1997

Parents and kindergartners: money and number, practices, concepts and skills

Jyh-Tsorng Jong
Iowa State University

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Parents and kindergartners:
Money and number, practices, concepts and skills

by

Jyh-Tsorn Jong

A dissertation submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of
DOCTOR OF PHILOSOPHY

Major: Human Development and Family Studies (Early Childhood Education)
Major Professor: Joan E. Herwig

Iowa State University
Ames, Iowa
1997

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Major Professor

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ABSTRACT

The purpose of this study was to examine an exploratory model to explain the interactive relationships among parents' number and monetary practices, and their kindergartners' number concepts, monetary concepts, and monetary skills. The 207 kindergartners participated in three number and monetary tasks during clinical interviews. Each child's father or mother completed two kinds of home practices questionnaires. By using path analysis through LISREL 8.12, the results showed that kindergartners' use of money was influenced significantly by their number concepts (i.e., cardinality) and knowledge of coins (i.e., knowing the coin names and coin values). Kindergartners' cardinality benefited their acquisition of knowledge of coin values. They learned numbers representing small amounts to large amounts, understood the coin names before the coin values, and were able to complete matching paying prior to the transformation paying. Parental direct money teaching strategies had a positive impact on kindergartners' acquisition of knowledge of coin names. Kindergarten parents who reported more frequent direct teaching of numbers also reported more frequent direct teaching of money with their children. No relationship was found between parents' number practices with kindergartners and kindergartners' number learning, and there was no effect of parents' monetary practices with their kindergartners on kindergartners' monetary use.
GENERAL INTRODUCTION

"Daddy, where does money come from?" 5-year-old Cyndy inquired.
"Mommy, I want my birthday party at McDonalds?" 7-year-old Norman asserted.
"Look, Dad, this is the best toy. All the guys have one. I want it," announced a little boy in the supermarket.
"It is my responsibility to talk to her about what she sees and why it may or may not be a good thing to buy. When we look at a toy I ask her if she really believes it is worth the cost." said a mother as she explained her opinions about her young child and toy commercials on television.

These statements reflect today’s consumer-oriented society where everyone is a consumer, even children. Reports show that American children between the ages of 4 and 12 years influence more than $165 billion in spending in the U.S. (McGee, 1997). About 6.2 billion dollars a year of children’s personal money is spent on a wide range of products and services for their immediate consumption (McNeal, 1991). It is estimated that they also direct parental expenditures of over $50 billion a year (McNeal, 1991). Children and their parents play an important role in the consumer-oriented society.

The need for consumer education is one of the rights of consumers. In 1962, President Kennedy proclaimed the four rights of the consumer as: 1) to be safe; 2) to be informed; 3) to choose; and 4) to be heard (Warne & Morse, 1993). These rights were supported in 1975 when President Ford stated the importance of the right to consumer education through proposed funding (Maynes & ACCI Research Committee, 1988). In 1975 the U.S. Office of Consumer Education was established in the Office of Education (USOE) in the Department of Health, Education and Welfare (HEW). With a budget of $3.1 million for fiscal year 1976, the Office of Consumer Education started to fund many consumer education projects and research studies (Maynes & ACCI Research Committee, 1988). Several of these researchers concluded that it is important to provide children with consumer education experiences early in life when they are impressionable and are influenced strongly by exposure to the marketplace (Davis, 1982; Koeller, 1981; Kourilsky, 1977; McKitric, 1986;
According to the definition from the President's Commission on Consumer Interest (Charters, 1973), consumer education is the study concerned with the development of knowledge, understandings, appreciations and skills involved in the economic welfare of consumers and consumer groups in everyday life; for example, competency in managing money, consumer legislation, evaluation of consumer research and product testing, and the role of the consumer in the economy. (p. 3)

For young children, simple, practical experiences of consumer activities are the buying and selling of goods in the marketplace and in pretend play activities (Robison, 1964; Stacey, 1982). During the buying-selling process, the individual needs some basic knowledge and skills that are associated with numbers and money. That is, it is necessary for the consumer to possess a primary understanding of numbers and money. Ende and Earl (1974) state that getting top value for every dollar you spend is a tricky business, and getting more difficult every day. Increased technology, sophisticated merchandising techniques, and well-camouflaged frauds mean that you must investigate every purchase carefully before you buy. It takes time, effort, and study, but your reward is increased purchase power. (p. 1)

Being a wise consumer means that you need to know how to use money thoughtfully, and this begins at an early age for children who are young consumers in the marketplace and who learn consumer behaviors from those around them. Also, these premises are reminders that it is important to understand how children learn about numbers and money, and how their concepts about numbers and money develop during a period when we are concerned
with their acquisition of basic understandings about consumerism.

How do children learn about numbers and money? Research indicates that parents are the first important people to influence children's learning about numbers and money at home (Blevins-Knabe & Musun-Miller, 1995; Ely & Gleason, 1995; Marshall & Magruder, 1960; Neitzey, 1992; Sears & Medearis, 1992). These findings are also supported by Bronfenbrenner's Ecological Theory (1979) that addresses the important role of the parent in the family. According to Bronfenbrenner, the family is the basic unit (microsystem) of a society (macrosystem). For a young child, her microsystem begins with her family, and thus the parent has a direct impact on the child's development and learning in today's consumer-oriented society. In addition, the theories of Vygotsky (1978) and Rogoff (1990) argue the significant effect of interaction between parents and their children, such as explicit instruction and communication. They emphasize that the more interaction between parents and their children during everyday life, the more benefits there are for the children's conceptual thinking.

How do children's concepts about numbers and money develop? Several studies have found that five-year-old children are able successfully to perform one-to-one correspondence in matching tasks (Avesar & Dickerson, 1987; Becker, 1989); they also are able to count by using the numbers 1 to 5 (Becker, 1989), numbers 1 to 6 (Becker, 1989; Fischer & Beckey, 1990), and numbers 1 to 7 (Fischer & Beckey, 1990). Moreover, they can solve simple addition and subtraction problems based on the number 5 or 10 (Yoshida & Kuriyama, 1986). Further, research indicates that five-year-old children are very capable of learning about money (Anderson & Fulton, 1987; Edmunds & Whitehurst, 1973; Kourilsky, 1977). They can name a penny, nickel, and dime, and compare the values between a penny and a nickel, a penny and a quarter, a nickel and a quarter (Anderson & Fulton, 1987; Dunkin, 1972; Paxton, 1986). Besides, they display obligatory payment by using simple coins during buying-selling activities (Berti & Bombi, 1981).
The question remains, what is the relationship among parenting behaviors and young children's number and money learning? Many researchers have studied the development of young children's number concepts (Becker, 1989, 1993; Fischer & Beckey, 1990; Gelman & Gallistel, 1978; Halford & Boyle, 1985; Michie, 1985; Mohan, 1984; Yoshida & Kuriyama, 1986), and monetary concepts (Anderson, 1974; Betti & Bombi, 1981; Dunkin, 1972; Edmunds & Whitehurst, 1973; Harper, 1973; McCarty, 1967; Strauss, 1952; Strauss & Schuessler, 1951). In addition, other researchers have explored the parent-child relationship and children's mathematical learning (Blevins-Knabe & Musun-Miller, 1995; Lehrer & Shumow, 1995; Sears & Medearis, 1992), as well as the influence of parents on young children's monetary learning (Ely & Gleason, 1995; Kourilsky, 1977; Marshall & Magruder, 1960). Researchers have not examined the relationships among the variables of young children's number concepts, monetary concepts, and monetary skills, and parenting practices in promoting these concepts and skills.

Because kindergarten is the entry level for elementary school in the United States, it is important to explore the nature of relationships among kindergartners' basic consumer knowledge and skills (i.e., number concepts, monetary concepts, and monetary skills) and their parents' number and monetary practices before it can be argued that fundamental consumer education needs to be included in the elementary school curriculum. The purpose of this empirical study is to test an exploratory model to explain the relationships between parenting mathematics behaviors and their kindergartners' number and money learning. There are five basic variables: parental number practices, parental monetary practices, kindergartners' number concepts, kindergartners' monetary concepts, and kindergartners' monetary skills. This study attempts to answer the following research questions:

1. Are kindergartners' monetary concepts influenced by their number concepts?
2. Are kindergartners' monetary skills influenced by their number concepts?
3. Are kindergartners' monetary skills influenced by their monetary concepts?
4. Are kindergartners' number concepts influenced by their parental number practices?

5. Are kindergartners' monetary concepts influenced by their parental monetary practices?

6. Are kindergartners' monetary skills influenced by their parental monetary practices?

Dissertation Organization

This dissertation includes two sections. The first section (Chapter 1) is a manuscript that focuses on a literature review concerning young children's number and monetary concept development, and parental influence. The second section (Chapter 2) is a manuscript that reports the development of an exploratory research model to identify relationships among parental number practices, parental monetary practices, kindergartners' number concepts, kindergartners' monetary concepts, and kindergartners' monetary skills. The methodology, results, and discussion of this study, and suggestions for further research, are reported in the second chapter. The general conclusion follows. The last part of the dissertation presents the appendices, such as correspondence including the superintendent's, principal's, and teacher's letters, and the parent permission letter, parent questionnaires, children's number concept tasks, children's monetary concept tasks, children's monetary skill tasks, and children's composite score sheet. In addition, each chapter includes the references that are cited.

References


CHAPTER 1: YOUNG CHILDREN'S NUMBER AND MONETARY CONCEPT DEVELOPMENT AND PARENTAL INFLUENCE: 
A LITERATURE REVIEW

A paper to be submitted to Early Child Development and Care

Jyh-Tsomg Jong and Joan E. Herwig

Abstract

This literature review focuses on the current understanding of how young children's number concepts, and monetary concepts and monetary skills develop, and how parenting practices influence this learning for their children. Research reveals that children's number concepts emerge from their numerosity in infancy. According to Gelman and Gallistel, number concepts are number abstraction, such as one-to-one correspondence, cardinality, and comparison of numbers. Counting is the common way for young children to learn number concepts. Young children, 2- to 6-year-olds, can learn numbers. Numbers 1 to 7 are counted accurately by many 5-year-olds. Similarly, monetary concepts are an aspect of money abstraction, such as identifying money and comparing the value of money. Monetary skills are considered as money reasoning, such as young children's paying in buying-selling activities. Most 3-year-olds can distinguish between money and non-money items and can name pennies. For 4- and 5-year-olds, they can name a penny, a nickel, and a dime, and compare the value of coins. Five-year-olds have basic knowledge of money and the functions of money, business practices, and banks. Several studies have indicated that parenting was a significant factor influencing children's learning of numbers and money. Parents who provided more number learning practices at home or participated in more school activities benefited their children's achievement in mathematics. Parents who provided more direct money experiences at home helped their children acquire monetary knowledge.
Introduction

Everyone is a consumer, even young children. In a consumer-oriented society, money is a resource available in limited amounts to satisfy needs and wants. A wise consumer needs to possess consumer knowledge and skills when spending money and using other resources.

Research on the consumer behavior of teenagers and adults has established a relationship between numbers and money (Miller, 1987; National Assessment of Educational Progress, 1979; Ohio State Board of Education, 1980). They identify mathematical ability as one kind of consumer skill. Mathematical abilities emerge from number concepts (Bjorklund, 1995). In mathematical problem-solving situations, one needs to use basic knowledge about numbers (e.g., what are numbers?) to devise reasonable strategies and solutions. Consumer skills include monetary skills involving buying, selling, saving, budgeting, and resource decision-making. Number concepts are a necessary foundation for using money. For example, during budgeting, one needs to know the quantity of money that is available to complete a financial plan.

Numbers and money begin to be understood in early childhood (Berti & Bombi, 1981; Gelman & Gallistel, 1978; Piaget, 1965; Strauss & Schuessler, 1951). Furth (1980) has asserted that children's monetary skills require them to know the numerical system, and they must master monetary concepts (Berti & Bombi, 1981; Furham & Lewis, 1986). Monetary concepts include children's recognition of money (i.e., they can name coins and bills and know their value). In buying and selling activities, children need to establish an understanding of the one-to-one correspondence between numbers and monetary units. One-to-one correspondence (e.g., when two sets have the same cardinal value) relates strongly to children's acquisition of number concepts (Piaget, 1965). After children establish the concepts of numbers and money, they begin to understand how to match the amount of money needed to pay the stated price for an item during buying and selling activities.
Numbers and money are basic elements of consumer knowledge needed when people use money in marketing. How do basic number and monetary concepts develop? It is an interesting question as we think about becoming wise consumers. The ecological theory indicates that parents are the primary influence on their children's early learning (Bronfenbrenner, 1979; Ward, 1974). In addition to providing young children basic physical and psychological needs, parents also nurture their children's learning in direct and indirect ways.

What is the context in which young children learn about numbers and money form their parents? Several reports indicate the importance of parenting practices which provide incidental and direct learning experiences for young children (Alberta Consumer and Corporate Affairs, 1979; Kourilsky, 1977; Marshall & Magruder, 1960; Mastin, 1994; Neitzey, 1992; Nicolau & Ramos, 1990; Prevey, 1945). Fox (1978) identified the direct monetary learning experiences as buying, trading, owning, and saving (Koeller, 1981). Direct number learning includes teaching children rote counting (i.e., 1, 2, 3, 4, 5,...), naming numbers, singing related number songs, reading number books, and playing number games with children. Incidental learning experiences occur as noncentral aspects of a task or situation (Bjorklund, 1995). For example, parents and their children may count the number of passing red cars as they are walking down the street (incidental number learning); children see how their parents buy in the market (incidental money learning). What does research indicate about parenting and their young children's number and money learning?

This literature review will focus on understanding how young children's number concepts develop, and identification of their monetary concepts and skills, and the influences of parents on their children's learning with numbers and money. Young children are defined as 2- to 6-year-old children. In the first section, the definition and origin of number concepts, Piagetian theory about children's number concepts and Gelman and Gallistel's counting principles, and the related research of young children's number concepts will be discussed.
Then, in the second section, the theoretical perspectives, definitions, and relative study approaches of young children's monetary concepts and skills will be explored. Further, Vygotsky's theory and Ward’s information processing will be considered in how parenting influences children. The study approaches of parental impacts on young children's number and monetary learning will be discussed in the third section.

Young Children's Number Concepts

The definition and origin of number concepts

Children's number concepts vary with age. During infancy these concepts are called numerosity as they refer to perceptual abilities. Piaget (1965) referred to numerosity as the perceptual intuition of number as well as the perception of numbers (Kamii & DeVries, 1976). Loosbroek & Smitsman (1990) defined numerosity as "an invariant property of a collection of objects specifying its numerical size" (p. 916). Others, such as Bjorklund (1995), have used the word "subitizing" to describe the ability to quantify small numbers of items without conscious counting. Subitizing and numerosity refer to the same ability.

Piaget (1952) and Gibson (1987) addressed the relationship between perception and cognition during infancy. Piaget (1952) theorizes that the cognition of infants is sensorimotor in nature (i.e., they explore the environment by their own actions). Therefore, what they know depends on their basic perceptual experiences (e.g., they notice there are dots on an object through visual experiences). Similarly, Gibson (1987) theorized that the perception of infants is active, exploratory, and motivated. Infants can track a moving high-contrast target and move their eyes toward a stationary target in an immediately accessible optic array. Moreover, perception is a process of differentiation (Pick, 1992). Human beings are born capable of perceiving differences in their environment and of analyzing the differences between perceptual properties. For instance, infants can distinguish between two kinds of stimuli in an array (Strauss & Curtis, 1981).
Interest in studying infants' numerosity started in the 1970s, and research continues to address three primary issues. In the first issue, researchers explore whether infants can discriminate between visual arrays of different numerosity. The discrimination of numerosities refers to the quantitative ability, called cardinality, which is the ability to recognize whether two arrays are equivalent. Several researchers have reported evidence of infants' cardinality (e.g., using the habituation paradigm ten-month-old infants can discriminate two-item versus three-item arrays); the habituation paradigm is the process by which a repetitive stimulus becomes so familiar or uninteresting that responses initially associated with it are no longer apparent (Starkey & Cooper, 1980; Starkey, Speike, & Gelman, 1980; Strauss & Curtis, 1981).

The second research issue is whether infants can distinguish one quantity as greater than or less than a second quantity. This ability is related to infants' numerosity judgments, known as ordinality. Using N and N+1 (N-1) numerosity tasks, empirical findings show that infants cannot detect and remember less-than and greater-than relationships until they are 14- to 16-months-old (Cooper, 1984; Curtis & Strauss, 1982, 1983). However, 5-month-olds distinguished one quantity as greater or lesser than the other one in the "possible" and "impossible" experimental design (Wynn, 1992).

The third issue, whether infants can perceive the invariance of numerosity over arrays of continuously moving objects, has been investigated by Loosbroek and Smitsman (1990). Their results showed that infants who were at least 5 months old were able to perceive small numerosity units, 2, 3, 4. These infants abstracted the numerosity of small sets as patterns of 2, 3, and 4 rectangular figures moving continuously on a black-and-white TV monitor. They concluded that infants can discriminate limited number units using both numerical perception and pattern perception.

In summary, infants have basic number awareness. They can abstract numbers using visual perception as early as five months old. According to the theories of Piaget (1952) and
Gibson (1987), perception is the basis of cognition, thus numerosity is the foundation for number concepts. This viewpoint is supported by Strauss and Curtis (1981), who argue that numerosity is an innate process and is the beginning of mathematical development. When children enter kindergarten, they possess a rudimentary knowledge of the number system (Gelman & Gallistel, 1978; Leder, 1989). They have a foundation to acquire further quantitative knowledge, such as counting, one-to-one correspondence, conservation of number, and estimation of number.

A review of the research concerning children's number concept reveals that there are two primary approaches that attempt to explain the development of young children's number concepts. One is the Piagetian theory of children's number concepts and the other is Gelman and Gallistel's counting principles. These two approaches are presented in the following sections.

**Piagetian theory of number concepts**

Piaget (1965) agrees that children can perceive numbers at a young age (e.g., the numerosity of 1 to 3 at age 3, 1 to 4 at age 4, and 1 to 5 at age 5); however, he does not support the position that young children have number concepts. According to Piaget (1965), children cannot have any meaningful understanding of numbers until they reach the concrete-operational period of cognitive development at approximately seven years.

Piaget (1965) argued that number is essentially a logical system that combines the coordination of classes and the seriation of transitively ordered elements. Understanding the grouping of classes helps children know the cardinality of the sets; that is, children know that the number of a set is the total count of individual elements of the set. By understanding seriation, children can count objects without skipping or repeating objects. Children learn number concepts, also called number schemes, by their individual actions. Those actions are creative in reality, not only as the manipulation of objects but also as an adjustment to a situation. The adjustment is the function of equilibration; children get an understanding of
numbers when they operate on concrete objects and disturb their old experiences. According to Piaget, children need to complete one-to-one correspondence tasks and to conserve numerical structures through their own experiences to understand numbers.

One-to-one correspondence is the relationship between two sets that had the same cardinal value (Becker, 1989). In the number conservation tests devised by Piaget, children are shown two sets with the same cardinality and are asked to judge their relative numerosity. Whether one of the sets is transformed by closing up the spaces or by spacing it out with the same number of objects, children need to realize that the number of elements in each set is the same. That is, one-to-one correspondence, according to Piaget, requires that children are not distracted by perceptual contact between the elements. They readily determine equivalence without actual counting.

Halford and Boyle's research findings (1985) support Piaget's view; that is, most children younger than seven years said that the longer the row, the more the numerosity. Using five experiments to test the number conservation of 3- to 4-year-old and 6- to 7-year-old boys and girls, Halford and Boyle (1985) hypothesized that, "if children understood conservation, their pretransformation judgments would influence their posttransformation judgments" (p. 165). To test this hypothesis, the children were shown four displays using two rows of beads with each row including 20 beads but varying in density. Then each child was asked to point out the row having more beads without counting. The findings indicated that 3- to 4-year-old children were not successful in these number conservation tasks, whereas 6- to 7-year-olds accurately completed the tasks. The findings were interpreted to mean that children without number conservation showed no recognition of invariance. Conversely, children with number conservation showed significantly consistent judgments in all five tasks.

Contrasting findings were reported by Sophian (1988), who investigated the relationship between numerosity and one-to-one correspondence of 40 3- and 4-year-old boys and girls. Two experiments were conducted using small sets of 3 or 4 objects and large
sets of 6 or 7 objects. Questions using equal and unequal sets were asked during the number tasks; for example, "if we want to put every block in a truck, will we have enough trucks?" (p. 1405). Children needed to "make inferences about the correspondence between two sets from information about their numerosities and to make inferences about the numerosity of a set from information about its correspondence to another set and the numerosity of that set" (pp. 1403-1404). The results showed significant degrees of success for both age groups. In addition, the children performed better with the very small sets than with the large sets. Sophian (1988) concluded that 3- and 4-year-old children could acquire knowledge about numerosity and one-to-one correspondence primarily through experience, which they gradually could generalize.

Similarly, Becker (1989) interviewed 96 preschoolers to examine whether they had one-to-one correspondence in matching tasks and counting tasks. In the matching tasks, the 3½- to 5½-year-olds were asked to match two sets to determine whether they could put the items in one-to-one correspondence. The word "same" was used in questions; for example, "There are six dolls. Is there the same number of rings?" (p. 1149). For the counting tasks, the preschoolers counted two sets and they were to use the final number counting word to determine whether the two sets could be put in one-to-one correspondence. Numbers 5 and 6 were included in the questions. The findings showed that most 3½- and 4-year-old children used numbers to indicate one-to-one correspondence for each task, and all 5-year-olds were successful with all of the tasks.

In conclusion, these studies (Becker, 1989; Halford & Boyle, 1985; Sophian, 1988) indicate that young children possess numerosity and one-to-one correspondence ability based on their experiences with relevant items and questions although they did not complete conservation tasks successfully. It appears that most young children can learn numbers. Numbers under 5 are used accurately by most 3- and 4-year-olds, and 5-year-olds can deal accurately with numbers from 1 to 6 (Becker, 1989; Sophian, 1988).
In contrast, Piaget (1965) seldom elaborated about his perspective on children's early arithmetic abilities because his theoretical perspective for children's number concepts did not support the presence of these abilities. Early arithmetic is concerned with the addition and subtraction of numbers (Bjorklund, 1995). Piaget (1965) proposed that children need to possess inversion reversibility to learn addition and subtraction; for example, children are required to understand that $2 + 5 = 7$, which results in $7 - 2 = 5$. Therefore, his theory argues that children cannot achieve the problem-solving of addition and subtraction until they attain concrete operations, at about 7 years old, because they cannot use reversibility or conservation of number before then.

**Gelman and Gallistel’s counting principles**

Gelman and Gallistel (1978) did not support Piaget’s perspectives regarding number concepts. They emphasized that young children do not totally lack appreciation of invariance of number. Most children have acquired considerable mathematical knowledge before they start formal schooling (Gelman & Gallistel, 1978; Leder, 1989). Gelman and Gallistel also declared that the development of numerical abilities in young children is represented by their number abstraction and numerical reasoning. Number abstraction is the process that children use to obtain a numerical representation of a particular array; abstraction enables children to answer questions dealing with discrimination learning (i.e., which number is larger or smaller), absolute judgment (i.e., how many are there), and matching to sample (one-to-one correspondence). Numerical reasoning is the process that children use to define the outcomes of manipulating sets in various ways, such as class-inclusion tasks, addition tasks, and subtraction tasks. Bjorklund (1995) suggested that number abstraction indicates children’s knowledge of number concepts, and numerical reasoning represents children’s arithmetic concepts.

Gelman and Gallistel (1983) asserted that counting is the common way for children to represent number abstraction. Counting enables young children to make quantitative
determinations of amount. Many children know about numbers and counting operations from two years of age. For example, Fuson et al. (1985) found that 53% of 2-year-old subjects could count accurately in the number set sizes of 2 and 3.

Further, Gelman and Gallistel (1983) argued that counting involves the coordinated use of several components such as noticing the items in an array one after another, pairing each noticed item with a number name, using the conventional list of number names in the conventional order, and recognizing that cardinality is the last counting name representing the numerosity of the array. In addition, children possess basic conceptual principles to guide them in learning numbers. Together, these principles offer a very different perspective for understanding children's number concepts than the theory of Piaget. They identify five counting principles used by children: (1) the one-one principle, where one counting word is assigned to each object; (2) the stable-order principle, where a single sequence of counting words is used in agreement; (3) the cardinal principle, where the last counting word used is the total in the set; (4) the abstraction principle, where the counting procedure can be applied to all kinds of objects; and (5) the order-irrelevance principle, where objects can be counted in any reasonable sequence. This approach emphasizes that children lack the number-conservation ability that was implicit in their counting (Sophian, 1988); however, young children are able to deal with problem-solving questions based on their counting skills such as addition and subtraction.

