Title: Ethnic differences in cognitive development during early childhood, the Mapuche case

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Abstract

This article studies the differences in cognitive development among Mapuche and non-Mapuche preschoolers in Chile. The Mapuches are the main indigenous group in Chile, besides being a socioeconomically vulnerable group. We are studying the differences in cognitive development between these two groups, focusing on the role of the families' socioeconomic and parenting resources. We use data from the *Encuesta Longitudinal de Primera Infancia* (ELPI) 2012, a nationally representative survey of early childhood in Chile (0 to 6-year-old), which includes a test of cognitive development validated among Mapuche preschoolers. Our results indicate that the cognitive gap between Mapuche and non-Mapuche children in Chile starts before they enter primary education and it reaches 0.2 SD ($p < 0.001$), which is in the lower bound of the gap found in previous studies during the school period. We run OLS models of cognitive development, finding that socioeconomic resources and parenting practices account for part of the gap between Mapuche and non-Mapuche children, but not for all of it. Because of the reduction of the cognitive gap when the parenting practices regarding learning materials are included in the model, we believe that reading with children (a practice about which we do not have direct measures) may be an important determinant of what is left of the cognitive gap between Mapuche and non-Mapuche children at an early age.

Keywords: Cognitive development, Mapuche children, Parenting resources, Socioeconomic resources, Preschooler

Introduction

The association between race and ethnicity with child development has received ample attention in social sciences (Burchinal et al., 1997; Cottrell, Newman, & Roisman 2015; Duncan & Magnuson 2005; Yeung & Conley, 2008). U.S. based research consistently shows that minority children score lower than other children do in standardized tests. Most of this research analyzes the specific case of Black and White children. The evidence indicates the gap exits at ages as young as three years old or even earlier (Brooks-Gunn et al., 2003; Burchinal et al., 2011; Duncan & Magnuson, 2005; Fryer & Levitt, 2004; Yeung & Pfeiffer, 2009), and it increases during the school period (Burchinal et al., 2011; Fryer & Levitt, 2004). Child development is typically measured by the score children obtain on standardized tests in several cognitive and non-cognitive domains, but also with indicators of school success, such as educational attainment, or rates of repetition and dropout. Both school-aged children and preschoolers have been studied. Specific studies looking at Latino children are scarcer, but they also find a gap when compared to White children (Burchinal et al., 1997; Duncan & Magnuson, 2005).

When school-aged children are studied, the framework for analyzing the ethnic gap is generally a multilevel framework, taking into account the influence of the family, school, and the neighborhood. One of the main referents for this type of analysis is the work of Garcia Coll et al. (1996), who proposed an integrative model to understand the developmental competencies of minority children, emphasizing the separated and combined effects of the children's experiences in these contexts over time. For preschoolers, though, the family is probably the most important context. Schools and neighborhoods begin to matter after children reach school age and even adolescence (Brooks Gunn & Duncan, 1997; Duncan & Magnuson, 2005). Therefore, most studies of the ethnic gap in early childhood focus on the family as the source of differences in child development.

Thomson, Hanson and McLanahan (1994) proposed a simple framework for understanding the effects of the families on children's well-being. Even though the framework was not originally developed for understanding differences in race and ethnicity, but rather to study the effect of family structure on child well-being, it is useful for understanding the mechanisms by which different families can affect child development. Moreover, it is a referent for much subsequent research (Thomson & McLanahan, 2012). The framework proposed that child well-being depends on two features of family life: economic resources and parental behaviors. Both economic resources and parental behaviors are necessary for healthy child development, and their effects on children are likely to be

interrelated (Thomson et al., 1994). For instance, the socioeconomically advantaged parents spend more time with their children (Kalil, Ryan & Corey, 2012).

Economic resources are measured in most studies by family income. These studies have shown that family income and cognitive development are strongly correlated. Some authors have even argued that family income has a stronger effect on children's abilities and achievements than on children's socioemotional development (Brooks-Gunn & Duncan, 1997). Studies of the relation between cognitive development and family income typically analyze the effect of being poor versus non-poor. Poor children are more likely to experience learning disabilities and developmental delays, and differences in cognitive achievement between poor and non-poor children are already noticeable at such young ages as two or three years. The timing of poverty also matters, with studies suggesting that the earlier it is experienced, the more intense is the effect of poverty on children. In this vein, children who experienced poverty during preschool and in the early school years had lower rates of school completion (Brooks-Gunn & Duncan, 1997) and family income seemed to matter more for preschoolers than for older children (Duncan & Magnuson, 2005). The mechanisms by which income (or poverty) may shape children's lives are many. Some of them occur even before birth, given that sufficient family income secures access to good prenatal healthcare and nutrition, variables that predict birth outcomes. Babies born prematurely and with low birth weight tend to show worse cognitive outcomes than normal weight children later in life (de Kieviet et al., 2012). After children are born, income gives families the possibility of offering children a rich learning environment both inside and outside of their homes (daycare facilities, school or college, later in life) and a safe neighborhood to live in (Duncan & Magnuson, 2005; Mayer, 1997). During early childhood, several studies suggested that one of the main ways in which family income contributes to development is through providing a stimulating learning environment, including books, newspapers, CDs, computers and other learning materials (Brooks-Gunn & Duncan, 1997; Waldfogel & Washbrook, 2011).

A concept that is related to income, even though it is more complex, is socioeconomic status. Parents with high socioeconomic status have more economic, cultural, and social capital than parents from lower strata, and they may use their capital to consolidate their advantage, investing more in their children's education, and enhancing their children's abilities and opinions (Gillies, 2005; Lareau, 2011). Many times parental education is used as a measure of the family socioeconomic status. Indeed, parental education indirectly benefits children through increasing family

income, but its influence may go through other paths as well, for instance, by enhancing the parents' abilities to accomplish parenting goals. The association between parental education and cognitive development is evident as early in a child's life as three months of age (Duncan & Magnuson, 2005). All these findings refer to economic or socioeconomic resources *per se*. Because families of color are often socioeconomically disadvantaged, these findings apply to them, but the implication is that more than race or ethnicity, what explains the differences in cognitive development is family income or socioeconomic status. After accounting for the family socioeconomic status, measured either by family income or by a collection of other measures, most studies have found that the White-Black gap decreases substantially in the U.S., but it typically does not disappear (Brooks-Gunn et al., 2003; Yeung & Pfeiffer, 2005).

