Chapter 5
Parental Appraisal of the Vocabulary of Mexican Infants from Families of Different Socioeconomic Status

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Introduction

The presence of individual differences in the study of development is undeniable, family context and socioeconomic status (SES) being the most notable variables in which this can be observed. In studies on vocabulary development, it is known that preschoolers from lower SES families performed significantly lower than preschoolers from higher SES families on different language components, and that children whose primary caregivers had only a few years of education showed the lowest scores on those components. It has been specifically found that when the mother's level of schooling is lower than high school, the infant shows a set of effects such as reduced expressive language, social and behavioral problems, deficits in social interaction, and delays in reading skills, among other difficulties (e.g., Pace et al., 2017).

Results showing that SES differences in verbal abilities are evident in the preschool years suggest that these disparities might begin to develop in the first years of life, setting children on particular trajectories with far-reaching consequences for later academic success. Until recently, measures available for assessing language and cognitive proficiency in children younger than 3 years have not been high in predictive validity, limiting their effectiveness in linking characteristics in infancy to long-term outcomes. The aim of this work was to establish criteria for parental estimation of language development in 1302 infants from 12 to 30 months of age, living in Mexico City, using the Inventory of Understanding and Production of Language in Mexican Infants (ICPLIM; *Mexican Infants' Language Comprehension and Production Inventory*). Variables of age and gender of the infant and

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educational level of the mother were considered, as well as comprehension and word production measures. In addition to revealing the convergent and content validity of the ICPLIM, the main results showed an effect of the mother's educational level on the estimated vocabulary of the infants, specifically among the levels of higher education (Bachelor's degree) compared with the basic education groups (less than 9 years of education). Results are offered as a tool for the study of language acquisition in Mexican infants from different SES contexts and are discussed within the framework of individual differences considering international research with Spanish- and English-speaking infants.

Influential Factors in Language Development: The Role of Individual Differences

Language ability in early childhood is among the best predictors of school readiness and later school success, as well as most critical developmental milestones (Gambi et al., 2020; Hoff, 2009; Madigan et al., 2019; Pace et al., 2017, 2019). This fact becomes significant because most of the social exchanges in which the infant participates constitute a relevant background of the language acquisition process. One of the infant's first and most significant social experiences comes from interactions that occur in parenting situations involving mother and child, where eye contact during breastfeeding begins to increase, which will subsequently lead to speech shifts (Arias-Trejo & Hernández, 2007; Teepe et al., 2017).

Understanding the form and function of individual differences can be important across many research traditions as it helps to determine the reach as well as the predictive value of developmental science. Indeed, "a clear understanding of when, where, and for whom, mechanisms of interest are at play in development is a core feature, necessary to our discipline's social utility" (Pérez-Edgar et al., 2020). In their work, Madigan et al. (2019) highlight the importance of mother–child interaction behaviors. Through a meta-analysis, the author found that infants whose caregivers showed high levels of responsiveness and sensitivity had stronger language skills than infants who received lower levels of such behavior. At this level of analysis, responsive parenting can encourage children to have greater social interactions that in turn, favor language. In general, it has been described that children (both English and Spanish learners) of responsive mothers are more motivated, exploratory, and enthusiastic in seeking new information than children whose mothers exhibit less responsive behaviors (Guerrero & Alva, 2015; Madigan et al., 2019).

As Kidd et al. (2018) mentions, the presence of individual differences in the study of development is undeniable; however, there are some experimental methods that, owing to the nature of the measurements used, may underestimate their importance. Such is the case of Intermodal Preferential Looking Paradigms (Alva, 2007; Fernald et al., 2006; Golinkoff et al., 1987, 2013; Kidd et al., 2018), which, although they are very useful systematic procedures for the study of language acquisition and language development at an early age, have the disadvantage of being unreliable

when few trials are available for the analysis of visual reaction times, which is a known measure of linguistic processing (Egger et al., 2020). On the other hand, this methodological perspective has the potential to clarify theoretical controversies, specifically in research whose measurements infer language processing (Donnelly & Kidd, 2020; Kidd et al., 2018; Leite et al., 2007).

