0.01)
Income-to-needs ratio	0.00 (0.01)	0.00 (0.01)
Child solves on own	0.01 (0.03)	0.01 (0.0)
Average card total	-0.02 (0.01)	-0.02 (0.01)

Table 3. Regression models predicting child addition accuracy at end of year.