Parental behaviors, or parenting, is a broader concept. Intuitively, parenting encompasses all the activities that parents engage in with their children. In their original work, Thomson et al. (1994) considered indicators of parental control and parental support. They measured parental support though the frequency of activities that parents did with their children, such as eating together with children, home activities (a group of activities as diverse as playing, helping with homework and talking in private) and going out with children (Thomson et al., 1994). Subsequent studies have conceptualized parenting differently. For instance, Brooks-Gunn & Markman (2005) used seven types of behaviors, namely, nurturance, discipline, language, monitoring, management, teaching, and materials. They applied this scheme to study the ethnic gap among preschoolers, between White and Black children, but also between White and Latino children. Black mothers obtained lower scores than White mothers in all the areas of parenting, as do generally Latino mothers (even though there were not White-Latino significant differences in nurturance).

One explanation for these ethnic differences in parenting is the family stress/processes hypothesis, that is to say, that low family income increases parental stress, it translates into parental depression, and it leads parents to negative practices, such as yelling at their children (Yeung & Conley, 2008). Another explanation is that the lower scores that families of color obtain in parenting may be related to the instruments applied in the U.S., which typically measure practices that are representative of middle class, White families. Some parenting behaviors, which may be important for families of color, are probably not measured. For instance, Latino parents may value compliance and they may motivate it among their toddlers more than other ethnic groups do, but that type of behavior is not measured in these

instruments (Brooks-Gunn & Markman, 2005). In the same vein, the idea of a deficit in the development of minority children has been strongly criticized. These critics emphasize the cultural strengths that minority children and their families have, which a deficit approach ignores (Cabrera, 2013). For instance, being bilingual may give children a cognitive advantage (Galindo & Fuller, 2010), and the strong social skills that some cultures foster may be predictive of positive outcome among minority children (Phinney, Ong & Madden, 2000).

With this caveat in mind, standardized measures of parenting typically have found large differences according to ethnicity in the language domain. The frequency with which parents read with their children is generally used as a measure of parents' practices in this domain. White parents read more to their children than Latino parents, who in turn read to them more than do Black parents (Brooks-Gunn & Markman, 2005). Because of the racial composition of the socioeconomic groups, it is difficult to isolate the effect of race/ethnicity from the effect of socioeconomic status in language, and children´s exposure to language and conversations varies markedly according to social class. Farkas & Beron (2004) found that at age three, children from the most advantaged groups had three times more vocabulary than children from the most disadvantaged groups. In addition, a qualitative study provided evidence that Black and White parents interact differently with written texts. Black parents tended to narrate orally stories to their children, whereas White parents tended to read the stories (Vernon-Feagans, 1996). When reading stories to their children, working class Black mothers were less likely than White mothers to ask their children questions, and if they did, they typically asked simple yes/no questions (Anderson-Yockel & Haynes, 1994). Even though the amount of time all parents spent reading and in other educational activities with their children has increased in the U.S. over the last twenty years, advantaged parents still spend more time reading with their children (Noel, Stark & Redford, 2013). Furthermore, the gap in the time that different groups of parents spent with their children in educational activities widened, because advantaged parents increased the amount of time they dedicate to these tasks at a higher rate than parents from disadvantaged backgrounds (Guryan, Hurst & Kearney, 2008; Ramey & Ramey, 2010).

Cognitive science research supports the benefits of reading with children from an early age for cognitive development. Even though most studies have been done with adults (Dehaene et al., 2010; Dehaene & Cohen, 2011; McCandliss, Cohen & Dehaene, 2003), the evidence with children also indicates that learning to read enables changes in the physical structure of the brain, that is to say, the brain responds to external demands (Linkersdörfer et al., 2014; Yeatman et al., 2012). The earlier that these brain areas are stimulated, the more likely the person will

meet with reading success in subsequent years (Brem et al., 2010). Research on brain development beyond the effects of reading is also supportive of the idea that early brain development is predictive of cognitive outcomes later on in life (Knudsen et al., 2006). We believe that parenting practices that are related to the development of language are, therefore, a crucial predictor of the cognitive gap between minority and non-minority children.

There are few studies analyzing differences in cognitive development according to ethnicity in developing countries, in general, and in Latin America, specifically. In Chile, the *Mapuche* are the main indigenous group. According to estimates from 2017, they represented 8.1 percent of the total population, and 85 percent of the people who identified themselves with an ethnic group declared to be Mapuche. The Mapuche people tended to live in the original *Araucania* region, in the south of Chile (23 percent), or in the Metropolitan area of Santiago, the capital city (32 percent) (CASEN, 2017). They are a socioeconomically vulnerable group. According to the 2017 census, they had the fewest years of schooling of all the indigenous groups in the country (Censo, 2017). Whereas 8 percent of the non-indigenous population was poor in 2017, 15.5 percent of the Mapuche people were (CASEN, 2017). The poverty level was even higher for the Mapuches in the Araucania (Cerda, 2009), even though there is some evidence that these figures are changing among the younger cohorts of Mapuches, who have better access to higher education and are more likely to experience social mobility (INJUV, 2015). Similar to what happened with other Latin American indigenous groups, the process of assimilation of the Mapuche people included the replacement of their native language by Spanish and increasing migration to urban areas. Intermarriage is especially high among Mapuche people, with about half of married Mapuches coupled with non-Mapuches. Because of the racial mixing, ethnic markers are not very prominent, except for surnames (Valenzuela & Unzueta, 2015). The media and the non-Mapuche population frequently use negative stereotypes to represent the Mapuche, such as being violent or lazy (Undurraga, Valenzuela & Godoy, 2015; Valenzuela & Unzueta, 2015).