In addition, children identify linguistic number words before they understand the meanings of number words. They can transfer their first experience (i.e., the linguistic number words) to the second one (i.e., the meaning of number words) according to relational cues. Thus, children do not possess innate knowledge of the number words, but they can map the linguistic number words onto their mental number tags. Wynn (1992) investigated this principle in a longitudinal study. Using a sample of 2- and 3-year-olds, he used four tasks to study how the understanding of meanings of number words developed. First, the Give-a-
Number task for the numbers 1 to 5 was used to determine which children understood their cardinal number meanings by perception and which by numbers. Second, the How-Many task was designed to determine whether the same children were able to complete cardinal counting for numbers 2 to 6. The Point-to-X task and the Color Control task tested whether children could link numerosity with the linguistic number word. The findings showed that even the 2- and 3-year-old children knew the spoken counting words which referred to a unique numerosity although they did not understand the written numbers. Also, they knew the number words sequentially up to “two” or “three;” this ability was associated with the understanding of cardinality. This finding implies that children need to connect numerosity with number words very well in order to learn the counting system.

Gelman and Gallistel's view is supported by Hiebert and Lefevre (1986), who distinguished between conceptual knowledge and procedural knowledge in the learning of mathematics. They define conceptual knowledge as knowledge that is rich in appropriate relationships. Those relationships include the unique facts and propositions that can be linked to some pieces of information stored as networks in memory. Procedural knowledge is composed of the formal language (i.e., the sounds of one, two, three), or mathematical symbol representation system (i.e., 1, 2, 3), and the algorithms, or rules, for completing mathematical tasks. According to Hiebert and Lefevre, a unit of conceptual knowledge cannot be an isolated piece of information; procedural knowledge is learned by linking with conceptual knowledge. However, young children can use their conceptual knowledge only to reason about specific numerosities, that is, about quantities to which a numerical value has been assigned. Counting is a procedure to bring number within the purview of conceptual knowledge by generating specific numerosities with which conceptual knowledge can reason. So, young children’s cardinality and ordinality can be represented by their conceptual knowledge, or both conceptual knowledge (e.g., numerosity) and procedural knowledge (e.g., counting). During the early years, the relationships between conceptual and procedural
knowledge are intricate and dynamic.

Other researchers have included such tasks as "Compare-Sets," "Counting All or Subsets," "Small or Large Sets," and "Equal or Unequal Questions" for 3- to 5-year-old children to demonstrate their counting and cardinality abilities (Becker, 1993; Frye et al., 1989; Fuson et al., 1985; Sophian, 1988). They found that the preschoolers were very good at recognizing a correct standard counting procedure (i.e., their cardinality response was their last-word response). Fuson et al. (1985) concluded that preschoolers are readily able to count small sets, like 2, 3, 4, and even large sets, 5, 6, and 7.

Fischer and Beckey (1990) investigated the number concepts of 97 kindergartners. The individual interviews included seven tests for children (i.e., rote counting, rational counting, numerosity, one-to-one correspondence, conservation, inequality, and ordinality). The results showed that only 9% of kindergartners were successful in rote counting from 1 to 30, and most kindergartners stopped counting at number 12. Of the 97 kindergartners, 84 were able to count six blocks correctly. A majority of those kindergartners (91%) succeeded in making a set of seven blocks. Almost all (97%) the kindergartners were able to compare two sets successfully; however, only 31% of the children understood the term "third", and just 59% of them completed the conservation tasks.

Mohan (1984) tested 64 3- to 6-year-olds to examine their understanding of indefinite number terms, such as some, many, and seldom. They devised a method for determining the value assigned to indefinite number terms that required children to take "a few," "some," or "a lot" of blocks from one of three metal trays containing 10, 20, or 40 blocks. They assumed that the number of blocks taken from the tray was related to the requested term. Results showed that there was significant interactions among ages, terms, and available number. The three-year-olds responded in an absolute way (i.e., they took about the same number of blocks regardless of the number of blocks in the container). Four-year-olds began to show a rudimentary understanding of the quantitative terms of some, a few, and a lot. However, five-
and six-year-olds completed the tasks successfully; they took more blocks from the 40-block container than the other containers.

Similarly, Michie (1985) studied the development of absolute and relative number concepts for 3- to 5-year-old children. He defined an absolute number as a number that can be understood without referring to any other numbers and a relative number as a number sequence, or the order component of numbers. A "matching to task" test was used to determine whether children understood absolute numbers and "choosing a series of lengths or numbers" was used to examine their understanding of relative numbers. She concluded that preschoolers understand numbers as an absolute "amount" before they understand the "order" of numbers. This finding was supported by Frye et al. (1989), who found that 3- and 4-year-olds did not understand order irrelevance in their number judgments.

Leder (1989) investigated the number concepts of 43 preschoolers using written representations of small numbers of objects (i.e., children made written symbols on a piece of paper to show how many blocks were in a container). Their responses were categorized in one of four categories. An idiosyncratic response indicated that there was no obvious link between the number of objects provided during the interview and the child's numeral representations. A pictographic response required reproducing the appearance of the stimuli. An iconic response required labeling discrete marks. A conventional symbol (e.g., 0, 1, 2, 3) was categorized as a symbolic response. The findings showed that 56% of the preschoolers produced various types of written representations. This implies that many preschoolers have substantial written and oral mathematical skills and concepts when they enter kindergarten.

In addition, two researchers investigated young children's addition and subtraction operations (Fuson et al., 1988; Yoshida & Kuriyama, 1986). Fuson et al. (1988) used a class-inclusion task (e.g., soldiers and army) to ask 4- and 5-year-old children's understanding of the relevance of addition and subtraction. For example, two rows of items were displayed to represent number conservation tasks, and one object was added to or subtracted from one
of the rows. Then children were asked whether the two rows were equal. They found that most of these children could answer the questions correctly.

Yoshida and Kuriyama (1986) examined the ability of 5-year-old Japanese children to solve addition and subtraction problems based on the number 5 or 10. The results showed that they could do simple addition and subtraction. They concluded that the numbers 1, 2, 3, 4, and 5 were easy for young children to operate. In addition, results indicated that resolving numbers (e.g., the experimenter said "6" and asked the child to represent it into 5 and X) was easier for the children than finding supplements (e.g., the experimenter said "3" and asked the child to find a supplement to 10).

In summary, young children learn about the quantity of numbers first, then they understand the order of numbers. They need to make number judgments based on their direct experiences. Counting is the general procedure for young children to learn numbers. There is considerable support among research findings (e.g., Leder, 1989; Michie, 1985) for Gelman and Gallistel's view that young children use their particular individual perspective to formulate their own number concepts. They are capable of learning numbers. Numbers 1 to 7 are accurately counted by many young children. For example, five-year-old children readily complete one-to-one correspondence in matching tasks and counting tasks when using numbers from 1 to 5 (Becker, 1989), numbers 1 to 6 (Becker, 1989; Fischer & Beckey, 1990), or numbers 1 to 7 (Fischer & Beckey, 1990). Also, they can succeed in compare-sets tasks, counting all or subsets, small or large sets, and equal or unequal questions using the numbers 1, 2, 3, and 4. They can recognize the meanings of number terms, such as some, a few, and a lot (Mohan, 1984). Moreover, they can solve simple addition and subtraction problems based on the number 5 or 10 (Yoshida & Kuriyama, 1986).
Young Children's Monetary Concepts and Skills

Theoretical perspectives of children's monetary development

While number concepts relate to children's understanding of the physical world, children's monetary concepts are associated with their understanding of the social world (Furnham & Lewis, 1986). As coins and paper money do not have any apparent systematic physical relationship to each other (Bradford, 1980), children need to acquire some method for learning about money. Money and its use are a part of children's lives. Reports show that four- to twelve-year-old children spend $6.2 billion a year of their own money on a wide range of products and services for direct consumption (McNeal, 1991). Little is known about children's monetary concepts and how their monetary skills develop in contrast to the knowledge about children's number concepts.

Most studies concerning young children's monetary knowledge are based on Piagetian theory with a developmental stage approach (Berti & Bombi, 1981; Schuessler & Strauss, 1950; Strauss & Schuessler, 1951; Strauss, 1952). As a new stage is reached, the previous meanings of a particular concept are changed, revised, and qualified; thus, little remains of the early meanings of the concept. Development is truly cumulative. As a child moves from one stage to another, her behaviors are transformed. This is evident, for example, in the six stages of children's monetary behaviors presented by Berti and Bombi (1981). Across the stages in buying and selling play activities, the monetary behaviors of children change as follows:

Stage 1: No awareness of payment. Children do not pay during the store game or recognize money.

Stage 2: Obligatory payment. Children recognize that the customer must pay but they do not discriminate between the various kinds of coins or bills.

Stage 3: Realization that not all types of money can buy everything; that is, not all money is equivalent.
Stage 4: Realization that sometimes money is insufficient for certain goods because something costs more.

Stage 5: Strict correspondence between money and objects. Children establish an exact correspondence between the value of the various coins and bills and the prices of the objects.

Stage 6: The correct use of change. Children realize that the excessive value of money may be compensated for by the storekeeper's returning the difference in money to the customer.

According to Piaget, children's understanding of money develops from concreteness to abstractness (Schuessler & Strauss, 1950). This understanding for Piagetian preoperational children is different because their judgment is limited by their perception and intuition (Bjorklund, 1995) and they organize reality from their own experiences. These children find it difficult to judge the higher value between a dime and a nickel at the same time because the size of a nickel is larger than that of a dime and the value of a nickel is smaller than that of a dime (Anderson, 1974; Anderson & Fulton, 1987; Dunkin, 1972; Harper, 1973; McCarty, 1967; Paxton, 1986; West, 1971).

Bruner (1966) described children's conceptualization as the three levels of enactive, ikonic, and symbolic levels. This means that children at the enactive level learn about money by their direct operation or experiences. For instance, a child knows what a penny is by seeing or playing with a true penny and linking those experiences with an adult saying "penny." In the ikonic level, children recognize a penny represented in a picture instead of an actual coin. The symbolic learning level is represented when a child reflects an understanding of a penny in her conversation; for example, Jane said, "I only need a penny to buy this peppermint" without having a penny present.

In addition to learning the name of coins or paper money, children also need to learn the value of each coin and each paper bill. This knowledge is related to the cardinality of
money which is the ability to connect the number of a unit with the name of the coin or bill. For example, a nickel is associated with five cents and “nickel.” Following attainment of the cardinality of money, children need to develop the ordinality of money for comparing the value between two different kinds of coins or paper money. Both the cardinality and the ordinality concepts of money facilitate children’s addition and subtraction problem-solving in their actual and pretend buying and selling activities. Berti and Bombi (1981) also recognize that children need to establish one-to-one correspondence between goods and money when they are involved in buying or making change. It seems apparent that young children’s number concepts relate to their monetary concepts and monetary skills. Further, monetary concepts benefit the acquiring of monetary skills.

Definitions of monetary concepts and skills

There are several views about what is money. Wyatt and Hinden (1991) refer to money as bits of metal and paper that makes it possible for children to play video games, save for a new bike, or buy some candies. Fumham and Lewis (1986) suggest not only coins and paper money (notes, bills) as money but also credit cards.

Operational definitions of children’s monetary concepts have changed over the past 40 years. Strauss and Schuessler (1951) defined children’s monetary concepts as coin recognition (i.e., naming coins by various ways), comparative value (i.e., knowing which money is worth more), and equivalence (i.e., realizing the change). McCarty (1967) defined children’s monetary concepts as distinguishing coins, naming coins, comparing the value of coins, and knowing the equivalent value of coins using a penny, a nickel, a dime, a quarter, and a half-dollar. Edmunds and Whitehurst (1973) argued that monetary concepts include naming the denominations of money and being aware of the purchasing power of money. They expanded monetary concepts to include the paper bills, especially naming the coins and bills, comparing the values of coins or bills, and knowing what money could buy.
Few studies have focused on children's monetary skills, although monetary skills seem to be implied in the preceding definitions of monetary concepts. It seems that money abstraction and monetary reasoning are parallel concepts with a similar relationship to the conceptualization of number abstraction and numerical reasoning. Money abstraction, as presented by Gelman and Gallistel (1978), can be defined as the process that children use to get a monetary representation for a special array, such as distinguishing money, naming money, and comparing the value of money. Money abstraction, as presented here, is a new definition of monetary concepts.

Similarly, monetary reasoning can be defined as monetary skills, which are the procedures that children use to decide the outcome of manipulating money in various ways, such as using money in buying and selling activities or saving money. However, it is reasonable for young children, because of their limited experiences, to adopt the narrower definition of monetary skills as using money in buying and selling activities (Robison, 1964; Stacey, 1982). Fox (1978) argued that it is important for children to understand the nature of exchanging money for goods when they use money in the process of buying and selling activities. Dunkin (1972) and Harper (1973) also found that five-year-old children were able to complete the equivalent value task between goods and money while using simple coins, such as pennies, dimes, or nickels. Therefore, in the future studies, it is better to operationalize monetary skills for young children as their equivalent paying behaviors during the process of buying and selling activities.

Children's monetary study approaches

Monetary concept studies. The two kinds of research methodologies used in children's monetary studies are the clinic interview and a dramatic play situation with a store theme. An early monetary study by Strauss and Schuessler (1951) used 71 interview questions with sixty-six 4½ - to 11-year-old children, five boys and five girls at each age interval. Their findings revealed developmental stages for coin recognition, comparative
value, and equivalence tasks. Five-year-olds distinguished nickels from other silver coins but they could not name all of the remaining coins correctly. Six-year-olds knew the value of coins and recognized that nickels could buy more candy than pennies, and dimes more than nickels or pennies. Seven-year-olds could add piles of coins and know the differences in the total value. Also, they could make correct change with the idea that the customers needed to pay more than the storekeeper for the same item. After age 8, they understood the roles of a buyer and a seller.

Using a Piagetian-type interview, Edmunds and Whitehurst (1973) studied the monetary concepts of eighty 2- to 8-year-old African-American children. The study showed that 2- and 3-year-olds named any kind of coins as money; 4-year-olds could identify a penny; and 5-year-olds could easily recognize a penny and dime but they still confused a nickel and a quarter. Children recognized the one-dollar bill around age seven. Knowledge about the purchasing power of money began to emerge at age four; however, it was not until age 6 that true knowledge of money was presented. By age eight, the children were responding correctly to the question "Which is more?" and they were starting to offer explanations based on value or purchasing power. In addition, socioeconomic status was a significant factor in children's monetary development. Low-socioeconomic children tended to identify coins more correctly than middle-socioeconomic children. Middle-socioeconomic children identified paper money earlier than their low-socioeconomic agemates.

A number of studies have investigated children's monetary concepts (Anderson, 1974; Anderson & Fulton, 1987; Dunkin, 1972; Harper, 1973; Paxton, 1986; West, 1971) by using McCarty's Monetary Concepts Task Test (1967). McCarty's (1967) Monetary Concepts Task Test includes four subtasks: Money-Sorting Tasks, Coin-Identification Tasks, Comparative-Value Tasks, and Equivalent-Value Tasks. The Money-Sorting Tasks investigates whether children can sort coins from other objects. In the Coin-Identification Tasks, children are asked to put their finger on a coin, and name the coin. In the
Comparative-Value Tasks, children are asked, "Which piece of money would buy the most candy at the store?" (p. 15) These three tasks use a Piagetian-clinical interview format and the Equivalent-Value Tasks use combinatorial coins to buy objects in a dramatic play store setting.

The studies by Anderson (1974), Dunkin (1972), Harper (1973), Paxton (1986), and West (1971) used the four monetary concept subtasks described above for 3- to 8-year-old children. Harper (1973) and Dunkin (1972) asserted that the Money-Sorting Tasks were not challenging for children beyond age 5. Children as young as 3 years were able to distinguish between money and non-money objects very well (West, 1971). Dunkin (1972), Harper (1973), and West (1971) found that the Equivalent-Value Tasks were too difficult for 3- to 5-year-old children because of the complicated values of coins; for example, using five nickels, three dimes, and a half-dollar to buy an item that was worth a quarter.

Research using McCarty's Monetary Concept Task Test, shows that children's monetary concepts increase with age without differences between boys and girls (Anderson, 1974; Anderson & Fulton, 1987; McCarty, 1967; Paxton, 1986; West, 1971). Chi-square analyses revealed that it was easier for 3- and 4-year-olds to identify a penny and a nickel than a dime, a quarter, and a half-quarter (West, 1971). The findings of Anderson and Fulton (1987), Dunkin (1972), Harper (1973) and Paxton (1986) indicated that 5-year-olds were able to name a penny, nickel, and dime, but they could not distinguish between the value of a dime and a nickel in the Comparative-Value Tasks. Further, it was difficult for 3- to 5-year-olds to use dimes, quarters, or half-dollars in the dramatic play store setting (Dunkin, 1972; Harper, 1973; McCarty, 1967; Paxton, 1986; West, 1971).

Using a buying and selling dramatic play setting, Berti and Bombi (1981) identified four developmental stages for preschoolers' monetary skills as reported earlier: no payment, displaying obligatory payment, presenting the notion that not all types of money can buy everything, and showing that sometimes the amount of money available is not enough to buy
an item. This sequence suggests that 5-year-old children can understand the notion of some items costing more than others. Although the preschoolers did show an understanding of monetary concepts, they did not use the correct monetary skills when various kinds of coins were present simultaneously. The complicated monetary value of coins seemed to easily confuse them. Pollio and Gray's (1973) results also support this finding. They studied the change-making strategies of children and adults, and found that 7-year-olds were able to use pennies and dimes in change-making but not quarters or nickels.

Rea and Reys (1971) explored the geometry, number, money, and measurement abilities of 727 entering kindergartners. They found that 71% of the five-year-olds were able to identify numbers from 1 to 5, and 44% of them knew 1 to 11. Their cardinality was numbers 1 to 8. Approximately 72% of them were capable of comparing number 3 with number 4. Most of the children (87%) succeeded in identifying a penny, nickel, and dime; about 40% knew a quarter and half dollar; more than 57% were aware of the $1, $5, and $10 bills. In addition, they reported that 70%-72% knew the penny would buy the least amount, whereas the half-dollar would buy the most. Only 48%-53% achieved the value comparison among the $1, $5, and $10 bills. Also, pennies were easy for them to use when they were making change.

Economic concept studies. One aspect of monetary concepts concern understandings about economics as an area of economics education. Some researchers have investigated young children's monetary concepts and skills. Several decades ago, Danziger (1958) explored the understanding of relationships among economic concepts of 41 Australian children. Using interviews with children ages 5 to 8 years, he asked them three questions about money: "Why do we have to give money when we buy things in a shop?", "What does the man in the shop do with the money he gets?", and "Where does money come from?" (pp. 233-235). The qualitative findings showed that children's conceptual development of money was stagelike with a significant difference in development between
ages 5 and 8. Five-year-olds used more moral imperatives in their answers, such as "You'll be put in jail because that's stealing without paying the money (p. 233)." In contrast, most eight-year-olds responded in terms of rational economic considerations.

Grojean (1972) investigated 41 4- to 5-year-old children and their parents about the monetary experiences and consumer practices of young children. The findings showed that all of the children had some experience in obtaining money as well as spending money. Their money sources were allowances, gifts, or earnings. While more than 85% of the parents and children reported children's experience in saving money, less than 20% of those children had experience in borrowing money. There were no age and sex differences in children's monetary experiences.

Tan and Stacey (1981) investigated the economic concepts of Malaysian Chinese school children. Through interviews, 120 children ages 6 to 15 years were asked questions related to money such as buying and selling, saving money, banks, and gambling. The interview questions included "Where does money come from?", "Why do we have to give money when we buy things in the shop?", "What do you do with your spending (pocket) money?", and "Is money important?" The qualitative data showed a developmental trend for children's economic concepts. Most 6- and 7-year-old children already knew the importance of money because of its purchasing power. An age by sex interaction effect also was found. Between 14 and 15 years, boys displayed a greater understanding of money for buying and selling, and of the importance of money than girls. Family socioeconomic status was not a significant influence on children's understanding of economic concepts.

Ng (1983) studied children's ideas about the profit earned by shopowners and at the bank. He interviewed 96 6- to 13-year-old boys in Hong Kong. The results showed that the understanding of shop profit emerged at age 6, while that of bank profit was present at age 10. In this study, the understanding of shop profit was represented by the boys' knowledge of a lower buying price together with a higher selling price.
In summary, 3-year-olds can distinguish between money and non-money items, and they can name pennies. Most 4- and 5-year-olds can name a penny, a nickel, and a dime. Most of them are able to compare the value of coins; however, it is difficult for them to use various coins or bills to make change. Perhaps this skill is more challenging because it requires the understanding of the larger numbers used in addition or subtraction problem solving, such as 10, 25, or 50. For 5-year-olds, they have basic knowledge of money as well as the functions of money, business practices, and banks, and they also have some monetary experience. In fact, 5-year-olds live in a world familiar with money practices, and they have the knowledge base to learn more about money.

Parental Influence On Young Children's Learning

Theoretical perspectives on parents and children

According to Vygotsky (1978), children’s intellectual skills are products of the activities practiced in the social institutions of their culture. Cognitive development is the process of children internalizing the processes and outcomes of their transactions with their environment. Environment shapes children’s thinking and learning. Saxe’s (1988) findings regarding children’s mathematical abilities showed that Brazilian unschooled child street vendors’ experiences of candy selling facilitated their mathematical understandings. They were able to deal with arithmetical questions with large currency values, e.g., Cr$ 2000 + Cr$ 3500 = ?, while children with school learning were taught standardized procedures with little or no application.

In addition to the influence of culture, Vygotsky (1978) also argued that children learn appropriate solutions to problems through interacting with their parents. He defined the zone of proximal development to explain the differences between children’s current ability and their ability when they are assisted by an adult (including parents). Rogoff (1990, 1993) used the term "guided participation" to extend Vygotsky’s zone of proximal development. Guided
participation refers to "adult-child interactions, not only during explicit instruction, but also during the more routine activities and communication of everyday life," such as doing chores and watching television (Bjorklund, 1995, p. 447). Therefore, parents are an important factor in promoting their children's learning about such concepts as numbers and money. Some research findings already have supported Vygotsky and Rogoff's view. For example, Sears and Medearis's Natural Math project (1992), which encouraged parents to engage in 3- and 4-year-old preschoolers' math activities and games at home, revealed the efficacy of their activity on the children's kindergarten mathematical achievement. Lehrer and Shumow (1995), based on Vygotsky's view of proximal development, designed an experimental situation to provide parents with information, examples, and experiences about children's mathematical thinking. They found benefits in the areas of arithmetic skills and spatial reasoning of second-grade children using these strategies. Ely and Gleason (1995) examined conversations concerning the vocabulary of money between parents and their young children ages 27 to 61 months in a laboratory setting. They observed explicit interactions between parents and their children involving money. This issue will be explored later.

Ward's (1974) information processing notion of consumer socialization proposes that learning specific basic economic concepts occurs at various developmental stages for children and parents are a major influence on children's experiences with money and their attitudes toward consumption. Consumer socialization is the "processes by which young people acquire skills, knowledge, and attitudes relevant to their effective functioning as consumers in the marketplace" (Ward, 1974, p. iv). Neisser (1960) argued that young people's monetary understanding and attitudes derive from direct experiences and explicit teaching in their home. Parents are the role models identified in McGuire's consumer information processing model (1974). McGuire's consumer information processing model hypothesized that children learn about money from their parents in a multistage process.
using attention, representation, comprehension, acceptance, retention, and behavior (as presented in Calder, Robertson, & Rossiter, 1975). For example, children pay attention to the ways their parents use money, and later they imitate these behaviors when playing store.

Parental influence on young children's number learning

Educators have devoted much attention and energy to improving the learning of children. Several studies provide further evidence of the impact of the parental attitudes, belief, or behavior on the educational achievement of their children (Blevins-Knabe & Musun-Miller, 1995; Chance, 1968; Jordan, Huttenlocher, & Levine, 1992; Lehrer & Shumow, 1995; Lummis & Stevenson, 1990; Neitzey, 1992; Pletan, Robinson, Beminger, & Abbott, 1995; Rankin, 1967; Sears & Medearis, 1992).

