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Chapter · May 2019

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7 The Relationship between Early Childhood Development and Later Elementary School Performance in Chile

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The relationship between early childhood skills and second-grade reading ability is of substantial developmental and policy import. This chapter explores the nature of that presumably cumulative relationship, in that stronger skills in preschool beget stronger skills in elementary school; the chapter goes on to describe the association between four- and five-year-old children from the *Un Buen Comienzo (UBC)* study in Chile and their second-grade standardized reading test scores (SIMCE), controlling for family background characteristics. We found that children's preschool-age vocabulary, early reading, and early math skills positively predicted second-grade reading scores. Self-regulation and low problem behavior as well as inhibitory control positively predicted later reading test scores. Other socioemotional and executive function variables, such as attention, pro-social behavior, and positive behavior did not predict reading scores in these analyses, similar to the results from the United States, Canada, and the United Kingdom in the Duncan et al. (2007) study. The influence of other developmental domains such as socioemotional development, early mathematics, and self-regulation skills on later literacy development is important to study, and the originality of this research in Spanish monolinguals is important to highlight as a contribution to the field. This chapter ends with a discussion of the implications of this work for practice, contributing to an "educationally informed theory of language learning".

Early childhood development across a range of domains, in particular language and literacy development, form a basis for further development in elementary school and beyond (Snow, Burns, & Griffin, 1998; Duncan et al., 2007). It is important to understand, in particular in at-risk children, what early childhood skill levels are important to ensure future academic achievement, across such domains as cognitive, language, emergent literacy and numeracy, executive function, and socioemotional skills. In addition, it is important to understand how these trajectories develop over time, for example, beginning with preschool skills and then early elementary reading, a fundamental skill that will provide the basis for academic language and reading comprehension

for children as they continue to grow and develop over the years (Uccelli et al., 2015). Research has examined the relationship between young children's initial skill levels and their second-grade skills in the United States (e.g., Duncan et al., 2007), but these relationships have not been examined in the context of monolingual Spanish speakers in a Latin American context, to our knowledge. The study discussed here, using *Un Buen Comienzo* and national Chilean test data, was designed in part to fill this gap.

Using six longitudinal data sets from Canada, Great Britain, and the United States, Duncan and colleagues (2007) estimated links among three fundamental elements of school readiness – school-entry cognitive, attention, and socio-emotional skills – and later school reading and math achievement. In an attempt to isolate the effects of these school-entry skills, the authors controlled skills measured prior to school entry, as well as a host of family background measures. Across all six studies, the strongest predictors of later achievement were school-entry math, reading, and attention skills. A meta-analysis of the results showed that early math skills had the greatest predictive power, followed by reading and then attention skills. By contrast, measures of socioemotional behaviors, including internalizing and externalizing problems and social skills, were generally insignificant predictors of later academic performance, even among children with relatively high levels of problem behavior (Duncan et al., 2007). Interestingly, Grimm et al. (2010) reanalyzed three of the data sets and argued that, in fact, attention measures were more predictive than behavioral measures of elementary achievement, but that behavioral measures still exhibited small to moderate associations with academic achievement. Two studies we found replicated the Duncan analyses with a different population, French speakers from Quebec, Canada. The first examined similar constructs such as cognition, attention and socioemotional development for kindergarten school readiness (Pagani et al., 2010). Most of the coefficients were similar to the original study, with math skills predicting strongly consistently, followed by attention, receptive language, attention problems, and behavior.

The second study also chose to replicate and extend findings from the original Duncan et al. (2007) study with Canadian data in two sets of analyses (Romano et al., 2010). The first set examined the influence of kindergarten literacy and math skills, mother-reported attention, and socioemotional behaviors on third-grade math and reading outcomes. Similar to Duncan et al., math skills were the strongest predictor of later achievement, and literacy and attention skills predicted later achievement. However, some kindergarten socioemotional behaviors, specifically hyperactivity/impulsivity, prosocial behavior, and anxiety/depression, were significant predictors of third-grade math and reading.