There are few studies in Chile analyzing the differences in cognitive development between Mapuche and non-Mapuche children. The studies looked at differences in the national student achievement testing system (*Sistema de Medición de la Calidad de la Educación,* SIMCE) in the fourth, eighth and tenth grades. They reported a similar gap in achievement, detrimental to Mapuche children, which reaches between 0.2-0.5 standard deviations (SD) (McEwan, 2004, 2008; Noe, Rodriguez Cabello & Zuñiga, 2005; Undurraga et al., 2015; Canales & Webb, 2018). This research analyzed the influence of the family and the school on achievement. They found a strong association

between the family socioeconomic status and race/ethnicity, even arguing that the Mapuche gap disappeared after controlling for socioeconomic status (Noe et al., 2005). Concerning the school, they suggested that the school context tended to increase the differences between Mapuche and non-Mapuche children, via peer and compositional effects. Taken together, these studies suggest that rather than ethnicity, what explains the low educational achievement of the Mapuche children is their socioeconomic resources, either due to the influence of their family socioeconomic status or from the effects of school segregation.

There are no studies in Chile about ethnic differences in cognitive development among preschoolers. There are, however, ethnographic studies analyzing the parenting practices of Mapuche people in rural areas during early childhood. Mapuche parents value autonomy and enhance the development of volition in early in their children's lives. These values materialize, for instance, in letting children explore their surroundings freely, without constant adult supervision (Murray et al., 2015). It is not clear, though, whether or not Mapuche parents in urban areas share these practices or, more importantly, what this emphasis in autonomy means for cognitive development. On the one hand, it may foster the will to understand their surroundings. Such will would be in line with the Mapuche belief that children learn by exploring the world through their senses. Accordingly, Mapuche families encourage the ability to observe among their children from a very early age (Sadler & Obach, 2006). The cognitive development of a child with a strong sense of autonomy could benefit from such learning activities. On the other hand, there is no clear link between fostering autonomy and the development of language, which is an important predictor of future cognitive development. It is known that oral tradition is important in the Mapuche culture and that parents tends to narrate the traditional tales and legends to their children by speaking instead of reading (Sadler & Obach, 2006). It is reasonable to expect, then, that reading practices will be less frequent among Mapuche parents, which may have a negative impact in children scores in standardized measure of cognitive development.

We use this cumulative evidence to ask about the existence of a gap in cognitive development between Mapuche and non-Mapuche preschoolers in Chile, and to explore its association with socioeconomic resources and parenting practices. We hypothesize that the score in cognitive development of Mapuche preschoolers will be lower than the score of non-Mapuche children, and that more socioeconomic resources as well as a higher score in parenting practices will be associated with a higher score in cognitive development. . We aim to contribute to the understanding of the inequalities the Mapuche people experience in Chile by tracing their appearance to early stages

of life and by bringing to the discussion variables that go beyond socioeconomic status, which is the only determinant of the Mapuche gap that has been explored in Chile. By comparing these results to the larger research on child development and ethnic minorities, we expect to elucidate to what extent the differences we observed in Chile are shared with children in other contexts, and to better understand the mechanisms by which ethnicity exerts its effects on cognitive development.

Method

Participants and Procedure

Data for this study came from the Early Childhood Longitudinal Study (*Encuesta Longitudinal de Primera Infancia*, ELPI). The survey had two waves (2010 and 2012). The sample design was probabilistic and it was representative of children born between January 1, 2006 and August 31, 2009, who were between six months and five years old in 2010. In each wave, the focal child took several standardized tests to measure different areas of development and the primary caregiver answered a questionnaire. The 2012 wave retained about 85 percent of the original sample (more than 12,000 children), and it added 3,135 new cases, corresponding to children born between September 2009 and December 2011. We used wave 2 as cross-sectional data, because this wave included a multidimensional test for measuring child development, whose content has been validated among Mapuche children. The sample size for wave 2 totaled 16,033 children. We used only the cases in which the children's evaluations were completed and the primary caregiver is the biological mother (n= 15.516 cases, 98 percent of the total sample).

Measures

Our dependent variable was cognitive development, as measured by the Test of Children's Learning and Development (*Test de Aprendizaje y Desarrollo Infantil,* TADI). This instrument was created in Chile in 2011 and it may be used with children between three months and six years old. It covers four areas: language, socio-emotional, motor skills, and cognitive development. Either a total score or separate scores for each area may be computed. As mentioned, this instrument was validated among Mapuche children, and its psychometric properties were evaluated as appropriate (for details, see Pardo, Gómez & Edwards, 2012). The ELPI includes other well-known instruments to measure child development, namely, the Peabody Picture Vocabulary Test and the Batelle Development Inventory. However, only the TADI is validated among Mapuche children, which is why we preferred this instrument. The score on each TADI test is expressed as a T score, correcting by the child's age. Considering that

previous studies of the Mapuche gap among school-aged children have used Z scores, we standardized the TADI scores likewise (mean 0, standard deviation 1), in order to facilitate the interpretation and comparability of our results.

Our key independent variable was the Mapuche origin of children. The primary caregiver identified him or herself as belonging to one of the nine indigenous groups existing in Chile and reported the same information for the rest of the people in the household, including the focal child. We used the answer the primary caregiver gave for the focal child as the ethnic identifier, creating a dummy variable, which distinguishes Mapuche children from children with no indigenous affiliation. Members of other indigenous groups (239 cases) were excluded, because they were a very small group.

