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Confirmatory factor analysis of the Early Arithmetic, Reading, and Learning Indicators (EARLI) ☆

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ABSTRACT

Despite growing interest in early intervention, there are few measures available to monitor the progress of early academic skills in preschoolers. The Early Arithmetic, Reading, and Learning Indicators (EARLI; DiPerna, Morgan, & Lei, 2007) were developed as brief assessments of critical early literacy and numeracy skills. The purpose of the current study was to examine the factor structure of the EARLI probes via confirmatory factor analysis (CFA) in a sample of Head Start preschoolers ($N = 289$). A two-factor model with correlated error terms and a bifactor model provided comparable fit to the data, although there were some structural problems with the latter model. The utility of the bifactor model for explaining the structure of early academic skills as well as the utility of the EARLI probes as measures of literacy and numeracy skills in preschool are discussed.

1. Introduction

Research regarding the nature, correlates, and predictors of academic achievement has been mounting for decades (National Institute of Child Health & Human Development, 2000). Although the majority of this research has focused on school-aged children, studies within the past decade have begun to highlight the importance of early reading and mathematics skills prior to school entry. Early deficits in literacy and mathematics skills are highly predictive of later negative academic outcomes and remain relatively stable over time if not remediated (Jordan, Glutting, & Ramineni, 2010; Torgesen, 2002). Despite growing interest in early intervention for young children demonstrating skill deficits, there are relatively few measures available to periodically monitor the progress of early academic skills in preschoolers. The Early Arithmetic, Reading, and Learning Indicators (EARLI; DiPerna, Morgan & Lei, 2007) were developed to provide brief and easily administered assessments of critical early literacy and numeracy skills for preschool students. Initial evidence has suggested that scores from the EARLI probes (i.e., literacy and numeracy tasks) demonstrate good technical adequacy, as demonstrated by moderate to high reliability estimates and concurrent relations with norm-referenced achievement test scores; however, the underlying factor structure of the EARLI probes has not yet been investigated. The purpose of the current study was to examine the underlying factor structure of the EARLI probes via confirmatory factor analysis (CFA).

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1.1. Early literacy

Although the National Reading Panel report (National Institute of Child Health & Human Development, 2000) provided an extensive review of research related to reading in grades K-12, it did not include research regarding early literacy in children younger than 5. As a result, the National Early Literacy Panel (NELP) was formed in 2002. This panel distinguished between *conventional* literacy skills, or those that are taught and developed in the primary and secondary school years, and *early* or *emergent* literacy skills. Early or emergent literacy refers to the knowledge and skills developed prior to school entry that are necessary precursors of conventional reading and writing (Missall et al., 2007; Sulzby & Teale, 1991; Teale & Sulzby, 1986). In the NELP report, National Early Literacy Panel (2008), 11 early literacy skills were identified as being predictive of future success in reading. Three of these skill domains, alphabet knowledge, phonological awareness, and oral language are assessed by the EARLI measures featured in the present study.

1.1.1. Alphabet Knowledge

Alphabet Knowledge (AK) broadly consists of both knowledge of the names of letters and knowledge of the sound or sounds that each letter makes. Letter name knowledge (LNK) has been shown to be a powerful predictor of later reading acquisition by aiding in inventive and phonetic spelling and word recognition (see Foulin, 2005 for a review). Knowledge of letter names also significantly aids in the development of letter–sound knowledge. For example, Kim, Petscher, Foorman, and Zhou (2010) found that LNK increased the probability of knowing letter sounds from 4% to 63% in a sample of kindergarten students. The contribution of LNK to knowledge of letter sounds is likely due to the iconic nature of the English language, in that many of the names of letters of the alphabet contain the sound that they represent (Treiman, Kessler, & Bick, 2003). Coupled with LNK, letter–sound knowledge fosters growth in decoding skills (Phillips, Clancy-Menchetti, & Lonigan, 2008).

1.1.2. Phonological awareness

Phonological awareness, or phonological sensitivity, involves the ability to detect and manipulate the sound structure of language. This ability includes skills such as the ability to blend segmented syllables into words, and in turn, the ability to segment words into their constituent parts (Anthony & Lonigan, 2004). Children with strong phonological awareness skills learn to read more quickly than those who are less skilled at performing these tasks (Bryant, MacLean, Bradley, & Crossland, 1990; Lonigan, Burgess, & Anthony, 2000). Although there is general agreement that phonological awareness consists of several different skills varying in terms of linguistic complexity (Anthony et al., 2002), disagreement exists as to whether these skills are distinct or increasingly complex points on the same developmental continuum. Research within the past decade has shown support for the latter viewpoint, suggesting that phonological awareness is best described as a unitary construct, consisting of several interrelated skills (e.g., Anthony & Lonigan, 2004; Anthony et al., 2002). These skills range from the ability to manipulate larger units of sound, such as words and syllables, to smaller units of sound such as onset-rimes and individual phonemes (Phillips et al., 2008).

1.1.3. Oral language

In addition to code-related skills such as letter knowledge and phonological awareness, oral language skills in preschool are important precursors of reading acquisition. Oral language consists of several interrelated skills, including vocabulary knowledge, discourse and syntax (Dickinson & McCabe, 2001). During preschool, it appears that the development of oral language skills has both direct and indirect effects on decoding skills, and reciprocally, the development of decoding skills fosters growth in oral language skills (Kendeou, van den Broek, White, & Lynch, 2009; Lonigan et al., 2000). As children progress into elementary school, oral language skills become strong predictors of comprehension in the later grades (Storch & Whitehurst, 2002).

Research has demonstrated a high degree of continuity between literacy skills in early childhood and reading achievement in as late as the high school years (Cunningham & Stanovich, 1997). Children who enter school with limited early literacy skills often fail to catch up to their peers by the end of fourth grade and typically continue to have difficulties in reading throughout their school years (Torgesen, 2002). Decoding and oral language skills in preschool are also predictive of comprehension skills in the primary grades (Kendeou et al., 2009). Children who do not develop these skills are subsequently at an increased risk for becoming poor readers when they are older (Juel, 1988) and often lack the skills necessary to be successful in school and work (e.g., Pressley & Rankin, 1994).

1.2. Early numeracy

Researchers also have begun to highlight the importance of early mathematics, or numeracy, skills in predicting later outcomes in mathematics achievement. In an extensive summary of research on early numeracy, Cross, Woods, and Schweingruber (2009) identified two core areas that are important for future success in mathematics: number and geometry/measurement.

1.2.1. Number

According to the National Research Council's report, *Adding it Up* (Kilpatrick, Swafford, & Findell, 2001), *number* is one of the most important concepts necessary for mastery of mathematics in elementary school. At the preschool level, this concept often has been referred to as *number sense* in the empirical literature. Although there is some debate as to the exact definition of number sense, critical skills are thought to include informal skills that underlie the formal mathematical knowledge learned