A study conducted in the United States examined younger children and the link between one- to three-year-old-children's behavior problems and poor

levels of second-grade reading (Gray et al., 2014). Reports of inattentive and overactive behaviors at ages one to three years and changes in inattention through toddlerhood predicted reading achievement in second grade. The effects of early inattention on reading appear to be most robust. Findings underscore the contribution of social-emotional development to school readiness and the importance of early identification of children with externalizing problems, as early interventions designed to reduce externalizing problems may improve later reading skills, an interesting contradiction to the Duncan and other studies with older preschool children. It is interesting that with younger children, socioemotional behavior was found to be an important predictor of second-grade reading.

In addition to looking at younger children, authors have looked at kindergarteners and the relationship between their school readiness skills and such important outcomes at the other end of the educational spectrum as high school completion (Hickman et al., 2008). The authors of this study found that students in northeaster Arizona who had dropped out of high school had lower achievement skills and worse behavior problems as early as kindergarten (and possibly sooner, but they didn't have the data); the authors postulated that in part this could be due to their greater absenteeism, a topic which will be discussed in the discussion of the *Un Buen Comienzo* intervention, which evolved to intervene in absenteeism, which our own work had indicated was affecting Chilean students' outcomes.

We will also conclude with a brief summary of other studies that have conducted similar analyses but with different age ranges than the ones examined in this chapter and/or not usually assessing with as comprehensive a battery of preschool skills and also predominantly with children from the United States, not allowing for a great deal of linguistic and/or sociocultural diversity. For example, Claessens, Duncan, and Engel (2009) examined the relationship between kindergarten skills and fifth-grade outcomes, finding that mathematics, language and literacy skills, and attention were the best predictors of fifth-grade outcomes, while socioemotional skills were not as strong predictors. Hair et al. (2006) did find that low socioemotional skills in kindergarten were predictive of lower reading skills in first grade, unlike other studies already cited. In New Zealand, researchers found that four-year-olds' executive function skills predicted their mathematics achievement at age six (Clark, Pritchard, & Woodward, 2010).

Given the predictive power of specific kinds of preschool skills, such as mathematics, early reading, attention, and potentially behavior, socioemotional skills, and executive function, it is important to examine which skills are the best predictors of later achievement in order to guide future interventions that can prevent later academic difficulties. It appears that age of study may be important – in this case, children, were examined at the beginning of

prekindergarten, four to five years of age, and in second grade, seven to nine years of age. At the same time, however, replicating these kinds of studies in other populations is fundamental, as the sociocultural and linguistic context may be important.

Chilean Context

Preschool education in Chile is mandatory beginning in prekindergarten (four years of age) and seeks to promote integral development and relevant learning in young children. In terms of access, Chile has lower rates than the OECD average but higher than the average of Latin American countries. Spending on preschool education in Chile represents a percentage of the GDP equal to the OECD, average increasing considerably from 0.4 percent of the GDP in 2004 to almost double or 0.75 percent in 2013. The only nationally representative measurement of young children in Chile under the age of six is the Encuesta Longitudinal de Primera Infancia (ELPI), which was first applied in 2010 and then again in 2012. Results indicated the existence of favorable psychomotor development of children relative to other Latin American results but in general low levels of cognitive and language skills; in general, children from wealthier backgrounds outperform their at-risk counterparts (Centro de Estudios, Ministerio de Educación, 2013; Berlinski & Schady, 2015). Given the weak preschool skills described and the lack of competitive academic skills Chile shows in comparison to other OECD countries, it is important to examine more specifically what preschool skills are associated with better academic outcomes in the elementary years in this population.

After this review of the research on preschool skills predicting early elementary reading and some contextual information on Chile and a rationale for doing this work in Chile, we will now describe the research interest that guides this chapter, namely, to what degree stronger skills in certain domains in preschool beget stronger skills in elementary school reading.

Evidence

Our goals for working with the *Un Buen Comienzo* longitudinal data were to explore the relationship between incoming prekindergarten skill levels with a rich data set and national elementary school outcomes in the Chilean population.¹ Our first question was in regard to children's incoming skills. We asked, what is the association of prekindergarten levels of language, mathematics, socioemotional development, and executive function on elementary school reading outcomes in low-income children living in Santiago, Chile?