For measuring socioeconomic status, we included the biological mother's educational attainment (less than high school; high school diploma; post-secondary technical; post-secondary college or higher) and the natural logarithm of the per capita income. Our indicators of parenting practices were learning materials and parental responsivity. Both indicators came from the short form of the Home Observation for Measurement of the Environment, HOME inventory (Bradley & Caldwell, 1984). The HOME inventory is made up of age-specific items, distinguishing, in this case, between children younger and older than 36 months old. The number of items included in each sub-scale differs according to age. In order to have a synthetic measure, and because the items have a yes/no answer, we used the proportion of items passed as the indicator of learning materials and parental responsivity (a similar strategy was used by Burchinal et al., 1997). There is one precedent of using the complete short form of the HOME inventory in ELPI for studying differences between the home environment of Mapuche and non-Mapuche children, which found that the Mapuche families obtained lower scores on the total scale than the non-Mapuche families. Even though the difference is small, it was statistically significant (Cárcamo et al., 2015).

We controlled for relevant characteristics of the child and the biological mother. Specifically, we include the child's sex, age in months, the natural logarithm of the birth weight, and daycare attendance (whether or not he or she had ever attended), as well as the biological mother's age and marital status. Finally, we controlled for the urban/rural status of the residence where the family lives.

Missing values were considerable for the dependent variable, reaching 11.6 percent, because the children did not complete all of the exercises in the TADI test or did not take the test at all. In addition to the TADI, children were asked to complete other tests during their evaluation. Considering their age, fatigue may explain non-response. Missing values also existed in the child's age in months (7.5 percent) and birth weight (9.9 percent), and in the maternal educational attainment (0.3 percent), and in the per capita family income (1.9 percent). We used multiple imputation for handling missing values, in both the dependent and independent variables (Johnson & Young, 2011). Specifically, we utilized imputation by chained equations, using MICE in Stata. We included in the imputation model all the variables in the analytic model. We used 10 imputations. The estimates were averaged across the ten imputed data sets.

Analytical Strategy

Our analysis begins with a description of the analytic sample, according to Mapuche origin, in order to get a first idea of the differences between Mapuche and Non-Mapuche children. We tabulated the differences, but because the data is multiply imputed, classic tests for differences in means or proportions are not appropriate. Instead, in order to test the significance of the differences between ethnic groups, we run a simple regression for each predictor on Mapuche origin. We report the t statistic associated with each coefficient, as well as the degrees of freedom and associated p value. For continuous predictors, we run linear simple regressions, and for categorical predictors, we run simple logistic regressions (we created several dummies for predictors with more than two categories). Secondly, we present our multivariate analysis, which consists in a set of OLS models for cognitive development. Model 1 included only the Mapuche origin of the child. Model 2 added the socioeconomic variables. Model 3 added the parenting measures and Model 4 added the other controls. In order to test whether the effect of the socioeconomic or parenting resources is different for Mapuche and Non-Mapuche children, we tried several interactions. Model 5 is similar to Model 4, but adding the interaction term between Mapuche origin and the HOME learning materials subscale (as an indicator of parenting resources). We did not include the other interactions because they were not statistically significant. In our models, we used Montecarlo standard errors in order to reflect the variability of the multiple imputation results across repeated uses of the same imputation procedure (StataCorp 2013). For simplicity, and because the results are similar, we only present the models for the cognitive development TADI score, but the results for the other three outcomes (the TADI score in the area of language, as well as the

scores in the other two instruments that ELPI used to measure child development, namely, the Peabody Picture Vocabulary Test and the Batelle Inventory) are available as Supplementary Material. We did not use them as our main outcome because they are not validated among Mapuche children and because they have more missing data than the TADI tests. The results, though, were consistent with the models that use the TADI cognitive development score as dependent variable.

Results

Table 1 provides descriptive statistics of the sample, according to the Mapuche origin of the child. The percentage of Mapuche children in these data were similar to the last published national estimate (CASEN, 2017), reaching about eight percent. The gap in cognitive development between Mapuche and non-Mapuche children existed during early childhood, and it reached 0.2 SD (t= -7.16, p=0.000, df=15.514), which resembles the unadjusted gap a recent study found during school years (Canales and Webb, 2018: 0.2-0.3 SD), even though it is smaller than other estimates in the same period (McEwan, 2004, 2008: 0.3-0.5 SD). As a reference, the difference in cognitive development between children whose parents had complete secondary education or a lower educational achievement also reached 0.2 SD in this sample.

[INSERT TABLE 1 ABOUT HERE]

Regarding socioeconomic status, as expected, the Mapuche children lived in more vulnerable families, as indicated by their per capita family income (t= -12.67, p=0.000, df=15.514) and by their mothers' educational attainment: a larger proportion of the mothers of Mapuche children did not complete high school, and a smaller proportion pursued post-secondary studies, as compared with the mothers of non-Mapuche children. In terms of parenting, the mothers of Mapuche children obtained lower scores than the mothers of non-Mapuche children, both in the areas of learning materials (t= -9.57, p=0.000, df=15.514) and in parental responsivity (t= -4.9, p=0.000, df=15.514).

Concerning the other covariates, we found no differences between Mapuche and non-Mapuche children in terms of sex and birth weight. Daycare attendance was somewhat higher among the Mapuche group (t= -2.1, p=0.0360, df=15.514). There were not significant differences between the children's mothers in terms of age, but the differences were significant regarding marital status. The mothers of Mapuche children were slightly more likely to be cohabiting and less likely to be married or single than the mothers of non-Mapuche children. Differences

between separated or divorced Mapuche and non-Mapuche mothers were not significant. The families of Mapuche children were more likely to live in rural areas (t= 7.95, p=0.000, df=15.514).

Table 2 summarizes the results of the regression analysis for cognitive development. Model 1 showed the above mentioned 0.2 SD difference in cognitive development between Mapuche and non-Mapuche children.

[INSERT TABLE 2 ABOUT HERE]

The effect of Mapuche origin decreased as more variables were added to the model. The largest reduction occurred in Model 2, when both socioeconomic predictors were included. This is according to the previous research on school-aged children in Chile, which showed that the Mapuche gap was related to poverty. However, and distinct from those studies, even though diminished, the Mapuche gap persisted among preschoolers after controlling for socioeconomic resources. Model 3 indicated that the effect of the parenting practices was strong, especially for the learning materials subscale (t= 7.95, p=0.000, df=15.514). This coefficient did not change much in the final model, where the other controls were added. In this final model, all the children's characteristics included, as well as that of rural residence, were significantly related to cognitive development, and the effects were in the expected direction. On the contrary, neither maternal age nor marital status were significantly related to cognitive development.

