International Journal of Educational Research 53 (2012) 278–288

Contents lists available at SciVerse ScienceDirect

International Journal of Educational Research

journal homepage: www.elsevier.com/locate/ijedures

# Studying children's early literacy development: Confirmatory multidimensional scaling growth modeling

Cody Ding [a,b,*]

[a] University of Missouri-St. Louis, United States
[b] School of Psychology, Southwest University, China

ARTICLE INFO

*Article history:*
Received 22 November 2011
Received in revised form 4 April 2012
Accepted 5 April 2012
Available online 1 May 2012

*Keywords:*
Word-reading growth
DIBELS
Confirmatory MDS growth analysis
Theory testing

ABSTRACT

There has been considerable debate over the ways in which children's early literacy skills develop over time. Using confirmatory multidimensional scaling (MDS) growth analysis, this paper directly tested the hypothesis of a cumulative trajectory versus a compensatory trajectory of development in early literacy skills among a group of 1233 kindergarteners over a three-year period. Based on age-sensitive subscales of the Dynamic Indicators of Basic Early Literacy Skills (DIBELS), the finding supported the hypothesis of compensatory trajectory of development in early literacy skills. The results indicated a slower growth rate for children who had a higher initial score than those who had a lower initial score so that those who started at a lower point caught up by the end of the second grade. In addition, reading achievement at the end of the second grade did not show a statistically significant difference between these two groups of children. We discussed some substantively important questions in light of the theoretical articulations of constrained skills proposed by Paris (2005). The study also illustrated confirmatory MDS growth analysis as a viable alternative for theory testing.



## 1. Introduction

Children's early literacy is a learned skill, one whose development during early childhood is especially important for the subsequent acquisition of more advanced language skills (Cunningham & Stanovich, 1997; Entwisle, Alexander, & Olson, 2005). In response to the National Reading Panel (NRP) report (National Institute of Child Health and Human Development, 2000) and No Child Left Behind (NCLB), schools are expected to focus on excellent instruction in the areas of early literacy skills and evaluation of student achievement. For these reasons, early literacy skills have become an important learning goal for young children. For example, the U.S. schools with Reading First programs set explicit goals for increasing letter knowledge and letter–sound correspondence. The principle focus of the current study was to test two hypotheses, as suggested by Leppänen, Niemi, Aunola, and Numi (2004), regarding developmental trajectory of children's early literacy skills over their first three years of schooling by using confirmatory multidimensional scaling (MDS) growth approach. The term "early literacy skills or word-reading skills" is used in the present paper as a general factor that indicates competency in phonological awareness, alphabetic principles, and fluency, which was assessed by the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) (Good & Kaminski, 2002a) (described in Section 2). Examples of early literacy skills include phonemic awareness (such as rhyming, blending, and segmenting), alphabetic and print awareness, and letter–sound relationships.

* Correspondence address: 404 Marillac Hall, Department of Educational Psychology, Research & Evaluation, University of Missouri-St. Louis, St. Louis, MO 63121, United States. Tel.: +1 314 516 6562; fax: +1 314 516 5784.
*E-mail address:* dinghc@umsl.edu.

0883-0355/$ – see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.ijer.2012.04.002

The first hypothesis to be tested with respect to growth of early literacy skills was a cumulative trajectory of development (Leppänen, Niemi, Aunola, & Numi, 2004). According to Leppänen et al. (2004), which indicated a steady widening of achievement between children of lesser and greater ability; that is, early developmental differences in literacy skills became more evident as development proceeded. The second hypothesis to be tested was a compensatory trajectory of development (Leppänen et al., 2004), which indicated a narrowing of achievement; that is, children who began learning to read with low literacy skills may accelerate their development and catch up with those who began at a higher level. On the other hand, those who started with better early literacy skills may show a slower rate of growth once they reached a certain level of performance. Previous research showed evidence for both types of developmental trajectories. For example, Luftig (2003) found that even after a short intervention, children at-risk for reading failure could actually make significant gains in their reading score as compared to the gains of a control group. Other studies also indicated that children who are behind upon entering school can show improvement (e.g., Cunningham & Stanovich, 1997; Lerkkanen, Rasku-Puttonen, Aunola, & Nurmi, 2004; Phillips, Norris, Osmond, & Maynard, 2002; Shaywitz et al., 1995; Snow, Barnes, Chandler, Goodman, & Hemphill, 1991; Spira et al., 2005).

