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Predicting growth trajectories in early academic learning: Evidence from growth curve modeling with Head Start children

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ABSTRACT

The purpose of this study was to evaluate the association between children's academic and social-emotional skill levels at entry into Head Start (HS) and their subsequent academic growth through HS and into kindergarten. We first examined HS children's growth trajectories in math, reading, and receptive vocabulary skills over a period of 2.5 years (i.e., between HS entry and kindergarten). Then, we examined whether children's capabilities in academic and social-emotional skills at HS entry were associated with their academic growth trajectories. The study was guided by two competing theories on the effectiveness of early care and education (ECE) programs, the "skills-beget-skills hypothesis" and the "compensatory hypothesis." A sample from the Head Start Family and Child Experiences Survey 2006 Cohort (FACES 2006) was analyzed using three-level growth curve modeling. Children who had lower receptive vocabulary skills at HS entry showed faster growth in receptive vocabulary skills. This result supports the compensatory hypothesis, which suggests that quality ECE programs have larger program effects for more disadvantaged children. For math and reading skills, no association between children's entry-level skills and their growth rate was found. Social-emotional skills at HS entry were positively associated with either concurrent baseline academic skills or their growth rate over time, partially supporting the skills-beget-skills hypothesis, which posits that the skills children possess before an intervention allow them to better acquire program benefits.

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1. Introduction

Decades of research have shown that low-income status poses significant risks for children's academic development (Aikens, Kopack Klein, Tarullo, & West, 2013; Brooks-Gunn & Duncan, 1997; Dearing, McCartney, & Taylor, 2001; Tarullo, West, Aikens, & Hulsey, 2008). The achievement gap is evident at a strikingly early stage of development. For example, Tarullo et al. (2008) found that children living in poverty present one-third to one whole standard deviation below national norms in various academic areas (e.g., receptive language comprehension, reading, and math) at the beginning of preschool. Overall, even the top 25% of achievers among low-income children in Tarullo et al.'s (2008) study displayed academic skills that were lower than the national norms at preschool entry. Unfortunately, young children are particularly vulnerable to the negative influences of poverty (Brooks-Gunn & Duncan, 1997; Dearing, Berry, & Zaslow, 2008;

Duncan & Magnuson, 2013a; Duncan, Yeung, Brooks-Gunn, & Smith, 1998). Additionally, the achievement gap between richer and poorer young children has been widening over the last 60 years (Reardon, 2011).

In light of the need to support low-income children's achievement, several early child education and care programs aiming to mitigate the negative links between poverty and early learning and development have been launched. The Head Start (HS) program is the nation's most significant effort to reduce income disparities on young children's achievement. The nation's oldest and largest federally sponsored early intervention program for low-income children, HS provides comprehensive services, including early childhood education, health, parenting intervention, and social services for approximately 900,000 children each year at a cost of around $7 billion (or over $7,000 per child; Haskins & Barnett, 2010). One of the main aims of HS has been to support early school readiness skills. For example, enhancing early social-emotional competence has been an emphasis of HS from its inception (Raver & Zigler, 1997), and in recent years, increasing attention has been paid to supporting academic performance

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(Gibbs, Ludwig, & Miller, 2013; Raver & Zigler, 2004; Zigler & Bishop-Josef, 2006).

Researchers and program leaders have found it increasingly important to understand which children benefit most from HS programs. Indeed, several HS studies showed that the impact of HS on early academic outcomes may vary by children's characteristics. For example, among children who entered HS at age 3 years, HS has been found to have a larger positive effect for dual-language learners, children with low academic skills, children with special needs, and children who started the program with more household risk factors (Puma et al., 2010, 2012). However, few studies have examined whether children's rate of academic growth during their time in the HS program varies as a function of the academic and social-emotional skills that they bring to the program.

Two theories have been put forth to explain the relationship of initial skill levels to the attainment of positive outcomes from quality early childhood education (ECE) programs (Duncan & Vandell, 2012). The "skills-beget-skills hypothesis" (Cunha & Heckman, 2007) proposes that skills are self-reinforcing (or, that children manifest "self-productivity") and thus that early skills predict greater or faster skill acquisition. This hypothesis is also referred to as the "complementarity of human capital investments," a phrase suggesting that skills obtained prior to an investment increase the productivity of the investment, or in other words, that the skills that children possess prior to intervention allow them to acquire further skills from the intervention. This implies that ECE investments, such as participation in the HS program, may be particularly beneficial for children who enter the program with higher skill levels (e.g., academic and social-emotional competencies; Duncan & Magnuson, 2013b). Another theory, the "compensatory hypothesis," proposes quite different influences (Sameroff & Chandler, 1975). This theory posits that quality ECE can compensate for children's more extreme vulnerabilities and thus may exert a greater effect on children entering the program with higher risks (e.g., poor academic or prosocial skills, difficult temperaments, and economic risks; Duncan & Vandell, 2012). This compensatory effect would eventually reduce achievement gaps between higher- and lower-functioning children.