Model 5 included the interaction between Mapuche origin and the learning materials subscale, indicating that a higher score on learning materials was associated with a more pronounced increase in the score of the cognitive development test of Mapuche children as compared with the score of non-Mapuche children (t= 2.26, p=0.024, df=15.499). That is to say, a richer learning environment at home seemed to benefit Mapuche children more than non-Mapuche children when it comes to cognitive development. These results were displayed in Figure 1, where the grey line corresponded to the predicted z-score of the cognitive development test for Mapuche children and the black line corresponded to the predicted z-score of non-Mapuche children. This figure not only showed the more pronounced increase in cognitive development for Mapuche children, but it also suggested the existence of a crossover in the effect of learning materials according to Mapuche origin. In the lower 75 percentile of distribution of the learning materials scale, that is to say, in most of the houses, where learning materials were not so abundant for children, Mapuche children scored lower than non- Mapuche children. But in the upper 25 percentile of the learning materials distribution, that is to say, in the houses with the richest learning environment, Mapuche children

scored higher than non-Mapuche children in cognitive development. This trend is consistent with the idea that bilingualism may benefit the cognitive development of minority children and that in general, when accounting for material resources, ethnicity may be an asset for child development. However, the confidence intervals for both groups actually overlap at the higher end of the learning materials subscale, which is why we only suggest this interpretation.

[INSERT FIGURE 1 ABOUT HERE]

Discussion

This paper analyzed the ethnic gap in cognitive development between Mapuche and non-Mapuche children in Chile, in a sample of preschoolers. Our main finding was that the gap that other Chilean studies have found for educational outcomes in school-aged children also existed at an earlier age. The amount of the gap was similar to the smaller estimates of the Mapuche gap during school years. This result was also in line with the U.S. based research analyzing ethnic differences on early child development. We found that the ethnic gap decreased after controlling for socioeconomic resources, but it did not disappear. This result was different from what scholars have reported among school-aged children in Chile, where the ethnic gap seemed to be mainly explained by the socioeconomic vulnerability of Mapuche children. During early childhood, children in Chile were not obligated to attend educational centers (or at least attendance was not compulsory when the data we used was collected) and they were too young to spend time in the neighborhood by themselves, without adult supervision. Therefore, the most important environment for their development was the family. We believe that something in the parenting practices of Mapuche and non-Mapuche families may be explaining the ethnic gap in cognitive development we observed in preschoolers.

In fact, our results showed that parenting practices were significant determinants of cognitive development. In particular, a better learning environment at home was related to better results in cognitive development. The significant interaction between the HOME learning materials subscale and Mapuche origin indicated that Mapuche children benefited more than Non-Mapuche children from a rich learning environment at home, and it suggested that for children living in the better equipped houses, the score that Mapuche children obtained in cognitive development was higher than the score of non-Mapuche children. We used the HOME learning materials subscale as an indicator of parenting practices, but indeed the amount of learning materials parents may offer their children depends on the

family economic resources. Therefore, these results suggests that when accounting for material resources, ethnicity may be an asset for child development, which is in line with the idea of positive development among ethnic and racial minorities (Cabrera, 2013). Although, it is less likely for Mapuche children to live in homes with a high score in the HOME learning materials subscale. Moreover, as mentioned earlier, the Mapuche culture relies heavily on oral tradition instead of written texts. In addition, the Mapuche people have the lowest educational attainment in Chile. School was not such a fundamental socialization institution for Mapuche parents as it was for the rest of Chilean parents. The emphasis in oral tradition and the preference for developing children's autonomy that seems to be crucial in the Mapuche culture, may implicate that many Mapuche parents did not stimulate language practices in their children in the same way non-Mapuche parents did. That is to say, they may not read to their children as often or may not work with the text in more complex ways (i.e., not asking their children questions about the reading). Given that cognitive science shows the importance of reading regarding brain development, failing to expose children to written texts from an early age could explain the Mapuche lower score in cognitive development.

Limitations

Alas, we could not directly test of our ideas about reading with children and cognitive development according to ethnicity, because we lacked direct measures of such practices. We used the HOME learning materials subscale as the better proxy of reading activities with children. Perhaps including good measures of reading practices with children would make the ethnic gap disappear in the Mapuche case. In any case, we believe that the ethnic gap in cognitive development during early childhood should decrease in the future, as the Mapuche people improve their educational attainment, which may change the way they relate to reading when rearing their children. This does not imply that the ethnic gap should disappear during the entire span of childhood. Among school-aged children, the ethnic gap may still exist, independent of the family's socioeconomic and parenting resources, probably reflecting the effect of other contexts that become important as children age. For instance, institutional discrimination may lead to Mapuche students obtaining worse educational outcomes because of the stereotyping their teachers do. Previous research in Chile suggests that discrimination may affect the academic results of Mapuche school-aged children, through their teachers' expectations (Undurraga et al., 2015). However, we do not believe that discrimination is an important determinant of the gap in cognitive development between Mapuche and non-Mapuche children during early childhood, because the interaction between the school system and the children is still minimal

at this stage. If discrimination were to affect Mapuche preschoolers, it should do so through their parents' internalization of low expectations, which could also affect their parenting practices, but we also lack measures of that type of attitude.

Ethic statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The ELPI study obtained informed consent obtained from the focal child's primary caregiver.

Author Contributions

VS designed the study, reviewed the literature, and conducted the data analysis, and wrote the paper. EV collaborated with the design and the writing of the study. DA assisted with the data analysis and literature review.