Predictions between information processing and vocabulary were strongly established during the first decade of the twenty-first century, in part, thanks to the use of the aforementioned preferential attention paradigms (Fernald et al., 2001, 2006, 2008; Gambi et al., 2020; Golinkoff et al., 2013). In recent years, research has replicated some of the findings from the beginning of the century, in both English and Spanish learners (Alva & Suárez, 2017; Kidd et al., 2018; Suárez, 2015), as well as helping to understand how differences arise in the general linguistic ability of young children (Mahr & Edwards, 2018). One of the first studies to longitudinally analyze processing speed (measured as visual reaction time) and vocabulary of English-speaking infants aged 18 and 21 months was that by Fernald et al. (2001). In their study, the authors found that at both ages the infants who presented fewer errors and shorter reaction times had more than 100 words in their vocabulary reported by their parents, and that infants with fewer than 60 words in their vocabulary had the longest reaction times and the highest number of errors on the experimental task. Subsequently, Fernald et al. (2006) showed that 25-month-old infants with short reaction times and fewer errors in a word recognition task had a higher vocabulary reported by their caregiver; in contrast to infants with longer reaction times and more errors, who had a lower vocabulary according to their parental report.

In another study, Donnelly and Kidd (2020) showed some evidence of a causal effect of lexical processing, measured with the *Looking while listening* paradigm proposed by Fernald et al. (2008), on the vocabulary size of infants aged 18–24 months (Donnelly & Kidd, 2020). Although the study did not replicate findings regarding the strength and direction of the relationship between variables, the importance that lexical processing is stable in childhood and can help to understand lexical development in later ages was highlighted in other works (Alva & Suárez, 2017; Donnelly & Kidd, 2020; Egger et al., 2020; Gambi et al., 2020; Pace et al., 2019). Likewise, it has been shown that making methodological modifications to the original paradigm helps to solve the implicit disadvantages in said settings (Egger et al., 2020; Golinkoff et al., 2013).

The aforementioned studies have contributed and described the performance of infants who are mostly English learners; however, there is recent evidence that describes these types of skills and the relationships between variables with Spanish learners. For example, Suárez et al. (2015) conducted a study to determine whether processing speed (reaction time) of Mexican babies aged 10 months could be a predictor of communication skills such as productive vocabulary, in the same babies at later ages. Through a Word learning task in an Intermodal Preferential Looking Paradigm, the authors found that reaction time measured at 10 months of age can be used as a predictor of performance in vocabulary measures in the same infants a year and a half later. The results presented in this study imply that infants who take longer to process a novel object associated with a novel word are those who will

have more words in their productive vocabulary during the second year of life, as reported by parents. The results obtained support the study of processing speed at early ages in tasks that measure cognitive abilities other than word recognition. Furthermore, the study by Suárez et al. (2015) suggests taking into account the analysis of individual differences, either processing speed or vocabulary, to better understand the relationship between these two variables in the first years of life, emphasizing the importance of the study of processing speed across different linguistic abilities in infants.

Likewise, in a follow-up to the findings with Mexican infants, Alva and Suárez (2017) analyzed the individual differences in processing speed in the first year of life. Using the same paradigm of preferential attention as Suárez et al. (2015), they obtained the reaction time in a word learning task, in addition to the vocabulary score through the MacArthur Inventory (CDI-I). The authors found that infants who scored above the 75th percentile on the comprehension subscale of the test were 11% faster in the word learning task than their peers below the 25th percentile. Overall, these results supported the importance of information processing and vocabulary, from the perspective of individual differences.

Socioeconomic Status

Among the most notable individual differences in language acquisition are an infant's gender and family context, the latter including SES (Madigan et al., 2019; Montanari et al., 2020; Pérez-Edgar et al., 2020; Teepe et al., 2017). Regarding gender, it is known that girls have more advanced vocabulary development than boys, and sometimes demonstrate word-learning techniques that boys of the same age do not show. In this sense, girls mature faster, and the area of their brain devoted to language specializes sooner, giving them some advantage over boys. Significant early effects of gender have also been found in studies combining parental-report procedures with other, experimenter-controlled, methods (e.g., Bornstein et al., 2004); however, it is worth noting that in their study of 329 children age from 1 to 6 years, Bornstein and colleagues found that the female advantage disappears during the 6th year (Bornstein et al., 2004).

