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Parental facilitation of early mathematics and reading skills and knowledge through encouragement of home-based activities

Carol S. Huntsinger[a,*], Paul E. Jose[b], Zupei Luo[c]

[a] Northern Illinois University, United States
[b] VictoriaUniversity of Wellington, New Zealand
[c] QVC, Inc., United States

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ABSTRACT

Early experiences with mathematics and reading are important to the future academic success of children in the United States. The present longitudinal study examined the role of parent-provided experiences in giving young children basic foundations in mathematics and reading. Participants at Time 1 were 200 4- and 5-year-old children (100 boys, 100 girls; m_{age} = 4.48 years) and their parents from suburban areas. One year later, 97 children (46 boys, 51 girls; m_{age} = 5.88 years) participated again. At both time points, children's reading and mathematics abilities were assessed using the TERA-3 and the TEMA-2 respectively, and parents completed the Encouragement of Academic Skills in Young Children (EASYC) questionnaire. Factor analyses of the EASYC responses revealed three mathematics activities factors (at T1 and T2) and three reading activities factors. After child age, the strongest predictor of children's math and reading scores was T1 Formal Mathematics Activities (e.g., "practice adding and subtracting single-digit numbers"). Parent-provided reading activities significantly predicted reading scores concurrently, but parent-provided mathematics activities predicted both mathematics and reading scores concurrently and mathematics scores one year later.

1. Introduction

Early experiences with mathematics and reading are important to the future academic success of children in the United States (e.g., Bennett, Weigel, & Martin, 2002; Bowman, Donovan, & Burns, 2000; Duncan et al., 2007; Huntsinger, Jose, Larson, Krieg, & Shaligram, 2000; Snow, Burns, & Griffin, 1998). Research shows that children who enter formal schooling without foundational skills in literacy and numeracy continue to lag behind those who do have those skills (Aunola, Leskinen, Lerkkanen, & Nurmi, 2004). Early mathematics competency is the strongest predictor of later mathematics achievement in elementary and middle school (Duncan et al., 2007). In addition, early mathematics competency has been shown to be a better predictor of later reading achievement than is early literacy competency (Duncan & Magnuson, 2011). Much research has focused on the influence of home environments and parental attitudes, while less attention has been given to what parents actually do to promote children's learning, particularly in mathematics. Thus, the present study was an in-depth investigation of the activities in which parents engage their young children in order to facilitate academic preparedness.

Two theories have guided the present study. First, Bronfenbrenner's bioecological systems theory (1979) has described the influence of proximal and distal systems on a child's social and academic development. The most proximal microsystems are the child's family and the child's early childhood program or school. These are both settings in which the child is directly involved and interactions take place between an adult (parent, teacher) and a child. Second, Vygotsky's sociocultural theory (1978) suggests that cognitive development occurs through social interactions between a more experienced partner (a mentor) and a less experienced partner (a child). To be optimal, the mentor's teaching should be directed toward the upper boundary of a child's *zone of proximal development.* Parents (and frequently, grandparents or older siblings) and early childhood teachers are children's usual early mentors.

The attitudes parents hold regarding their child influence parents' actions with their child. Both parental attitudes (including parental perceptions of their child's abilities and interest in academic areas) and the experiences in which parents engage with their child are significant to their child's academic development

* Corresponding author.
E-mail addresses: chuntsinger@att.net, CSHuntsinger@gmail.com, huntsinger@niu.edu (C.S. Huntsinger).

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Table 1
Factor analysis of Time 1 parent-provided mathematics activities.

Parent-provided mathematics activity	Informal	Formal	Fine motor
	$\alpha = .83$	$\alpha = .72$	$\alpha = .62$
Play with math toys	**.68**		
Read counting books	**.68**		
Math fingerplays and songs	**.66**		
Play made-up math games	**.57**		
Plays with puzzles	**.54**		
Count objects or pictures	**.46**		
Plays with blocks or construction toys	**.46**		
Watches TV or videos with math content	**.45**		
Play board and card games	**.44**		
I use math in everyday home routines	**.38**		
I place numbers around the house.	**.37**		
Add and subtract single-digit numbers		**.86**	
Taught him to add on fingers		**.52**	
Give math challenges in the car		**.51**	
Does math workbooks		**.45**	
Uses math software		**.35**	
Strings beads in a pattern			**.56**
Constructs using pattern or symmetry			**.52**
Practices writing numerals			**.46**
Fold or cut paper			**.42**
Enroll in Kumon Program			
Teach child to tell time			
Play with Tangrams			

Note. Extraction method: Principal Axis Factoring. Rotation Method: Obliminwith Kaiser Normalization.