References

Anderson-Yockel, J., & Haynes, W. (1994). Joint Book-Reading Strategies in Working-Class African American and White Mother-Toddler Dyads. *Journal of Speech, Language, and Hearing Research* ,37, 583-593.

Brem, S., Bach, S., Kucian, K., Guttorm, T.K., Martin, E., Lyytinen, H., Brandeis, D., & Richardson, U. (2010). Brain sensitivity to print emerges when children learn letter-speech sound correspondences. *Proceedings of the National Academy of Sciences of the United States of America*, 107, 7939–7944.

Bradley, R. H., & Caldwell, B. (1984). The HOME Inventory and family demographics. *Developmental Psychology*, 20, 315-320.

Brooks-Gunn, J., & Duncan, G. J. (1997). The effects of poverty on children. *The Future of Children*, 7, 55–71.

Brooks-Gunn, J., Klebanov, P. K., Smith, J., Duncan, G. J., & Lee, K. (2003). The Black-White Test Score Gap in Young Children: Contributions of Test and Family Characteristics. *Applied Developmental Science*, 7, 239–252.

Brooks-Gunn, J., & Markman, L. (2005). The Contribution of Parenting to Ethnic and Racial Gaps in School Readiness. *The Future of Children*, 15, 139–168.

Burchinal, M. R., Campbell, F. A., Bryant, D. M., Wasik, B. H., & Ramey, C. T. (1997). Early Intervention and Mediating Processes in Cognitive Performance of Children of Low-Income African American Families. *Child Development,* 68, 935–954.

Burchinal, M., McCartney, K., Steinberg, L., Crosnoe, R., Friedman, S. L., McLoyd, V., & Pianta R. (2011). Examining the Black–White Achievement Gap Among Low-Income Children Using the NICHD Study of Early Child Care and Youth Development. *Child Development,* 82, 1404–1420.

Cabrera, N. (2013). Positive Development of Minority Children. *Social Policy Report,* 27, 3-15

Canales, A., & Webb, A. (2018). Educational Achievement of Indigenous Students in Chile: School Composition and Peer Effects. *Comparative Education Review,* 62, 231-273.

Cárcamo, R. A., Vermeer, H., Van der Veer, R., & van IJzendoorn, M. (2015). Childcare in Mapuche and Non-Mapuche Families in Chile: The Importance of Socio-economic Inequality. *Journal of Child and Family Studies,* 24, 2668–2679.

CASEN. (2017). *Encuesta de Caracterización Socioeconómica Nacional*. Santiago: Ministerio de Desarrollo Social.

Censo. (2017). Resultados Censos Nacional de Población y Vivienda 2017.Retrieved from https://redatam-ine.ine.cl/redbin/RpWebEngine.exe/Portal?BASE=CENSO_2017&lang=esp

Cerda, R. (2009). Situación Socioeconómica Reciente de los Mapuches en la Región de las Araucanía. *Estudio Públicos,* 27-107.

Cottrell, J. M., Newman, D. A., & Roisman, G. I. (2015). Explaining the black–white gap in cognitive test scores: Toward a theory of adverse impact. *Journal of Applied Psychology,* 100, 1713–1736.

de Kieviet, J. F., Zoetebier, L., van Elburg, R. M., Vermeulen, R.J., & Oosterlaan, J. (2012). Brain development of very preterm and very low-birth weight children in childhood and adolescence: a meta-analysis. *Developmental Medicine and Child Neurology,* 54, 313–323.

Dehaene, S., & Cohen, L. (2011). The unique role of the visual word form area in reading. *Trends in Cognitive Sciences,* 15, 254–262.

Dehaene, S., Pegado, F., Braga, L.W., Ventura, P., Filho, G. N., Jobert, A., … Cohen, L. (2010). How Learning to Read Changes the Cortical Networks for Vision and Language. *Science,* 330, 1359–1364.

Dickens, W., & Flynn, J. (2006). Black Americans Reduce the Racial IQ Gap: Evidence from Standardization Samples. *Psychological Science,* 17, 913-920.

Duncan, G. J., & Magnuson, K. A. (2005). Can family socioeconomic resources account for racial and ethnic test score gaps? *The Future of Children,* 15, 35–54.

Edwards, M., & Pardo, M. (2013). *TADI. Test de Aprendizaje y Desarrollo Infantil. Manual del examinador.* Santiago de Chile: Centro de Investigación Avanzada en Educación.

Farkas, G., & Beron, K. (2004). The Detailed Age Trajectory of Oral Vocabulary Knowledge: Differences by Class and Race. *Social Science Research,* 33, 464-497.

Fryer, R. G., & Levitt, S. D. (2004). Understanding the Black-White Test Score Gap in the First Two Years of School. *Review of Economics and Statistics,* 86, 447–464.

Galindo, C., & Fuller, B. (2010). The social competence of Latino kindergartners and growth in mathematical understanding. *Developmental psychology*, *46*, 579-592.

García Coll, C., Lamberty, C., Jenkins, R., McAdoo, H., Crnic, K., Wasik, B., & Vázquez García, H. (1996). An integrative model for the study of developmental competencies in minority children. *Child Development*, *67*, 1891-1914.

Guillies, V. (2005). Raising the meritocracy: Parenting and the individualization of social class. *International Journal of Inclusive Education*, 39, 835-853.

Guryan, J., Hurst, E., & Kearney, M. (2008). Parental Education and Parental Time with Children. *Journal of Economic Perspectives,* 22, 23-46.

INJUV (2015). Jóvenes y juventudes indígenas. Vivencias y tensiones en el Chile contemporáneo. Santiago de Chile: INJUV.

Johnson, D. R., & Young, R. (2011). Toward Best Practices in Analyzing Datasets with Missing Data: Comparisons and Recommendations. *Journal of Marriage and Family,* 73, 926–945.

Kalil, A., Ryan, R., & Corey, M. (2012). Diverging Destinies: Maternal Education and the Developmental Gradient in Time With Children. *Demography,* 49, 1361–1383.