The idea that there is an advantage of girls over boys in terms of their verbal and linguistic abilities arises from some classical developmental studies (Neprash & Anastasi, 1938; Tyler, 1965) and has been maintained to the present day, despite the existence of few systematic investigations that confirm these differences (Bornstein et al., 2004; Wallentin, 2009). In industrialized countries such as the USA, differences in linguistic abilities are more related to income disparities, years of education of one or both parents, private/public education, health care outcomes, high school graduation rates, geographical area of residence, job placement, and many more life milestones (Golinkoff et al., 2019; Levine et al., 2018). It is worth mentioning that mechanisms in which these factors operate are diverse and variable in

their potential impact because they describe multiple possible interactions between them (Bradley & Corwyn, 2002; Fenson et al., 1994).

As mentioned by Hart and Risley in their famous 1995 study, SES is a factor that influences vocabulary performance measures regardless of other variables (such as race) and in the previously mentioned work, the authors described for the first time a "vocabulary gap" of more than 3000 words between high and low SES children. Hart and Risley's study (1995) was pioneering in numerous findings on differences in early vocabulary development. Their postulates about the importance of SES for lexical development have been replicated in subsequent investigations, and its crucial role in child development continues to be analyzed (Dollaghan et al., 1999; Golinkoff et al., 2019; Montanari et al., 2020). Evidence suggests that income level in neighborhoods is also associated with the academic performance of preschoolers. Results have shown that household income levels at the ages of 4 and 5 are associated with verbal and academic performance in preschool education; that the effects of poverty are nonlinear (more accentuated at the lower limit of the income variable continuum); and that the effects of income from the geographical area of residence are less than the effects of household income, the level of education of parents or maternal marital status (Fenson et al., 1994). In a longitudinal study with Mexican infants, Castro and Alva (2003) found that the early advantage of upper-class infants allows them to stabilize smoothly between the ages of 5 and 8, and lower-class infants recover from the initial disadvantage until they reach their peers at age 8. However, the authors found that between the ages of 9 and 11, upper-class schoolchildren increase the advantage over their lower-class peers unattainably (Castro & Alva, 2003).

In studies on vocabulary development, it is known that preschoolers from lower SES families performed significantly worse than preschoolers from higher SES families on three language components, vocabulary, syntax, and language-learning processes, and that children whose primary caregivers had less than a high school diploma, showed the lowest scores on all these three components (Dollaghan et al., 1999; Horton-Ikard & Weismer, 2007; Levine et al., 2018; Pace et al., 2017). At the beginning of development, the differences in terms of SES are very small but they increase as children grow. Research in recent decades has focused on understanding the extent to which family SES relates to American parents' language input to their children and, subsequently, children's language learning (Schwab & Lew-Williams, 2016; Shavlik et al., 2020). Studies like those by Hoff (2013) and Chen' and colleagues (2018) showed that there is an indirect effect of SES on reading ability through the parent–child relationship, and remarks on the importance of building a better family atmosphere. In studies with Latin participants, García and Vargas (2008) made a comparison in the extension of narrative vocabulary by educational institution and by gender in Mexican children in the third year of primary school. They found that in the narrative vocabulary, derived from written texts, it was the upper-class participants who had a larger vocabulary than lower-class participants, especially boys. However, lower-class subjects showed no gender differences.

Thanks to previous literature, we now know that joint reading activities can be very beneficial for vocabulary development in infants. Studies carried out by Suárez,

Valdés, and colleagues (Alva et al., 2016; Suárez et al., 2016a, b; Valdés, 2015; Valdés et al., 2015a, b, 2017) that assess mother–child interactions in Mexican families from middle SES have shown a positive and direct relationship between the caregiver's vocabulary and the lexical repertoire of their children. This relationship was reported to be stronger at early ages (30–42 months) and starts to diminish after 48 months of age (Ferreira et al., 2016).

Derived from the studies mentioned above, we can infer that a more enriched environment that includes dyadic interaction, as well as having a privileged SES, can reduce the effects on the linguistic domains of children in stages of acquisition of this cognitive process (Alva, 2020; Mendive et al., 2017; Price & Kalil, 2018). Also, it has been revealed that the impact of SES can be minimized by the involvement of children in school programs (Madya et al., 2019), as well as dyadic activities with their caregivers (Guerrero & Alva, 2015; Suárez et al., 2016a).