At the same time, however, a number of studies have shown a divergent growth over time (e.g., Juel, 1988; Smith, 1997; Torgesen & Burgess, 1998). There is a high probability that children who fall behind in early literacy skills will remain behind at later times (Eamon, 2002). Children in kindergarten with higher levels of code-focused skills and stronger vocabularies demonstrate more growth than their counterparts with lower level skills after intervention (Al Otaiba et al., 2008). Kindergartners identified as having difficulties in early literacy skills were found to continue struggling with difficulties in reading skills in subsequent years (Boscardin, Muthén, Francis, & Baker, 2008). Sharp, Sinatra, and Reynolds (2008) found that the initial gap between higher and lower achieving students widened substantially over a five-month period. However, in studying the trajectories of preschool and first-grade children's early literacy skills, Leppänen et al. (2004) found that individual differences in reading grew larger during preschool but such differences diminished during the first grade.

An understanding of early literacy achievement requires an understanding of several models of development as well as an appreciation of their underlying developmental processes (McCoach, O'Connell, Reis, & Levitt, 2006). Although studies have made an effort to identify developmental trajectories of different groups of children, there is a need for studies that directly test the presence of possible developmental trajectory in early literacy skills using large samples, with intensive measurement schedules (e.g., three measurements on a yearly basis). Thus far, few empirical studies have used the kind of analytical techniques capable of hypothesis testing regarding subgroups that develop differentially over a longer period of time.

In this study, we employed confirmatory multidimensional scaling (MDS) growth analysis as a analytical tool to test the hypothesis of a cumulative trajectory versus a compensatory trajectory in early literacy skills. Such a hypothesis testing was done by utilizing a large sample of kindergarteners followed over a three year period, with intensive measurement schedules. By applying the confirmatory MDS growth analysis, we not only examined the correlation between the initial level of early literacy skill and its growth rate for each trajectory group but also test the assumption of variances associated with each trajectory. It was assumed that the cumulative trajectory had an increasing variance but the compensatory trajectory had a decreasing variance. In addition, we also examined the association between the growth trajectory supported by the data and the reading comprehension at the end of the second grade.

## 2. Method

### 2.1. Participants

The participants of the present study were 1233 kindergarteners (53% boys and 48% girls) of 51 schools from high-risk areas (indicated by the poverty status as defined by percentage of students who received free or reduce-priced lunch) in a mid-west state in the U.S. Thirty-seven percent (37%) of these schools were from the urban area and 67% were from the rural area. The participants were predominately White, including 76% White, 19% African American, and 5% multi-racial children. Among them, 13% were identified as being eligible for special education and 69% with free or reduce-priced lunch (i.e., poverty) status. They were from a large evaluation study that investigated the reading development of children during early childhood.

These same children were followed over time from kindergarten (2004–05) through the end of second grade (2006–07). At each grade level, these children were tested three times during the academic year, resulting in a total of 9 measurement points for each child. The data were provided by the state education agency.

### 2.2. Measures

#### 2.2.1. DIBELS

The principle instrument used to assess word literacy progress was the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) (Good & Kaminski, 2002a). Although DIBELS had some limitations, including incompatible score interpretations over time, the present study used the DIBELS for the following reasons. First, despite the fact that subscales of DIBELS change over time, the tests are change-sensitive and not based on fixed-content regardless of age level. Such change-sensitive subscales can reflect the developmental nature of the literacy skills, which is exactly the purpose of longitudinal study.