Knudsen, E., Heckman, J., Cameron, J., & Shonkoff, J. (2006). Economic, Neurobiological and Behavioral Perspectives on Building America's Future Workforce. *Proceedings of the National Academy of Sciences of the United States of America,* 103, 10155–10162.

Linkersdörfer, J., Jurcoane, A., Lindberg, S., Kaiser, J., Hasselhorn, M., Fiebach, C. J., & Lonnemann, J. (2014). The Association between Gray Matter Volume and Reading Proficiency: A Longitudinal Study of Beginning Readers. *Journal of Cognitive Neuroscience*, 27, 308–318.

Mayer, S. E. (1997). What Money Can't Buy: Family Income and Children's Life Chances. Cambridge, MA: Harvard University Press.

McCandliss, B. D., Cohen, L., & Dehaene, S. (2003). The visual word form area: expertise for reading in the fusiform gyrus. *Trends in Cognitive Sciences*, 7, 293–299.

McEwan, P. J. (2004). The indigenous test score gap in Bolivia and Chile. *Economic Development and Cultural Change*, 53, 157–190.

McEwan, P. J. (2008). Can schools reduce the indigenous test score gap? Evidence from Chile. *Journal of Development Studies*, 44, 1506–1530.

MIDEPLAN. (2015). CASEN 2013: Pueblos Indígenas. Síntesis de Resultados. Retrieved from http://observatorio.ministeriodesarrollosocial.gob.cl/documentos/Casen2013_Pueblos_Indigenas_13mar15_publicacion.pdf

Murray, M., Bowen, S., Segura, N., & Verdugo, M. (2015). Apprehending Volition in Early Socialization: Raising "Little Persons" among Rural Mapuche Families. *Ethos*, 43, 376–401.

Noe, D., Rodríguez Cabello, J., & Zuñiga, I. (2005). Brecha étnica e influencia de los pares en el rendimiento escolar: Evidencia para Chile. Santiago de Chile: CEPAL. División de Desarrollo Social.

Noel, A., Stark, P., & Redford, J. (2013). Parent and family involvement in education, from the National Household Education Surveys Program of 2012 (NCES 2013-028). Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

Pardo, M., Gómez, M., & Edwards, M. (2012). Test de Aprendizaje y Desarrollo Infantil (TADI). UNICEF.*Serie Reflexiones: Infancia y Adolescencia*, 1-38.

Phinney, J. S., Ong, A., & Madden, T. (2000). Cultural values and intergenerational value discrepancies in immigrant and non-immigrant families. *Child development*, 71, 528-539.

Ramey, G., & Ramey, V. (2010). The Rug Rat Race. Cambridge: The Brookings Institution.

Sadler, M., & Obach, A. (2006). Pautas de crianza Mapuche. Estudio Significaciones, actitudes y prácticas de familias Mapuches en relación a la crianza y cuidado infantil de los niños y niñas desde la gestación hasta los cinco años. Santiago de Chile: CIEG, Universidad de Chile y CIGES, Universidad de La Frontera.

StataCorp. (2013). Stata: Release 13. Statistical Software. Texas: StataCorp LP.

Thomson, E., Hanson, T. L., & McLanahan, S. (1994). Family Structure and Child Well-Being: Economic Resources vs. Parental Behaviors. *Social Forces,* 73, 221–242.

Thomson, E., & McLanahan, S. (2012). Reflections on Family Structure and Child Well-Being: Economic Resources vs. Parental Socialization. *Social Forces,* 91, 45–53.

Undurraga, E., Valenzuela, E., & Godoy, R. (2015). Understanding the academic achievement gap between indigenous and non-indigenous students at school: Evidence from Chile. Unpublished manuscript, last modified 2015. Microsoft Word file.

Valenzuela, E., & Unzueta, M. B. (2015). Parental transmission of ethnic identification in mixed couples in Latin America: the Mapuche case. *Ethnic and Racial Studies,* 38, 2090-2107.

Vernon-Feagans, L. (1996). Children's talk in communities and classrooms. Oxford: Blackwell.

Waldfogel, J., & Washbrook, E. (2011). Early Years Policy *Child Development Research* (2011): 1-12

Yeatman, J. D., Dougherty, R. F., Ben-Shachar, M., & Wandell, B. A. (2012). Development of white matter and reading skills. *Proceedings of the National Academy of Sciences,* 109, E3045–E3053.

Yeung, W. J., & Conley, D. (2008). Black–White Achievement Gap and Family Wealth. *Child Development,* 79, 303–324.

Yeung, W. J., & Pfeiffer, K. (2005). The Black-White Test Score Gap: Lessons from the Panel Study of Income Dynamics. National Poverty Center Working Paper Series.

Yeung, W. J., & Pfeiffer, K. (2009). The black–white test score gap and early home environment. *Social Science Research,* 38, 412–437.

Table 1: Characteristics of Mapuche and non-Mapuche Children and their Families. Descriptive Statistics

Variables	Non-indigenous (n=14,205)	Mapuche (n= 1311)	Total (n=15,516)
Mapuche origin %	91.5	8.5	100
Mean Cognitive Child development			
TADI, T score	51.7	49.2	51.5
(std. dev.)***	(12.4)	(12.8)	(12.5)
TADI, Z score	-.01	-.21	-.03
(std.dev.)***	(1.0)	(1.0)	(1.0)
Mother's educational attainment			
Less than high school***	31.2	48.8	32.7
High school diploma***	47.9	38.5	47.1
Post-secondary technical, college or higher ***	20.9	12.7	20.2
Total	100.0	100.0	100.0
Mean log per capita income (std. dev.)***	11.4	11.1	11.4
	(0.8)	(0.8)	(0.8)
Parenting			
Learning materials***	44.2	34.7	43.4
Parental responsivity***	73.6	68.7	73.2
Male child	50.6	49.8	50.5
Mean child's age in months (std. dev.)	50.4	50.6	50.5
	(18.0)	(18.5)	(18.1)
Mean log child's birth weight (std. dev.)	8.1	8.1	8.1
	(0.1)	(0.2)	(0.1)
Child attended daycare**	72.7	69.9	72.4
Mean mother's age (std. dev.)	30.8	31.1	30.9
	(7.1)	(7.3)	(7.2)