¹ The intervention variable was used as a control in all of the analyses described.

This question aimed to answer how much of children's elementary school performance is predicted by what children bring to the public prekindergarten classroom, essentially their skills, controlling for family background characteristics.

Our hypotheses were that prekindergarten emergent language and literacy skills would predict elementary school reading (Claessens, Duncan, & Engel, 2009); the relationship between preschool socioemotional development and second-grade reading would be weaker or nonexistent (Hair et al., 2006); and prekindergarten mathematics skills and executive function would predict second-grade reading (Clark, Pritchard, & Woodward, 2010; Claessens, Duncan, & Engel, 2009).

To reach the objectives explained above, we used SIMCE databases, which provide national test results in reading for all Chilean children in second grade. We analyzed individual and family initial characteristics at the preschool level. We then analyzed the relationship between the characteristics mentioned above and SIMCE reading performance in second grade, controlling for cohort, treatment status (UBC or control), gender, and family background characteristics.

Intervention and Measures

Un Buen Comienzo (A Good Start; UBC) is a two-year professional development intervention for early childhood educators in Chile, with the objective of enhancing children's language, literacy, health, and socioemotional outcomes. A cluster-randomized trial was implemented to determine the impact of the program on classroom quality and on multiple domains of child development. The study of sixty-four municipal schools in Chile followed three cohorts of prekindergarteners in the following years: 2008–2009, 2009–2010, and 2010–2011 (Leyva et al., 2015; Yoshikawa et al., 2015). We did not include the first cohort in this study because it was a much smaller sample.

The Chilean children who participated in this study attended public prekindergarten and kindergarten and then continued on to elementary school. We used the preschool-age data of the 2009–2010 and 2010–2011 cohorts to analyze the relationship between initial characteristics at the preschool level – namely, children's language, literacy, math, socioemotional development, and executive function – and student performance in second grade in reading. More details about the original sample and the context can be found in Yoshikawa et al. (2015). By merging the two UBC cohorts, before merging with the second-grade SIMCE data, we obtained a sample of 5 municipalities (two in the 2009 cohort), 58 schools (29 in each cohort), 79 classrooms (41 in the first cohort), and 1,583 students.

Preschool-age or initial characteristics are those that were measured at the beginning of the intervention (2009 or 2010 in each case). The UBC databases contain information about the initial characteristics of the sample in preschool and the SIMCE database provides information about elementary school characteristics.

The preschool-age variables we considered are (and detailed in Yoshikawa et al., 2015) child performance in language and math, as measured by the Woodcock–Muñoz (WM) in Spanish (Vocabulary, Letter-Word Identification, Dictation, Passage Comprehension, and Applied Problems); child socioemotional development and executive function, as measured by the battery administered in the study (as detailed in Yoshikawa et al., 2015); and family characteristics such as maternal and paternal educational, socioeconomic status, educational expectations, number of children and adults at home, and presence of father/mother at home.

Posttest or final characteristics are those that were measured the year in which the SIMCE was administered to the children in the sample in 2012 and 2013, when the children were in second grade of primary school, respectively, depending on their cohort. The Measurement System of Educational Quality (SIMCE)² is a national assessment system of the Chilean Ministry of Education, and its objective is to provide information on achievement levels. SIMCE is a standardized test in which second-grade reading comprehension is assessed. The SIMCE database contains school-level and student-level information (test scores and socioeconomic status).³

To understand the generalizability of our sample to other low-income municipalities in Santiago, Chile, Yoshikawa et al. (2015) conducted analyses comparing elementary school students in the five selected municipalities to those in municipalities that were eligible but not selected. These analyses showed that there were no significant differences in the national academic test scores (SIMCE scores measuring fourth-grade reading and math skills) between elementary school students living in municipalities that participated in the study and children from other candidate low-income municipalities. Similarly, no significant differences were found in students' household socioeconomic status. Hence, the sample of municipalities is considered representative of other municipalities in Santiago with similar characteristics.⁴

² More information can be found at www.simce.cl.