Sears and Medearis's (1992) Natural Math project encouraged 140 Native American and African-American parents to engage in math activities and games at home. The purpose of this project was to determine if family interaction in math activities with 3- and 4-year-old children was able to lead to higher performance by the children at kindergarten and to a higher level of family-child interaction with math through activities and games. The children, who were enrolled in five Head Start and two kindergarten classes, were assigned randomly into an experimental group and a control group respectively, and were tested by the ABC Inventory to determine their verbal, math, and social skills when they entered kindergarten. Also, before and after participation in this project, their parents were surveyed using the Parent-Child Interaction Questionnaire developed by Medearis (Sears & Medearis, 1992). The Natural Math activities include counting rhymes, parent-child conversation, incidental math learning, number counting, and the recognition of shapes and math symbols. Although the results showed that the Parent-Child Interaction Questionnaire had limited value owing to the low return rate of the survey, those who returned the questionnaires indicated that the Natural Math project had helped their children. The Parent-Child Interaction Questionnaire had high construct validity with the standards of the National Council of Teachers of
Mathematics. In order to get more information from parents, observations and one to one conversations with parents and family members were used. The results showed that the parents who were provided with tools and suggestions were willing and interested in helping their child. In addition, their children had higher raw scores on the ABC Inventory test than those children whose parents did not participate in this parent-child interaction project.

Neitzey (1992) examined the efficacy of parents' participation in kindergarten children's learning at home through self-report and a 12-week parent education program. First, participating parents were asked to list the activities that they shared with their children during the 12-week parent workshop. Second, the parents were instructed how to use appropriate activities to develop their children's language, math learning, and critical thinking skills. Third, they discussed their successes and difficulties with the activities. A follow-up survey revealed that the workshop was successful in training parents to choose appropriate home activities; however, the kindergartners' math and language scores did not change.

Jordan, Huttenlocher, and Levine (1992) compared the influence of middle- and low-income families on their kindergarten children's calculation abilities. They found that children from middle-income families had higher scores than those from low-income families on each of the verbal calculation tasks. There was no difference on the nonverbal calculation tasks between the two groups.

In addition, Lehrer and Shumow (1995) adopted Vygotsky's zone of proximal development to study whether parents who received information, examples, and experiences about children's mathematical thinking affected their children's mathematical learning. Using an experimental design, a randomly selected group of second-grade children's parents (N = 42) were provided with related mathematical information, examples, and experiences. The results showed that children whose parents participated in an educational program were more successful in arithmetic problem-solving than children whose parents did not take part in the program.
Blevins-Knabe and Musun-Miller (1995) examined whether parents' beliefs about sources of influence on their own learning of mathematics were associated with their beliefs about influences on the mathematics learning of their kindergartners. There were 61 parents and 49 five-year-old children in the study. The Test of Early Mathematics Ability-Second Edition (TEMA-2) was used to measure the children's math achievement and as the basis for the questions in the parents' interviews. TEMA-2 includes counting, concept, and computation items. For each TEMA-2 item, parents were asked to rate the degree of influence of parents, school, natural ability, self-discovery, peers, and television. Results indicated that it was important for parents to believe that they had an effect on how their children learned mathematics. This finding suggests that the adequacy of parents' learning instructions and their attitudes toward their children's learning are critical for children to learn about numbers.

Similarly, Pletan, Robinson, Beminger, and Abbott (1995) used questionnaires to understand parents' beliefs about their kindergartners' mathematical abilities, and tested children by the arithmetic subtests of the Kaufman Assessment Battery for Children and the Wechsler Preschool and Primary Scale of Intelligence. They found that parents were able to identify their children's mathematical abilities and that they could describe their children's mathematical behaviors in coherent ways; that is, there was a high correlation between the parents' observations about children's knowledge and their children's number learning.

Researchers have found a significant relationship between parenting and the academic achievement of their elementary school children (Chance, 1968; Lummis & Stevenson, 1990; Rankin, 1967; Reynolds & Mavrogenes, Bezruoczko, & Hagemann, 1996). Rankin (1967) chose 32 high-achieving and 32 low-achieving third and fourth graders and their parents for the study. Their mothers were interviewed by questionnaire to explore the kinds of behavior considered to have potential influence on their children's achievement. The results indicated that children's achievement in school was related to the amount of interest
the parents showed in their children's school activities, the extent to which parents
encouraged their children to read, their level of aspiration for their children’s educational
attainment, the extent to which parents shared experiences with children, and the extent to
which parents communicated with school personnel. These findings support Vygotsky's view
of zone of proximal development and Rogoff’s notion of guided participation.

Chance (1968) explored the relationships between mother-child relations and their
third-grade children's achievement. The participants were 59 boys and 59 girls with high IQ
and their mothers. This research showed that children’s effective achievement performances
were associated with maternal attitudes toward control of children’s behavior. Maternal
permissive behaviors rather than greater concern with control, facilitated their children's
school performance for both sexes. Mothers’ expectations were related to children’s gender;
that is, boys had higher expectations than girls.

Concerning the influence of gender, Lummis and Stevenson (1990) examined the
relationships between parental beliefs and their children’s achievement in reading and
mathematics in kindergarten, grade 1, and grade 5 in Taiwan, Japan, and the United States.
The 864 kindergartners, with equal numbers of boys and girls, were tested for general
information, visual memory, verbal-spatial skills, and digit span. The other 720 first-graders
and 720 fifth-graders received the mathematics test, 10 tests of cognitive ability, and a rating
scale interview. Mothers of all participants were given rating scales to indicate their children's
performance in reading and mathematics and the child's motivation to do well in school. The
findings showed that there were no gender differences for the mathematical tests in
kindergartners, first-graders, and fifth-graders. However, the first-grade boys showed higher
interest in the solution of word problems and higher abilities in visualization and estimation
tests than the same age girls. Gender differences were of equal magnitude in all three
countries. Moreover, there were no gender differences in cognitive tests of kindergartners,
whereas the differences increased with age. After first grade, girls got higher scores than
boys on coding, verbal memory, and auditory memory. Boys had higher scores than girls on spatial relations and general information. Specifically, this study found that there were gender differences in mothers' beliefs about who was better at reading and mathematics. In general, no matter what country and grade, mothers tended to believe that boys were better at mathematics and that girls were better at reading as early as first grade.

Reynolds, Mavrogenes, Bezruyczko, and Hagemann (1996) examined whether cognitive and family support influence children's school achievement by testing 360 low-income black children at a 3-year follow-up in the sixth grade. The children's cognitive readiness at kindergarten entry was incorporated in an explanatory model. The entering kindergarten cognitive readiness was measured by the Iowa Tests of Basic Skills (ITBS), which includes listening, word analysis, vocabulary, language, and mathematics. By using LISREL 8 path analysis, the results revealed that parents' involvement in school significantly mediated the estimated effects of preschool participation on school achievement. That is, children who had attended preschool had parents with higher participation in school activities, which in turn facilitated their children's achievement in reading and math in the sixth grade.

In conclusion, parents play a significant role in young children's mathematical learning. The more attention that parents give their children's learning, the higher achievement their children attain.

**Parental influence on young children's monetary learning**

Although numerous researchers have studied the relationship between parental practices towards their children's learning of numbers, few researchers have examined the impact of parental practices on young children's monetary concepts and monetary skills. Symth (1994) argues that parents are responsible for teaching their children about the value of money; however, little is known about the actual practices of parents or the outcomes for young children. Neisser (1960) argued that children's attitudes toward money were learned
from explicit teaching in their homes and the implicit teaching of the culture.

Several decades ago, Marshall and Magruder (1960) examined the relations between parental money education practices and their children's knowledge and use of money among 128 children each at the ages of 7, 8, 11, and 12 years and their parents. Children were interviewed at school and their parents were interviewed at home within two months following the child's interview. The children's questions included how they received money, how much was received and how it was used, their experiences making decisions about and purchasing their own clothing, their part in family decisions about purchases, and their experiences in saving money. Parents' questions were related to family practices in the following areas of money management: planning the use of the family income, decisions for and selection of purchases, control of the family purse, the use of banks and commercial financial records, provision for the future, talking to children about money, use of money to reward and punish children's behavior, attitudes toward the importance of money, and family income. Their research resulted in five important findings that emphasized the role of parental practices in children's money learning. First, children showed more knowledge of and experience with money if they had been given wide experience in the use of money. Second, children had more knowledge of money use if they had been given money to spend. Third, it was not the amount of money given to the child, but the way money had been used that determined whether the child gained knowledge from the experience. Fourth, children had more knowledge of money if they had saved money. Fifth, children ages 11 and 12 years had more knowledge of and experience with money if their parents handled the family income wisely.

Ely and Gleason (1995) studied how parents exposed their children to statements or explanations about money. The participants were 24 white middle-class families, including 12 boys and 12 girls between the ages of 27 and 62 months, who were audio-recorded during dinner at home. In addition, children were observed once with their mother and once with their father playing store in a laboratory setting. The monetary terms of buy, dollar, cash,
dime, change, and quarter were used. This research found that there were more conversations about money in the laboratory setting than at home. In the laboratory, most parents explicitly taught their children about monetary terms. The complexity of the mother's money lexicons was correlated positively with the child's age. Fathers talked more about money with boys than with girls.

Other attributes of parenting and family also are associated with children's money learning. Eliot (1932) and Neisser (1960) found that the emotional climate of the home was instrumental in the development of children's attitudes toward money. Edmunds and Whitehurst's study (1973) indicated that parents' socioeconomic status (SES) was related to children's monetary concept development. They found that lower-SES children generally identified coins at an early age while middle class children identified various denominations of paper money earlier.

Kourilsky (1977) designed a case study of the kinder-economy and asserted that the extent of dialogue initiated by the child with the parents about economics was a predictor of economic comprehension. She used a five-point rating questionnaire survey to understand parents' attitudes about the teaching of economics. The results showed that parents' attitudes toward economics education had a highly positive effect in determining the children's learning of economics topics. In addition, children's economic learning from school can facilitate the dialogue between parents and children at home.

Guberman (1996) studied Brazilian children's everyday mathematics. Interviews with the parents of 105 children from 4 to 14 years of age showed that parents required their children to make purchases everyday and they involved greater arithmetical complexity with increasing age of the children. Based on preliminary interviews and observations, there were four categories to indicate the responsibilities parents assigned their children. First, exact purchase indicated that children were given the exact amount of money needed for the purchase. Second, expect change represented the interaction that children were told to wait
for change. Third, confirm change meant that children were told the amount of change to expect and they were responsible for confirming the change. Fourth, calculate purchase indicated that children needed to add and subtract item costs and monetary values. This study found that most 4- to 8-year-old children were given the exact amount of money to purchase or if they needed to wait for change they were not expected to count the money. Those children did not identify the values of currency in the monetary screening task very well. Conversely, 9- to 14-year-old children were assigned more responsibilities and showed greater arithmetical accuracy and more sophisticated problem-solving strategies. Parents who provided their children opportunities to participate in community activities (e.g., buying), then benefited their children's learning and development.

In summary, while research findings from the previous studies are informative, none of them distinguish between monetary concepts and monetary skills. Although parents are significant persons who provide direct money learning experiences for their children at home, little is known about the relationships among parental monetary practices and their children's monetary concepts and monetary skills. For future research, it is worthwhile to explore whether parental monetary practices facilitate their children's monetary concepts and monetary skills development and to examine what parental monetary practices are effective.

Conclusions

The previous review of literature clearly shows that children's number concepts emerge from their numerosity in infancy. They understand smaller amounts of numbers before larger amounts of numbers. They realize the amount of numbers first, then they figure out the order of numbers. According to Piaget (1965), for children under 7, their number judgments depend on their direct experiences. Children cannot have any meaningful understanding of numbers until they reach the concrete-operational period of cognitive development about age 7. However, Gelman and Gallistel (1978) assert that young children
can learn numbers although they cannot conserve numerical structures. Counting is the common way for young children to judge the quantity (i.e., cardinality) and to judge which number is larger or smaller (i.e., ordinality). Numbers 1 to 7 are manageable for many young children to count accurately. For example, numbers 2 and 3 are suitable for many 2-year-olds (Fuson et al., 1985) and numbers under 5 are used by most 3- and 4-year-olds (Sophian, 1988). Five-year-olds can work successfully with numbers 1 to 6 (Becker, 1989; Fischer & Beckey, 1990), or numbers 1 to 7 (Fischer & Beckey, 1990). Besides, they can operate simple counting up to the number 10, understand the meanings of "some," "a few," and "a lot," and do addition and subtraction problems based on the number 5 or 10. Gelman and Gallistel (1978) define children's number concepts as number abstraction, such as one-to-one correspondence, cardinality, and comparison of numbers. The ability of children's operating addition and subtraction is defined as numerical reasoning, which represents children's arithmetic concepts.

Concerning young children's monetary development, little is known about the distinction between monetary concepts and monetary skills. However, it seems that money abstraction and money reasoning are parallel concepts with a similar relationship to the conceptualization of number abstraction and numerical reasoning defined by Gelman and Gallistel (1978). Young children's monetary concepts include distinguishing money, naming money, and comparing the value of money. Their monetary skills are using money in buying and selling activities. Research has shown that most 3-year-olds could distinguish between money and non-money items and name a penny (West, 1971). For 4- and 5-year-olds, they were capable of naming a penny, a nickel, and a dime, and comparing the value of coins (McCarty, 1967; West, 1971). For 5-year-olds, some monetary experiences occur, such as buying and getting allowance (Grojean, 1972). They were able to identify the penny as a basic money unit and to name a penny, nickel, and dime (Anderson & Fulton, 1987; Dunkin, 1972; Edmunds & Whitehurst, 1973; Harper, 1973; Paxton, 1986). They also were able to
understand that some items cost more than others, and to pay the equivalent value for goods by using simple coins such as pennies, nickels, and dimes.

The environmental factor, parental practices on children's learning of number and money, is a significant influence on children's number and monetary learning. Research showed that parents who provided more number learning practices at home or participated in more school activities facilitated their children's mathematical achievement (Lehrer & Shumow, 1995; Sears & Medearis, 1992). Also, parents who provided more direct money learning experiences at home helped their children's acquisition of monetary knowledge (Guberman, 1996; Marshall & Magruder, 1960). Previous research did not distinguish monetary concepts and monetary skills. Researchers also did not examine the effective parental practices for their young children's learning of numbers and money. According to Gelman and Gallistel's definition of number concepts, monetary abstraction and monetary reasoning can be considered to use in the future studies. Moreover, how parental monetary practices influence their children's number concepts, monetary concepts and monetary skills, needs to be explored in the future.

References


CHAPTER 2: THE IMPACT OF PARENTS’ NUMBER AND MONETARY PRACTICES ON THEIR KINDERGARTNERS’ NUMBER CONCEPTS, MONETARY CONCEPTS, AND MONETARY SKILLS

A paper to be submitted to Early Childhood Research Quarterly

Jyh-Tsomg Jong, Joan E. Herwig, and Mack C. Shelley

Abstract

The purpose of this empirical study was to test an exploratory model to explain the relationships between parents’ math behaviors and their kindergartners’ number and money learning. The 207 kindergartners participated in number and monetary tasks during clinical interviews. Each child’s father or mother completed number and monetary home practices questionnaires. By using path analysis through LISREL 8.12, the results showed that kindergartners’ use of money was influenced significantly by their number concepts (cardinality #9 and cardinality #12) and monetary concepts (knowing coin names and knowing coin values). Kindergartners’ cardinality benefited their acquisition of knowledge of coin values. They learned numbers representing a small amount to a large amount, understood the coin names before the coin values, and were able to complete matching paying prior to transformation paying. Parental direct money teaching strategies had a positive impact on kindergartners’ acquisition of knowledge of coin names. Kindergarten parents who reported more frequent direct teaching of numbers also reported more frequent direct teaching of money with their children. No relationship was found between parents’ number practices with kindergartners and kindergartners’ number learning, and there was no effect between parents’ monetary practices with their kindergartners and kindergartners’ monetary use.
Knowledge about numbers and money is the basis for consumer skills. Research has shown that people start to know about numbers and money in early childhood (Berti & Bombi, 1981; Gelman & Gallistel, 1978; Piaget, 1965; Strauss & Schuessler, 1951), and parents are a major influence on their children's number and money learning (Bronfenbrenner, 1979; Ward, 1974). Many researchers have studied the development of young children's number concepts (Becker, 1993; Frye et al., 1989; Michie, 1985; Mohan, 1984; Sophian, 1988; Wynn, 1992; Yoshida & Kuriyama, 1986), and monetary concepts (Anderson, 1974; Berti & Bombi, 1981; Dunkin, 1972; Edmunds & Whitehurst, 1973; Harper, 1973; McCarty, 1967; Robison, 1964). Others have explored the parent-child relationship and children's mathematical learning (Blevins-Knabe & Musun-Miller, 1995; Lehrer & Shumow, 1995; Sears & Medearis, 1992), as well as the influence of parents on young children's monetary learning (Ely & Gleason, 1995; Kourilsky, 1977; Marshall & Magruder, 1960). However, researchers have not examined the interactive relationships among children's number concepts, monetary concepts, and monetary skills, or the relationship of these concepts and skills with parenting practices. These relationships for kindergartners and their parents will be examined in this study.

Young children's number concepts

A review of the research concerning children's number concept reveals that there are two approaches attempting to explain the development of young children's number concepts. One is the Piagetian theory (1965) of children's number concepts and the other is Gelman and Gallistel's counting principles (1978).

According to Piaget (1965), children need to complete one-to-one correspondence tasks and to conserve numerical structures to understand numbers. One-to-one correspondence is the relationship between two sets that had the same cardinal value (Becker, 1989). In the number conservation tests devised by Piaget, children are shown two
sets in one-to-one correspondence and are asked to judge their relative numerosity. Whether 
one of the sets is transformed by closing up the spaces or by spacing it out with the same 
number of objects, children need to understand that the numbers in both sets are the same. 
This theory maintains that children cannot have any meaningful understanding of numbers 
until they reach the concrete-operational period of cognitive development, at the age of 
approximately seven years; otherwise, they are easily distracted by perceptual contact.

Gelman and Gallistel (1978) offered another explanation regarding the development 
of number concepts. They emphasized that young children do not lack totally understanding 
of invariance of number. Most children have acquired considerable mathematical knowledge 
before starting formal schooling (Gelman & Gallistel, 1978; Leder, 1989). Gelman and 
Gallistel also declared that the development of numerical abilities in young children is 
represented by their number abstraction and numerical reasoning, respectively. Number 
abstraction is the process that children use to obtain a numerical representation of a 
particular array, such as discrimination learning (i.e., which number is larger or smaller), 
absolute judgment (i.e., how many are there), and matching to sample (one-to-one 
correspondence). Numerical reasoning is the process that children use to define the 
outcomes of manipulating sets in various ways, such as class-inclusion tasks, addition tasks, 
and subtraction tasks. Bjorklund (1995) suggested that number abstraction indicates 
children's knowledge of number concepts and numerical reasoning represents children's 
arithmetic concepts.

Gelman and Gallistel (1983) asserted that counting is the common way children 
represent number abstraction. Counting enables young children to make quantitative 
determinations of amount. They identify five counting principles used by children: (1) the one-
one principle, where one counting word is assigned to each object; (2) the stable-order 
principle, where a single sequence of counting words is used in agreement; (3) the cardinal 
principle, where the last counting word used is the total in the set; (4) the abstraction
principle, where the counting procedure can be applied to all kinds of objects; and (5) the order-irrelevance principle, where objects can be counted in any reasonable sequence. Children possess these basic conceptual principles to guide them in learning numbers.

Several studies found that 3- to 7-year-old children possessed one-to-one correspondence ability based on their direct experiences with relevant items and questions, although they did not complete conservation tasks successfully (Becker, 1989; Halford & Boyle, 1985; Sophian, 1988). Also, 3- to 5-year-old children were very good at recognizing a correct standard counting procedure (i.e., their cardinality response was their last-word response); they counted small sets using numbers from 1 to 5 (Becker, 1989; Fuson et al., 1985), numbers from 1 to 6 (Becker, 1989; Fischer & Beckey, 1990; Sophian, 1988), or numbers from 1 to 7 (Fischer & Beckey, 1990; Sophian, 1988). The 4-year-olds began to show a rudimentary understanding of the quantitative terms of some, a few, and a lot, whereas 5- and 6-year-olds knew those quantitative terms (Mohan, 1984). The 5-year-olds were very successful in completing the compare-sets tasks, counting all or subsets, small or large sets, and equal or unequal questions (Becker, 1993; Fischer & Beckey, 1990), and even the simple addition and subtraction problems based on the number 5 or 10 (Fuson et al., 1988; Yoshida & Kuriyama, 1986). These findings offer considerable support for Gelman and Gallistel's view that young children can use their particular individual perspective to formulate their own number concepts. In the present study, children's number concepts are defined as number abstraction using Gelman and Gallistel's principles. The operationalization of number concepts includes Counting/Cardinality Tasks and Comparing/Ordinality Tasks beyond the number 7.

**Young children's monetary concepts and skills**

Most studies concerning young children's monetary knowledge are based on the constructivist, developmental stage theory of Piaget (Berti & Bombi, 1981; Schuessler & Strauss, 1950; Strauss & Schuessler, 1951; Strauss, 1952). According to Piaget, children's
understanding of money develops from concreteness to abstractness (Schuessler & Strauss, 1950). Preoperational children differ from children in concrete operations because their judgment is limited by their perception and intuition (Bjorklund, 1995) and they organize reality from their own experiences. They confuse the size of a coin with its value; for example, they frequently believe incorrectly that a dime is worth less than a nickel (Anderson, 1974; Anderson & Fulton, 1987; Dunkin, 1972; Harper, 1973; McCarty, 1967; Paxton, 1986; West, 1971). As coins and paper money do not have any apparent systematic physical relationship to each other, children need to acquire another method to distinguish them from each other. Relatively little is known about children's monetary concepts and how their monetary skills develop, in contrast to their knowledge about children's number concepts.

Operational definitions of children's monetary concepts have changed over the past 40 years. Strauss and Schuessler (1951) defined children's monetary concepts as coin recognition (i.e., naming coins by various ways), comparative value (i.e., knowing which money is worth more), and equivalence (i.e., making change). McCarty (1967) defined children's monetary concepts as distinguishing coins, naming coins, comparing the value of coins, and knowing the equivalent value of coins using a penny, a nickel, a dime, a quarter, and a half-dollar. Edmunds and Whitehurst (1973) argued that monetary concepts include naming the denominations of money and being aware of the purchasing power of money. They expanded the definition of monetary concepts to include paper bills, specially naming the coins and bills, comparing the values of coins or bills, and knowing what money can buy.

Few studies have focused on children's monetary skills, although knowledge associated with monetary skills seems to be inferred in the preceding definitions of monetary concepts. It appears that money abstraction and monetary reasoning are parallel concepts with a similar relationship to the conceptualization of number abstraction and numerical reasoning. Money abstraction, as presented by Gelman and Gallistel (1978), is defined as
the process that children use to get a monetary representation for a set of items, such as distinguishing money, naming and valuing money (cardinality of money), and comparing the value of money (ordinality of money).

Similarly, monetary reasoning can be defined as a component of monetary skills, which are the procedures that children use to decide the outcome of manipulating money in various ways, such as using money in buying and selling activities or saving money. Generally, however, the monetary reasoning of young children is using money in buying and selling activities, a more restricted definition (Robison, 1964; Stacey, 1982).

Young children have demonstrated increasing knowledge concerning money. Researchers have found that children as young as 3 years were able to distinguish between money and non-money objects (West, 1971). Four-year-olds could identify a penny, and 5-year-olds readily could name a penny, nickel, and dime, and compare the value between a penny and a nickel, a penny and a quarter, a nickel and a quarter; the 5-year-olds sometimes confused the value of a nickel and a dime because size was the most outstanding perceptual feature of the coins for them (Anderson & Fulton, 1987; Dunkin, 1972; Edmunds & Whitehurst, 1973; Paxton, 1986; Rea & Reys, 1971). Berti and Bombi's (1981) study showed that 5-year-old children understood the notion of some items costing more than others and they displayed obligatory payment by using simple coins during buying-selling activities. Rea and Reys (1971) found that most of the 5-year-olds knew that a penny buys the least amount, whereas a half-dollar buys the most.

These findings demonstrate that 5-year-olds are very capable of learning about money. This age group also is the entry level for elementary school; therefore, 5-year-old kindergartners are a good age group with which to study the monetary concepts and skills that exist prior to more focused academic instruction. Although some studies indicated that it was difficult for 5-year-olds to use various coins simultaneously, for example, using five nickels, three dimes, and a half-dollars to pay for an item that was worth a quarter (Dunkin,
1972; Harper, 1973; McCarty, 1967; Paxton, 1986; West, 1971), there is evidence that they can use pennies, nickels, and dimes to pay for items of lesser value based on their number understanding. In the present study, children’s monetary concepts are defined as monetary abstraction and monetary skills are defined as monetary reasoning. Their operationalized definitions are coin-identification and comparative-value for monetary concepts, and using money in pretend buying and selling activities for monetary skills.