Although it is widely accepted that childhood SES correlates with language ability and subsequent academic achievement (Bojczyk et al., 2016; Chen et al., 2018; Fernald et al., 2008; Golinkoff et al., 2019; Madya et al., 2019; Montanari et al., 2020; Pace et al., 2019; Rose et al., 2011; Strouse & Ganea, 2017), much less is known about the pathways by which SES exerts its well-established influence (Pace et al., 2019). On the contrary, we do know that poverty has a greater impact when it is long term in the family and is associated with the mother's low level of education (Bradley & Corwyn, 2002; Cadime et al., 2018; Chaparro et al., 2016; Gonzalez et al., 2017; Mendive et al., 2017; Montanari et al., 2020).

Maternal Education

Maternal education (usually measured as a categorical variable representing groups of various levels of formal schooling, ranging from no high school education or limited high school education to high school education, some college, or an earned college degree) appears to be the component of SES most strongly related to child development outcomes (Pace et al., 2017; Teepe et al., 2017). It has been specifically found that when the mother's level of schooling is lower than high school, the infant shows a set of effects such as reduced expressive language, social and behavioral problems, deficits in social interaction, delays in reading skills (when they begin to develop), and even mental retardation (Cadime et al., 2018; Campbell et al., 2003; Friend et al., 2017; Gonzalez et al., 2017; Iwaniec, 2020; Montanari et al., 2020).

In contrast, there are some studies that report that the father's educational level (more than that of the mother) influences the vocabulary of infants. Zvara and Schoppe-Sullivan (2010) mention that when the father has a higher level of education than high school, children benefit in terms of cognitive development, whether or not they had low birth weight problems (Zvara & Schoppe-Sullivan, 2010). Also, in studies with Spanish learners from Latin countries such as Mexico, this has been observed in infants whose fathers completed a college degree (more than 16 years

of study) compared with infants of fathers with less than 9 years of study, even if the father doesn't live in the same house with the child and his/her mother (Alva, 2004). A consequence of children's limited language and/or limited interest or engagement in reciprocal exchanges with a parent is that parents may find fewer opportunities to engage in sensitive/responsive parenting (Guerrero & Alva, 2015; Madigan et al., 2019). This leads us to a similar problem when parents are asked to respond to parental reports. Because caregivers need to recall those situations in which their children comprehend or produce a specific word, frequently they tend to underestimate or overestimate the size of the infants' vocabulary, and trying to please the experimenter enhances the bias.

Parental Reports

An area where marked differences have been observed according to parents' education and SES, is the estimation of the infants' lexicon. As mentioned above, it is a fact that there is a tendency to overestimate or underestimate infant's vocabulary according to parent schooling (Alva, 2004; Fenson et al., 1994; Roberts et al., 1999). According to Reznick and Goldsmith (1989), parents with a lower level of education give significantly higher vocabulary scores to their children learning English in comprehension tests than more highly educated parents. On the contrary, Alva (2007) showed that in Mexican families, parents with a high level of education reported a larger vocabulary from their children than parents with fewer years of study.

Parental reports are widely used in language acquisition and language development research. These instruments are defined as a useful tool for measuring vocabulary through daily estimates that parents make of the words their children comprehend and produce (Fenson et al., 2000). In order to be able to answer such instruments, specific behaviors exhibited by the child need to be recognized; thus, parents are invited to reflect and learn about their children's language in detail (DeMayo et al., 2021), allowing the evaluation of infants in different contexts without requiring their active participation.

It should be noted that this type of instrument presents a wide variability in the production and comprehension scores, as well as providing comprehensive and representative assessments of children's language skills that could hardly be obtained in the clinical or experimental setting. One of the advantages of parental reports is that their administration and scoring are not high-cost in terms of time and money; thus, their use is quite attractive for those studies in which it is intended to study a large sample and individual evaluations would be expensive (Giammarco, 2020). However, despite all the advantages of parental reports, such instruments fail to detect identifiable linguistic development patterns and estimate neither the effects of contextual variables such as the socioeconomic level nor the ethnographic group to which the infant belongs.

