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Sex-Differences in Language and Socio-emotional Skills in Early Childhood[1]

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Abstract

This study explores sex differences in language and socio-emotional skills. It focuses on children 7 months old to 6 years old in Chile in 2012 and Nicaragua in 2013. A focus on young children allowed for ruling out a set of environmental and identity effects to explain the gap. Females had an advantage in both countries and both dimensions. Males in Chile scored at -0.13 standard deviations (SD) in language in the distribution of females. In addition, males scored at -0.20 SD in socio-emotional skills. The gaps in Nicaragua were not statistically different to those in Chile. Thus geographical and cultural variation across the two countries did not affect the gap. Within countries, variation in family characteristics, parenting practices and health investments did not explain the gap either. These findings shed light on the role of biological and environmental factors to explain sex gaps. The identification of the role of these factors is necessary to inform policy.

JEL CODE: I25, J13, J16, O15, Z13

Key words: gender gaps, sex gaps, language, social skills, emotional skills, early childhood

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Highlights

- This study focused on children 7 months old to 6 years old in Chile in 2012 and Nicaragua in 2013.
- Females had an advantage in language and socio-emotional skills relative to males.
- The sex gap held despite variation in household characteristics, parenting practices, health investments, geography and culture.
- The sex gap held net of identity effects.
- There was little to no evidence of discriminatory treatment by parents.

Introduction

An assessment of sex differences in early childhood contributes to our understanding of them later in life. Indeed, labor participation among females is lower to that of males across the globe. In 2009, 78 percent of males participated in the labor market, while only 52 percent of females did (International Labor Organization, 2010). In addition, females self-select into fields that leave them at an economic disadvantage. In most countries females dominate in the fields of education, health and welfare (World Bank, 2012). In contrast, males dominate engineering, manufacturing, construction, agriculture and science (World Bank, 2012). These differences come at a cost. Sex differences in the labor market weaken economic growth and human development (World Bank, 2012). Despite its importance, the existence and sources of sex gaps in the labor market is a matter of debate.

One such debate is that on the role of innate fixed attributes versus that of environmental conditions. Both factors play a role to shape skills and preferences. Identifying the role of biological and environmental contributors is important. For example, suppose females had a genetic predisposition to be more sensitive to social stimulus. Such attribute would explain why females have an advantage in language and socio-emotional skills (Feldman, 2009; Berglund et al., 2005; Mildner, 2008; Smieja, Orzechowski and Stolarski, 2014; Kret and Gelder, 2012; Thomson and Voyer, 2014; World Bank, 2012). It would also explain why females do not seem to capitalize on this advantage. Indeed, it would explain why females choose professions where they can respond to the social stimulus around them.[3]

[3] Females rank occupations where they can aid others higher when compared to men. This is present even before they enter the labor market (Fortin, 2008). Females also tend to be more altruistic and show more pro social behavior in laboratory experiments (Betrand, 2011).

However, such differences could also result from environmental conditions. More specifically, differences may result from discrimination by institutions, social norms, social preferences or information problems (Akerlof and Kranton, 2012; Blau and Kahn, 1999; Becker, 1957; Arrow, 1973; World Bank, 2012). Nevertheless, identifying biological from environmental attributes is difficult. Researchers cannot observe a large number of females receiving male treatment and vice versa. Thus, it impossible to differentiate between the two. Comparing skills between males and females ignoring environmental factors beyond sex may be misleading. However, the identification of biological and environmental contributors is necessary to inform policy. Indeed, biological factors require addressing specific individual needs. In contrast, non-biological factors require addressing environmental conditions.

In this paper we explore sex differences in child development across two domains. The two are related to sensitivity to social interactions: language and socio-emotional skills. Social interactions pave the way for the development of language and socio-emotional in children (Feldman, 2009). Language and socio-emotional skills promote communication. Then, communication provides the base for the more structured social interactions (Feldman, 2009). This study focuses on children 7 months old to 6 years old in Chile and Nicaragua. We find females have an advantage in language and socio-emotional skills relative to males. The average male in Chile scores at -0.13 standard deviations (SD) and -0.20 SD in the distribution of females respectively. The results for Nicaragua are similar. The average male scores at -0.15 SD in language and -0.16 SD in socio-emotional skills. These gaps hold across a range of family characteristics and input levels. Moreover, the magnitude of the gaps is not statistically different across the two countries. Therefore, the gap holds despite geographical and cultural variation. Moreover, we found little to no evidence of discriminatory treatment by parents. These findings shed new light into the role of biological and environmental contributors. They contribute to our understanding relative to previous studies for three reasons.

First, data on inputs to human capital production on young children is rich relative to older age groups. Individuals have a relative short history. Compared to data on adults, data for children go beyond family characteristics and health investment. Indeed, data for children includes a wide set of parenting behaviors. For example, it includes information on stimulation, discipline and maltreatment. As a result, this data allowed us to test a subset of social discrimination theories to explain the gap. More specifically, the data enabled us to explore the role of a robust set of environmental factors. It allowed us exploring the role of the quality of the environment, family traits, care practices, and health investments.

Second, data on child development has become available for large samples in several countries.[4] This study uses data from two countries. The first one is Chile, one of the richest countries in LAC. The second one is Nicaragua, the second poorest nation in LAC. In addition, the Nicaragua sample focuses on poor communities. Therefore, these data sets allowed us to contrast societal and cultural variations between the two countries to explain the sex gap.

Third, children at this age group allowed observing differences net of identity effects. Identity effects are changes in behavior so as to comply with the norms of the group with which an individual identifies. This effect is present regardless of skill. Akerlof and Kranton (2002) propose it as a key driver of behavior. However, this behavior starts around the age of six (Rye, 2011; Wetherell, 1996). Thus, a focus in the first years of life provides measurement net of identity behavioral adjustments.

[4] Data exists for four nationally representative datasets on child development in LAC: ELPI from Chile, ELCA from Colombia, ENDIS from Uruguay and the YL dataset from Peru.

This study explores a robust set of socialization theories. In addition, this study is one of the first studies on language and socio-emotional skills to focus on children 7 months old to 6 years old. Moreover, this study is one of the first to explore sex gaps in Latin America. Indeed, socioeconomic gaps have been largely explored in the region (Schady et al, 2015). However, to our knowledge, sex gaps early in life and in Latin America are not documented.