**Relations among children’s number concepts, monetary concepts, and monetary skills**

A direct relationship between number concepts and monetary skills has been established with the consumer behavior studies of teenagers and adults (Miller, 1987; National Assessment of Educational Progress, 1979; Ohio State Board of Education, 1980). These studies showed that consumer skills include mathematical abilities. Monetary skills are a kind of consumer skill that involves buying, selling, saving, budgeting, and resource decision-making. Thus, it is apparent that monetary skills are related to mathematical abilities. Moreover, children’s mathematical abilities emerge from their number concepts (Bjorklund, 1995). In mathematical problem-solving situations, children need to use their basic knowledge about numbers (e.g., what are numbers?) to solve any math problem that is presented to them. Consequently, based on logical reasoning, it appears that number concepts are associated with monetary skills. For example, people need to know the cost of an item to purchase it during the buying process. Number concepts are a necessary foundation for people to use money. Thus, it is hypothesized that children’s number concepts facilitate their monetary skills, that is, that there is a direct relationship between children’s number concepts and monetary skills.

Additionally, it is assumed that there is an indirect relationship between children’s number concepts and monetary skills. Furth (1980) has asserted that children’s monetary skills require them to know the numerical system and master monetary concepts (Berti & Bombi, 1981; Furham & Lewis, 1986). Berti and Bombi (1981) also recognized that children
need to establish one-to-one correspondence between goods and prices, as well as money and value when they are involved in buying items or making change. One-to-one correspondence (i.e., two sets have the same cardinal value) relates to children's number concepts (Piaget, 1965). The understanding of values and names of money is associated with children's monetary concepts. The buying and making change activities are connected with children's monetary skills. Thus, there are close relationships among children's number concepts, monetary concepts, and monetary skills.

When children use money, they need to know not only the name of coins but also the value of the coins. This knowledge is related to the cardinality of money, which is the understanding to associate the number of a unit with the name of the coin. For example, a nickel is associated with five cents and "nickel." In addition, following attainment of the cardinality of money, children need to develop the ordinality of money for comparing the value between two different kinds of coins. The understanding of the value of coins and the comparison of the value of coins are related to children's number concepts. Both the cardinality and the ordinality concepts of money are monetary concepts, which facilitate children in addition and subtraction problem-solving in their actual and pretend buying and selling activities. Thus, it is evident that number concepts help children acquire their monetary concepts. After children establish concepts of numbers and money, they begin to understand how to match the amount of money needed to pay the stated price for a given item during buying and selling activities. Therefore, it is hypothesized that children's number concepts have a positive impact on their monetary concepts, and this in turn positively influences their monetary skills. There is an indirect relationship between children's number concepts and monetary skills, and monetary concepts could be a mediating factor.

Parents and children’s learning of numbers and money

How do children learn about numbers and money? Research indicates that parents are the first important people to influence children's learning about numbers and money
These findings are also supported by Bronfenbrenner's Ecological Theory (1979) that addresses the important role of the parent in the family where the family is the basic unit (microsystem) of society (macrosystem). For a young child, her microsystem starts from her family and therefore the parent has a direct impact on the child's development and learning. In addition, Vygotsky (1978) and Rogoff (1990) emphasize that the more frequent the interaction between parents and their children, the more benefits there are for children's conceptual thinking.

Parents and number learning. Some research findings demonstrate support for Vygotsky and Rogoff's view on children's number learning (Lehrer & Shumow, 1995; Reynolds, Mavrogenes, Bezruczko, & Hagemann, 1996; Sears & Medearis, 1992). For example, Sears and Medearis's Natural Math project (1992), which encouraged parents to engage in their 3- and 4-year-old preschoolers' math activities and games at home, revealed the efficacy of their activity as related to their kindergartners' mathematical achievement. The recommended home math activities for parents and their preschoolers included counting rhymes, parent-child conversation, incidental math learning, number counting, and recognition of shapes and math symbols. Other studies have shown that kindergartners whose parents participated in educational programs to learn more mathematical information, examples, and experiences, or who were involved in more school activities, were more successful in their arithmetic problem-solving than those whose parents did not take part in the school program (Lehrer & Shumow, 1995; Reynolds et al., 1996). Other research findings have shown that parents' beliefs influence their kindergartners' and school age children's mathematical learning (Blevins-Knabe & Musun-Miller, 1995; Chance, 1968; Lummis & Stevenson, 1990; Pletan, Robinson, Berninger, & Abbott, 1995; Rankin, 1967).

Adequate parental instructions and positive parental attitudes (e.g., identification of their impact on children) toward their children are critical for young children to learn about
numbers and other cognitive concepts. Numbers are an important part of mathematics. These findings strongly support the hypothesis that parental number practices at home have an impact on their kindergartners' number concepts. Furthermore, based on previous discussion about the relations among children's number concepts, monetary concepts, and monetary skills, it is assumed that parental number practices influence kindergartners' number concepts, which in turn influence their kindergartners' monetary concepts and monetary skills, respectively. The more often parents include number practices in interactions with their young children, the greater the development of number and money concepts and skills for kindergartners.

Parents and money learning. An empirical study by Ely and Gleason (1995) also supports Vygotsky and Rogoff's view. They examined how parents exposed their children to statements or explanations about money for their young children ages 27 to 61 months through audiotaped recordings at home at dinner, a one-time observation with the mother and child, and a one-time observation with the father playing store in a laboratory setting. They found that there were more conversations about money in the laboratory setting than at home. In the laboratory, most parents explicitly taught their children about monetary terms such as buy, dollar, cash, dime, change, and quarter.

Ward (1974) introduced an information processing notion of consumer socialization that proposes that learning specific basic economic concepts occurs at various developmental stages for children, with parents acting as a major influence on their children's experiences with money and attitudes toward consumption. Consumer socialization is the "processes by which young people acquire skills, knowledge, and attitudes relevant to their effective functioning as consumers in the marketplace" (Ward, 1974, p. iv). The acquisition of monetary concepts and skills is associated with consumer socialization. Neisser (1960) argued that young people's monetary understanding and attitudes derive from direct experiences and explicit teaching at home. Fox (1978) identified the direct monetary
experiences as buying, trading, owing, and saving (Koeller, 1981), with explicit teaching including recognition of the name or value of coins. Parents as consumer role models have been explained in McGuire's consumer information processing model (1974). He hypothesized that children learn about money from their parents in a multistage process, such as attention, representation, comprehension, acceptance, retention, and behavior as presented in Calder, Robertson, and Rossiter (1975). For example, children pay attention to the ways parents use money, and later they imitate these behaviors when they play stores and restaurant.

Marshall and Magruder (1960) also investigated the relationships between parental money education practices and their school-age children's knowledge of money use. Children’s knowledge of money use was tested in four parts: naming coins, testing the use of the coins (e.g., what will a penny buy?), identifying goods they can buy, and pricing goods at the store. Five important findings were identified emphasizing the role of parental practices in children’s money learning. First, children showed more knowledge with money if their parents gave them a variety of experiences with money. Second, children had more knowledge of money use if their parents gave them money to spend. Third, the way that money was used was more important than the amount of money the child received in determining whether the child learned from the experience. Fourth, children had more knowledge of money if they saved money. Fifth, 11- and 12-year-old children had more knowledge and experience with money if their parents handled the family income wisely. Guberman's (1996) study also supported Marshall and Magruder's findings. For 4- to 14-year-old Brazilian children, their parents assigned them different purchase responsibility levels according to their age. Parents provided more buying opportunities for older children, and these children had higher achievement on the monetary value tests.

Clearly, parents are the significant persons who provide the initial direct money learning experiences for their young children at home. Although research has not
investigated specifically the influence of parents on children's monetary concepts and monetary skills, the constructs of monetary concepts and monetary skills seem included in the measures of children's knowledge of money use. It can be hypothesized that parental monetary practices facilitate their kindergartners' monetary concept development, which in turn benefits their monetary skills. Also, parental money practices might have a direct impact on kindergartners' monetary skill acquisition.

**Primary exploratory theoretical model**

The purpose of this study was to examine the relationships among kindergartners' number concepts, monetary concepts, monetary skills, and the number practices and monetary practices of their parents. Previous literature has shown that five-year-old kindergartners demonstrate one-to-one correspondence in matching tasks and counting tasks by using the numbers 1 to 5. Also, they are able to complete simple counting tasks up to the number 10, to understand the meanings of "some," "a few," and "a lot," and to do addition and subtraction based on the numbers 5 or 10. Moreover, they are able to identify the penny as a basic money unit and to name a penny, nickel, and dime. They have some numerical knowledge and monetary experience to serve as a base for learning more about numbers and money. Kourilsky's (1977) survey indicates that 97% of 96 5- and 6-year-old children's parents agreed that economics (including money) should be taught to children starting at age 5.

Thus, it is reasonable to explore the relationships between parents and their kindergartners among these variables: parental number practices, parental monetary practices, kindergartners' number concepts, kindergartners' monetary concepts, and kindergartners' monetary skills. It is hypothesized that parental number practices influence kindergartners' number concepts, which in turn influence kindergartners' monetary concepts and monetary skills, respectively. Furthermore, parental monetary practices influence kindergartners' monetary concepts, and they influence kindergartners' monetary skills. Also,
there are direct impacts of kindergartners' number concepts on monetary concepts, and of parental monetary practices on kindergartners' monetary skills, respectively. This is an exploratory study about children's primary number and money learning; therefore, the study will not examine the reciprocal relationships among children's number concepts, monetary concepts, and monetary skills. The primary exploratory theoretical model is depicted in Figure 1.

In this study, it is hypothesized that:

1. Kindergartners' number concepts have a positive impact on their monetary skills.
2. Kindergartners' number concepts have a positive impact on their monetary concepts.
3. Kindergartners' monetary concepts have a positive impact on their monetary skills.
4. Parental number practices have a positive impact on kindergartners' number concepts.
5. Parental monetary practices have a positive impact on kindergartners' monetary concepts.
6. Parental monetary practices have a positive impact on kindergartners' monetary skills.

![Figure 1](image)

The primary exploratory theoretical model of relations among variables
Materials And Method

Participants

A total of 207 kindergarten children (106 boys, 101 girls) and their parents (mother or father) participated in this study. The 5-year-old kindergartners (M = 70.6 months) were recruited from eight public elementary schools located in five central Iowa school districts. These typically developing kindergartners all used English as their first language and were U.S. residents. The majority of these children (95%) were Caucasian, and the others were Hispanic/Latino, Asian, or American Indian/Native American (see Table 1). In addition, most of the kindergartners had attended preschool (85%) and lived with older siblings who were between 6 and 18 years old (61%).

Table 1.

Demographics of children participants (N = 207)

<table>
<thead>
<tr>
<th>Items</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (Months)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-72</td>
<td>133</td>
<td>64%</td>
</tr>
<tr>
<td>73-84</td>
<td>73</td>
<td>35%</td>
</tr>
<tr>
<td>85-96</td>
<td>1</td>
<td>12%</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>106</td>
<td>51%</td>
</tr>
<tr>
<td>Girls</td>
<td>101</td>
<td>49%</td>
</tr>
<tr>
<td>Ethnic Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>198</td>
<td>95%</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>1</td>
<td>12%</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>2</td>
<td>12%</td>
</tr>
<tr>
<td>American Indian/Native American</td>
<td>1</td>
<td>12%</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>22%</td>
</tr>
<tr>
<td>Preschool Attendance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>176</td>
<td>85%</td>
</tr>
<tr>
<td>No</td>
<td>31</td>
<td>15%</td>
</tr>
<tr>
<td>Living With Older Children</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>126</td>
<td>61%</td>
</tr>
<tr>
<td>No</td>
<td>81</td>
<td>39%</td>
</tr>
</tbody>
</table>
The kindergarten parent participants primarily were either the mothers or fathers who completed the three parent questionnaires. The majority of the participants were mothers (90%). The average age of parents was 33 years. Most of the parents were Caucasian (98%) and were married (81%). About 48% of parents had an associate degree, bachelor's degree, or graduate degree, while 26% of them had attended college but did not receive a degree (see Table 2).

**Materials and instruments**

Two parent questionnaires and three kindergartner tasks were used for this study. The two parent questionnaires concerned parental practices with their kindergartner in learning numbers and money. The three kindergartner tasks examined the number concepts, monetary concepts, and monetary skills of kindergarten children. The measures are described below.

**Parental number practices measure.** Parental number practices were measured using a revised version of the Home Math Parent/Child Interaction Questionnaire (Sears & Medearis, 1992). The original questionnaire included 14 interrogative sentences that described daily parenting interactions with their specific child's number learning. No reliability was reported. For the present study, item 7 on the original questionnaire was changed from "Do I model using mathematics as a daily behavior?" to "My child sees me counting and using numbers." Item 15 was added to the questionnaire (i.e., "My child and I play board and/or card games"). In addition, for the Revised Home Math Parent/Child Interaction Questionnaire the interrogative sentences were changed to narrative statements, and the 5-point rating scale (i.e., 1 = Never, 2 = Not Often, 3 = Sometimes, 4 = Frequently, 5 = Always) was changed to more precise frequency categories (i.e., 1 = Never, 2 = Monthly, 3 = Weekly, 4 = 2 or 3 Times A Week, and 5 = Daily). Higher scores indicated that parents reported providing more opportunities for their children to learn about numbers than parents with lower scores (see Appendix B).
Table 2.

Demographics of parent participants (N = 207)

<table>
<thead>
<tr>
<th>Items</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relationship to Kindergartner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Father</td>
<td>12</td>
<td>6%</td>
</tr>
<tr>
<td>Mother</td>
<td>188</td>
<td>90%</td>
</tr>
<tr>
<td>Stepmother</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Adoptive Father</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Adoptive Mother</td>
<td>3</td>
<td>1%</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>Age (Years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-30</td>
<td>60</td>
<td>29%</td>
</tr>
<tr>
<td>31-40</td>
<td>131</td>
<td>63%</td>
</tr>
<tr>
<td>41-50</td>
<td>16</td>
<td>8%</td>
</tr>
<tr>
<td>Ethnic Group</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>204</td>
<td>98%</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>Asian or Pacific Islander</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never Married</td>
<td>13</td>
<td>6%</td>
</tr>
<tr>
<td>Married</td>
<td>167</td>
<td>81%</td>
</tr>
<tr>
<td>Divorced</td>
<td>21</td>
<td>11%</td>
</tr>
<tr>
<td>Separated</td>
<td>3</td>
<td>1%</td>
</tr>
<tr>
<td>Widowed</td>
<td>3</td>
<td>1%</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grades 9-12 (No Diploma)</td>
<td>7</td>
<td>3%</td>
</tr>
<tr>
<td>High School Graduate</td>
<td>45</td>
<td>22%</td>
</tr>
<tr>
<td>GED (General Education Diploma)</td>
<td>3</td>
<td>1%</td>
</tr>
<tr>
<td>Some College, But No Degree</td>
<td>54</td>
<td>26%</td>
</tr>
<tr>
<td>Associate Degree</td>
<td>39</td>
<td>19%</td>
</tr>
<tr>
<td>Bachelor's Degree</td>
<td>49</td>
<td>24%</td>
</tr>
<tr>
<td>Graduate Degree</td>
<td>10</td>
<td>5%</td>
</tr>
</tbody>
</table>
The face validity of the Revised Home Math Parent/Child Interaction Questionnaire (HMPCIQ) was examined by subject matter experts after the pilot test with parents was completed. Construct validity was determined by exploratory factor analysis using principal components extraction. The description of the examination of construct validity is discussed in the results section. The test-retest reliability for each item ranged from .52 to .89 ($M = .78$) measured by Pearson product-moment correlations after a 3-week interval with 23 parents (see Table 3). The internal consistency reliability (Cronbach’s alpha) for this measure was .83.

**Parental monetary practices measure.** Parental monetary practices were measured by the Parent-Child Money Activities Questionnaire (PCMAQ) (see Appendix B). It was developed for this study from the Money Sense for Young Children bulletin (Iowa State University Extension, 1992). It is comprised of 12 items using a 5-point rating scale from 1 (never) to 5 (daily) to indicate different frequencies of occurrence. Higher scores indicate that the parents reported providing more opportunities for their children to learn about money than those with lower scores. The face validity of the Parent-Child Money Activities Questionnaire was determined by subject matter experts after the pilot test with parents was completed. Construct validity was determined by exploratory factor analysis using principal components extraction, and is reported in the results section. The test-retest reliability of this questionnaire ranged from .67 to .86 ($M = .79$) measured by Pearson product-moment correlations after a 3-week interval with 23 parents (see Table 3). The internal consistency reliability (Cronbach’s alpha) for this questionnaire was .79.

**Children's number concepts measure.** Children’s number concepts were measured using the Counting/Cardinality Tasks and the Comparing/Ordinality Tasks (see Appendix C). The Counting/Cardinality Tasks investigate whether children understand that the final number used in a count sequence represents the number of objects in the set. For example, when the child is counting four miniature cups as one, two, three, four, she understands that the
Table 3.

Test-retest reliability of the Revised Home Math Parent/Child Interaction Questionnaire (HMPCIQ) and the Parent-Child Money Activities Questionnaire (PCMAQ)

<table>
<thead>
<tr>
<th>Questionnaire Items</th>
<th>Pearson Correlation Coefficient (r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revised Home Math Parent/Child</td>
<td></td>
</tr>
<tr>
<td>Interaction Questionnaire</td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>0.84***</td>
</tr>
<tr>
<td>Q2</td>
<td>0.64***</td>
</tr>
<tr>
<td>Q3</td>
<td>0.83***</td>
</tr>
<tr>
<td>Q4</td>
<td>0.85***</td>
</tr>
<tr>
<td>Q5</td>
<td>0.74***</td>
</tr>
<tr>
<td>Q6</td>
<td>0.80***</td>
</tr>
<tr>
<td>Q7</td>
<td>0.52*</td>
</tr>
<tr>
<td>Q8</td>
<td>0.65**</td>
</tr>
<tr>
<td>Q9</td>
<td>0.78***</td>
</tr>
<tr>
<td>Q10</td>
<td>0.81***</td>
</tr>
<tr>
<td>Q11</td>
<td>0.67**</td>
</tr>
<tr>
<td>Q12</td>
<td>0.82***</td>
</tr>
<tr>
<td>Q13</td>
<td>0.89***</td>
</tr>
<tr>
<td>Q14</td>
<td>0.85**</td>
</tr>
<tr>
<td>Q15</td>
<td>0.64**</td>
</tr>
<tr>
<td>(M = 0.78)</td>
<td></td>
</tr>
<tr>
<td>Parent-Child Money Activities</td>
<td></td>
</tr>
<tr>
<td>Questionnaire</td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>0.67***</td>
</tr>
<tr>
<td>Q2</td>
<td>0.69***</td>
</tr>
<tr>
<td>Q3</td>
<td>0.82***</td>
</tr>
<tr>
<td>Q4</td>
<td>0.80***</td>
</tr>
<tr>
<td>Q5</td>
<td>0.74***</td>
</tr>
<tr>
<td>Q6</td>
<td>0.85***</td>
</tr>
<tr>
<td>Q7</td>
<td>0.82***</td>
</tr>
<tr>
<td>Q8</td>
<td>0.77***</td>
</tr>
<tr>
<td>Q9</td>
<td>0.68***</td>
</tr>
<tr>
<td>Q10</td>
<td>0.67***</td>
</tr>
<tr>
<td>Q11</td>
<td>0.86***</td>
</tr>
<tr>
<td>Q12</td>
<td>0.82***</td>
</tr>
<tr>
<td>(M = 0.79)</td>
<td></td>
</tr>
</tbody>
</table>

Note. n = 23 parents

*p < .05. **p < .01. ***p < .001.
four represents the fourth cup as well as the total number of cups.

Becker's (1989) counting task procedure and Frye et al.'s (1989) cardinality question design were adapted to create six total trials for equal-sets and unequal-sets. The sets used three types of cardinality questions, that is (1) "How many counters are there?", (2) "Are there [x] counters here?", and (3) "Give me [x] counters." The materials included twenty-one teddy bear counters 20 mm in height and nine plastic cups 15 mm in height, and fourteen plastic plates 35 mm in diameter (see Appendix C).

For example, the investigator showed the child nine teddy bears, and asked "How many teddy bears are there?" Then, the child was shown another nine cups, and asked "Are there a total of nine cups here?" "Give me the same number of cups to match the teddy bears (or give me nine cups)." During this procedure, each child was encouraged to count the items. If the child had difficulty counting, the investigator would say "Let's count the X and Y together." Equal and unequal sets were presented across the trials.

The Comparing/Ordinality Tasks investigate children’s quantitative understanding about the concepts of more and less as presented in arrays of items that were available for comparison. For the ordinal properties of numbers (Siegler, 1991), there were two types of trials using these questions: "What is more, the X or the Y?" (or "Are there more X or more Y?", if the child did not understand), and "What is less, the X or the Z?" (or "Are there less X or less Y?"). Two types of questions were used for this study, using Sophian’s (1988) correspondence inference task with two unequal sets. For example, "If we give each teddy bear a glass, will we have any glasses left?", and "If we give each teddy bear a bowl, will we have enough bowls?" Twenty-one teddy bear counters 20 mm in height, ten plastic glasses 23 mm in height, and eleven plastic bowls 30 mm in diameter were used in the arrays.

For this study, the two sets of materials used for each task were arranged in two rows of equal length. The investigator encouraged the children to count the items in each row in order to minimize the influence of children’s perceptual awareness cues. Each child’s correct
responses were recorded. Each correct answer received one point, with the total score ranging from 0 to 10 for the combined Counting/Cardinality Tasks and Comparing/Ordinality Tasks. Also, the investigator recorded whether the child used counting for each question (see Appendix F).

The face validity of the tasks was evaluated by subject matter experts, following the pilot test with kindergartners. The construct validity of the Counting/Cardinality Tasks and Counting/Cardinality Tasks was determined by exploratory factor analysis using principal components extraction with oblique rotation; these findings are reported in the results section. Interobserver reliability for the two investigators was 1.00 (n = 4) for the pilot study and .98 (n = 20) midway through data collection. Cohen's kappa statistic (k) was 1.00 for the pilot study, and showed high agreement (range .80 - 1.00) for 9 items through data collection except for one item k = -.05 (see Table 4 & Table 5). Internal consistency reliability (Cronbach's alpha) on the Counting/Cardinality Tasks and Comparing/Ordinality Tasks was .60 and .39, respectively. The factor analysis and internal consistency reliability will be discussed further in the results section.

Children's monetary concepts measure. Children's monetary concepts were measured by two tasks, the Revised Coin-Identification Tasks and the Revised Comparative-Value Tasks (see Appendix D). They were modified from the Monetary Concepts Task Test (McCarty, 1967), which was validated by Dunkin (1972) and Harper (1973) for kindergartners. The Revised Coin-Identification Tasks focus on children's ability to identify coins by name (i.e., two quarters, one dime, two nickels, and three pennies). Coins are placed in three rows before the child in the following pattern: 25-10, 10-5-1-5-25, and 1-5, and the investigator says, "I have some real pieces of money on the board. Put your finger on a penny." After the child responds, the investigator says, "Good" regardless of the accuracy of the response. In this manner, the investigator instructs the child to put his finger on a coin either by name (a penny) or by its value (one cent). The coins were presented in random order for the eight
Table 4.

Interobserver reliability of the Counting/Cardinality Tasks of children's number concepts.

<table>
<thead>
<tr>
<th>Items</th>
<th>Kappa and Crosstable (n = 4 in pilot study)</th>
<th>Kappa and Crosstable (n = 20 during the study)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>#2</td>
<td>1.00</td>
<td>b</td>
</tr>
<tr>
<td>#3</td>
<td>1.00</td>
<td>-0.05</td>
</tr>
<tr>
<td>#4</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>#5</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>#6</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Note. * The four cells represent the investigators' recording of the kindergartners' responses. Thus, top left cell = both investigators recorded "incorrect" responses, top right cell = #1 investigator recorded "correct" & #2 investigator recorded "incorrect," lower left cell = #1 investigator recorded "incorrect" & #2 investigator recorded "correct," lower right cell = both investigators recorded "correct" responses.

b Statistics cannot be computed when the number of non-empty rows or columns is one.
Table 5.