The most prominent parental report used in the study of verbal skills is the Communicative Development Inventory, known as MacArthur CDI (DeMayo et al., 2021; Fenson et al., 1994, 2000; Saeed, 2019; Wallentin, 2009). The various investigations carried out with these parental reports have found high correlations between the scores obtained from CDI's and the measures derived from audiovisual recordings or experimental observations (Moore et al., 2019; Styles & Plunkett, 2009; Suárez, 2015); therefore, some authors (Mariscal et al., 2007; Suárez et al., 2015) deduced that parents are reliable informants of their children's communicative development (DeMayo et al., 2021) when they are under the age of 3 years.

However, despite the various applications and standardizations, Fenson et al. (2000) acknowledge that the CDI has some limitations that may be due not only to the instrument but also to the intrinsic properties of the phenomenon studied, in particular to the great variability that occurred in the production of vocabulary up to 30 months of life, which arises as a result of the "vocabulary spurt" that occurs between 18 and 30 months of age in English learners (Bloom, 2001; Hollich et al., 2000) and from 23 to 36 months in Spanish learners (Alva & Hernández-Padilla, 2001a, b).

Research Data on Parental Estimation of Mexican Infants' Vocabulary

Among the various adaptations that were made of the CDI is the one adapted and used in the Baby Lab from the Faculty of Psychology (UNAM) in Mexico City. This version was originally called Inventory on the Production of Language in Mexican Infants (Inventario de Producción de Lenguaje en Infantes Mexicanos, IPLIM) (Alva & Hernández-Padilla, 2001b), later becoming the Inventory of Comprehension and Production of Language in Mexican Infants (Inventario de Comprensión y Producción de Lenguaje en Infantes Mexicanos, ICPLIM; Alva et al., 2013).

Each of the items that formed the ICPLIM correspond to words considered to be frequently used in the vocabulary of Mexican infants. The ICPLIM consists of a vocabulary list of 560 items in which the parents or caregivers indicate which words the child comprehends and produce. This vocabulary list is divided into 19 semantic categories: *animals*; *toys*; *food*; *games and routines*; *vehicles*; *body*; *clothes*; *prepositions and locations*; *household items*; *exterior*; *quantifiers*; *furniture*; *people*; *pronouns and articles*; *descriptive words*; *onomatopoeia*; *time*; *words of action*; and *interrogative words*. Also included in the ICPLIM are verbs, pronouns, and the most relevant descriptive words of the Mexican lexicon, as well as offering the option for participants to report extra words.

Several authors have had an interest in studying verbal comprehension, as they consider that this gives a more accurate picture of the content of the infant's language system (Fernald et al., 2006; Hadley et al., 2016; Hurtado et al., 2007; Patrucco-Nanchen et al., 2019). In addition, studies on language understanding allow evaluation of a wide range of syntactic knowledge that is not produced,

assuming that when children produce a word it is because they have usually already understood it (Golinkoff et al., 1987; Karmiloff & Karmiloff-Smith, 2001; Styles & Plunkett, 2009). Specifically, the term comprehension refers to the situation in which parents assume that the infant identifies or recognizes a particular word, object, or action (even if it is not present). The term production includes in addition to the above that the infant is able to emit the word spontaneously in any context (even if he does not pronounce it correctly). ICPLIM is an instrument that is presented to Mexican parents for the purpose of knowing their child's language skills in their early years of life, essentially those based on the elements of verbal comprehension and production.

The ICPLIM has been used in numerous research works since its first versions. Vocabulary scores reported by parents through this instrument were used in many important studies, such as that performed by Naves et al. (2007), where the percentage of comprehended and produced words of children aged 18, 24, and 30 months was analyzed, finding an increase in vocabulary in relation to age. Similarly, Suárez et al. (2010) conducted a study comparing the effectiveness of two methods, one being direct observation in natural scenarios or environments and the other that of parental reports, in which it was found that both yielded similar results in terms of the acquisition and development of language in infants aged 12–30 months, using the ICPLIM as the parental report, which concluded that both methods have the same level of reliability.

According to Jackson-Maldonado et al. (2003), content validity is defined as the degree to which the content of the scale records the one the researcher wishes to evaluate. It is determined by assessing whether the components relate to the skills that the instrument is designed to measure (Jackson-Maldonado et al., 2003). This kind of validity of the ICPLIM is based on the fact that it contains a sample of the main characteristics of communicative development over the age range from 12 and up to 30 months. In addition to the words included in each category, they were taken from published studies of Spanish-speaking journals, doctoral thesis databases, unpublished Spanish language data, comparable elements in Spanish-speaking language tests, and extra words reported by parents.