³ The database includes information about the students, their parents and families, and their schools: (1) student information such as gender, age, and test scores; (2) family information such as parental education levels, income per capita, and knowledge about school; and (3) school information such as administration, socioeconomic composition, number of students, and area of localization.

⁴ Characteristics required to participate in this study were (1) a minimum of 20 percent of children at risk in the primary grades (see Yoshikawa et al., for details), (2) a minimum of eight municipal schools with prekindergarten and kindergarten classrooms, and (3) location in the Metropolitan

By merging the aforementioned UBC and SIMCE databases, we found that 77.7 percent⁵ of children from the original UBC study had a second-grade SIMCE reading score resulting in a sample size of 1,230. All the children's initial schools were municipal/public. The socioeconomic level was measured with a scale from 1 to 5, in which 1 is a low socioeconomic level and five is a high socioeconomic level. The average level, 2, shows that the schools were mostly of a medium to low socioeconomic level.

Results

We analyzed the relationship or correlations between the initial child variables and SIMCE results. The relationship between SIMCE reading scores and (1) the language, literacy, and mathematics subtests; (2) socioemotional development results such as pro-social and positive behavior, self-regulation, and low problem behavior; (3) variables related to parental stimulation at home; (4) variables of executive function; and (5) the treatment variable (a control variable)⁶ are positive and significant. Overall, around 32.6 percent of the variance in second-grade reading variance is accounted for by prekindergarten-entry child skills, controlling for family and child characteristics.

To better estimate the correlation of initial characteristics on child development, we used Hierarchical Linear Modeling (HLM), which accounted for the nesting of students within classrooms, classrooms within schools, and schools within municipalities (Bloom et al., 2008; Hedges & Hedberg, 2007; Raudenbush & Bryk, 2002).

Summarizing the variables that were predictive of later reading, we found that with the Woodcock–Muñoz (WM) subtests Vocabulary, Letter-Word Identification, and Applied Problems are all positively predictive of SIMCE reading scores. In particular, an increase of one point in the WM Vocabulary subtest and in the WM subtest of Letter-Word Identification⁷ is associated with a respective increase of 0.043 and 0.056 standard deviations in SIMCE reading scores, while an increase of one point in the WM Applied Problems⁸ is

Region of Santiago. Fourteen municipalities met these selection criteria and were invited to apply to participate in the UBC program and its evaluation. Then, interviews with municipal representatives from mayors' offices and departments of education and health were conducted to make sure the goals of the program were clear, to explain the evaluation design, and to answer any questions. In this stage, six municipalities were ultimately selected.

⁵ This could be because schools select/exclude some children from taking the SIMCE exam or children had been retained a year in school or the child was absent the day of testing due to illness or other reasons.

⁶ Once background variables were controlled for, this variable was no longer significant.

⁷ Which represent about 5 percent and 19 percent of the overall mean, respectively.

⁸ Which represent about 14 percent of the overall mean.

correlated with an increase of 0.02 standard deviations in SIMCE reading scores.

Among the socioemotional and executive function variables, self-regulation and low problem behavior and inhibitory control are significantly correlated with reading test scores. In particular, an increase of 1 point in the self-regulation and low problem behavior variable predicts an increase of 0.31 standard deviations in reading, and an increase of 1 point in the Walk-a-Line task is associated with an increase of 0.26 standard deviations in reading.⁹

Conclusions and Implications

This kind of study, which examines preschool mathematical skills and socio-emotional development in addition to early language and literacy skills to test what skills predict second-grade reading scores in Chile in a large sample of low-income Spanish monolinguals, makes a unique contribution to the field because it helps to determine precursors to later reading comprehension in a language other than English and in a middle-income country. In this chapter we described an analysis of the 2009–2010 and 2010–2011 cohorts of the UBC intervention for early childhood educators in Chile and their corresponding reading test results (SIMCE) in order to analyze the relationship between initial characteristics at preschool level, namely, children’s language, literacy, math, socioemotional development, and executive function and students’ performance in reading in the second grade, controlling for other background characteristics.