In spite of these advantages, this study faces important limitations. One such limitation is its focus on children 7 to 70 months of age. Thus, it is not possible to learn on behavior at later stages. Moreover, it is not possible to make a direct link to labor market outcomes or other welfare related indicators in adulthood. In addition, the study is limited to two countries. Thus, more research is necessary to make an informed policy recommendation. Despite these limitations, this study contributes to the knowledge on potential contributors for sex gaps.

The organization of the paper is as follows. Section 2 discusses the evidence on sex gaps in language and socio-emotional skills. It also discusses why it is difficult to identify biological and environmental contributors. Section 3 describes the data sources. Section 4 describes the methodology for the analysis of sex gaps. Section 5 describes results from the analysis. Section 6 includes a discussion on the results. Section 7 concludes.

2. Other evidence on language and socio-emotional skills across sex groups

The claim that females have an advantage in language and socio-emotional skills is common. However, this claim is a matter of debate. In this section we describe the evidence that supports such idea and why making such claim is difficult.

Females outperformed males in literacy in all countries that participated in the 2012 PISA test except for Colombia (World Bank, 2012). The sex gap is present in countries across the performance level spectrum. This difference was present despite the fact males and females performed equally well in mathematics (World Bank, 2012). Other studies find females have higher verbal abilities and use more tentative, less assertive language than men (Berglund et al., 2005; Mildner, 2008; Feldman, 2009). In addition, females tend to outperform males to regulate and read emotions and function in social groups (Smieja, Orzechowski and Stolarski, 2014; Kret and Gelder, 2012; Thomson and Voyer, 2014). These differences seem to relate to biological differences. Indeed, electrophysiological studies show that males and females differ in the neural activation system. A task to identify faces and facial affect activates this system . Males use the right hemisphere, while females activate the left hemisphere (Everhart et al, 2001).

Sex differences in language and socio-emotional skills seem to be present right after birth. For example, neonate males make fewer basic oral rhythmic and lingual movements during sucking (Miller et al. 2006). On the other hand, neonate females are more responsive to sweetened formula with a reflexive "smile" and show more auditory sensitivity (Cassidy and Ditty, 2001; Erickson and Schulkin, 2003). Differences in the subsequent months include pain sensibility, responsiveness to maternal vocalizations, and discrimination of emotional expressions (Guinsburg et al. 2000; McClure, 2000; Gunnar and Donahue, 1980).

However, even at early stages of development differences do not favor one sex group. For example, some studies find that boys show more joy, examinelook at their mother for a longer time, and make more gestures to be picked up (Weinberg et al. 1999). Moreover, some studies do not find differences in neonatal eye contact, in contagious crying, or in response to maternal still face (Leeb and Rejskind, 2004; Geangu et al. 2010; Mesman et al. 2009; Wager et al. 2003).

Identifying biological and environmental contributors to the sex gap is difficult. Physiological sex characteristics develop at prenatal stages of life. These characteristics remain to adulthood. Thus, sex differences in physiology may establish behavioral predispositions during a lifetime. For example, Baron-Cohen (2003) finds that prenatal exposure to testosterone influences the ability to empathize with others. Thus, it may affect how social a child is.

A factor that makes difficult to establish how biological differences across sex groups is that the brain is plastic. The plasticity of the brain makes it malleable to experiences (Wood et al, 2008; Phillips and Shonkoff, 2010). Studies on twins show that even if about 50 per cent of the variance in child development is due to genetic factors, a child's genetic expression is influenced by environmental inputs (Teasdale and Owen 1984, Wilson 1983. This is particularly the case at younger ages (Teasdale and Owen 1984, Wilson 1983). Thus, social treatment will affect a sex comparison even at very young ages and even based on anthropometric measures. Thus, social treatment becomes a confounding factor for biological factors.

Differential treatment across sex groups makes it difficult to understand how social and biological factors interact. Males and females get differential treatment (Lopez Boo and Canon, 2014; Qian, 2008; Barcellos et al. 2014). Differences in social treatment affect language and social development (Wester et al. 2002). For example, caregivers are more likely to drop boys during the first 3 months of life, resulting in a higher rate of head injuries (Greenes et al. 2001). By age 32 months, girls hear twice as many diminutives as boys and hear warmer phrases (Gleason et al. 1994, Feldman, 2009). Moreover, mothers are more likely to respond to a child request with a firm "no" to a male. Yet, mothers are more likely to respond with a less direct answer such as "Why don't you do this instead?" to a girl (Feldman, 2009). What is more, discriminatory treatment may be present even at prenatal stages. For example, selective abortion affects the male-female ratio at birth in some countries in Asia (Qian, 2008; Barcellos et al. 2014).

In addition, biological and environmental interactions are cumulative and dynamic (Wallentin, 2009; Bertrand, 2011, Barbu et al., 2011). Bornstein et al. (2004) tested for language differences in English-speaking, European American families in the United States. Focusing on children 1 to 6 years of age, the authors found girls have an advantage at ages 2 to 5 but not at other ages. At age four, girls express more sadness and anxiety than males (Brody and Hall, 2008). For example, Barbu et al. (2009) found that girls develop cooperative play around the age of 3 and earlier than boys. However, the authors find that by age 6, boys show higher social skills. The authors explored other dimensions. These included unoccupied behavior, solitary play, parallel play and associative play. They found each dimension progresses at differing rates and sex differences are dynamic. A long term study by Wallentin (2009) found that the advantage for woman in language seems to be small and reduced to zero in adulthood.

Another development feature that makes the identification of biological and environmental factors difficult is identity. Individuals adjust their behavior to comply with the norms of the group with which they identify, regardless of skill. This behavior starts around the age of six (Rye, 2011; Wetherell, 1996). It is important to acknowledge the identity effect. Indeed, Akerlof and Kranton (2002) proposed identity as a key driver of behavior. The authors apply their model to explain variation in educational achievement. Basically, once a child is aware of gender social norms, that child will engage in behavior to comply.

Identity differs from an acknowledgement of sex differences. Indeed, children start to enforce gender stereotypes as early as 18 months old (Rye, 2011). However, at this age, children may think that sex is something that can change. It is only around age 5 that children know that their sex is permanent (Rye, 2011). At age 6 children start showing flexibility in stereotypes and start to segregate. But it is until around age 7 that children develop a gender identity which they consider consistent (Rye, 2011). Therefore, at this age, children select behaviors according to gender identity.