Interobserver reliability of the Comparing/Ordinality Tasks of children’s number concepts

<table>
<thead>
<tr>
<th>Items</th>
<th>Kappa and Crosstable (n = 4 in pilot study)</th>
<th>Kappa and Crosstable (n = 20 during the study)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Crosstable" /></td>
<td><img src="image" alt="Crosstable" /></td>
</tr>
<tr>
<td>#2</td>
<td>1.00</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Crosstable" /></td>
<td><img src="image" alt="Crosstable" /></td>
</tr>
<tr>
<td>#3</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Crosstable" /></td>
<td><img src="image" alt="Crosstable" /></td>
</tr>
<tr>
<td>#4</td>
<td>1.00</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Crosstable" /></td>
<td><img src="image" alt="Crosstable" /></td>
</tr>
</tbody>
</table>

Note. * The four cells represent the investigators’ recording of the kindergartners’ responses. Thus, top left cell = both investigators recorded “incorrect” responses, top right cell = #1 investigator recorded “correct” & #2 investigator recorded “incorrect,” lower left cell = #1 investigator recorded “incorrect” & #2 investigator recorded “correct,” lower right cell = both investigators recorded “correct” responses.
items (see Appendix D). This revised measure removed two original items, that is, a half-dollar and fifty cents, due to its relatively uncommon use today. There were a total of eight items in the Revised Coin-Identification Tasks.

The Revised Comparative-Value Tasks, modified from the Monetary Concepts Task Test (McCarty, 1967), investigate children's ability to identify coins of greater and lesser value. There were four pairs of coins included in this task, that is, nickel-penny, quarter-nickel, penny-dime, and quarter-penny (see Appendix D). The coin pairs were mounted on 3"-by-5" cards. During the interview, the child is asked, "Do you go to the store with your mother sometimes?" (Child responds.) "What do you buy?" (If candy was not mentioned, the investigator says, "Do you buy candy sometimes?") Then, the child is shown the first card of paired coins. The investigator says "Show me the coin that would buy the most candy at the store." The same questions are used for all four trials as the coin pairs are changed. Each answer is recorded with each correct response receiving one point. For this study, the operationalization of children's monetary concepts was the combined score for each child on the Coin-Identification Tasks (ranging from 0 to 8) and the Comparative-Value Tasks (ranging from 0 to 4), with a total score ranging from 0 to 12. According to the validity data of Dunkin (1972) and Harper (1973) for this measure, the paired groupings of half dollar-quarter, dime-quarter, and dime-nickel were not applicable for kindergartners, so these items were eliminated.

In this study, face validity was evaluated by subject matter experts, following the pilot test with kindergartners. The degree of construct validity for the Coin-Identification Tasks and for the Comparative-Value Tasks was determined by exploratory factor analysis using principal components extraction with oblique rotation, which are described later in the results section. Interobserver reliability for the two investigators was .98 (n = 4) for the pilot study and .99 (n = 20) midway through data collection. Cohen's kappa statistic (k) for 12 items showed complete agreement (k = 1) for 11 items in the pilot study (n = 4) except one (k = .5)
and strong agreement (range .90 - 1.00) midway through data collection (n = 20) (see Table 6 & Table 7). Internal consistency reliability (Cronbach’s alpha) on the Coin-Identification Tasks and the Comparative-Value Tasks was .62 and .28, respectively. The factor analysis and interobserver reliability will be discussed further in the results section.

Children’s monetary skills measure. Children’s monetary skills were measured by the Revised Equivalent-Value Tasks (see Appendix E), modified from the Monetary Concepts Task Test subtest Equivalent-Value Tasks (McCarty, 1967). The Equivalent-Value Tasks investigated children’s ability to match coins with equivalent value in a role-playing situation. For example, a nickel was glued on a shelf to indicate the price of a toy car. Children needed to pay for the car by using seven pennies and a dime. In addition, a half dollar, a quarter, a dime, and a nickel were used to represent different prices of items. According to the validity test by Dunkin (1972) and Harper (1973), the Equivalent-Value Tasks was not suitable for kindergartners due to the use of coins with higher value (i.e., 25, 50). The Revised Equivalent-Value Tasks investigate whether children can represent the tasks of using money to purchase goods, such as pencils and candy, during a simulated dramatic play store task. These tasks focus on children using pennies, nickels, and dimes in an application of one-to-one correspondence (e.g., paying 7 pennies for an item, the same as the example of seven pennies), of equal value (e.g., paying 5 cents by using five pennies instead of a nickel), and of addition (e.g., paying 6 pennies for two pencils displayed as three pennies each).

There were six small items in same-sized boxes with coins and a price symbol glued to each box indicating the cost of each item. The items (and their value) included a toy car (7 cents), a small doll (10 cents), a toy dinosaur (5 cents), a chocolate bar (9 cents), two pencils (3 cents each), and two kinds of candy (8 cents and 10 cents, respectively). In addition, there were six small purses containing various coins for the children to pretend that they were buying the items (i.e., ten pennies, one nickel, and one dime for the toy car; ten pennies and two nickels for the small doll; ten pennies and two dimes for the toy dinosaur;
Table 6.

Interobserver reliability of the Revised Coin-Identification Tasks of children's monetary concepts

<table>
<thead>
<tr>
<th>Items</th>
<th>Kappa and Crosstable (n = 4 in pilot study)</th>
<th>Kappa and Crosstable (n = 20 during the study)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td><img src="image" alt="Table" /></td>
<td><img src="image" alt="Table" /></td>
</tr>
<tr>
<td>#2</td>
<td>1.00</td>
<td><img src="image" alt="Table" /></td>
</tr>
<tr>
<td>#3</td>
<td>1.00</td>
<td><img src="image" alt="Table" /></td>
</tr>
<tr>
<td>#4</td>
<td>1.00</td>
<td><img src="image" alt="Table" /></td>
</tr>
<tr>
<td>#5</td>
<td>0.50</td>
<td><img src="image" alt="Table" /></td>
</tr>
<tr>
<td>#6</td>
<td>1.00</td>
<td><img src="image" alt="Table" /></td>
</tr>
<tr>
<td>#7</td>
<td><img src="image" alt="Table" /></td>
<td><img src="image" alt="Table" /></td>
</tr>
<tr>
<td>#8</td>
<td>1.00</td>
<td><img src="image" alt="Table" /></td>
</tr>
</tbody>
</table>

Note: * Statistics cannot be computed when the number of non-empty rows or columns is one. † The four cells represent the investigators' recording of the kindergartners' responses. Thus, top left cell = both investigators recorded "incorrect" responses, top right cell = #1 investigator recorded "correct" & #2 investigator recorded "incorrect," lower left cell = #1 investigator recorded "incorrect" & #2 investigator recorded "correct," lower right cell = both investigators recorded "correct" responses.
Table 7.

Interobserver reliability of the Revised Comparative-Value Tasks of children’s monetary concepts

<table>
<thead>
<tr>
<th>Items</th>
<th>Kappa and Crosstable (n = 4 in pilot study)</th>
<th>Kappa and Crosstable (n = 20 during the study)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Crosstable" /></td>
<td><img src="image" alt="Crosstable" /></td>
</tr>
<tr>
<td>#2</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Crosstable" /></td>
<td><img src="image" alt="Crosstable" /></td>
</tr>
<tr>
<td>#3</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Crosstable" /></td>
<td><img src="image" alt="Crosstable" /></td>
</tr>
<tr>
<td>#4</td>
<td>1.00</td>
<td><img src="image" alt="b" /></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Crosstable" /></td>
<td><img src="image" alt="Crosstable" /></td>
</tr>
</tbody>
</table>

Note. * The four cells represent the investigators’ recording of the kindergartners’ responses. Thus, top left cell = both investigators recorded “incorrect” responses, top right cell = #1 investigator recorded “correct” & #2 investigator recorded “incorrect,” lower left cell = #1 investigator recorded “incorrect” & #2 investigator recorded “correct,” lower right cell = both investigators recorded “correct” responses.

*b Statistics cannot be computed when the number of non-empty rows or columns is one.
ten pennies, two nickels, and two dimes for the chocolate bar; ten pennies, three nickels, and three dimes for the two pencils; and twenty pennies, two nickels, and two dimes for the two kinds of candy). At the beginning of the task, the child is told that she is a shopper who is going to play a shopping (selling-buying) game with a storekeeper (i.e., the investigator). The six items are shown to the child, consecutively, for the six questions. For example, when the investigator shows one set of items, she says, "The toy car costs seven cents (pointing to the glued coins on the box). You can buy it with the money in your purse. Give me the money you need to buy the toy car," or "One pencil costs three cents. If you want to buy two pencils, how much do you need to pay? You can buy them with the money in your purse. Give me the money you need to buy the two pencils." The storekeeper (investigator) holds out her hand to accept the coins (see Appendix E). The child's responses were recorded with each correct response receiving one point. The operationalization of children's monetary skills for this study was the total score for each correct response on the Revised Equivalent-Value Tasks, ranging from 0 to 6.

For this study, face validity was evaluated by subject matter experts, following a pilot test with kindergartners. The construct validity of the Revised Equivalent-Value Tasks was determined by exploratory factor analysis using principal components extraction with oblique rotation, which is described in the results section. Interobserver reliability for the two investigators was 1.00 (n = 4) for the pilot study and 1.00 (n = 20) midway through data collection. Cohen's kappa statistic (k) for 6 items showed complete agreement (k = 1) in the pilot study (n = 4) and midway through data collection (n = 20) (see Table 8). In addition, internal consistency reliability (Cronbach's alpha) for the Children's Monetary Skill Tasks was .79.

Procedure

Pilot study. Ten kindergartners and four parents from the Child Development Laboratory School at Iowa State University participated in the pilot study to determine the
Table 8.

Interobserver reliability of the Revised Equivalent-Value Tasks of children's monetary skills

<table>
<thead>
<tr>
<th>Items</th>
<th>Kappa and Crosstable (n = 4 in pilot study)</th>
<th>Kappa and Crosstable (n = 20 during the study)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>1.00 * 3 0 1 0</td>
<td>1.00 13 0 0 7</td>
</tr>
<tr>
<td>#2</td>
<td>1.00 3 0 1 0</td>
<td>1.00 17 0 0 3</td>
</tr>
<tr>
<td>#3</td>
<td>1.00 3 0 1 0</td>
<td>1.00 15 0 0 5</td>
</tr>
<tr>
<td>#4</td>
<td>1.00 2 0 0 2</td>
<td>1.00 13 0 0 7</td>
</tr>
<tr>
<td>#5</td>
<td>1.00 3 0 0 1</td>
<td>1.00 8 0 0 12</td>
</tr>
<tr>
<td>#6</td>
<td>1.00 2 0 0 2</td>
<td>1.00 13 0 0 7</td>
</tr>
</tbody>
</table>

Note. * The four cells represent the investigators' recording of the kindergartners' responses. Thus, top left cell = both investigators recorded "incorrect" responses, top right cell = #1 investigator recorded "correct" & #2 investigator recorded "incorrect," lower left cell = #1 investigator recorded "incorrect" & #2 investigator recorded "correct," lower right cell = both investigators recorded "correct" responses.
appropriateness of the procedures, the accuracy of the measures, and the overall plausibility of the instruments for the kindergartners and parents. Also, the length of the testing session was noted to review the appropriateness and scheduling needs for kindergartners during the study.

During the pilot study for the children's measures, three changes were evident. First, there was a ceiling effect for the Number Concept Tasks using numbers 10 and less, such as 5, 7, 8, and 10. Second, most kindergartners were accurate in paying for items worth 2 cents, 3 cents, 6 cents, and 7 cents on the Revised Equivalent-Value Tasks. Third, the question "Are there twelve plates here?" when there were fourteen plates present was confusing to all of the children. So, the Number Concept Tasks were revised by using a number less than 10 and a number more than 10. Also, the price for each item was adjusted on the Revised Equivalent-Value Tasks to demonstrate a wider range of understanding. Third, the question, "Are there twelve plates here?", was changed to "Are there a total of twelve plates here?" The Revised Children's Number Concept Tasks (Counting/Cardinality Tasks and Comparing/Ordinality Tasks), Monetary Concept Tasks (Coin-Identification Tasks and Comparative-Value Tasks), and Monetary Skill Tasks (Revised Equivalent-Value Tasks) are presented in Appendix C, D, and E, respectively.

In the pilot study for the parents' measure, the majority of questions for the General Family Information Questionnaire, the Revised Home Math Parent/Child Interaction Questionnaire, and the Parent-Child Money Activities Questionnaire were suitable. Following the suggestions of parents, an item was added to the Revised Home Math Parent/Child Interaction Questionnaire: my child and I play board and/or card games (Candyland, UNO, Go Fish). The three parent questionnaires are presented in Appendix B.

During the pilot study with kindergartners, interobserver reliability was established by the two investigators observing 4 kindergartners (2 boys and 2 girls) after the measures were revised. Interobserver reliability was very high, showing strong agreement for interpreting
and recording the children's scores. The information is presented in Table 4 to Table 8.

**Data collection.** Following approval by the Iowa State University Human Subjects Committee, public school superintendents in central Iowa were contacted by telephone to participate in this study. Eight elementary schools in five school districts agreed to participate (see Appendix A). For each identified classroom parent letter and parent questionnaires were sent to all kindergarten parents whose kindergartners spoke English as their first language. Parents received an information and consent letter, the General Family Information Questionnaire (see Appendix B), the 15-item Revised Home Math Parent/Child Interaction Questionnaire (see Appendix B), and the 12-item Parent-Child Money Activities Questionnaire (see Appendix B). Parents were instructed to return the completed permission form and questionnaires to the kindergarten teacher in an enclosed addressed envelope. Follow-up phone calls were made for missing consent letters, as necessary. A total of 279 questionnaires were distributed in the eight schools, and 223 (80%) questionnaires were returned, with 75% granting permission to participate (see Table 9). One child was unable to complete all of the tasks; there were 207 child-parent pairs for this study.

After receiving the completed parent consent letter and questionnaires, each kindergartner was interviewed individually in a quiet location at the school. The Number Concept Tasks (see Appendix C), Monetary Concept Tasks (see Appendix D), and Monetary Skill Tasks (see Appendix E) were completed during the interview. The Number Concept Tasks and the Monetary Concept Tasks were counter-balanced for administration, that is, half of the boy and girl participants in each school received the Number Concept Tasks first and the other half of the kindergartners received the Monetary Concept Tasks first (see Table 10). The total interview time was 20-25 minutes per child. Data collection occurred between November 1996 and January 1997.

The test-retest reliability of parent questionnaires was conducted by randomly selecting 25 parents and mailing them a second set of parent questionnaires 2 weeks after
Table 9.

Distribution of questionnaires and parent consent rates

<table>
<thead>
<tr>
<th>School</th>
<th># of letters sent</th>
<th># of total received (%)</th>
<th># of total permission gotten (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>18</td>
<td>18 (100%)</td>
<td>17 (94%)</td>
</tr>
<tr>
<td>B</td>
<td>55</td>
<td>45 (82%)</td>
<td>41 (75%)</td>
</tr>
<tr>
<td>C</td>
<td>41</td>
<td>34 (83%)</td>
<td>33 (80%)</td>
</tr>
<tr>
<td>D</td>
<td>68</td>
<td>58 (85%)</td>
<td>54 (79%)</td>
</tr>
<tr>
<td>E</td>
<td>45</td>
<td>30 (67%)</td>
<td>29 (64%)</td>
</tr>
<tr>
<td>F</td>
<td>18</td>
<td>14 (78%)</td>
<td>12 (67%)</td>
</tr>
<tr>
<td>G</td>
<td>12</td>
<td>8 (67%)</td>
<td>7 (58%)</td>
</tr>
<tr>
<td>H</td>
<td>22</td>
<td>16 (73%)</td>
<td>15 (68%)</td>
</tr>
<tr>
<td>Total</td>
<td>279</td>
<td>223 (80%)</td>
<td>208 (75%)</td>
</tr>
</tbody>
</table>

Table 10.

Distribution of testing order of kindergartners by elementary school

<table>
<thead>
<tr>
<th>School</th>
<th>#Concept/$$Concept</th>
<th>$$$Concept/#Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Boys</td>
<td>Girls</td>
</tr>
<tr>
<td>A</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>C</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>D</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>E</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>F</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>G</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>H</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Subtotal</td>
<td>53</td>
<td>51</td>
</tr>
<tr>
<td>Total</td>
<td>207</td>
<td></td>
</tr>
</tbody>
</table>
their first questionnaires were returned. A total of 23 completed questionnaires were returned for the retest. The second interobserver reliability was completed by randomly selecting 10 boys and 10 girls who were observed simultaneously by the two investigators at the midway point of data collection (see Table 4, Table 5, & Table 6).

Data analysis

Analyses of this study were conducted by SPSS for Windows version 6.0 and LISREL version 8.12. SPSS for Windows version 6.0 was used to analyze the demographic information, test-retest reliability, interobserver reliability, the internal consistency reliability, and construct validity. LISREL 8.12 was used to complete the path analysis and to examine the research model.

Demographic information, such as parents’ age, ethnic group, education, and marital status, and kindergartners’ sex, ethnic group, and preschool experiences, are presented by frequencies and percentage (see Table 1 & Table 2). Test-retest reliability was calculated by Pearson product-moment correlations due to interval-level data (Kuo, 1989). The interobserver reliability was examined by total agreement percentage based on the unit of items (Kuo, 1989) and Cohen's kappa due to the dichotomous data based on the unit of the child (Appelbaum & McCall, 1983). Cronbach’s alpha was calculated to present the internal consistency reliability for each of the measures. Exploratory factor analysis was used to examine the construct validity of each instrument (Kuo, 1989).

Path analysis is a form of multivariate analysis in which causal relationships among variables are presented graphically and assessed through estimating multiple regression equations (Pedhazur, 1982). Its advantage is to force the researcher to specify a causal order among the variables. In addition, it allows for the evaluation of indirect effects of explanatory variables on dependent variables. To test the theoretical model of this study, LISREL 8.12 (Jöreskog & Sörbom, 1993) was used to set structural parameters representing unmixed, invariant, and autonomous features of the observed variables. The function of
LISREL goes beyond the conventional regression analysis. In this study, the covariance matrix, β regression parameter estimates, and t-test values, as well as direct, indirect, and total effects in the path analysis, are presented.

Results

Examination of assumed variables

In this study, there are five assumed variables in the primary exploratory theoretical model (i.e., parental number practices, parental monetary practices, kindergartner's number concepts, kindergartner's monetary concepts, and kindergartner's monetary skills). The Revised Home Math Parent/Child Interaction Questionnaire and the Parent-Child Money Activities Questionnaire were completed by parents to collect information about their number and monetary practices with their kindergartners. The Children's Number Concept Tasks (Counting/Cardinality Tasks and Comparing/Ordinality Tasks), Monetary Concept Tasks (Coin-Identification Tasks and Comparative-Value Tasks), and Monetary Skill Tasks (Revised Equivalent-Value Tasks), were completed by kindergartners in individual interviews to understand their knowledge of number and money and how they use money. An initial exploratory factor analysis was used to examine the data for each measure to establish reasonable constructs for further path analysis.

Parental number practices. The 15 items of the Revised Home Math Parent/Child Interaction Questionnaire were examined by factor analysis. A principal components analysis revealed a three-factor structure having a simple and clear interpretation. The first factor included high factor loadings on the ninth item (i.e., I teach my child to count 1, 2, 3, 4, 5), the tenth item (i.e., I teach my child shapes), and the fourteenth item (i.e., I teach my child to count objects). These high factor loadings indicated that parental number practices were interrelated closely on a factor of direct teaching. Also, the eigenvalue for factor one was 4.67, and that factor explained 31.2% of the variance across the 15 items (see Table 11). In
addition, the factor scree plot showed a steep line between the first factor and the second factor (see Figure 2). Those results indicate that factor one, which was named number direct teaching, was able to represent the construct of parental number practices. Thus, "number direct teaching" factor scores were used to represent the parental number practices in later statistical analyses.

**Parental monetary practices.** A principal components analysis on the Parent-Child Money Activities Questionnaire (12 items) also showed a three-factor structure. Factor one had a high loading on the second item (i.e., I teach my child the name of coins) and the fifth item (i.e., I help my child understand the value of coins) of the questionnaire. Its eigenvalue was 3.78 and explained 31.5% of the common variance (see Table 12). The factor scree plot also produced a steep line between the first factor and the second factor (see Figure 3). This analysis showed that parental direct teaching to their kindergartner about money was the main idea of the parental monetary practices measure. Factor one, named "money direct teaching," is treated as the composite outcome of the parental monetary practices measure in subsequent statistical analyses.

**Children's number concepts.** Children's number concepts were measured by Counting/Cardinality Tasks and Comparing/Ordinality Tasks. According to Cronbach's alpha measure of reliability, the level of internal consistency on the Comparing/Ordinality Tasks was very low ($\alpha = 0.39$), while that on the Counting/Cardinality Tasks was 0.6. The Comparing/Ordinality Tasks measure was removed from subsequent factor analysis (see Appendix G for the factor analysis of the Comparing/Ordinality Tasks). For the Counting/Cardinality Tasks, a principal components extraction with oblique rotation revealed that there were two factors in this measure (see Table 13), and they explained 36.1% and 21.2% of common variance, respectively. Their eigenvalues were well in excess of one (i.e., 2.16 and 1.27) and the factor scree plot did not show a steep line between the two factors (see Figure 4). These indicators imply that there were two factors present in the constructs of
Table 11.
Construct validity of the Revised Home Math Parent/Child Interaction Questionnaire: Principal components factor analysis

<table>
<thead>
<tr>
<th>Items</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>.44</td>
<td>.28</td>
<td>-.42</td>
</tr>
<tr>
<td>Q2</td>
<td>.43</td>
<td>.43</td>
<td>-.29</td>
</tr>
<tr>
<td>Q3</td>
<td>.60</td>
<td>.34</td>
<td>.11</td>
</tr>
<tr>
<td>Q4</td>
<td>.50</td>
<td>.46</td>
<td>.08</td>
</tr>
<tr>
<td>Q5</td>
<td>.48</td>
<td>.38</td>
<td>.44</td>
</tr>
<tr>
<td>Q6</td>
<td>.63</td>
<td>-.08</td>
<td>.16</td>
</tr>
<tr>
<td>Q7</td>
<td>.54</td>
<td>-.23</td>
<td>.35</td>
</tr>
<tr>
<td>Q8</td>
<td>.45</td>
<td>-.21</td>
<td>.48</td>
</tr>
<tr>
<td>Q9</td>
<td>.76</td>
<td>-.20</td>
<td>-.12</td>
</tr>
<tr>
<td>Q10</td>
<td>.75</td>
<td>-.07</td>
<td>-.02</td>
</tr>
<tr>
<td>Q11</td>
<td>.35</td>
<td>.49</td>
<td>.05</td>
</tr>
<tr>
<td>Q12</td>
<td>.51</td>
<td>-.34</td>
<td>-.34</td>
</tr>
<tr>
<td>Q13</td>
<td>.48</td>
<td>-.43</td>
<td>.13</td>
</tr>
<tr>
<td>Q14</td>
<td>.75</td>
<td>-.23</td>
<td>-.12</td>
</tr>
<tr>
<td>Q15</td>
<td>.50</td>
<td>-.12</td>
<td>-.45</td>
</tr>
</tbody>
</table>

Eigenvalue | 4.67 | 1.48 | 1.21 |
Percentage of Variance | 31.20% | 9.90% | 8.00% |
Cumulative Percentage | 31.20% | 41.10% | 49.10% |

Figure 2.
Factor scree plot of the Revised Home Math Parent/Child Interaction Questionnaire
Table 12.

Construct validity of the Parent-Child Money Activities Questionnaire: Principal components factor analysis

<table>
<thead>
<tr>
<th>Items</th>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>.53</td>
<td>-.35</td>
<td>-.08</td>
</tr>
<tr>
<td>Q2</td>
<td>.73</td>
<td>-.19</td>
<td>-.21</td>
</tr>
<tr>
<td>Q3</td>
<td>.65</td>
<td>-.13</td>
<td>-.09</td>
</tr>
<tr>
<td>Q4</td>
<td>.64</td>
<td>-.01</td>
<td>-.35</td>
</tr>
<tr>
<td>Q5</td>
<td>.75</td>
<td>-.11</td>
<td>-.40</td>
</tr>
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<td>Q6</td>
<td>.47</td>
<td>-.39</td>
<td>.49</td>
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<td>Q7</td>
<td>.43</td>
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<td>Q8</td>
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<td>-.04</td>
</tr>
<tr>
<td>Q9</td>
<td>.16</td>
<td>.42</td>
<td>.34</td>
</tr>
<tr>
<td>Q10</td>
<td>.61</td>
<td>.38</td>
<td>.04</td>
</tr>
<tr>
<td>Q11</td>
<td>.45</td>
<td>.56</td>
<td>.19</td>
</tr>
<tr>
<td>Q12</td>
<td>.56</td>
<td>.08</td>
<td>.31</td>
</tr>
</tbody>
</table>

Eigenvalue: 3.78, 1.42, 1.11

Percentage of Variance: 31.50%, 11.80%, 9.20%

Cumulative Percentage: 31.50%, 43.40%, 52.60%

Figure 3.