We found that the Woodcock–Muñoz (WM) subtests of Vocabulary, Letter-Word Identification, and Applied Problems all positively predict SIMCE reading scores. As for the other socioemotional and executive function variables, self-regulation and low problem behavior as well as inhibitory control positively predict reading test scores. Other socioemotional and executive function variables, such as attention, pro-social behavior, and positive behavior, are not significantly associated with SIMCE reading scores in these analyses. Again, overall, around 32.6 percent of the variance in second-grade reading variance is accounted for by prekindergarten-entry child skills, controlling for family and child characteristics. These findings suggest that working on these skills in an integrated fashion at the preschool level should lead to promising results at the elementary level.

Similar to Duncan et al. (2007), we found that preschool math, language, and literacy predicted later reading. On the other hand, attention was not predictive

⁹ This does not necessarily mean that the self-regulation and low problem behavior variable is more “important” than the Walk-a-Line task because their measurement scales are not the same. In this case, the main message is that both variables predict reading scores controlling for other background characteristics.

in our study, while some socioemotional and executive function variables did positively predict reading scores. The first obvious conclusion, our initial hypothesis, is that incoming skills beget later skills; therefore, the focus many times needs to be on at-risk children who enter preschool without the foundational skills that will lead to later academic success. The other potential but much more tentative conclusion is that different executive function and socioemotional skills may be necessary precursors in different sociocultural contexts; in the Chilean context, where class sizes are larger, socioemotional and executive function skills may be more important for later academic achievement.

It seems evident that emergent language and literacy skills will predict later reading – that almost goes without saying. What is interesting is that in Chile, as in other countries, the finding is also replicated that strong math skills predict reading in early elementary. This may have to do with the fact that at this young age, some math skills simply require reading-like abilities – the ability to recognize numbers as opposed to letters, for example – or it may have to do with the fact that throughout the academic careers of students, there is often an important correlation between language and mathematics achievement.

That the importance of socioemotional skills as well as executive function is similar in terms of executive function has not been replicated as frequently with socioemotional skills. It would appear that in the Chilean context, these skills are indeed important, indicating that not only is there an executive function component which may be universal but there may also be a social component which is important culturally.

As professionals who have worked in professional development and classrooms in Chile for many years, it is our impression that there are a great deal more whole-group activities and a teacher-centered pedagogy in Chile, which would suggest that children's learning in the classroom would require more socioemotional and executive function skills than American preschool and early elementary classrooms, which have smaller class sizes and would seem to promote greater autonomy through center work, for example. One potential implication from this study in Chile is that an "educationally informed theory of language learning" needs to understand the educational practices in diverse contexts and how those practices may draw more or less upon specific skills, thus diminishing or increasing the importance and role of those skills in later academic success.

An issue of concern from this study is that our intervention, *Un Buen Comienzo*, begins in prekindergarten, while these results indicate that our students already exhibit important differences among themselves – and these are students who are relatively similar in terms of socioeconomic status. If we were to obtain a nationally representative sample, we would probably find greater achievement gaps between the advantaged and those at risk.

The project over the years has taken steps to provide professional development to give students more access to the learning experiences they need by providing teachers with structured lesson plans that incorporate specific elements of language and literacy instruction and effective interactions based on the CLASS observation instrument (Pianta, LaParo, & Hamre, 2012), and strategies for increasing instructional time and improving school attendance. The CLASS observation instrument can be used as an instrument for professional development, helping classroom teams focus on improving the emotional support, classroom organization, and instructional support they provide through their interactions with children in the classroom (Early et al., 2017). We have also introduced Continuous Quality Improvement (CQI) (Arbour et al., 2015), a methodology to involve stakeholders; help them take ownership of their change at the classroom, school, and district level; and use data to monitor their improvement over time based on clearly defined goals. Attendance is one of the clear inputs that have been shown to have a positive impact on our students' outcomes (Arbour et al., 2015). We have shown impact on improving quality classroom interactions and on student outcomes in kindergarten, but we are waiting to see if these results continue in elementary school with our more recent cohorts (Universidad Diego Portales, 2016). Ultimately, we hope the research presented here, coupled with our professional development and collaboration with public schools in Chile, will help foster the necessary early skills that preschool children will need to succeed in school and will contribute to an "educationally informed theory of language learning."