In summary, identifying biological from environmental factors is difficult. The difficulty rises due to differential treatment. The brain is plastic. Environmental interactions are cumulative and dynamic. Individuals develop an identity and adapt behavior. Thus a simple comparison across sex groups is the result of both biological and environmental inputs.

3. Data sources

The *Encuesta Longitudinal de la Primera Infancia* (ELPI) survey provides data for Chile. The 2012 survey consists on a second round of data collection of a sample of approximately 18,000 children. Children were randomly selected from the national birth records. The sample size guaranteed it is representative at the national level (Centro de Microdatos, 2010). This study focuses on children 7 to 71 months. As a result, the sample size for Chile is of 12,564 children.

A baseline survey of a large parenting program in Nicaragua provided data for Nicaragua. Data collection took place between July of 2013 and February of 2014. The sample is representative of the households targeted for the parenting programs. The program targeted households living in communities with an Index of Basic Needs of at least 0.20 (*Índice de*

Necesidades Básicas Insatisfechas, NBI). A higher NBI indicates more unsatisfied basic needs (Feres y Mancero, 2001). The elevated cost to collect data in the North and South Autonomous Region resulted on its exclusion from the sample.[5] We focus on children 7 to 71 months. The dataset for Nicaragua consist on 8,400 children.

In Chile, the *Test de Aprendizaje y Desarrollo Infantil* (TADI) assessed child development. In Nicaragua, an amended version of the Denver Developmental Screening Test II (Denver hereafter) did so. Both instruments demand a set of tasks for children to perform during the interview. Trained enumerators score based on observation of child performance. The tasks included in the tests aimed to focus on sex-neutral skills. As a result, manuals make no discrimination by sex for its application or for the interpretation of results (Frankenburg, Dobbs and Archer, 1992; Pardo et al. 2012).[6]

Survey data complements the measurement for children development. The surveys collected information on family traits, parenting behavior and health investments. The surveys collected basic characteristics of household members including age, sex and education.

4. The methodology

We estimate sex gaps by taking the average difference in means between males and females. The main hypothesis is whether males and females differ on average. To do this, we take the distribution of skills in females as the benchmark. We allow the distribution to vary by month of

[5] A comparison of the asset ownership of households in our sample with the EMNV 2009 (Encuesta de Medición de Nivel de Vida, 2009) and ENDESA 2011 (Encuesta Nicaraguense de Demografía y Salud, 2011) show that the households in the sample does not include the poorest households.

[6] We assume that the DENVER II and TADI scores in language and social skills reflect a monotonic underlying scale of development. In other words, we assume that DENVER II and TADI scores will not decrease when an individual increases its skills.

age. Therefore, we standardize scores to the girl's month-of-birth distribution. This standardization allows for removing age variation under the null that both groups develop at equal rates. We explore potential sources for the sex gaps in three steps.

First, we explore if household characteristics explain sex gaps. Indeed, there are studies that show that some households in Asia may choose to have births of a specific sex. For example, boys in India tend to live in larger households resulting from gender stopping rules (Barcellos et al, 2014, Jensen, 2005). We confirm quantitatively this is the case. Therefore, we explore whether the sex balance differs from that in gender neutral countries. We explore if characteristics before the birth of the child can predict sex. We include individual, household, and community characteristics. If these characteristics can predict sex, then differences after children are born can be the result of these and not sex *per se*.

Second, we investigate the explanatory power of household investments on the development of children. This check is important because parents and other members of the society discriminate children from birth based on sex (Smith and Lloyd, 1978; Sroufe et al., 1993; Archey and Lloyd, 2002; Lopez Boo and Canon, 2014). More specifically, we estimate the following equation:

$$z_i = \alpha + \beta M_i + \boldsymbol{\gamma} \boldsymbol{X_i} + \varepsilon_i$$

Where *z* denotes the standardized language or socio-emotional score and *i* denotes an individual. The letter *M* denotes a dicotomical variable for sex with value 1 for males and 0 otherwise. With this specification, the null for no sex differences is $H_o: \beta = 0$. The vector $\boldsymbol{X}$ includes several variables related to early child development. The introduction of these variables as controls allows controlling for observable household characteristics. We classify household characteristics and investments in the following categories:

A. Family traits: Includes an asset index constructed as in Fernald, Gertler and Neufeld (2008), household size, the age of the mother in years, a dummy for whether the mother completed secondary or not, and a dummy for whether both the biological mother and father live in the household at the moment of the observation.

B. Home reported behaviors on stimulation and discipline: Includes a dummy which equals one if parents read to the child, a dummy which equals one if parents tell stories to the child, a second dummy which equals one if the kid was slapped, hit with the hand, or hit with a belt for disciplinary reasons. For Chile, we include an additional dummy which equals one if parents sing to the child.

C. Home observed environment based on HOME scale: Consists of the HOME harsh and HOME cold indexes built upon on the Home Observation for Measurement of the Environment (HOME) scale (Bradley 1993; Caldwell and Bradley 1984). A higher harsh score denotes a more hostile interaction for the child with the caregiver. A higher home cold index denotes a warmer environment for the child. The HOME observations relied on spontaneous behavior observed during the home visit.[7] Information for the home harsh score is not available for Chile. Therefore, home observed behaviors for this country include those of the home cold score. Scores for the home indexes range from 0 to 1. The use of this instrument has aided an assessment of parenting practices in other countries in the region. These include Ecuador, Perú and a group of countries

[7] The home harsh index is composed of the average of the following dummies: a dummy which equals 1 if the caregiver shouts to the child, a dummy which equals 1 if the caregiver expresses hostility towards the child, a dummy which equals 1 if the caregiver beats the child, a dummy which equals 1 if the caregiver scolds the child and a dummy which equals 1 if the caregiver prohibits something to the child. All dummies equal zero otherwise. The home cold index is composed of the average of the following dummies: a dummy which equals 1 if the caregiver expresses affection to the child, a dummy which equals 1 if the caregiver responds verbally in words, a dummy which equals 1 if the caregiver shows or explains something to the child about a thing or a person, a dummy which equals 1 if the caregiver spontaneously talks to the child, a dummy which equals 1 if the caregiver conveys positive sounds to the child, and a dummy which equals 1 if the caregiver hugs or kisses the child.

in the Caribbean (Paxson and Schady 2010, Macours, Schady, and Vakis 2012 and Chang et al., 2015). There is evidence of a strong correlation between the HOME scores and children's mental development in a number of settings (Aboud et al., 2013, Boivin et al., 2013), Hamadani et al., 2010), Tofail and others (2012).