Factor scree plot of the Parent-Child Money Activities Questionnaire
Table 13.

Construct validity of the Counting/Cardinality Tasks of children's number concepts: Principal components factor analysis with oblique rotation

<table>
<thead>
<tr>
<th>Items</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>.71</td>
<td>-.29</td>
</tr>
<tr>
<td>Q2</td>
<td>.78</td>
<td>-.05</td>
</tr>
<tr>
<td>Q3</td>
<td>.79</td>
<td>-.16</td>
</tr>
<tr>
<td>Q4</td>
<td>.38</td>
<td>.60</td>
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<tr>
<td>Q5</td>
<td>-.03</td>
<td>.70</td>
</tr>
<tr>
<td>Q6</td>
<td>-.13</td>
<td>.73</td>
</tr>
</tbody>
</table>

| Eigenvalue | 2.16 | 1.27 |
| Percentage of Variance | 36.10% | 21.20% |
| Cumulative Percentage | 36.10% | 57.30% |

Figure 4.

Factor scree plot of the Counting/Cardinality Tasks of children's number concepts
counting/cardinality in the children's number concepts measure. The first factor and the second factor represent children's number concepts of the cardinality of the number 9 and the cardinality of the number 12, respectively. These factors also demonstrated that the cardinality of the number 9 and the cardinality of the number 12 would be the two new variables used in subsequent path analysis.

**Children's monetary concepts.** The two subtasks of the children's monetary concept measure were the Coin-Identification Tasks and the Comparative-Value Tasks. The Comparative-Value Tasks showed low internal consistency reliability as measured by Cronbach's alpha ($\alpha = 0.28$) and were removed from further analysis (see Appendix H). For the Coin-Identification Tasks, a principal components factor analysis with oblique rotation showed a two-factor structure (see Table 14). Their eigenvalues were 2.25 and 1.34, and explained 28.1% and 16.8% of common variance, respectively. The factor scree plot did not present a clear steep line (see Figure 5). Items loading heavily on the first factor displayed a common feature of the kindergartners' knowing coin names and items loading heavily on the second factor represented a common feature of children's knowing coin values. Consequently, the two features of knowing coin names and knowing coin values are treated as two separate composite variables representing children's monetary concepts in subsequent path analysis.

**Children's monetary skills.** Six buying-selling tasks were used to test kindergartners' monetary skills with the Revised Equivalent-Value Tasks. A principal components factor analysis with oblique rotation revealed a two-factor structure (see Table 15). Their eigenvalues were 2.96 and 1.19, and they explained 49.3% and 19.9% of the common variance, respectively. The scree line dropped slowly (see Figure 6). The items loading heavily on factor one strongly represent matching paying (i.e., paying for the cost by using the same coins as shown in the examples, such as a nickel and four pennies for a nine-cent candy bar or six pennies for two pencils that each costs three cents) for kindergartners,
Construct validity of the Revised Coin-Identification Tasks of children’s monetary concepts:

Principal components factor analysis with oblique rotation

<table>
<thead>
<tr>
<th>Items</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>.59</td>
<td>-.04</td>
</tr>
<tr>
<td>Q2</td>
<td>.71</td>
<td>.01</td>
</tr>
<tr>
<td>Q3</td>
<td>.79</td>
<td>-.11</td>
</tr>
<tr>
<td>Q8</td>
<td>.49</td>
<td>.30</td>
</tr>
<tr>
<td>Q4</td>
<td>.04</td>
<td>.64</td>
</tr>
<tr>
<td>Q5</td>
<td>-.10</td>
<td>.58</td>
</tr>
<tr>
<td>Q6</td>
<td>.25</td>
<td>.63</td>
</tr>
<tr>
<td>Q7</td>
<td>-.08</td>
<td>.70</td>
</tr>
</tbody>
</table>

Eigenvalue 2.25 1.34

Percentage of Variance 28.10% 16.80%

Cumulative Percentage 28.10% 44.90%

Figure 5.

Factor scree plot of the Revised Coin-Identification Tasks of children's monetary concepts
### Table 15.

**Construct validity of the Revised Equivalent-Value Tasks of children's monetary skills:**

**Principal components factor analysis with oblique rotation**

<table>
<thead>
<tr>
<th>Items</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>.40</td>
<td>.54</td>
</tr>
<tr>
<td>Q2</td>
<td>.05</td>
<td>.79</td>
</tr>
<tr>
<td>Q3</td>
<td>-.13</td>
<td>.87</td>
</tr>
<tr>
<td>Q4</td>
<td>.78</td>
<td>.19</td>
</tr>
<tr>
<td>Q5</td>
<td>.89</td>
<td>-.04</td>
</tr>
<tr>
<td>Q6</td>
<td>.87</td>
<td>-.11</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Eigenvalue</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.96</td>
<td>1.19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Percentage of Variance</th>
<th>49.30%</th>
<th>19.90%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumulative Percentage</td>
<td>49.30%</td>
<td>69.10%</td>
</tr>
</tbody>
</table>

**Figure 6.**

Factor scree plot of the Revised Equivalent-Value Tasks of children's monetary skills
whereas the second factor represents transformation paying (i.e., paying for the cost by using coins that were transferred in value, such that the cost of a nickel is paid by five pennies or the cost of a dime is paid by two nickels, a nickel and five pennies, or ten pennies). The first factor (matching paying) and the second factor (transformation paying) form two composite variables representing children's monetary skills that are used in further path analysis.

Path analysis of the interactive relationships among variables

After the factor analysis, there were a total of eight study variables constructed for use in path analysis, that is, number direct teaching, money direct teaching, cardinality of the number 9, cardinality of the number 12, knowing coin names, knowing coin values, matching paying, and transformation paying. These variables were tested to examine whether they met the normal distribution assumption before path analysis (see Appendix I).

Network of relationships. According to the theoretical argument, it is assumed that parental number practices influence her kindergartner's number concepts and the extent to which number concepts affect monetary concepts and monetary skills. Furthermore, parental monetary practices influence her child's monetary concepts and the extent to which monetary concepts affect monetary skills. Besides, there are direct impacts of kindergartner's number concepts on monetary concepts, and parental monetary practices on kindergartner's monetary skills, respectively. In this path analysis, “number direct teaching” represented the parental number practices; “money direct teaching” indicated the parental monetary practices; “cardinality #9” and “cardinality #12” represented kindergartner's number concepts; “knowing coin names” and “knowing coin values” were new constructs of kindergartner's monetary concepts; also, “matching paying” and “transformation paying” represented kindergartner's monetary skills.

The previous theory also inferred that children's number concepts were associated with their understanding of the value of coins; children's cardinality of the number 9 might
occur before their acquisition of the cardinality of the number 12; children's understanding of the coin names might benefit their acquisition of the coin value; children's matching paying might occur prior to their transformation paying. For these reasons, an analytic model is hypothesized in which parental number direct teaching has a positive impact on kindergartner's cardinality of the number 9 and on the extent to which the cardinality of the number 9 might positively influences her cardinality of the number 12, knowing the coin values, matching paying, and transformation paying, respectively. Also, parental direct number teaching is assumed to influence positively kindergartner's cardinality of the number 12, and to influence the extent to which the cardinality of the number 12 has a positive impact on her understanding of the coin values, matching paying, and transformation paying, respectively. Parental money direct teaching is assumed to have a positive impact on kindergartner's learning of coin names and coin values, which in turn positively influences kindergartner's paying with various types of coins. In addition, parental money direct teaching is assumed to have an impact on her child's matching paying, and transformation paying, respectively. The theoretical model and the fully-recursive model of path analysis among the study variables are presented in Figure 7 and Figure 8, respectively. Table 16 presents the correlation matrix for these study variables, all of which have a mean of zero and a standard deviation of one.

The fully-recursive model and the theoretical model were tested on the covariance matrix using the LISREL 8.12 program. The results of the two structural equation models are presented in Table 17. Standardized path coefficients were removed that were not significant at $p < .05$. The reduced model was examined and all notable standardized path coefficients were displayed ($p < .05$, see Table 17). The reduced model is presented in Figure 9.

Comparison of alternative models. Model testing confirmed that the fully-recursive saturated and that its fit was perfect ($\chi^2 = 0$, df = 0, $p = 1$). However, the model was theoretical model, which eliminated eight paths from the fully-recursive model, did not show a
Figure 7.
Theoretical model of study variables

Figure 8.
Fully-recursive model of study variables
Figure 9.
Reduced model of study variables
(*p < .05, one-tailed. **p < .01, one-tailed. ***p < .001)

Table 16.
Correlation matrix for variables used in path analysis

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Number Direct Teaching</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Money Direct Teaching</td>
<td>0.50***</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Cardinality #9</td>
<td>0.02</td>
<td>-0.07</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Cardinality #12</td>
<td>-0.01</td>
<td>0.08</td>
<td>0.15*</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Knowing Coin Names</td>
<td>0.04</td>
<td>0.12</td>
<td>0.07</td>
<td>0.06</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Knowing Coin Values</td>
<td>-0.02</td>
<td>-0.02</td>
<td>0.15*</td>
<td>0.15*</td>
<td>0.19**</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>7. Matching Paying</td>
<td>0.03</td>
<td>-0.05</td>
<td>0.06</td>
<td>0.28***</td>
<td>0.11</td>
<td>0.29***</td>
<td>1.00</td>
</tr>
<tr>
<td>8. Transformation Paying</td>
<td>-0.06</td>
<td>-0.07</td>
<td>0.11</td>
<td>0.23**</td>
<td>0.19**</td>
<td>0.26***</td>
<td>0.33***</td>
</tr>
</tbody>
</table>

Note. M = 0 and SD = 1 for all variables (N = 207).

*p < .05. **p < .01. ***p < .001.
Table 17.

Comparison of fully-recursive model, theoretical model, and reduced model

<table>
<thead>
<tr>
<th>Fully-Recursive Model</th>
<th>Theoretical Model</th>
<th>Reduced Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSS β-value (T-value)</td>
<td>CSS β-value (T-value)</td>
<td>CSS β-value (T-value)</td>
</tr>
<tr>
<td>β₁₁</td>
<td>0.07 (0.08)</td>
<td>0.02 (0.27)</td>
</tr>
<tr>
<td>β₁₂</td>
<td>-0.10 (-1.28)</td>
<td>————</td>
</tr>
<tr>
<td>β₁₃</td>
<td>-0.08 (-0.95)</td>
<td>-0.01 (-0.18)</td>
</tr>
<tr>
<td>β₁₄</td>
<td>0.13 (1.58)</td>
<td>————</td>
</tr>
<tr>
<td>β₁₅</td>
<td>0.16 (2.35**)</td>
<td>0.15 (2.21*)</td>
</tr>
<tr>
<td>β₁₆</td>
<td>-0.03 (-0.43)</td>
<td>————</td>
</tr>
<tr>
<td>β₁₇</td>
<td>0.14 (1.74*)</td>
<td>0.12 (1.69*)</td>
</tr>
<tr>
<td>β₁₈</td>
<td>0.07 (1.02)</td>
<td>————</td>
</tr>
<tr>
<td>β₁₉</td>
<td>0.04 (0.61)</td>
<td>————</td>
</tr>
<tr>
<td>β₂₁</td>
<td>-0.01 (-0.11)</td>
<td>————</td>
</tr>
<tr>
<td>β₂₂</td>
<td>-0.04 (-0.48)</td>
<td>-0.04 (-0.63)</td>
</tr>
<tr>
<td>β₂₃</td>
<td>0.12 (1.78*)</td>
<td>0.12 (1.78*)</td>
</tr>
<tr>
<td>β₂₄</td>
<td>0.12 (1.72*)</td>
<td>0.12 (1.74*)</td>
</tr>
<tr>
<td>β₂₅</td>
<td>0.18 (2.69**)</td>
<td>0.18 (2.70**)</td>
</tr>
<tr>
<td>β₂₆</td>
<td>0.10 (1.30)</td>
<td>————</td>
</tr>
<tr>
<td>β₂₇</td>
<td>-0.12 (-1.63)</td>
<td>-0.07 (-1.13)</td>
</tr>
<tr>
<td>β₂₈</td>
<td>-0.03 (-0.44)</td>
<td>-0.02 (-0.35)</td>
</tr>
<tr>
<td>β₂₉</td>
<td>0.26 (3.88**)</td>
<td>0.25 (3.82**)</td>
</tr>
<tr>
<td>β₃₀</td>
<td>0.06 (0.87)</td>
<td>0.05 (0.83)</td>
</tr>
<tr>
<td>β₃₁</td>
<td>0.25 (3.68**)</td>
<td>0.24 (3.66**)</td>
</tr>
<tr>
<td>β₃₂</td>
<td>-0.04 (-0.51)</td>
<td>————</td>
</tr>
<tr>
<td>β₃₃</td>
<td>-0.07 (-0.87)</td>
<td>-0.08 (-1.33)</td>
</tr>
<tr>
<td>β₃₄</td>
<td>0.04 (0.67)</td>
<td>0.04 (0.64)</td>
</tr>
<tr>
<td>β₃₅</td>
<td>0.13 (1.92*)</td>
<td>0.13 (1.97*)</td>
</tr>
<tr>
<td>β₃₆</td>
<td>0.14 (2.15**)</td>
<td>0.14 (2.18*)</td>
</tr>
<tr>
<td>β₃₇</td>
<td>0.13 (1.96*)</td>
<td>0.13 (1.98*)</td>
</tr>
<tr>
<td>β₃₈</td>
<td>0.24 (3.48**)</td>
<td>0.24 (3.45**)</td>
</tr>
</tbody>
</table>

χ² | 0 | 7.88 | 12.45 |

| df | 0 | 8 | 16 |
| p | 1 | 0.45 | 0.71 |
| GFI | —— | 0.99 | 0.99 |
| AGFI | —— | 0.96 | 0.97 |
| RMSR | —— | 0.029 | 0.037 |
| CN | —— | 526.34 | 530.56 |

Note. N = 207. * p < .05, one-tailed. ** p < .01, one-tailed. CSS = Completely Standardized Solution.
significant change in its $\chi^2$ value. This indicated that there were no obvious differences between the fit of the sample covariance matrix and the covariance matrix estimated from the theoretical model and the perfect fit obtained from the saturated model. It is suitable to use the theoretical model to explain the interactive relationships in this path model.

Calculation of the comparison between the fully-recursive model and the theoretical model proceeded as follows:

\[ \Delta \chi^2 \text{ (theoretical model - fully-recursive model)} = 7.88 - 0 = 7.88 \]

\[ \Delta \text{ df (theoretical model - fully-recursive model)} = 8 - 0 = 8 \]

\[ P (\Delta \chi^2 = 7.88) < \chi^2_{.05, 8} = 15.51) \]

\[ \therefore \text{ The theoretical model did not differ significantly from the fully-recursive model.} \]

For parsimony, the reduced model was compared with the theoretical model. After eliminating eight paths from the theoretical model, there was not a significant difference between the reduced model and the theoretical model although the $\chi^2$ value increased a little. Besides, the reduced model did not differ from the fully-recursive model significantly. There was no significant difference between the sample covariance matrix and the estimated covariance matrix for any of these three models. These results indicated that the reduced model had the same function as the fully-recursive model and the theoretical model. Using the reduced model would not lose any important information.

Calculation of the comparison between the theoretical model and the reduced model proceeded as follows:

\[ \Delta \chi^2 \text{ (reduced model - theoretical model)} = 12.45 - 7.88 = 4.57 \]

\[ \Delta \text{ df (reduced model - theoretical model)} = 16 - 8 = 8 \]

\[ P (\Delta \chi^2 = 4.57) < \chi^2_{.05, 8} = 15.51) \]

\[ \therefore \text{ The reduced model did not differ significantly from the theoretical model.} \]

Calculation of the comparison between the fully-recursive model and the reduced model proceeded as follows:
\[ \Delta \chi^2 \text{ (reduced model - fully-recursive model)} = 12.45 - 0 = 12.45 \]
\[ \Delta \text{df (reduced model - fully-recursive model)} = 16 - 0 = 16 \]
\[ (\Delta \chi^2 = 12.45) < (\chi^2_{.05, 16} = 26.30) \]

The reduced model did not significantly differ from the fully-recursive model.

In addition, the p-value, Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Root Mean Square Residual (RMSR), and Critical N (CN) presented were stable comparing between the theoretical model and the reduced model. This result implies that the reduced model fits the data well (i.e., \( \chi^2 (16, N = 207) = 12.45, \ GFI = 0.99, \ \text{AGFI} = 0.97 \)). The value of RMSR was 0.037, which indicated that the errors of approximation of the model to the population were small (\( p = .71 \)). All paths in this reduced model are significant. So, it is concluded that the reduced model was suitable based on the principle of parsimony.

**Paths of influence.** The results of the reduced structural equation model are presented in Figure 9, which includes path coefficients that are significant at \( p < .05 \). The direct effects, indirect effects, and total effects between variables are shown in Table 18.

From the model, there are interesting relationships among children's number concepts, monetary concepts, and monetary skills. Children's understanding of cardinality #9 helped them to understand cardinality #12 (total effects = .15, \( p < .05 \)). They knew the coin names, then knew their values (total effects = .18, \( p < .01 \)). They were able to complete matching paying which included single-item-buying and two-item-buying questions, and then they were able to use coins for the transformation paying (total effects = .24, \( p < .01 \)).

Kindergartners' understanding of the coin value was associated with their cardinality of number concepts (i.e., number 9, total effects = .14, \( p < .05 \), and number 12, total effects = .12, \( p < .05 \)) and their knowledge about coin names (total effects = .18, \( p < .01 \)). One of the children's monetary skills, matching paying, was related to their understanding of the cardinality of the number 12 (total effects = .27, \( p < .01 \)) and to knowing coin values (total effects = .25, \( p < .01 \)) directly. That is, kindergartners who succeeded in cardinality #12 tasks
Table 18.

Standardized effects and squared multiple correlations of the reduced model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Effects</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dependent</td>
<td>Independent</td>
</tr>
<tr>
<td>Cardinality #12</td>
<td>Cardinality #9</td>
<td>0.15*</td>
</tr>
<tr>
<td>Knowing Coin Names</td>
<td>Money Direct Teaching</td>
<td>0.12*</td>
</tr>
<tr>
<td>Knowing Coin Values</td>
<td>Money Direct Teaching</td>
<td>———</td>
</tr>
<tr>
<td></td>
<td>Cardinality #9</td>
<td>0.12*</td>
</tr>
<tr>
<td></td>
<td>Cardinality #12</td>
<td>0.12*</td>
</tr>
<tr>
<td></td>
<td>Knowing Coin Names</td>
<td>0.18**</td>
</tr>
<tr>
<td>Matching Paying</td>
<td>Money Direct Teaching</td>
<td>———</td>
</tr>
<tr>
<td></td>
<td>Cardinality #9</td>
<td>———</td>
</tr>
<tr>
<td></td>
<td>Cardinality #12</td>
<td>0.24**</td>
</tr>
<tr>
<td></td>
<td>Knowing Coin Names</td>
<td>———</td>
</tr>
<tr>
<td></td>
<td>Knowing Coin Values</td>
<td>0.25**</td>
</tr>
<tr>
<td>Transformation Paying</td>
<td>Money Direct Teaching</td>
<td>———</td>
</tr>
<tr>
<td></td>
<td>Cardinality #9</td>
<td>———</td>
</tr>
<tr>
<td></td>
<td>Cardinality #12</td>
<td>0.13*</td>
</tr>
<tr>
<td></td>
<td>Knowing Coin Names</td>
<td>0.13*</td>
</tr>
<tr>
<td></td>
<td>Knowing Coin Values</td>
<td>0.14*</td>
</tr>
<tr>
<td></td>
<td>Matching Paying</td>
<td>0.24**</td>
</tr>
</tbody>
</table>

Note. * p < .05, one-tailed. ** p < .01, one-tailed.
or coin-value-identification tasks successfully completed their tasks on buying-selling activities using coins to buy a candy bar, two pencils, and two kinds of candy according to the cost of the coins displayed. Cardinality #12 and knowing coin values also mediated the influence of matching paying on the cardinality of the number 9 (indirect effects = .07, p < .01) and the realization of coin names (indirect effects = .05, p < .05), respectively. In addition, the other monetary skill of transformation paying was directly connected to their cardinality of the number 12 (total effects = .21, p < .01), knowing coin names (total effects = .17, p < .01) and knowing coin values (total effects = .20, p < .01), as well as matching paying (total effects = .24, p < .01). Their cardinality of the number 9 also played an indirect role on the influence of their matching paying (indirect effect = .07, p < .01) and their transformation paying (indirect effects = .06, p < .01). These results suggest that kindergartners' knowledge of number and money facilitates their monetary skills. The number concepts have a positive impact on their monetary skills (i.e., cardinality #12 → matching paying, and cardinality #12 → transformation paying).

While kindergartners got high scores on number concept tasks, also they had high scores on monetary skill tasks. This demonstrates that there is a direct relationship between children's number concepts and their monetary skills. Besides, number concepts have indirect influences on monetary skills (i.e., cardinality #9 → knowing coin values → matching paying, cardinality #9 → knowing coin values → transformation paying, cardinality #12 → knowing coin values → matching paying, and cardinality #12 → knowing coin values → transformation paying). Knowing the value of a coin plays a mediating role between children’s understanding of the number and paying coins. This finding demonstrates that there is an indirect effect between children's number concepts and their monetary skills. Kindergartners' cardinality understanding benefits their understanding of coin values, which in turn influences their use of the same or various types of coins in paying (i.e., matching paying and transformation paying).
In this model, parental number direct teaching did not have a relationship with her kindergartner's acquisition of cardinality #9 and #12 (see Figure 9). However, the unanalyzed effect of parental number direct teaching was linked significantly to her money direct teaching ($r = .5, p < .01$). That is, parents teach their children more number knowledge and also show more teaching practices toward money for their children. On the other hand, parental money direct teaching had a directly positive impact on her kindergartner's understanding of coin names (total effects $= .12$, $p < .05$). This indicates that if parents use direct money teaching strategy with their children it will be a useful way to help children understand the names of coins. However, there was no significant effect of parental money direct teaching on her child's acquisition of understanding coin values, and how to pay by using various coins in further buying-selling activities.

**Spurious relationships.** Three spurious relationships were found in the reduced model (see Figure 10, Figure 11, & Figure 12). The relationship between matching paying and transformation paying decreased because of spurious influence from cardinality #12 (from $r = .33$ to $r = .24$) and from knowing coin values (from $r = .33$ to $r = .24$). The direct effect of matching paying on transformation paying is equal to .24. The remainder of the correlation between matching paying and transformation paying is spurious, due to the fact that they share common causes (i.e., cardinality #12 and knowing coin values). Also, the variable knowing coin names was the common predictor for the spurious relationship between knowing coin values and transformation paying. The relationship between knowing coin values and transformation paying decreased owing to the joint impact from knowing coin names (from $r = .26$ to $r = .14$). The direct effect of knowing coin values on transformation paying is equal to .14. The remainder of the correlation between knowing coin values and transformation paying is spurious because they share a common cause, knowing coin names. These spurious influences are apparent from the fact that the original correlational relationships (i.e., zero-order correlations) between matching paying and transformation
Figure 10.
Spurious relationship among cardinality #12, matching paying, and transformation paying

Figure 11.
Spurious relationship among knowing coin values, matching paying, and transformation paying

Figure 12.
Spurious relationship among knowing coin names, knowing coin values, and transformation paying
paying, and between knowing coin values and transformation paying, were stronger than the relations (i.e., partial correlations controlling for cardinality #12, knowing coin values, or knowing coin names, respectively) shown in the reduced model.

Discussion

The importance of understanding the primary learning of numbers and money by individuals in today's consumer society led to this study that explores the interactive relationships among children's number concepts, monetary concepts, and monetary skills. Moreover, the important role of parents in their young children's development was explored, specifically young children's initial number and money understanding. This study also examined the relationships between parents' number and money practices toward their young children and their children's number concepts and monetary concepts and skills development. This study investigated 207 kindergartners and their parents in order to understand these concepts prior to the children being influenced by formal school learning.