Although many researchers have investigated early development in the context of HS, much research on early academic gains has typically used a "lagged dependent variable model" approach (i.e., analyze later child assessment scores while controlling for time 1 scores), which has its limitations. Specifically, the lagged dependent variable model cannot include more than two time points of data, thereby restricting statistical power and the longer view that comes with additional repeated measures. Moreover, this approach can only detect linear change between two time points and does not allow the possibility of non-linear change over time. Previously, Peisner-Feinberg et al.'s (2001) study with children whose families were comparable to average U.S. families found that the rate of growth in math skills were accelerated over time and the rate of growth in reading skills were decelerating over time during the age between 4 to 8 years. Given previous research evidence showing that learning is not a strictly linear process, examining non-linear growth changes in HS children's academic skills will provide more precise understanding of early learning growth patterns for low-income children. Lastly, there is no inclusion of associations with baseline levels, only with differences (change); therefore, no distinction is made between children with the same rate of change but with very different starting and ending points.

In this study, we aimed to investigate HS children's early achievement trajectories during their years in the program, up to and including kindergarten, and to identify the entry-level skills that are associated with those trajectories. Guided by two theories, the skills-beget-skills hypothesis and the compensatory hypothesis, this study specifically focused on whether children's

academic and social-emotional skills at HS entry predicted subsequent growth trajectories in academic skills.

1.1. Prior academic skills

A number of studies have demonstrated that prior academic skills are significant predictors of later academic achievement (Duncan et al., 2007; Romano, Babchishin, Pagani, & Kohen, 2010; Welsh, Nix, Blair, Bierman, & Nelson, 2010). However, there is limited literature, especially on the preschool years, about whether the level of early academic skills predicts the rate of subsequent academic growth. In the literature on school-aged students' academic skills, two perspectives have been proposed regarding whether initial skills predict the growth rate of learning, particularly in literacy/reading.

First, Stanovich's (1986) classic article proposed a hypothesis called the Matthew effect in reading, which suggests "rich-get-richer and poor-get-poorer patterns" (p. 360) in development. The Matthew effect in reading proposes that a child's initial reading skill level determines the subsequent rate of growth in reading in favor of students who start with higher reading skills, and thus the gap between high and low achievers widens over time (a "fan-spread pattern" of development). In line with the skills-beget-skills hypothesis (Cunha & Heckman, 2007), the Matthew effect predicts that children with initially higher reading skills have a developmental advantage over children with initially lower skills.

More recent studies of elementary school students' reading (Aunola, Leskinen, Onatsu-Arvilommi, & Nurmi, 2002; Huang, Moon, & Boren, 2014; Parrila, Aunola, Leskinen, Nurmi, & Kirby, 2005), however, support an alternative hypothesis, the "compensatory trajectory of development" (Leppänen, Niemi, Aunola, & Nurmi, 2004). This hypothesis suggests that children who initially start with low literacy skills accelerate in their learning over time and eventually catch up with peers who begin with higher literacy skills. Those supporting the compensatory trajectory hypothesis explain that the rate of learning in reading/literacy may decelerate over time because early literacy acquisition is mostly receptive, whereas later literacy acquisition requires extensive practice and more effective instruction (Leppänen et al., 2004). In line with the compensatory hypotheses (Sameroff & Chandler, 1975), a compensatory trajectory of development in reading would predict higher developmental gains for initially low achievers over initially high achievers.

Given these contrasting perspectives on the influences of earlier skills on subsequent academic skill development, further study could extend our understanding. Additionally, considerable research to date has focused on literacy/reading development in elementary school students; however, it still unknown whether these results are applicable to the math, reading, and receptive vocabulary achievement of preschoolers in early childhood programs like HS.

1.2. Social-emotional skills

Promoting social-emotional skills has been highlighted as a way to facilitate children's learning in the classroom (National Scientific Council on the Developing Child, 2004; Nix, Bierman, Domitrovich, & Gill, 2013). Kindergarten teachers consider early social-emotional skills (e.g., not being disruptive) to be more critical components of school readiness than basic academic skills (e.g., knowing the alphabet; Lin, Lawrence, & Gorrell, 2003). Empirical evidence has further suggested that a deficit of prosocial skills or the presence of behavioral problems (e.g., aggressive, hyperactive, or withdrawal behaviors) in the classroom may hinder learning in subsequent years (Breslau et al., 2009; Bub, McCartney, & Willett, 2007; Curby, Brown, Bassett, & Denham, 2015; DiPrete & Jennings,