D. Health investment: Includes a dummy which equals one if the child was ever exclusively breastfed during the first 6 months, a dummy which equals one if the child had a complete and up-to-date vaccine schedule, and a dummy for whether the child ate a diversified food or not. A diversified food was defined as the caregiver reporting the child ate food from at least four categories in the last 7 days. Food categories included meat, eggs, rice, cheese, vegetables, legumes and fruits.

In a third step, we analyzed gap variation across specific population groups. These tests allow us to explore if sex gaps coincided with specific environmental conditions. Some studies have used this approach to explore sex differences in school age children in the USA. For example, see Fryer and Levit's paper (2010) on sex differences in mathematics. Bertrand and Pan (2013) used it to explore sex differences in disruptive behavior in the USA.

5. Results

In this section we present the main findings. We discuss how household characteristics and parental investments explain these gaps. Finally, we discuss variation in sex gaps across a number of subpopulations.

5.1 Average sex gaps in language and socio-emotional skills

Girls had a relative advantage both in language and socio-emotional skills. Table 2 shows sex gaps standardized by the girl's month-of-birth distribution. Column (1) shows that in Chile boys scored -0.13 and -0.22 SD relative to girls in the language and socio-emotional dimensions. In Nicaragua, boys scored -0.12 SD and -0.18 SD relative to girls in the language and socio-emotional dimensions. To put these differences in context, we compare to socioeconomic gradients. More specifically, we compare to skill differences between the lowest and highest socioeconomic quantiles. The sex gaps represent between one fifth and one half of the socio-economic gap.[8]

5.1 The role of household characteristics

Families may influence the sex of their children. Indeed, this may be the case in some regions in Asia with practices of gender based stopping rules or selective abortion. (Barcellos et al., 2014, Jensen, 2005). However, evidence does not favor any of these practices in Latin America. Indeed, female ratios at birth in the region are not consistent with sex discriminations before birth (Ueyama, 2007). Table 1 shows the sex ratio at birth in Chile and Nicaragua in column (1). For comparison purposes, the table includes values for the USA and India. The table also includes the sex ratio worldwide. The ratios in Chile and Nicaragua are close to that of the USA and other developed countries. Therefore, these ratios do not favor the idea of sex discrimination before birth.

[8] Another way to contextualize the magnitude of the gaps is to estimate back of the envelope returns. Early childhood education is associated to an improvement of about 0.21 standard deviations in child development (Duncan and Magnuson, 2014). In turn, early childhood education is associated to social returns later in life between 7 and 10 percent per year (Heckman, 2012).

Table 1 in column (2) shows the gender inequality index by the United Nations Development Programme (2015). The index aims to measure gender inequalities in reproductive health, empowerment and economic status. More generally, it aims to measure the human development cost associated to gender gaps. A higher value in the index indicates more disparities and more human development loss. The index is larger for Nicaragua and equal to the worldwide index. Chile has a lower index than the worldwide average. Still, both countries have larger indexes than the USA, but lower than India. Therefore, sex discrimination may be present. However, this discrimination is not as pervasive in adults in these two countries as in some countries in Asia.

Together columns (1) and (2) show some sex discrimination is present both in Chile and Nicaragua. However, it does not seem to influence sex ratios at birth. Column 3 shows p-values for individual, household and community characteristics to predict sex. We reject that observed characteristics predict the sex of children in the two samples. Therefore, we do not find evidence that supports sex discrimination before birth. The table includes the p-value estimated by Barcellos et al. (2014) for India for comparison purposes. In this case, it is clear that children and household characteristics differ across sex groups.

5.2 Parental investments

This section explores the role of discriminatory investments by parents to explain the sex gaps. Table 2 shows gaps in language and socio-emotional skills and how sensible these gaps are to the inclusion of controls. Column (1) shows gaps without controls. Columns (2) to (6) show estimates of gaps introducing controls as indicated in the last five rows of the table.

The gaps vary within 0.005 SD (between -0.131 SD and -0.126 SD) in Chile and 0.018 SD (between -0.119 SD and -0.101) in Nicaragua. The largest variation in point estimates is 12 percent of the gap without controls. More specifically, for language in Nicaragua the change goes from -0.115 to -0.101. This represents a change of -0.014/-0.115 or 12 percent.

The absence of correlation between gaps and investment may be due to no discrimination. To check if this is the case, we tested for discrimination in household characteristics or investments. For the two countries, we found differences in three out of twelve dimensions explored. For example, the percentage of parents that read to their children in Chile was 75 percent for females but 73 percent for males. Harsh punishment was 22 percent for females but 24 percent for males. The percentage of females with all vaccines for their age was 92 percent while it was 91 percent for males. In addition, home scores differed in Nicaragua. The harsh score was 0.04 for females but 0.05 for males. The cold score was 0.70 for females but 0.68 for males. However, we did not find differences in parents telling stories to the child, the home cold score, breastfeeding or diet in Chile. What is more, we did not find differences in reading, telling stories, harsh punishment, breastfeeding, vaccinations, or diet in Nicaragua

Thus, we conclude discrimination was not common. When it was present, it resulted in small differences. The magnitudes of those differences were not large enough to explain the observed gaps. Appendix A shows estimates on differential investments.

5.3 Gaps across subpopulation groups

This section explores how the sex varies across dimensions relevant to development. These dimensions included age, socioeconomic status, and family structure. Overall, we found gaps were not statistically different across the subpopulations we explored. An exception is that of children 24 to 35 months in socio-emotional abilities for Chile.

Table 3 shows gaps according to age. We found that females obtained higher scores for all age groups. We illustrated the results for this table in figures 1 and 2 to ease of exposition. Sex gaps were not statistically different across age groups.