Triangular relationships of number and money learning

This study found that there were interactive relationships among kindergartners' number concepts, monetary concepts, and monetary skills. Children's understanding of the cardinality of the number 9 and the number 12 facilitated their abilities in matching paying and transformation paying. This finding supports the hypothesis that kindergartners' number concepts have a positive impact on their monetary skills. The direct relation between number concepts and monetary skills is accepted. For children to be successful in using money, they need to understand numbers. Children's knowledge of coin names had an indirect effect on their matching paying and had a direct effect on their transformation paying. Their understanding of coin values directly influenced their paying various types of coins, also. These results support the hypothesis that kindergartners' monetary concepts have a positive impact on their monetary skills. Moreover, children's cardinality #9 and #12 were mediated...
through their knowing coin values and further influenced their paying with various types of coins. The direct and indirect relationships between children's number concepts and monetary skills are confirmed. These findings also support the hypothesis that kindergartners' number concepts benefit their acquisition of monetary concepts. In addition, these results support previous arguments that children's monetary skills require knowing the numerical system, and, also the mastery of monetary concepts (Berti & Bombi, 1981; Furham & Lewin, 1986, Furth, 1980).

Kindergartners' cardinality #9 might occur before their acquisition of cardinality #12. This finding explains children's number understanding from small to larger numbers that is reported in previous studies (Becker, 1989, 1993; Frye et al., 1989; Fuson et al., 1985; Halford & Boyle, 1985; Rea & Reys, 1971; Sophian, 1988). For example, the concept of number 10 is based on the concept of number 9 following the counting order 1, 2, 3, 4, 5, 6, 7, 8, and so on. Frye et al. (1989) found that the percentage of 3- to 5-year-old children completing the small-set tasks (4 & 5 tasks) was higher than that of the large-set tasks (12 & 14 tasks). Number concept development is a cumulative process. The current results support the school-like mathematics solution rather than everyday mathematics. According to Nunes, Schliemann, and Carraher (1993), school-like mathematics first deals with units and then move to tens and progressively larger value numbers; however, everyday mathematics deals with the largest numbers (values) first and then smaller numbers (values). School-like mathematics results from formal school learning; in contrast, everyday mathematics emphasizes the mathematics experiences of children outside of school, such as making purchases (Guberman, 1996) and serving as street vendors (Saxe, 1988). In the present study, parents reported that 43% of kindergartners never had an allowance and 66% of them seldom had experiences in paying for small items in the store more than once a week (see Appendix J), in contrast to Brazilian children who made small purchases several times a day (Guberman, 1996). Iowa kindergartners do not have the same living experiences as
Brazilian children. Clearly, their cardinality of number development represents a different pattern from the Brazilian children; that is, they learned numbers from small to large.

This study reveals that kindergartners' knowledge of coin names might occur before their acquisition of knowing coin values. This finding, indicating that the knowledge of coin names is acquired prior to the knowledge of coin values, supports the finding of others; that is, kindergartners learn the name of coins first, and then understand their values (Anderson & Fulton, 1987; Edmunds & Whitehurst, 1973; Rea & Reys, 1971; Strauss, 1952). These 5-year-olds were capable of using coins in the buying-selling activities by their one-to-one correspondence skills when provided with concrete examples. Besides, they were able to deal with addition questions in these tasks using other concrete examples of coins. The matching paying occurs prior to the transformation paying. These findings were not reported in previous studies; however, it clearly indicates that kindergartners can learn to use money. The matching strategy is a suitable way for them to learn monetary skills. When they master the matching paying and understand the coin names and values, they can easily transfer the coin values and, further, successfully use various types of coins for purchasing items.

This result supports the finding of Schuessler and Strauss (1950), who found that children's monetary responses developed from very simple modes to more complex ones. Schuessler and Strauss reported that more advanced children matched a dime with ten pennies, and then later matched it with a nickel and five pennies. However, this finding contradicts Guberman's (1996) work with 6- to 14-year-old Brazilian children whose money use progressed from global estimates to the mental decomposition and manipulation of money values (e.g., 200 - 35 = ?, Brazilian children simplified the subtraction by decomposing 35 into 30 and 5, and then subtracting the 30 from 200). The sociocultural context between Brazil and the United States may produce this divergence of children's monetary learning similar to that found for number development. The findings in the present study represent the initial relationships among Iowa kindergartners' number and money.
learning. The children in Iowa and in Brazil have distinct living and schooling experiences. In sum, the number and monetary activities designed from small amounts to large amounts, from coin names to coin values, from matching paying to value transformation paying appear to be practical strategies for young children in the United States to learn numbers and money.

Parental influence

Parental money practices have a positive impact on her kindergartner's monetary concepts. This finding is supported by Kourilsky (1977) and Marshall & Magruder (1960). Parental monetary practices in the present study were operationalized as parental direct money teaching in the path model. The results demonstrate that it is effective for parents to teach their young children directly the name of coins, the value of coins, and to provide their young children opportunities for exploring coins. Moreover, parents who engaged in more number teaching practices with their kindergartners also presented more money practices for them. This finding suggests that their parental practices are similar for teaching their kindergartners about numbers and money.

There was no significant relation between parental number practices and her kindergartner's number concepts to support the related research hypothesis. This may result from three possible explanations. First, it may be due to the design of children's counting/cardinality tasks. A ceiling effect was approximated in the Cardinality #9 tasks. Almost 80% - 93% of kindergartners were able to answer the Cardinality #9 questions. The nature of the cardinality measure might result in the lack of relationship with the parental number practices at home. Second, this study found that kindergartners had high scores on their number concepts tasks; however, they were not correlated with parental number practices. If it is assumed that parenting is an environmental factor, then there may be another possible inference for the role of nature, such as IQ. A function of one's biological constitution could be a central issue of children's primary number learning. According to
Scarr and McCartney's genotype → environment theory (1983), environment does play an important role in shaping intellect, but a person's inherited characteristics determine those experiences and what and how they are perceived. Number development is associated with individual intellect (Thorndike, Hagen, & Sattler, 1986; Thurstone, 1938; Wechsler, 1974). Inherited characteristics (i.e., naturalistic influences), such as children's IQ or parent's IQ, are worth considering in further empirical investigations. Third, parents' responses may reflect the effect of social desirability response set bias, to try to fit in with the researchers' perceived expectations rather than reporting their actual practices. Therefore, the results may fail to indicate the true relationship between parents' number practices and their kindergartners' number concepts.

Furthermore, parental monetary practices did not show obvious indirect effects on her kindergartners' money using and knowing coin values. When comparing the present study with Marshall and Magruder's (1960) work, the focus of parenting is different. By principal components factor analysis, the present study data revealed that parents' monetary practices emphasized their direct teaching strategies, such as teaching children the name of coins and the value of coins. However, Marshall and Magruder's (1960) effective parental monetary practices focused on giving children money to spend and to save. It seems that providing children with money to use rather than teaching children the coin names and coin values benefits children in learning monetary skills. In this present study, parents provided their kindergartners with money to pay for small items at the store once a month, yet 43% of the parents did not give their kindergartners an allowance (see Appendix J). These low frequencies for actual money activities at home between parents and children might explain the insignificant impact of parental monetary practices on kindergartners' monetary skills.

Kindergartners' comparing tasks of numbers and money

This study found that the internal consistency reliabilities (Cronbach's alpha) were very low for children's Comparing/Ordinality Tasks and Comparative-Value Tasks. Children'
performance on the Comparing/Ordinality Tasks revealed that there were two items either too
difficult or too easy for the kindergartners. The question, "What is more, the teddy bears or
the glasses?," was answered accurately by 84% of the kindergartners when comparing the
numbers 8 and 10. Yet the question, "If we give each teddy bear a bowl, will we have enough
bowls?" was difficult for kindergartners when the numbers 11 and 13 were used. The latter
question requires simultaneously children's counting, memory, and question understanding.
It may be too complicated for them to make correct judgment by using numbers beyond 10.
Also, it implies that kindergartners' understanding of the meaning "more" is better than "will
we have enough," although research has indicated that 5- and 6-year-old children were able
to identify "some," "many," and "seldom" (Mohan, 1984).

Previous research findings indicate that most young children's judgment about coin
values is still restricted by their perceptual experiences (Edmunds & Whitehurst, 1973;
Piaget, 1965). In this study, only 44% of kindergartners were successful in comparing a
penny and a dime. The other 56% of kindergartners replied that the reason they chose the
penny as worth more than the dime was that the penny was bigger. Their responses
indicated that perception-based judgments accounted for kindergartners' errors. Moreover, it
also displayed that those children did not understand completely the value of coins, even the
one-cent penny. The corrected item-total correlation information indicated that the value of
Cronbach's alpha in Comparative-Value Tasks would increase if this item (i.e., Penny-Dime)
was deleted. The development of children's perceptual-based understanding strongly
influences the stability of the items for the instruments used in this study.

Conclusions

In summary, the exploratory triadic relationships among kindergartners' number
concepts, monetary concepts, and monetary skills explored in this study represent American
kindergartners' understanding of numbers and money. The U.S. children's initial learning
experiences are different from those of Brazilian children. The U.S. children understand
number and money following a school-like model. They learn numbers from small to larger numbers, from coin names to coin values. In addition, their matching paying skills occur before their skills in using value transformation coins (e.g., using five pennies instead of a nickel). Parental direct teaching about money facilitated her kindergartner’s acquisition of knowing coin names. This result also implies that providing children the experiences of using money facilitates their monetary skills. There was a positive relationship between parental number practices and monetary practices. Inherited characteristics, such as the child’s IQ, could be considered to be an impact on young children’s number development. In the U.S. the typical 5-year-old kindergartner already has sufficient basic knowledge and ability to learn about numbers and money. It appears that more opportunities to learn about numbers and money in their everyday life would be beneficial.

Limitations And Recommendations

The squared multiple correlations for structural equations in the reduced model (see Table 18) showed that there were limitations to the explanatory power of the model estimated in this study, perhaps due to the study instruments. Sharma (1996) indicated that the squared multiple correlations are used to assess the appropriateness of each indicator, and that they are related closely to the reliability of the measures. It is known that the number of items in a measure is associated with its reliability. In this study, a total of 28 trials were included in the children’s measures (i.e., Counting/Cardinality Tasks, 6 trials, Comparing/Ordinality Tasks, 4 trials, Coin-Identification Tasks, 8 trials, Comparative-Value Tasks, 4 trials, and Revised Equivalent-Value Tasks, 6 trials) to accommodate a reasonable length of testing for kindergartners. This might be the main influence that resulted in the low squared multiple correlations shown in the reduced model. If possible, more test items for each measure would increase the reliability of the measure.
For future studies exploring the influence of these interactive relationships among parents and their kindergartners' number and monetary development, the sample size is another important consideration. In structural equation models, the number of participants needed for statistical power and model stability is associated with the number of parameters to be estimated. While the number of parameters was ample for this study, a larger sample size would be preferable to explore more elaborate models.

Based on these limitations, it is recommended that more reliable and valid measures with more items would be valuable. Young children could participate in different kinds of tasks during separate interviews. On the other hand, researchers need to consider increasing the sample size when trying to include more variables in this path model. Thus, some possible impacts on the young children's number and money learning and their parental practices, such as children's IQ, age, gender, living with sibling, preschool experience, parents' SES, parents' IQ, and parents' education, may be desirable to explore in future studies. Finally, reciprocal relationships may be examined in future studies of older children's number and money learning because they have more extended consumer experiences than young children.

References


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GENERAL CONCLUSIONS

Consumer education in early childhood is related to young children’s knowledge and skills concerning numbers and money. How do young children learn numbers? What are their monetary concepts and skills? Do their parents play an influential role in their early learning about numbers and money? These questions were addressed by studying 207 kindergartners and their parents. The purpose of the study was to examine the interactive relationships among kindergartens’ number concepts, monetary concepts, and monetary skills, and the number practices and monetary practices of their parents.

According to the literature review in Chapter 1, young children know about the amount of numbers, and then they learn the sequence of numbers. They make number judgments based on their direct experiences. Five-year-old children deal readily with one-to-one correspondence in matching tasks and counting tasks by successfully using the numbers 1 to 5. Also, they are able to operate simple counting tasks up to the number 10, understand the meanings of “some,” “a few,” and “a lot,” and do addition and subtraction problems based on the numbers 5 or 10. Moreover, they are able to identify the penny as a basic money unit and to name the coins penny, nickel, and dime. They have some basic numerical knowledge and monetary experience to learn more about numbers and money. Previous research reveals that parents’ interaction with their children by providing learning experiences or participating in school activities benefits their children’s acquisition of knowledge about numbers and money.

In Chapter 2, an empirical study investigated 207 kindergartners and their father or mother in central Iowa. The Revised Home Math Parent/Child Interaction Questionnaire and the Parent-Child Money Activities Questionnaire were used to investigate parental number and monetary practices, respectively. The Counting/Cardinality Tasks, the Comparing/ Ordinality Tasks, the Revised Coin-Identification Tasks, the Revised Comparative-Value Tasks, and the Revised Equivalent-Value Tasks through individual
clinical interview were used to collect data of kindergartners' number concepts, monetary concepts, and monetary skills. After exploratory factor analysis and screening with Cronbach's alpha for internal consistency reliability, eight new variables were used in the further path analysis. That is, "parental direct number teaching" represented the parental number practices; "parental direct money teaching" indicated the parental monetary practices; "cardinality #9" and "cardinality #12" represented the kindergartners' number concepts; "knowing coin names" and "knowing coin values" represented kindergartners' monetary concepts; "matching paying" and "transformation paying" indicated the kindergartners' monetary skills. Through LISREL 8.12 structural equation modeling, the exploratory path model showed the following results.

There were triangular relationships among kindergartners' number concepts, monetary concepts, and monetary skills, which supported the findings of Berti & Bombi (1981), Furham & Lewin (1986), and Furth (1980). Kindergartners' cardinality #9 and #12 facilitated their abilities for matching paying and transformation paying. This finding supports the hypothesis that kindergartners' number concepts have a positive impact on their monetary skills. The direct relation between number concepts and monetary skills is accepted. Children's knowledge of coin names had an indirect effect on their matching paying and had a direct effect on their transformation paying. Their understanding of coin values also directly influenced both types of coin paying. These results support the hypothesis that kindergartners' monetary concepts have a positive impact on their monetary skills. Moreover, children's cardinality #9 and #12 were mediated through their knowing coin values and further influenced their coin paying. The direct and indirect relationships between children's number concepts and monetary skills are confirmed.

Kindergartners' cardinality #9 benefits their acquisition of cardinality #12. This finding explains the expansion of children's number understanding from small numbers to larger numbers and is in agreement with previous studies (Becker, 1989, 1993; Frye et al., 1989;
The results revealed that kindergartners' knowledge of coin names occurred before their acquisition of knowing coin values. This finding indicates that the cardinality of coin names is understood prior to the cardinality of coin values. Kindergartners learn the name of coins first, then realize their value (Anderson & Fulton, 1987; Edmunds & Whitehurst, 1973; Rea & Reys, 1971; Strauss, 1952). Similarly, kindergartners' use of coins proceeds from simple to more complex combinations. They understand the one-to-one correspondence relationship between coins and cost and then they are able to use coins by the value transformation. Those monetary skills might facilitate their further use of various types of coins for purchasing items. These results support the work of Schuessler and Strauss (1950). The findings from this present study reflect initial relationships among the United States kindergartners' number and money learning as representing a school-like model. Results from this study provide a clear reference for parents and teachers today in designing number and money activities for kindergartners in the United States.

Parents' money practices have a positive impact on their kindergartners' monetary concepts. This finding supports the findings of Kourilsky (1977) and Marshall and Magruder (1960). The results indicate that it is effective for parents to teach their young children directly the name of coins and the value of coins and to provide their young children opportunities for exploring coins. Moreover, there was a significant positive relationship between parental number direct teaching and their monetary direct teaching. This implies that parents' practices concerning their kindergartners' learning of number and money are related. However, there was no significant relation between parents' number practices and their kindergartners' number concepts, so the respective research hypothesis is not supported. It seems that natural factors, such as IQ, could have an important impact. Furthermore, parents' monetary practices did not show obvious indirect effects on their kindergartners' money use and knowing coin values. Children's age could be a factor influencing parental
monetary practices. For example, these parents did not show highly frequent practices of providing their kindergartners money with experiences, such as buying or saving. This study also found that the development of children's understanding (e.g., their restriction of perception experiences for the coin size and coin values) strongly influences the stability of this study instruments (e.g., Comparative-Value Tasks).

The instruments were the main limitation for this study. It is necessary to increase the number of items in order to establish higher construct reliability. On the other hand, to analyze further the influence of these research variables it is necessary to increase the sample size. Other influencing factors, such as parental IQ, parental SES, parental education, children's age, preschool experiences, and living with a sibling, may be considered in further study. Even the reciprocal relationships can be significant when exploring older children's number and monetary learning. In summary, kindergartners already possess sufficient knowledge and ability to learn numbers to 9 and simple money skills. Providing more number and money learning experiences in their everyday life would be beneficial.

References


APPENDIX A

CORRESPONDENCE
October 28, 1996

Dear Parents:

I am a doctoral student in the Department of Human Development and Family Studies at Iowa State University. As a student of early childhood education, and as a consumer educator and early childhood educator in my home country Taiwan, Republic of China, I'm interested in exploring the relationship between parents and their kindergartners in learning about number and money. I'm also trying to develop a theoretical model to explain these relationships. I need your support and help to learn more.

My research involves both kindergarten children and one of their parents. I need kindergarten parents to answer about 30 questions and agree for their kindergartner to play some counting and money games with me when they are at school. If you agree to participate please complete the enclosed questionnaires and return the materials to your child's kindergarten teacher in the enclosed envelop. After I receive your completed questionnaires your kindergartner will individually participate in three number and money games (28 items total) in a quiet place at school. The games will take about 25 minutes. The information from both of you will be kept confidential. Neither you nor your child will be identified by name in the final research reports. Only group information will be reported. A copy of the research summary will be sent to all interested families after the study has been completed.

The participation of you and your kindergartner is important in understanding more about how young children learn. I'm looking forward to receiving your permission. Please indicate your interest in participating in this study by completing the enclosed materials and returning them by next week in the enclosed envelop to your child's teacher. The participation of you and your child is voluntary and you are free to withdraw at any time. As you have questions, you may contact me (515/296-4709) or my major professor, Dr. Joan Herwig (515/294-6230). We will be happy to answer any questions.

In advance, thank you for your careful consideration of this special request. We appreciate your time and cooperation.

Sincerely,

Jyh-Tsomg (Jocelyn) Jong  
Doctoral Candidate

Dr. Joan E. Herwig, Associate Professor HDFS  
Major Professor in charge of research

enclosures
PERMISSION FORM
FOR PARENT-CHILD NUMBER AND MONEY STUDY

The general purpose of the study and the research procedures have been explained to me. I understand that all information will be kept confidential and neither my child, my spouse nor I will be identified by name. I understand that my child and I are free to withdraw from the study at any time.

Please check the preferred option and return this form in the attached envelop as soon as possible. Your consideration with this study is greatly appreciated.

I have completed the questionnaires for this study and I am willing for my kindergartner to participate in the study as described in the attached letter.

We are not willing to participate in the study as described in the attached letter.

We are interested in receiving a copy of the results of this study.

Parent’s Signature __________________________ Date __________________________

BACKGROUND INFORMATION (Please Print) ID: __________________________
(Researchers Use Only)

Father’s Name: ______________________________________________________

Mother’s Name: ______________________________________________________

Child’s Name: ______________________________________________________

Child’s Birth Date: ___________ Sex: M F

Child’s School: ____________________________ Teacher: ____________________________

Home Address: ______________________________________________________ City: ____________

Home Phone: ____________________________

Jong/Herwig Research
December 28, 1996

Dear (Superintendents, Principals, and Teachers):

I am a doctoral student in the Department of Human Development and Family Studies at Iowa State University. As a student of early childhood education, and as a consumer educator and early childhood educator in my home country Taiwan Republic of China, I'm interested in exploring the relationship between parents and their kindergartners in learning about number and money. I'm also trying to develop a theoretical model to explain these relationships. The study is under the direction of Dr. Joan E. Herwig. To execute the purpose of this study, I need your support and help to learn more.

My research involves both kindergarten children and one of their parents. I need kindergarten parents to answer about 30 questions to agree for their kindergartner to play some counting and money games with me when they are at school. If parents agree to participate they will complete the enclosed questionnaires and return the materials to their child's kindergarten teacher in an enclosed envelop. After I receive their completed questionnaires their kindergartner will individually participate in three number and money games (28 items total) in a quiet place at school. The games will take about 25 minutes. The information from both of them will be kept confidential. Neither the parent nor their kindergartner will be identified by name in the final research reports. Only group information will be reported. A copy of the research summary will be sent to all interested families after the study has been completed.

The participation of the parent and their kindergartner is important in understanding more about how young children learn. Also, it is important to get your permission to use your kindergartners and their parent as my participants. I'm looking forward to receiving your consent and working with you. Enclosed is a sample parent letter, a parent permission form, the General Family Information Questionnaire, the Home Math Parent/Child Interaction Questionnaire, and the Parent-Child Money Activities Questionnaire. As you have questions, you may contact me (515/296-4709) or my major professor, Dr. Joan Herwig (515/294-6230). We will be happy to discuss the study with you.

Thank you for your careful consideration of this special request. I am looking forward to your kindergartners and their parent’s participation.

Sincerely,

Jyh-Tsomg (Jocelyn) Jong
Doctoral Candidate

Dr. Joan E. Herwig, Associate Professor HDFS
Major Professor in charge of research

enclosures
December 5, 1996

Dear (Parents):

Thank you for completing our parent questionnaires and giving us permission to work with your child. We have a good time working with . He/She was interested in the games and answered all of the questions. We have enjoyed your child and school.

Now we have another request! We need twenty parents to help us by completing the Home Math Parent/Child Interaction Questionnaire and the Parent-Child Money Activities Questionnaire again. Would you help us by spending 5 to 10 minutes to answer these questions? Please return the completed questionnaires in the enclosed addressed, stamped envelop by December 16.

In advance, thank you for supporting this special request. We appreciate your time and thought during this very busy holiday season. If you have questions about this request, please contact us directly (515/294-3042).

Sincerely,

Jyh-Tsong (Jocelyn) Jong
Doctoral Candidate

Dr. Joan E. Herwig, Associate Professor HDFS
Major Professor in charge of research

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APPENDIX B

PARENT QUESTIONNAIRES
Q-1 What is your relationship to your kindergartner? (Circle number of your answer)

1. FATHER
2. MOTHER
3. STEPFATHER
4. STEPMOTHER
5. ADOPTIVE FATHER
6. ADOPTIVE MOTHER
7. OTHER (specify):

Q-2 Your present age: _______ YEARS

Q-3 What is your ethnic or racial group? (Circle number)

1. WHITE/CAUCASIAN
2. BLACK/AFRICAN AMERICAN
3. HISPANIC/LATINO
4. ASIAN OR PACIFIC ISLANDER
5. AMERICAN INDIAN/NATIVE AMERICAN
6. ALASKAN NATIVE
7. OTHER (specify):

Q-4 Your present marital status. (Circle number)

1. NEVER MARRIED
2. MARRIED
3. DIVORCED
4. SEPARATED
5. WIDOWED

Q-5 Which is the highest level of education that you have completed? (Circle number)

1. GRADES 1-4
2. GRADES 5-8
3. GRADES 9-12 (NO DIPLOMA)
4. HIGH SCHOOL GRADUATE
5. GED (GENERAL EDUCATION DIPLOMA)
6. SOME COLLEGE, BUT NO DEGREE
7. ASSOCIATE DEGREE
8. BACHELOR'S DEGREE (specify major)
9. GRADUATE DEGREE (degree & major)

Q-6 Your kindergartner's sex. (Circle number)

1. BOY
2. GIRL

Q-7 What is the ethnic or racial group of your kindergarten child? (Circle number)

1. WHITE/CAUCASIAN
2. BLACK/AFRICAN AMERICAN
3. HISPANIC/LATINO
4. ASIAN OR PACIFIC ISLANDER
5. AMERICAN INDIAN/NATIVE AMERICAN
6. ALASKAN NATIVE
7. OTHER (specify):

Q-8 How many other children (between 6 and 18 years old) live in the home? (Do not include your kindergarten child)

Q-9 Did your kindergartner attend preschool? (Circle number)

1. YES, YEARS ATTENDED ______
2. NO

Q-10 Did the preschool teacher teach about numbers? (Circle number)

1. YES
2. NO
3. I DO NOT KNOW

Q-11 Did the preschool teacher teach about money? (Circle number)

1. YES
2. NO
3. I DO NOT KNOW
### REVISED HOME MATH PARENT/CHILD INTERACTION QUESTIONNAIRE

**ID:** __________

*Researchers Use Only*

**Directions:** Please circle the response that best fits you.

- If you **never** do the practice, circle 1
- If you **monthly** do the practice, circle 2
- If you **weekly** do the practice, circle 3
- If you 2 or 3 times a week do the practice, circle 4
- If you **daily** do the practice, circle 5

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Monthly</th>
<th>Weekly</th>
<th>2 or 3 Times</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I say counting rhymes with my child</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. I have a regular time to explore math in our home</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. I play the game “What are the numbers printed on the cereal boxes, street signs, and buildings?”</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. I show an interest in math on TV, exploring it with my child through conversation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. I take time to talk to my child about his/her new interest or new experiences in math</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. I take my child outside and allow him/her time to observe likenesses and differences in the world around us</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. My child sees me counting and using numbers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. I use positional words with my child (“on” the table, “over” the box)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. I teach my child to count 1, 2, 3, 4, 5</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10. I teach my child shapes (square, circle, triangle)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11. I teach my child the names of math symbols (=, +, -)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>12. I let my child help me cook</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>13. I tell my child how much I appreciate him/her</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>14. I teach my child to count objects</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>15. My child and I play board and/or card games (Candyland, UNO, Go Fish)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Revised Sears & Medearis (1992)
PARENT-CHILD MONEY ACTIVITIES QUESTIONNAIRE

Directions: Please circle the response that best fits you.