(*Continues*)

(*Continued*)

Variables	Non-indigenous (n=14,205)	Mapuche (n= 1311)	Total (n=15,516)
Mother's Marital status			
Married*	37.9	35.5	37.7
Cohabitant***	32.0	39.1	32.6
Separated/ Divorced	6.0	5.4	5.9
Single***	24.1	20.0	23.8
Total	100.0	100.0	100.0
Rural area of residence***	10.1	17.2	10.7

Statistical differences between groups were tested by simple regression models (OLS or logistic, several dummy variables were created for running logistic model if the covariate had more than two categories).
*** p<0.01, ** p<0.05, * p<0.1

Table 2: Summary of regression analysis predicting

cognitive development in children (n=15,516)

	Model 1	Model 2	Model 3	Model 4	Model 5
Mapuche origin	-0.201***	-0.105***	-0.073**	-0.064**	-0.138***
	(0.030)	(0.030)	(0.029)	(0.029)	(0.045)
Mother's educational attainment (ref= Less than high school)					
High school diploma		0.212***	0.167***	0.165***	0.164***
		(0.019)	(0.019)	(0.019)	(0.019)
Post-secondary		0.342***	0.278***	0.272***	0.273***
		(0.026)	(0.026)	(0.026)	(0.026)
Log per capita income		0.169***	0.137***	0.135***	0.134***
		(0.012)	(0.012)	(0.012)	(0.012)
Parenting					
HOME learning materials			0.426***	0.402***	0.387***
			(0.028)	(0.027)	(0.028)
HOME responsivity			0.199***	0.284***	0.283***
			(0.034)	(0.033)	(0.033)
Rural area of residence				-0.103***	-0.102***
				(0.027)	(0.027)
Mother's marital status (ref=married)					
Cohabiting				-0.020	-0.020
				(0.020)	(0.020)
Separated/divorced				-0.001	-0.002
				(0.039)	(0.039)
Single				0.014	0.014
				(0.023)	(0.023)

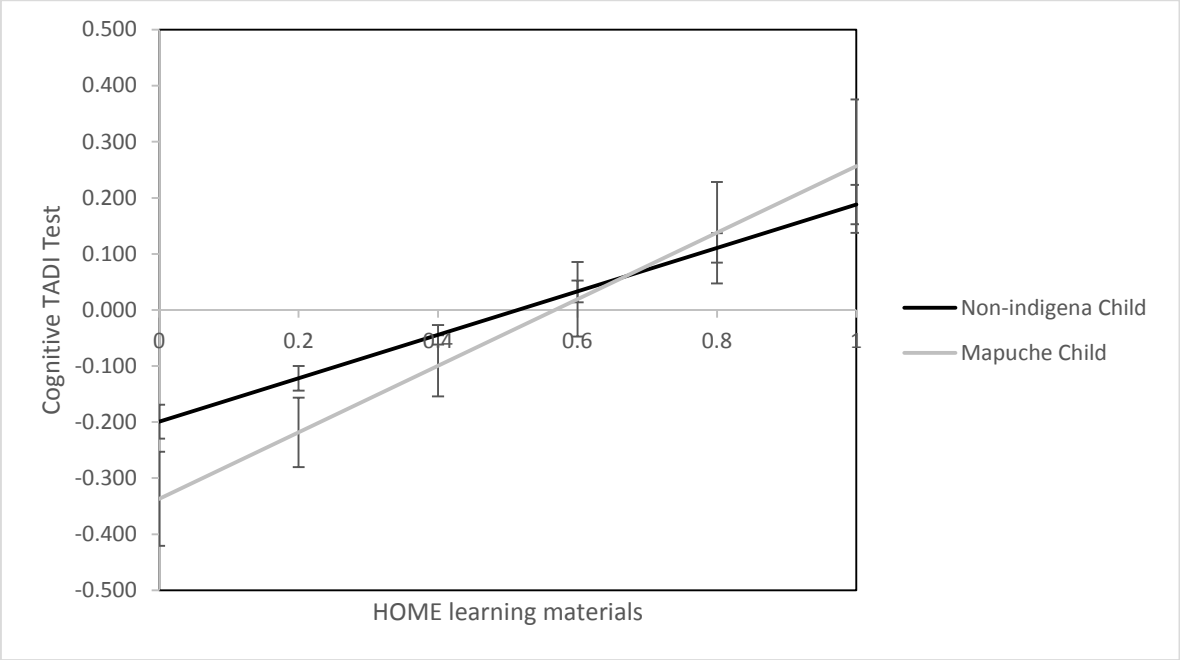
(*Continues*)

(*Continued*)

	Model 1	Model 2	Model 3	Model 4	Model 5
Each column shows coefficients and standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1					
Mother's age				-0.001	-0.001
				(0.001)	(0.001)
Child's age in months				0.007***	0.007***
				(0.001)	(0.001)
Daycare attendance				0.047**	0.047**
				(0.023)	(0.023)
Male child				-0.065***	-0.064***
				(0.016)	(0.016)
Log birth weight				0.240***	0.241***
				(0.061)	(0.061)
Mapuche origin* HOME learning materials					0.206**
			(0.089)		(0.0892)
Constant	-0.020**	-2.118***	-2.057***	-4.377***	-4.373***
	(0.009)	(0.129)	(0.129)	(0.507)	(0.506)
R-square	0.003	0.051	0.085	0.109	0.110
Adj R-square	0.003	0.051	0.084	0.109	0.109
Observations	15,516	15,516	15,516	15,516	15,516

Figure 1: Predicted Probabilities of TADI test (Z score),

according to Mapuche origin and Learning Materials score (HOME)



Brackets for 95% confidence intervals