Table 4 shows gaps across socioeconomic quintiles and by family structure. We illustrated the results for this table in figures 1 and 2. We found that sex gaps were not statistically different across quintiles. Table 4 also shows that the sex gap was not statistically different for families with both parents at home or with only one parent at home. Indeed, family structure shapes children behavior (Bertrand and Pan, 2013).

Finally, note the magnitudes of the gaps were very similar for the two countries. Indeed, raw gaps were not statistically different across the two countries (p= 0.713 for language and p=0.136 for socio-emotional).

We conclude that age, socioeconomic status and family structure may have influenced sex gaps, but not in a significant manner. Moreover, cultural and contextual variation between the two countries did not affect the magnitude of the gap.

These results are consistent with other studies. Fenson et al. (1994) found an advantage in language for girls in 1 and 2 year olds of up to 2 percent of the variance. These conclusions are based on a sample of 1,803 children in the USA. However, communicative development was not measured directly. It was rather reported by parents in the MacArthur Communicative Development Inventories. For younger ages, Ericksson et al (2008) found that girls outperform boys in language skills. Their study is based on 13,783 children ages 9 months to 2 and a half years in ten European communities. Their study was based on an adapted version of the MacArthur-Bates Communicative Development Inventories. They also find the sex gap does not change between language communities. The psychological and neurological literature reports an advantage by females on verbal tests and faster language development (Roselli et al., 2014, Burton, Henninger and Hafetz, 2005; Hyde and Linn, 1988).

6. Discussion

The analysis shows differences across sex groups. Indeed, the magnitude is slightly sensitive to asset ownership in the household. However, a rich set of observable environmental characteristics could not explain the gaps. These findings could have alternative explanations. In this section, we explore if measurement error, omitted variables, or differential reporting influenced the analysis.

6.1 Measurement error

The field work in both countries had very rigorous protocols for the administration of the tests. Enumerators were trained. In addition, evaluators selected enumerators based on their experience. All had experience working on psychology or related discipline. Moreover, evaluators conducted pilots to ensure enumerators collected data correctly during the field work. However, it could be the case that tester bias was present during the data collection process. Thus, we tested whether missing data differed across sex groups. Table 5 shows the test for differential share in missing data across sex groups. Column (1) shows the average across females and column (2) the difference of males minus females. We found miss reporting is unlikely to explain results. A second possibility is the sex of the tester biased results. In both cases, the selection of the unit of observation was random. Within a route, a tester could not choose the sex of the child. Thus any unconscious tester bias is likely to add measurement error. For Nicaragua, half of the testers were male and half were female. Thus, bias in tester composition was not systematic. Non-systematic measurement error bias gaps towards zero. In this case, the estimates in the analysis are a lower bound.

6.2 Unobservable explanatory variables

A reason why the sex gaps were not explained by data could be the dimensions observed were not relevant for development. However, the surveys collect data on this dimensions for its role in child development. Indeed, these factors are those that the literature cites as the most relevant for child development (Walker et al., 2011). Therefore, the variables in the analysis are relevant for early child development. An alternative explanation could be that children spent most of their time out of the household. In this case the explanatory power of household investments would decrease. We find that in our sample only 19 percent in Chile and 17 percent of children in Nicaragua attended a daycare center. Moreover, sex composition was not different between those that attended and those that did not (pvalue = 0.847 for Chile, and pvalue = 0.328 for Nicaragua). As a result, differential investments out of the household were unlikely to be a significant source of bias.

Another point to note is that the gap was always around 0.02SD of the point estimate without controls. Indeed, the sex gap varies around 12 percent of the raw gap. If observables and unobservables factors are measured at random, then omitted environmental variables would explain up to 12 percent of the observed gap. Gonzalez and Miguel (2015) propose a consistent gap estimator when the variances of observables and unobservables are not known. Using variation in the estimated gaps with the introduction of family traits, this approach results in gaps of -0.13 SD and -0.23 SD in language and socio-emotional skills in Chile. For Nicaragua, we estimate gaps of -0.12 SD and -0.18 SD. Therefore, this rationale indicates environmental differences explain up to 8 percent of the variation. Indeed, language scores in Nicaragua the varied in (-0.124-0.175)/ -0.175=0.08. The rest of the coefficients result in smaller variations. Thus, this approach indicates unobservables are unlikely to explain the observed gap.

6.3 Differential reporting

A reason why parenting practices did not explain the gaps may be due to parental bias in reports. Indeed, if parents had more than one child, their perception may had been influenced by their behavior towards siblings. Indeed, enumerators collected data for the HOME score at the household level. As a result, it assessed parental attitudes without making reference to a specific child. As a result, the average parental behavior may be weakly correlated to that of a specific child. This could be especially true in households with marked differences in treatment across sex groups. To explore this case, we restricted the sample to households with only one child. Households with one child likely differed from those of households with more children. However, such analysis allows us to isolate potential effects by parental bias in reports. Table 4 shows results. Column (8) shows gaps in households where children had no siblings. The gaps with the restricted sample were not statistically different from those including the full sample as shown by table 2 in column (1).

Another point to add is that gaps held in two countries where the data collection process was independent. We conclude that the data collection process unlikely affected measurement significantly.

7. Conclusions

This study explored the sex gaps in language and socio-emotional skills. It focuses on children 7 to 71 months in Chile and poor communities in Nicaragua. We found females had an advantage relative to males. The average male in Chile scored at -0.22 SD and -0.13 of the socio-emotional and language scores in the distribution of females. Males in Nicaragua scored at -0.18SD and -0.12SD of the socio-emotional and language scores. We explored the role of a set of environmental characteristics to explain sex gaps. However, we did not find evidence of significant household discrimination. In addition, we found the magnitude of the gaps varies up to 12 percent with the introduction of environmental variables as controls. These findings support the idea that a fixed factor net of environmental variation contributed to the gap. However, caution should be taken before making such claim.

This study faced important caveats. The first one is that its focus on early childhood did not allow making a direct link to labor outcomes later in life. Evidence shows sex gaps are dynamic. Thus, more research is necessary to establish if the gaps close later in life or not. In addition, this study observed a limited set of environmental characteristics. One such limitation is that this study relies on samples from only two countries. In addition, both countries used different instruments to measure language and socio-emotional skills. Future work could estimate gaps in more countries and use the same instrument to measure skills. Future work could also explore higher moments of the distribution, including the variance. However, this study contributes to the current debate on the existence of sex gaps. More specifically, this study explored if sex gaps in child development might be related to differential investment levels. It explored the role of variation across two cultures. The analysis is net of identity effects.