(Bornstein & Cheah, 2006; Eccles, 1993). Many parents in the United States believe they can influence their children's cognitive development, and therefore, engage in experiences they believe will promote their child's academic competence. Bornstein and Cheah (2006, p. 19) explain that "parent-provided experiences affect children via different mechanisms of action, but tend to follow the principles of specificity and transaction". The *specificity principle* (Bornstein, 2002), says, in essence, that specific experiences provided by parents at specific time points influence specific facets of a child's development in specific ways. For example, when a parent reads age-appropriate books to his two-year-old child, the child will likely enjoy being read to and will ask for more. The *transaction principle* (Sameroff, 1983) states that an individual's characteristics shape his or her experiences, and reciprocally, that those experiences shape the characteristics of the individual through time. For example, the child's desire to listen to more stories read by a parent will lengthen a child's attention span and extend her appreciation of longer and more complex books over time. The parent will focus on developmentally realistic and appropriate experiences, which change as the child grows older and becomes more knowledgeable and more cognitively mature.

Following Bronfenbrenner's and Vygotsky's general principles and Bornstein's more specific framework, the present longitudinal study examined the role that parent-provided home experiences play in giving young children basic foundational skills in reading and mathematics. We sought to answer the question, "What types of home experiences positively influence a young child's mathematics and reading test performance?"

1.1. Parental early enrichment practices

In the last several decades, researchers have investigated the influence of parental practices which encourage reading and writing, but only recently have researchers begun to focus on parental contributions to mathematics (Anders et al., 2012). Consequently, parents have had more exposure to recommendations for parent-provided activities to influence their child's reading development than recommendations to influence their child's mathematics development (LeFevre et al., 2009). Over 15 years ago, researchers Huntsinger, Jose, Larson, 1998; Huntsinger, Jose, Liaw, & Ching, (1997) found that parents' formal (more direct and systematic) teaching of mathematics predicted their preschool and kindergarten children's mathematics performance concurrently and four years later. Skwarchuk, Sowinski, and LeFevre, (2014) subsequently found that parents' formal home numeracy practices predicted children's symbolic number knowledge and that informal (more spontaneous and playful) home numeracy practices predicted non-symbolic arithmetic performance. Other research has supported the finding that parents' home numeracy practices are related to children's numeracy outcomes (e.g., Kleemans, Peeters, Segers, & Verhoeven, 2010; LeFevre et al., 2009).

Several instruments to assess the home learning environment have been developed in the last 30 years. The Early Childhood Home Observation for Measurement of the Environment (EC-HOME; Caldwell and Bradley, 1984) has been very useful in examining the factors in children's homes which foster thinking and learning (e.g., Son and Morrison, 2010; Totsika & Sylva, 2004). The broad-gauged measure of home environment, provided by the HOME, consists of a home observation and interview and includes 55 items assessing learning materials, language stimulation, physical environment, parental responsiveness, academic stimulation, modeling, variety, and acceptance. A short form (HOME-SF; Baker, Keck, Mott, & Quinlan, 1993) has predicted reading and mathematics scores in large, diverse samples of young children (Bradley, Corwyn, Burchinal, McAdoo, & Garcia-Coll, 2001). Because the HOME-SF is a broad-gauged measure, it includes only one four-part question regarding parental teaching: 'Circle the things that you or another adult are helping or have helped your child to learn here at home [Numbers, The Alphabet, Colors, Shapes, and Sizes]' (Bradley, Corwyn, McAdoo, & Garcia-Coll, 2001). The parental teaching variable did not predict children's math scores and was only weakly predictive of reading scores in the Bradley et al., (2001) study. The parental teaching question on the HOME-SF does not measure how frequently children experience parental teaching and does not describe the methods parents use to foster mathematics and reading skills and knowledge. While the HOME-SF has solid psychometric properties and has been found to predict later performance on tests in the academic domain, we argue that it may be useful in the literature to have a finer-gauged instrument to assess parent-provided learning activities.

Some existing self-report measures (e.g., Griffin & Morrison, 1997) inquire about the availability of literacy materials and the frequency of parents' reading to their children, but they do not reflect other things parents *actually do* with their children to facilitate the development of mathematics and literacy knowledge and skills. Other measures (e.g., Sy, Fan, & Huntsinger, 2003) ask whether parents have (or have not) taught their children letters of the alphabet, reading words, reading sentences, knowing numbers, adding, and writing their own name. However, assessments of this type are somewhat ambiguous. For example, does "knowing numbers" mean recognizing numerals or matching quantity with numeral or counting meaningfully? In addition, the nature or frequency of the parental teaching is not tapped.

In this vein, Fantuzzo, Tighe, and Childs (2000) developed the Family Involvement Questionnaire, with one of the factors being Home-Based Involvement. Home-Based Involvement describes 13 activities, which focus on "providing a place in the home for learning materials, actively initiating and participating in learning activities at home with children, and creating learning experiences for children in the community" (p. 371). One item specifically addresses working with the child on reading and writing skills and one item specifically addresses working with the child on number skills, with frequency of activity assessed on a 4-point Likert scale.

Miller, Farkas, Vandell, and Duncan (2014) used 10 pre-academic stimulation activities items (e.g., "helping their child