If you never do the practice, circle 1
If you monthly do the practice, circle 2
If you weekly do the practice, circle 3
If you 2 or 3 times a week do the practice, circle 4
If you daily do the practice, circle 5

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Monthly</th>
<th>Weekly</th>
<th>2 or 3 Times A Week</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

THANK YOU FOR YOUR HELP!
PLEASE CHECK TO SEE IF YOU ANSWERED ALL OF THE QUESTIONS.
APPENDIX C

CHILDREN'S NUMBER CONCEPT TASKS
CHILDREN'S NUMBER CONCEPT TASKS

Test 1-Counting/Cardinality Tasks

Purpose: To investigate whether children understand the final number used in the count sequence represents the number of objects in the set.

Materials: Twenty-one teddy bear counters 20 mm in height, nine plastic cups 15 mm in height, and fourteen plastic plates 35 mm in diameter.

Procedure: The investigator gives the child \([x]\) objects, and asks "How many X are there?" Then, she/he gives the child the other \([y]\) objects and asks "Are there \([y]\) here?", "Give me the same number of X to match the \(Y\)" (or "Give me nine cups"). If the child has difficulty counting, the investigator help the child by saying "Let's count the \(X\) and \(Y\) again," or by pointing as the child counts. Equal-sets and unequal-sets are executed respectively. The distribution of materials and questions arranged as follows (see Table I).

Table I.
The distribution of materials and questions (Counting/Cardinality Tasks)

<table>
<thead>
<tr>
<th>Questions</th>
<th># of Bears</th>
<th># of Cups</th>
<th># of Plates</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How many teddy bears are there?</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Are there a total of nine cups here?</td>
<td></td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>3. Give me the same number of cups to match the teddy bears. (Give me nine cups)</td>
<td>9</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>4. How many teddy bears are there?</td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>5. Are there a total of twelve plates here?</td>
<td></td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>6. Give me the same number of plates to match the teddy bears. (Give me twelve plates)</td>
<td>12</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

References:


Test II-Comparing/Ordinality Tasks

Purpose: To investigate children's quantitative understanding about more or less in two arrays by comparison.

Materials: Twenty-one teddy bear counters 20 mm in height, ten plastic glasses 23 mm in height and eleven plastic bowls 30 mm in diameter.

Procedure: The investigator arranges two materials into two lines and keeps the two lines with the same length. The investigator asks the child "What is more, the X or the Y? (Or, Are there more X or more Y?)" "If we want to give each X a Y, will we have any Y left?" "How do you know?" Then, the investigator shows the child a new trial, and asks "What is less, the X or the Z? (Or, Are there less X or less Z?)" "If we want to give each X a Z, will we have enough Z?" "How do you know?" Children are encouraged to count. During the individual interview, the child's correct responses are recorded with each correct answer receiving one point. The reason responses also are recorded. The distribution of materials and questions arranged as follows (see Table II).

Table II.

The distribution of materials and questions (Comparing/Ordinality Tasks)

<table>
<thead>
<tr>
<th>Questions</th>
<th># of Bears</th>
<th># of Glasses</th>
<th># of Bowls</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What is more, the teddy bears or the glasses? (Or, Are there more teddy bears or more glasses?)</td>
<td>8</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2. If we give each teddy bear a glass, will we have any glasses left? How do you know?</td>
<td>8</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3. What is less, the teddy bears or the bowls? (Or, Are there less teddy bears or less bowls?)</td>
<td>13</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>4. If we give each teddy bear a bowl, will we have enough bowls? How do you know?</td>
<td>13</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

References:


APPENDIX D

CHILDREN'S MONETARY CONCEPT TASKS
CHILDREN'S MONETARY CONCEPT TASKS

Test I-Revised Coin-Identification Tasks (McCarty, 1967)

Purpose: To investigate children's ability to identify coins by names.

Materials: Two quarters, two dimes, three nickels, and two pennies.

Procedure: The coins mounted on a 7.3" by 8.6" card are placed before the child in the following pattern,

25 - 10
10 - 5 - 1 - 5 - 25
1 - 5

The investigator says, "I have some real pieces of money on the board. Can you put your finger on a penny?" When the child responds, the investigator says, "Good." In this manner, the investigator directs the child either to put his/her finger on (a penny) or on a piece that is (one cent), in the following order,

(1) A penny
(2) A nickel
(3) A dime
(4) One cent
(5) Five cents
(6) Ten cents
(7) Twenty-five cents
(8) A quarter

The child's correct responses are recorded.

Test II-Revised Comparative-Value Tasks (McCarty, 1967)

Purpose: To investigate children's ability to identify coins of greater and lesser value.

Materials: Three pennies, two nickels, one dime, and two quarters.

Procedure: The investigator asks the child, "Do you go to the store with your mother sometimes?" (Child responds.) "What do you buy?" (If candy is not mentioned, the investigator asks, "Do you buy candy sometimes?" Then, the child is shown the first card of paired coins. The investigator says, "Show me the coin that would buy the most candy at the store." In this manner, the investigator instructs the child to choose the coin of greatest value in each of the following pairs which are mounted on 3" by 5" cards,

(1) Nickel-penny
(2) Quarter-nickel
(3) Penny-dime
(4) Quarter-penny

The child's choices are recorded on the score sheet. Also, the investigator asks "How do you know?" and records his/her response.

APPENDIX E
CHILDREN'S MONETARY SKILL TASKS
CHILDREN'S MONETARY SKILL TASKS

Test I-Revised Equivalent-Value Tasks (McCarty, 1967)

Purpose: To investigate if children can represent the reciprocal nature of exchanging money for goods during the process of dramatic play store setting.

Materials: A toy car, a doll, a toy dinosaur, a candy bar, two pencils, two kinds of candy, six purses, ninety pennies, thirteen nickels, and twelve dimes.

Procedure: At first, the child is told that he/she is a shopper who is going to play a shopping (selling-buying) game with a storekeeper, i.e., the investigator. The six items are shown to the child, respectively, for the six questions. Each kind of item is placed in a small box and coins are glued on the box to show the price of the item. Also, the child gets six different purses containing 2 or 3 various coins. The arrangement of items in the boxes, coins in purses and directions are shown as follows. The child's choices are recorded.

1. A toy car costs seven cents (shown by seven pennies and 7¢) using ten pennies, one nickel and one dime in the first purse. Direction: When the investigator shows the toy car, he/she says "The toy car costs seven cents (indicating the coins on that box). You can buy it with the money in your purse. Give me the money you would need to buy the car." The investigator holds out his/her hand to accept the coins.

2. A doll costs ten cents (shown by one dime and 10¢) using ten pennies and two nickels in the second purse. Direction: When the investigator shows the doll, he/she says "The doll costs ten cents (indicating the coins on that box). You can buy it with the money in your purse. Give me the money you would need to buy the doll." The investigator holds out his/her hand to accept the coins.

3. A toy dinosaur costs five cents (shown by one nickel and 5¢) using ten pennies and two dimes in the third purse. Direction: When the investigator shows the toy dinosaur, he/she says "The dinosaur costs five cents (indicating the coins on that box). You can buy it with the money in your purse. Give me the money you would need to buy the dinosaur." The investigator holds out his/her hand to accept the coins.

4. A candy bar costs nine cents (shown by one nickel and four pennies and 9¢) using ten pennies, two nickels and two dimes in the fourth purse. Direction: When the investigator shows the chocolate bar, he/she says "The candy bar costs nine cents (indicating the coins on that box). You can buy it with the money in your purse. Give me the money you would need to buy the candy bar." The investigator holds out his/her hand to accept the coins.

5. Two pencils cost six cents (shown by three pennies and 3¢ respectively) using ten pennies, three nickels and three dimes in the fifth purse. Direction: When the investigator shows the two pencils, he/she says "One pencil costs three cents (indicating the coin near the pencil). If you want to buy two pencils, how much do you need to pay? You can buy them with the money in your purse. Give me the money you would need to buy the two pencils." The investigator holds out his/her hand to accept the coins.

6. Two kinds of candy cost eighteen cents (shown by one dime and 10¢, and one nickel, three pennies and 8¢ respectively) using twenty pennies, two nickels and two dimes in the sixth purse. Direction: When the investigator shows the two kinds of candy, he/she says "This candy costs ten cents and the other one costs eight cents (indicating the coins for each candy). If you want to buy the two kinds of candy, how much do you need to pay? You can buy them with the money in your purse. Give me the money you would need to buy the two kinds of candy." The investigator holds out his/her hand to accept the coins.

APPENDIX F
CHILDREN'S COMPOSITE SCORE SHEET
**CHILDREN’S COMPOSITE SCORE SHEET**

**ID:**

**Name:**

**Boy**

**Girl**

**School:**

**Classroom:**

**Birth Date:** (Mon.) (Day) (Yr.)

**Date:** / /

**Age (Months):**

**Ethnicity:**

White/Caucasian

Black/African American

Hispanic/Latino

Asian or Pacific Islander

American Indian/Native American

Alaskan Native

Other: ____________________________

**Test Order:**

# Concept/ $$ Concept

$$ Concept/ # Concept

**NUMBER CONCEPT TASKS**

**Counting/Cardinality:**

(1) 9 ___Correct ___Incorrect (counting: ___yes___no)

(2) Yes ___Correct ___Incorrect (counting: ___yes___no)

(3) 9 ___Correct ___Incorrect (counting: ___yes___no)

(4) 12 ___Correct ___Incorrect (counting: ___yes___no)

(5) No ___Correct ___Incorrect (counting: ___yes___no)

(6) 12 ___Correct ___Incorrect (counting: ___yes___no)

**Subtotal:** ___Correct ___Incorrect

**MONETARY CONCEPT TASKS**

**Coin-Identification:**

(1) A penny ___Correct ___Incorrect

(2) A nickel ___Correct ___Incorrect

(3) A dime ___Correct ___Incorrect

(4) One cent ___Correct ___Incorrect

(5) Five cents ___Correct ___Incorrect

(6) Ten cents ___Correct ___Incorrect

(7) Twenty-five cents ___Correct ___Incorrect

(8) A quarter ___Correct ___Incorrect

**Comparative-Value:**

(1) Nickel-penny ___Correct ___Incorrect

How do you know? ____________________________

(2) Quarter-nickel ___Correct ___Incorrect

How do you know? ____________________________

(3) Penny-dime ___Correct ___Incorrect

How do you know? ____________________________

(4) Quarter-penny ___Correct ___Incorrect

How do you know? ____________________________

**Subtotal:** ___Correct ___Incorrect

**Comparing/Ordinality:**

(1) Glasses ___Correct ___Incorrect

How do you know? ____________________________

(2) Yes ___Correct ___Incorrect

(3) Bowls ___Correct ___Incorrect

How do you know? ____________________________

(4) No ___Correct ___Incorrect

How do you know? ____________________________

**Subtotal:** ___Correct ___Incorrect

**TOTAL:** __________CORRECT

**TOTAL:** __________CORRECT
**MONETARY SKILL TASKS**
(Equivalent-Value)

<table>
<thead>
<tr>
<th>Items</th>
<th>Correct</th>
<th>Incorrect</th>
<th>(How)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simple Match</td>
<td>Transformation</td>
<td>Match &amp; Addition</td>
</tr>
<tr>
<td>1. 7 cents</td>
<td>( ) 7 pennies</td>
<td>( ) 1 nickel &amp; 2 pennies</td>
<td></td>
</tr>
<tr>
<td>2. 10 cents</td>
<td>( ) 10 pennies /</td>
<td>( ) 2 nickels /</td>
<td>( ) 1 nickel &amp; 5 pennies</td>
</tr>
<tr>
<td>3. 5 cents</td>
<td>( ) 5 pennies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. 9 cents</td>
<td>( ) 1 nickel &amp; 4 pennies</td>
<td>( ) 9 pennies</td>
<td></td>
</tr>
<tr>
<td>5. 6 cents</td>
<td>( ) 1 nickel &amp; 1 penny</td>
<td>( ) 6 pennies</td>
<td></td>
</tr>
<tr>
<td>6. 18 cents</td>
<td>( ) 18 pennies /</td>
<td>( ) 3 nickels &amp; 3 pennies /</td>
<td>( ) 1 dime &amp; 1 nickel &amp; 3 pennies</td>
</tr>
<tr>
<td></td>
<td>( ) 2 nickels &amp; 8 pennies /</td>
<td>( ) 1 dime &amp; 8 pennies</td>
<td>3 pennies</td>
</tr>
</tbody>
</table>

*TOTAL: ____________________________CORRECT

* RECORER: _______________________
APPENDIX G

FACTOR ANALYSIS OF THE COMPARING/ORDINALITY TASKS
Table III.

Construct validity of the Comparing/Ordinality Tasks of children's number concepts: Principal components factor analysis with oblique rotation

<table>
<thead>
<tr>
<th>Items</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>.82</td>
<td>-.12</td>
</tr>
<tr>
<td>Q2</td>
<td>.69</td>
<td>.10</td>
</tr>
<tr>
<td>Q3</td>
<td>.33</td>
<td>.64</td>
</tr>
<tr>
<td>Q4</td>
<td>-.20</td>
<td>.88</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Eigenvalue</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Items</td>
<td>1.43</td>
<td>1.08</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Percentage of Variance</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Items</td>
<td>35.70%</td>
<td>27.00%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Cumulative Percentage</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Items</td>
<td>35.70%</td>
<td>62.70%</td>
</tr>
</tbody>
</table>

Note: Factor 1 represented the construct of "more" by comparison between 8 and 10.

Factor 2 represented the construct of "less" by comparison between 11 and 13.

Figure I.

Factor scree plot of the Comparing/Ordinality Tasks of children's number concepts
APPENDIX H

FACTOR ANALYSIS OF THE COMPARATIVE-VALUE TASKS
Table IV.

Construct validity of the Comparative-Value Tasks of children's monetary concepts: Principal components factor analysis with oblique rotation

<table>
<thead>
<tr>
<th>Items</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>.72</td>
<td>.12</td>
</tr>
<tr>
<td>Q2</td>
<td>.63</td>
<td>-.33</td>
</tr>
<tr>
<td>Q4</td>
<td>.81</td>
<td>.11</td>
</tr>
<tr>
<td>Q3</td>
<td>.07</td>
<td>.95</td>
</tr>
</tbody>
</table>

| Eigenvalue | 1.57 | 1.04 |
| Percentage of Variance | 39.30% | 25.90% |
| Cumulative Percentage | 39.30% | 65.20% |

Note: Factor 1 represented the construct of "bigger is more" by comparing with the coin pairs (i.e., nickel-penny, quarter-nickel, and quarter-penny). Factor 2 represented the construct of "bigger is less" by comparing with the coin pair (i.e., penny-dime).

Figure II.

Factor scree plot of the Comparative-Value Tasks of children's monetary concepts
APPENDIX I

GRAPHICAL EVIDENCE REGARDING THE ASSUMPTION OF NORMAL DISTRIBUTION OF DEPENDENT VARIABLES
Figure III.
Histogram of Number Direct Teaching (Variable 1)

Figure IV.
Histogram of Money Direct Teaching (Variable 2)
Figure V.
Histogram of Cardinality #9 (Variable 3)

Figure VI.
Histogram of Cardinality #12 (Variable 4)
Figure VII.
Histogram of Knowing Coin Names (Variable 5)

Figure VIII.
Histogram of Knowing Coin Values (Variable 6)
Figure IX.
Histogram of Matching Paying (Variable 7)

Figure X.
Histogram of Transformation Paying (Variable 8)
APPENDIX J

FREQUENCY DISTRIBUTIONS OF RESPONSES ON THE PARENTAL MEASURES
<table>
<thead>
<tr>
<th>Items</th>
<th>n (%)</th>
<th>Monthly</th>
<th>n (%)</th>
<th>Weekly</th>
<th>n (%)</th>
<th>2 or 3 Times A Week</th>
<th>Daily</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I say counting rhymes with my child</td>
<td>46(22)</td>
<td>68(33)</td>
<td>47(23)</td>
<td>38(18)</td>
<td>8(4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I have a regular time to explore math in our home</td>
<td>64(31)</td>
<td>63(31)</td>
<td>52(25)</td>
<td>22(11)</td>
<td>6(3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. I play the game &quot;What are the numbers printed on the cereal boxes, street signs, and buildings?&quot;</td>
<td>44(21)</td>
<td>45(22)</td>
<td>55(27)</td>
<td>41(20)</td>
<td>22(10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I show an interest in math on TV, exploring it with my child through conversation</td>
<td>66(32)</td>
<td>68(33)</td>
<td>47(23)</td>
<td>19(9)</td>
<td>7(3)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I take time to talk to my child about his/her new interest or new experiences in math</td>
<td>22(11)</td>
<td>30(14)</td>
<td>75(36)</td>
<td>57(28)</td>
<td>23(11)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I take my child outside and allow him/her time to observe likeness and differences in the world around us</td>
<td>13(6)</td>
<td>28(13)</td>
<td>57(28)</td>
<td>66(33)</td>
<td>42(20)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. My child sees me counting and using numbers</td>
<td>2(1)</td>
<td>6(3)</td>
<td>36(17)</td>
<td>70(34)</td>
<td>93(45)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I use positional words with my child</td>
<td>4(2)</td>
<td>4(2)</td>
<td>12(9)</td>
<td>10(5)</td>
<td>117(86)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. I teach my child to count 1, 2, 3, 4, 5</td>
<td>4(2)</td>
<td>11(5)</td>
<td>31(15)</td>
<td>67(32)</td>
<td>94(46)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. I teach my child shapes</td>
<td>7(3)</td>
<td>29(14)</td>
<td>59(29)</td>
<td>57(27)</td>
<td>55(27)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. I teach my child the names of math symbols</td>
<td>99(48)</td>
<td>59(29)</td>
<td>34(16)</td>
<td>13(6)</td>
<td>2(1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. I let my child help me cook</td>
<td>13(6)</td>
<td>45(22)</td>
<td>69(33)</td>
<td>62(30)</td>
<td>18(9)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. I tell my child how much I appreciate him/her</td>
<td>0(0)</td>
<td>2(1)</td>
<td>6(3)</td>
<td>23(11)</td>
<td>176(85)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. I teach my child to count objects</td>
<td>4(2)</td>
<td>11(5)</td>
<td>38(18)</td>
<td>80(39)</td>
<td>74(36)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. My child and I play board and/or card games</td>
<td>7(3)</td>
<td>54(26)</td>
<td>78(38)</td>
<td>55(27)</td>
<td>13(6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Items</td>
<td>Never n (%)</td>
<td>Monthly n (%)</td>
<td>Weekly n (%)</td>
<td>2 or 3 Times / Week n (%)</td>
<td>Daily n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------</td>
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<td>-------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. I let my child pay for small items in the store when we shop</td>
<td>34 (17)</td>
<td>102 (49)</td>
<td>50 (24)</td>
<td>16 (8)</td>
<td>5 (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. I teach my child the name of coins</td>
<td>14 (7)</td>
<td>71 (34)</td>
<td>75 (36)</td>
<td>39 (19)</td>
<td>8 (4)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. My child has opportunities to explore coins or bills at home</td>
<td>3 (1)</td>
<td>31 (15)</td>
<td>63 (30)</td>
<td>67 (32)</td>
<td>43 (21)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. I talk with my child about where money comes from</td>
<td>44 (21)</td>
<td>66 (32)</td>
<td>46 (22)</td>
<td>36 (18)</td>
<td>15 (7)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. I help my child understand the value of coins</td>
<td>24 (12)</td>
<td>71 (34)</td>
<td>64 (31)</td>
<td>35 (17)</td>
<td>13 (6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. I give my child money for an allowance</td>
<td>88 (43)</td>
<td>56 (27)</td>
<td>57 (28)</td>
<td>2 (1)</td>
<td>4 (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I use money as a reward or punishment for my child</td>
<td>138 (67)</td>
<td>37 (18)</td>
<td>23 (11)</td>
<td>5 (2)</td>
<td>4 (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. I help my child distinguish between the things they need and the things they want</td>
<td>11 (5)</td>
<td>57 (28)</td>
<td>64 (31)</td>
<td>38 (18)</td>
<td>37 (18)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. I help my child share and exchange his/her personal possessions and toys with family members and friends</td>
<td>1 (1)</td>
<td>21 (10)</td>
<td>30 (15)</td>
<td>38 (19)</td>
<td>117 (55)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. I help my child understand the difference between television programs and television commercials</td>
<td>39 (19)</td>
<td>27 (13)</td>
<td>51 (24)</td>
<td>41 (20)</td>
<td>49 (24)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. My child sees me decide between things I buy</td>
<td>5 (2)</td>
<td>24 (12)</td>
<td>84 (41)</td>
<td>59 (29)</td>
<td>35 (17)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. I tell my child money to put in his/her piggy bank or other savings places</td>
<td>9 (4)</td>
<td>63 (30)</td>
<td>90 (44)</td>
<td>32 (16)</td>
<td>13 (6)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


I strongly believe that we live in God we trust. Thank God for bringing me to Iowa State University and helping me to complete my pursuit for the Ph.D. degree.

It has been a long trip. Being a foreign student, I really appreciate that I have the most wonderful adviser, Dr. Herwig, who has taken care of me during the four years, teaching me professional knowledge, and helping me to find self-confidence in my life. I have learned and realized what I need to do as well as how to do in my future teaching. Thank you, thank you my dear adviser!

If you find that this is a nice study, let me tell you that it is due to my excellent committee members: Dr. Herwig, Dr. Shelley, Dr. Hegland, Dr. Fletcher, and Dr. Sharp. They supported me in my learning trip, instructed me during my research, and provided me constructive information and valuable feedback always. I will remember where my luck comes from. Oh, my dear committee teachers, I deeply appreciate all of you. Thank you very much and I wish you health and happiness forever!

Especially, my deep appreciation goes to Ms. Sterling, Hector, Fino, and My father, who are Very Important Persons during my research also. Dear Ms. Sterling, you must remember how fun the investigation was and how lovely those kindergartners were. Thank you for your help on my data collection from top to toe. May God bless you forever! Dear Hector and Fino, LISREL will not be a nightmare for me now. I appreciate your help during the critical moments. Thank you for your friendship! Dear Papa, thank you for giving me rides everyday. I know that it is very hard driving on the snowy days and it is not warm like Taiwan. You and Mama represent the greatest parents' love to me. I deeply appreciate you. Thank you!

Many thanks for the Superintendents, Principals, Teachers, Parents, and Kindergartners, who participated in my research. My dear Iowa friends, I cannot show your
names but you have impressed me forever. Thank you very much for your support and help!

Finally, my appreciation and indebtedness are sent to My family, My teachers, and My friends. My affectionate family (fathers, mothers, uncle, aunt, brothers, sisters, nephews, nieces, husband, son, and daughter), thank you for your continuing love and unconditional support. How terrific you are! I love you! The Ph.D. degree belongs to you, too. In addition, all of my dear teachers and my dear friends, thank you for your teaching, sharing, helping, and supporting during my four-year trip although I cannot write down all your names here. I hope you understand that the appreciation in my heart and the friendship between us are unchangeable. May God bless you everyday. Amen!