The identification of biological and environmental contributors is necessary to inform policy. For example, suppose the main driver of the sex labor gaps is biological. In this case, increasing female labor participation would require policies to address specific needs. A biological predisposition to social stimulus would demand to ensure high-quality care for others. These include children, the elder and the disabled in need. Policies such as flexible work arrangements would improve female labor participation. In addition, educational programs could help. For example, they could make females aware of such difference. Education could enhance female awareness on their potential to contribute to society in male dominated occupations.

On the other hand, suppose the main driver of sex gaps is environmental. In this case, closing sex gaps would require addressing discriminatory environmental conditions. For example, suppose gaps resulted from parental discrimination. Then policies to ensure that families gave equal treatment at the development stage would contribute to close the gap. However, in such case it would remain a question why females do not capitalize on the apparent advantage they enjoy. Indeed, evidence supports that social skills in children predict future social failures and successes (e.g., Beitchman et al., 1996; Elias et al., 1991; Howes, 1987; Perry, Guidubaldi, & Kehle, 1979). Early language skills are predictive of later school performance (Powell and Diamond 2012; Wasik and Newman 2009). Indeed, the ability to communicate well and socialize in adulthood favors education and labor market outcomes (Heckman and Rubinstein 2001; Heckman, Pinto, and Savelyev 2013; Flossmann, Piatek, and Wichert 2006; Bertrand and Pan 2011; Beaudry and Ethan, 2014; Case and Paxson 2008; Currie and Thomas 2001). However, males seem to succeed more in language related fields. For example, a higher share of males publishes in academic journals (Duch et al., 2012; Evans and Bucy, 2010). Thus, such finding would indicate other factors in the labor market may be playing a role to deter females from benefiting. Therefore, more research is necessary to understand how skills and social norms explain choices.

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Table A1. Differences in household characteristics and investments by gender.

	Mean in females (1)	*Chile* *Males - females* *(2)*	*Mean in females* *(3)*	*Nicaragua* *Males - females* *(4)*
Panel A. Family traits				
Asset index	0.044	0.000	-0.084	0.006
		(0.014)		(0.023)
Household size	3.610	-0.018	5.792	-0.043
		(0.020)		(0.053)
Mother age	30.257	-0.192	27.609	0.080
		(0.160)		(0.133)
1 if mother complete secondary school	0.850	0.006	0.287	0.017
		(0.006)		(0.010)*
1 if mother and father both at home	0.841	-0.007	0.653	0.003
		(0.005)		(0.011)
Panel B. Home reported behaviors				
1 if parents read to the child	0.754	-0.023	0.204	-0.008
		(0.009)**		(0.008)
1 if parents tell stories to the child	0.757	-0.004	0.756	-0.009
		(0.008)		(0.009)
1 if any harsh punishment	0.221	0.022	0.499	0.018
		(0.005)***		(0.011)
Panel C. Home observed behaviors				
Home harsh score†			0.037	0.011
				(0.003)***
Home cold score	0.398	-0.007	0.701	-0.023
		(0.006)		(0.008)***
Panel D. Health investments				
1 if the new born was breastfed	0.945	0.004	0.902	-0.007
		(0.004)		(0.006)
1 if complete vaccine	0.923	-0.011	0.547	0.002
		(0.006)*		(0.010)
1 if diversified food	0.796	0.013	0.428	0.001
		(0.009)		(0.011)

Note: Standard errors clustered at the locality level in parenthesis. *, **, *** indicate that the estimates coefficient is significantly statistically different from zero at the 0.10, 0.05 and 0.01 level, respectively.
†A complete set of home observations for the home harsh score is only available for children the subset of children 0 to 36 months old in Chile.
Source: Authors'calculations.