The additional evidence of validity lies in the fact that the development functions obtained through the various categories correspond closely to the development functions that have been mentioned for the same variables in observational studies. Close parallelism between data obtained with inventories and development patterns reported in specialized literature is considered to be extremely important evidence for convergent validity (Jackson-Maldonado et al., 2003; Suárez et al., 2010).

Present Study

Taking into account previous literature with Mexican infants, and in order to contribute to the study of vocabulary development within families from different SES, the aim of this study was to establish criteria for estimating the development of

language in Mexican infants from 12 to 30 months of age through the ICPLIM. The variables of interest considered in this study were: the educational level of parents and the age, gender, and number of words comprehended and produced by infants (reported by their caregivers). The age was recorded in months and days of infants at 12, 18, 24, and 30 months. As for the educational level of the mother, it was distributed among four levels recognized by the Mexican education system: basic (<9 years of education), high school (between 9 and 12 years), college education (between 12 and 16 years), and postgraduate (>16 years). Word comprehension corresponds to the number of words the child reacts to when listening to or seeing them represented in a physical stimulus. In turn, the production of words concerns the number of words that the child emits spontaneously, differentiating them from those he is able to imitate.

In the present study, inclusion and exclusion criteria were used for both infants and caregivers. For children, the inclusion criteria were infants born to term and Spanish as their first and only language. For caregivers the inclusion criterion was to be a native Spanish-speaking parent. The exclusion criteria were those infants with high-risk prenatal and genetic diseases that were potential producers of brain damage, perinatal problems, as well as hearing and vision problems reported by parents.

The final sample consisted of 1302 infants: 62 infants aged 12 months (34 boys/28 girls), 263 infants aged 18 months (134 boys/129 girls), 541 infants (278 boys/263 girls) aged 24 months, and 436 infants (244 boys/192 girls) aged 30 months, without perinatal problems, neither hearing nor vision problems, born to term, whose mother language is Spanish.

The invitation to participate in the study was made through dissemination such as brochures and posters in the public transport of Mexico City, as well as advertisements in the gazette of the university where the research was carried out. After such dissemination, interested parents phoned and provided their contact details and shared general data on their children, as well as verbally expressing their interest in collaborating in the study. Parents were subsequently contacted when their baby was the age required for the age groups of interest and an appointment was made. The meeting took place at the facilities of the Baby Lab; each of the caregivers along with their child were attended by a laboratory collaborator, who provided general instructions for answering the inventory themselves and responded to the questions that arose in order to obtain proper completion of the ICPLIM.

For data collection, the sociodemographic questionnaire (Alva & Arboleda, 1990) was used to obtain general information from the participants and subsequently the ICPLIM was applied to each of the participating parents, asking them to answer: whether their child already knew each of the words grouped into categories and that if in addition, he/she also produced it. After the collection of the data, all the words contained in the inventory were captured and codified to obtain the total number of words comprehended and produced by category. Finally, the corresponding analyses of the variables of interest were carried out, calculating quartiles of the vocabulary scores arranged by the variables: age, gender and mothers' years of

education. Table 5.1 shows the average and standard deviation of the words reported by caregivers as comprehended and produced by their children in the four age groups, differentiated by gender.

A variance analysis was performed to determine the effect of age on the total score of the Comprehension and Production measures, which was statistically significant: Comprehension (F = 41.60, 3, p = 0.000); Production (F = 241.54, 3, p = 0.000). For Comprehension, Bonferroni's post hoc test showed that there were differences between age groups, with the exception of the 18- and 24-month groups (p = 0.284), where no significant difference was found. On the other hand, for Production, the differences between age groups were statistically significant at all ages, with the exception of the comparison between the groups of 12 and 18 months of age, where no statistically significant differences were found (p = 0.065).

As for gender, Student's t tests were performed and showed that there were no statistically significant differences between groups of girls and boys for Comprehension at any of the ages studied: 12 months (t = −0.325, 60, p = 0.74); 18 months (t = −0.292, 261, p = 0.771); 24 months (t = 1.03, 538, p = 0.30); and 30 months (t = 1.38, 434, p = 0.16). For 12- and 18-month-old girls more comprehended words were reported than for boys. On the contrary, for 24- and 30-month-old boys more words were reported than for girls. As for the Production measure, differences were found by gender in two of the four age groups analyzed (24 and 30 months): 12 months (t = −0.158, 60, p = 0.875); 18 months (t = −1.885, 261, p = 0.061); 24 months (t = 3.79, 538, p = 0.000); and 30 months (t = 2.87, 434, p = 0.004). In all cases, the infants' word production reported by the parents was higher for girls than for boys.

As for the mother's educational level, variance analyses were performed to determine differences in Comprehension and Production between age groups. The results showed that, for Comprehension, there were no differences in the mother's schooling in 12 months (F = 0.629, 3, p = 0.599), 18 months (F = 0.221, 3, p = 0.882), or 24 months (F = 0.302, 3, p = 0.824), but statistically significant differences were found at 30 months of age (F = 7.2, 3, p = 0.000). Bonferroni's post hoc test showed that there were differences in this age group between basic education (<9 years of study) and the other three schooling groups. Estimates of mothers with basic education were higher than estimates of mothers with more than 9 years of study. However, these findings should be taken with caution because it can be explained by an effect of the instrument instructions given to caregivers. This means that when a word from the list is marked as produced, it implies that the infant also comprehends it. Thus, it is natural that the total of words comprehended reported by parents decreases as a function of the infant's age, because they were marked as produced (this will be discussed later).

For Production, there were no differences in the mother's schooling at 12 months (F = 0.383, 3, p = 0.765), 18 months (F = 0.871, 3, p = 0.456), or 24 months (F = 0.043, 3, p = 0.988), but there were at 30 months of age (F = 5.51, 3, p = 0.001). Bonferroni's post hoc test showed that there were differences at this age between group 1 (<9 years) and the other three groups. In contrast to the previous section, estimates of mothers with basic education were lower than estimates of mothers

Table 5.1 Total number of comprehended and produced words reported by caregivers for their children in each age group, and gender

			Both genders		Girls		Boys	
	Age (months)	*n* (girls/boys)	*M*	SD	*M*	SD	*M*	SD
Comprehended	**12**	62 (28/34)	**74.81**	78.22	78.39	81.4	71.85	76.5
	18	263 (129/134)	**182.79**	95.86	184.55	96.88	181.1	95.2
	24	541 (263/278)	**167.57**	104.14	162.61	101.76	171.85	106.3
	30	436 (192/244)	**116.15**	105.79	108.27	105.06	122.35	106.16
	Total	1302						
Produced	**12**	62 (28/34)	**6.92**	13.26	7.21	11.6	6.68	14.6
	18	263 (129/134)	**49.64**	71.47	58.07	80.48	41.53	60.77
	24	541 (263/278)	**149.11**	119.35	169.06	118.86	130.51	117.14
	30	436 (192/244)	**272.32**	145.72	294.72	141.09	254.69	147.16
	Total	1302						

M mean, *SD* standard deviation

with more than 9 years of study. In addition, these same variance analyses were performed taking into account the father's level of schooling, which made no statistically significant difference. For Comprehension: 12 months (F = 2.19, 3, p = 0.099); 18 months (F = 0.445, 3, p = 0.721); 24 months (F = 0.711, 3, p = 0.546); and 30 months of age (F = 0.537, 3, p = 0.657). For Production: 12 months (F = 2.27, 3, p = 0.090); 18 months (F = 0.854, 3, p = 0.465); 24 months (F = 0.702, 3, p = 0.551); and 30 months of age (F = 0.329, 3, p = 0.805).

Below, a quartile score table (Table 5.2) is presented for both Comprehension and Production scores arranged by age, gender, and mother's educational level of the 1302 infants. The reader may be able to identify specific cases that correspond to the combination of these variables (e.g., number of words produced by 18-month-old girls with mothers with a basic educational level), and make qualitative visual comparisons between groups.