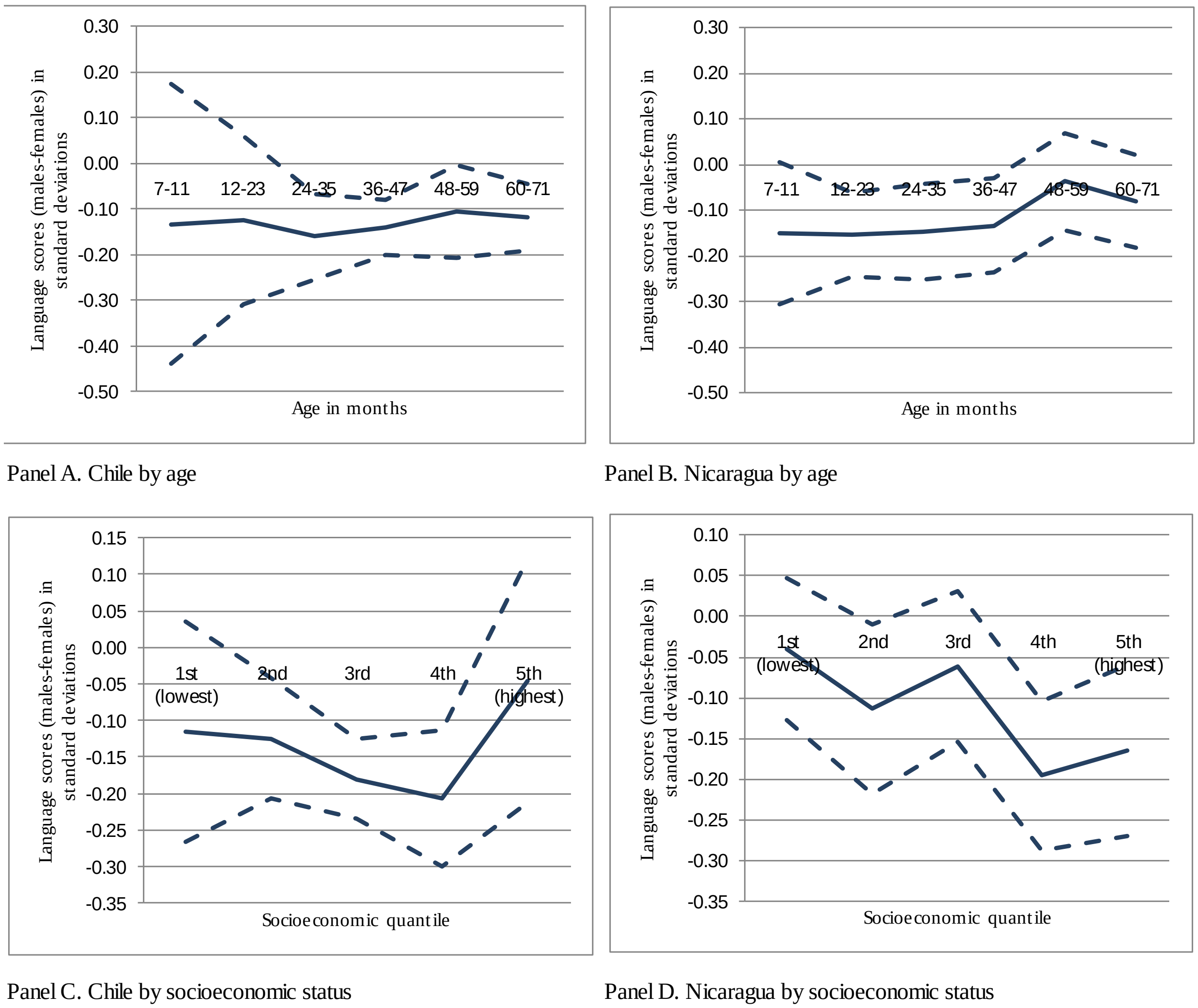
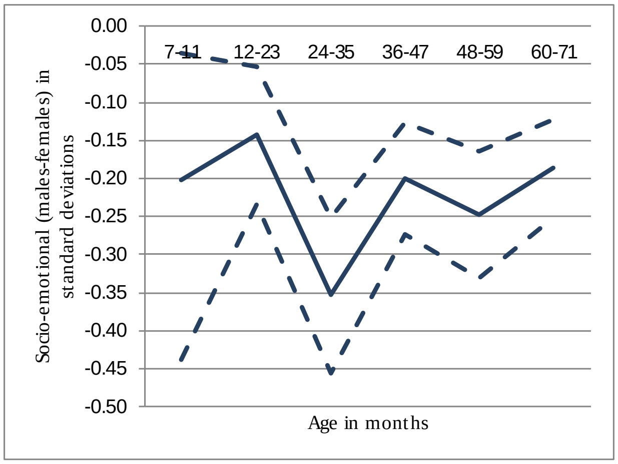
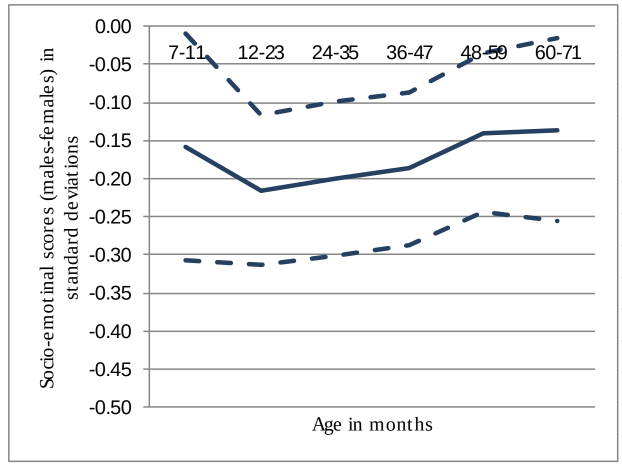


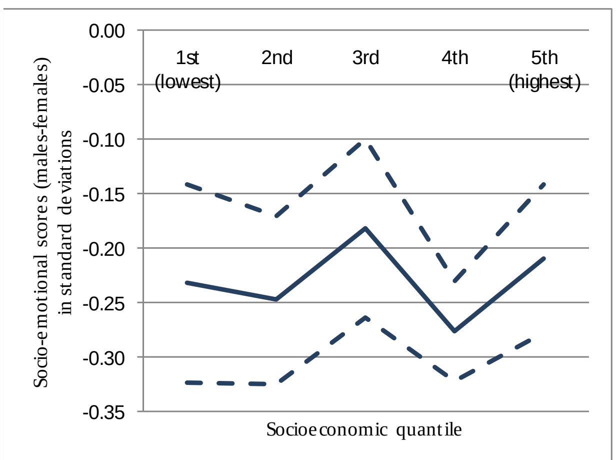
Figure 1. Standardized language gaps (males-females). The solid line indicates the average gap. The dashed lines indicate 95 percent confidence intervals.
Source: Authors' calculations.



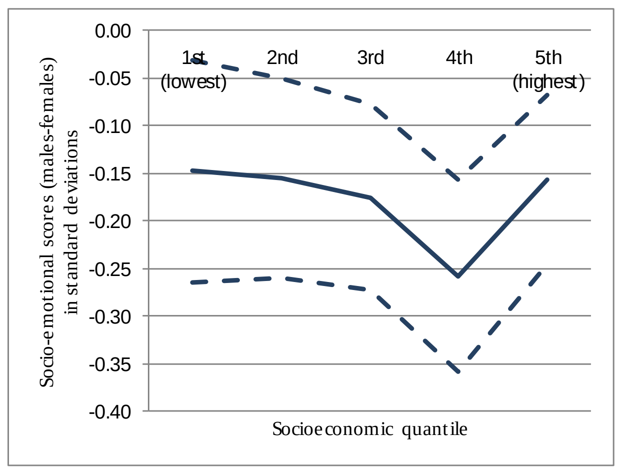
Panel A. Chile by age



Panel B. Nicaragua by age



Panel C. Chile by socioeconomic status



Panel D. Nicaragua by socioeconomic status

Figure 2. Standardized socio-emotional skill gaps (males-females). The solid line indicates the average gap. The dashed lines indicate 95 percent confidence intervals.
Source: Authors' calculations.

Table 1. The relationship between household composition and sex

	Sex ratio at birth (male/female)	Gender inequality index	Power of individual, household and community characteristics on birth of a male (p-value for joint test)
	(1)	(2)	(3)
Chile	1.04	0.338	0.505
Nicaragua	1.05	0.449	0.843
India	1.12	0.563	0.050
USA	1.05	0.280	
World wide	1.07	0.449	

Source: Authors' compilation based on sex ratio at birth (column 1) by CIA, the world fact book, https://www.cia.gov/library/publications/the-world-factbook/fields/2018.html as in 01/28/2016. Gender index inequality (column 2) by United Nations Development Programme (2015). Power of household characteristics to predict sex (column 3) by authors for Chile and Nicaragua and by Barcellos et al. (2014) for India.

Table 2. Estimated gender gaps (males-females)

	Simple differences	Family traits	Home reported	Home observed†	Health investment
	(1)	(2)	(3)	(4)	(5)
Chile					
Language	-0.129	-0.131	-0.126	-0.129	-0.131
	(0.032)***	(0.034)***	(0.033)***	(0.032)***	(0.032)***
Socio-emotional	-0.224	-0.225	-0.221	-0.224	-0.225
	(0.018)***	(0.020)***	(0.018)***	(0.018)***	(0.018)***
Observations			12,564		
Nicaragua					
Language	-0.115	-0.119	-0.110	-0.101	-0.116
	(0.023)***	(0.023)***	(0.023)***	(0.023)***	(0.023)***
Socio-emotional	-0.175	-0.179	-0.171	-0.165	-0.176
	(0.025)***	(0.025)***	(0.024)***	(0.025)***	(0.025)***
Observations			8,400		
Controls for family traits	no	yes	no	no	no
Controls for home reported	no	no	yes	no	no
Controls for home observed†	no	no	no	yes	no
Controls for health investment	no	no	no	no	yes

Notes: Standard errors clustered at the locality level in parenthesis. *** indicates that the estimates coefficient is significantly statistically different from zero at 0.01 level.

† Gaps estimated with home observed controls include controls for home cold score for Chile and home harsh and home cold scores for Nicaragua. Data to construct the home cold scores in Chile is not available.

Source: Authors' calculations.

Table 3. Sex gaps by age groups (males-females)

	7-11 months	12-23 months	24-35 months	36-47 months	48-59 months	60-71 months	All (7-71 months)
Chile							
Language	-0.13	-0.13	-0.16	-0.14	-0.11	-0.12	-0.13
	(0.14)	(0.09)	(0.04)***	(0.03)***	(0.05)**	(0.03)***	(0.03)***
Socio-emotional	-0.20	-0.14	-0.35	-0.20	-0.25	-0.19	-0.23
	(0.08)**	(0.04)***	(0.05)***	(0.03)***	(0.04)***	(0.03)***	(0.02)***
Observations	306	1183	1406	3326	3212	3131	12564
Nicaragua							
Language	-0.15	-0.15	-0.15	-0.13	-0.04	-0.08	-0.11
	(0.08)*	(0.05)***	(0.05)***	(0.05)**	(0.05)	(0.05)	(0.02)***
Socio-emotional	-0.16	-0.22	-0.20	-0.19	-0.14	-0.14	-0.18
	(0.08)**	(0.05)***	(0.05)***	(0.05)***	(0.05)***	(0.06)**	(0.02)***
Observations	737	1647	1486	1558	1499	1473	8400

Notes: Standard errors in parenthesis.
Source: Authors' calculations.

Table 4. Sex gaps by socioeconomic quantile and family structure (male-female).

	Socioeconomic quantile					Family structure		
	1st (lowest) (1)	2nd (2)	3rd (3)	4th (4)	5th (highest) (5)	Both parents at home (6)	One of the parents not at home (7)	Single child (8)
Panel A. Chile								
Language	-0.12	-0.13	-0.18	-0.21	-0.05	-0.116	-0.131	-0.179
	(0.07)	(0.04)***	(0.03)***	(0.04)***	(0.08)	(0.027)***	(0.041)***	(0.053)***
Socio-emotional	-0.23	-0.25	-0.18	-0.28	-0.21	-0.279	-0.213	-0.265
	(0.04)***	(0.04)***	(0.04)***	(0.02)***	(0.03)***	(0.033)***	(0.023)***	(0.032)***
Observations	2,562	2,497	2,520	2,496	2,489	10,455	2,109	5,078
Panel B. Nicaragua								
Language	-0.04	-0.11	-0.06	-0.20	-0.17	-0.107	-0.119	-0.120
	(0.04)	(0.05)**	(0.05)	(0.05)***	(0.05)***	(0.038)***	(0.029)***	(0.027)***
Socio-emotional	-0.15	-0.15	-0.18	-0.26	-0.16	-0.178	-0.174	-0.177
	(0.06)**	(0.05)***	(0.05)***	(0.05)***	(0.04)***	(0.042)***	(0.030)***	(0.032)***
Observations	1,702	1,743	1,612	1,671	1,672	5,394	3,006	5,076

Notes: Standard errors in parenthesis. **, *** indicates that the estimates coefficient is significantly statistically different from zero at the 0.05 and 0.01 level respectively.
Source: Authors' calculations.

Table 5. Miss-reporting across sex groups.

	Chile				*Nicaragua*			
	Males	Females	Difference	p-value	Males	Females	Difference	p-value
Language	0.015	0.015	0.000	0.521				
	(0.002)	(0.002)	(0.005)					
Socio-emotional	0.014	0.015	-0.001	0.773				
	(0.001)	(0.002)	(0.008)					
Family traits	0.013	0.012	0.001	0.647	0.163	0.153	0.004	0.650
	(0.001)	(0.001)	(0.005)		(0.006)	(0.006)	(0.008)	
Home reported	0.000	0.002	-0.001	0.114	0.001	0.002	-0.001	0.173
	(0.0002)	(0.001)	(0.001)		(0.001)	(0.001)	(0.001)	
Home observed	0.008	0.011	-0.003	0.782	0.008	0.009	-0.002	0.307
	(0.001)	(0.001)	(0.009)		(0.001)	(0.001)	(0.002)	
Health investment	0.001	0.000	0.001	0.535	0.124	0.113	0.007	0.295
	(0.0004)	(0.0002)	(0.001)		(0.005)	(0.005)	(0.007)	
Observations	6,385	6,179			4,247	4,153		

Notes: Standard errors clustered at the locality level in parenthesis. There was no missing information for language or socio-emotional in the Nicaragua sample.
Source: Authors' calculations.