Contributions and Final Considerations

The large number of studies regarding language development that currently exist account for the relevance that this domain has for child development and has helped us to understand from a broader perspective how this psychological process impacts the formation of other cognitive skills over time. The main variable discussed in this chapter was the family SES of infants of early ages, specifically, characterized as maternal educational level (years of study) and its influence on the development of the child's language, specifically, receptive (comprehension) and productive vocabulary. Given the great variability in lexical development in both English and Spanish learners (Bloom, 2001; Hollich et al., 2000), as well as some limitations for its measurement from the existing parental reports (Fenson et al., 2000), the aim of this research was to establish criteria for estimating vocabulary development relevant to Mexican children from different social contexts, in an age range of 12–30 months. This was achieved with the use of the ICPLIM (Alva & Hernández-Padilla, 2001a), a vocabulary inventory designed for use in research with Mexican children of early ages and whose value and validity have been demonstrated in previous studies (Naves et al., 2007; Suárez et al., 2010).

The data obtained in this study are of great value and establish a benchmark for the research of the vocabulary of Mexican children through instruments of "pencil and paper." The calculation of quartile scores with respect to inventory comprehension and production scores represents a useful tool where the size of the children's lexicon in four age groups, in the first years of life, can be identified. Likewise, researchers and health professionals can make use of the instrument's standards and establish criteria ad hoc to their research objectives or make comparisons with other development indicators considering the background of Mexican infants and their families. In particular, it is possible to find out the average size of the vocabulary of infants of specific age, gender, and SES, and use these variables in combination as a guidance framework for the treatment of infants, both under typical

Table 5.2 Comprehension and production Inventory of Understanding and Production of Language in Mexican Infants (ICPLIM) scores of boys and girls in the four age groups analyzed in this study, arranged by the educational level of the mother

		Comprehension															
		12 months								**18 months**							
		Girls				**Boys**				**Girls**				**Boys**			
		Mother's educational level (years)								**Mother's educational level (years)**							
		<9	**12**	**16**	**>16**	**<9**	**12**	**16**	**>16**	**<9**	**12**	**16**	**>16**	**<9**	**12**	**16**	**>16**
Quartiles	**25**	52	38	28.7	16.2	3	5	22	16	123	102	107	112.7	52	84	145.7	113
	50	70	73	50.5	33	3	33.5	69	42	167	151	204	176	198	139.5	209	160.5
	75	96	302.7	71.7	142.2	3	80	171	80	306	189.5	273	255	251	198.2	279.7	253.7
		24 months								**30 months**							
		Girls				**Boys**				**Girls**				**Boys**			
		Mother's educational level (years)								**Mother's educational level (years)**							
		<9	**12**	**16**	**>16**	**<9**	**12**	**16**	**>16**	**<9**	**12**	**16**	**>16**	**<9**	**12**	**16**	**>16**
Quartiles	**25**	41	89.5	79	87.7	68	87	84.7	105	19.7	25	24.5	33	30	36.7	43	34.5
	50	140	171.5	146	152	147	145	133.5	196	78	76	67	83	173.5	102	95	90
	75	219.5	238	217	222	243	235.5	214.7	263.5	174.25	161	195	150.5	295	193.5	184.5	146.5
		Production															
		12 months								**18 months**							
		Girls				**Boys**				**Girls**				**Boys**			
		Mother's educational level (years)								**Mother's educational level (years)**							
		<9	**12**	**16**	**>16**	**<9**	**12**	**16**	**>16**	**<9**	**12**	**16**	**>16**	**<9**	**12**	**16**	**>16**
Quartiles	**25**	0	0	1	0.7	25	0.5	0	0	11	11	13	8.7	1	10.7	12	7.2
	50	0.5	2.5	4.5	3.5	25	4	2	1	21	24	29	31.5	21	24.5	27	14.5
	75	6.2	7.5	13.2	18	25	60.7	7	4	79	56.5	81	82.7	44	48.2	48	59.2

		24 months								30 months							
		Girls				Boys				Girls				Boys			
		Mother's educational level (years)								Mother's educational level (years)							
		<9	12	16	>16	<9	12	16	>16	<9	12	16	>16	<9	12	16	>16
Quartiles	25	35.5	38.5	78	73	9.5	29	34.5	32	177.2	217	114.5	217	24.7	132.7	118.5	170
	50	139	136.5	175	157.5	87	112	89	97	251.5	319	331	330	186.5	265	310	305
	75	297.7	238	299	224.2	226	191.5	195.2	233.25	382.5	421	396	405.5	292.7	386.2	364	378.5

developmental conditions and in situations of suspected atypical development. The latter is relevant because, when considering the SES of the child, unfair comparisons of infants that normally score at the ends of the performance continuum are avoided.

It is important to mention that the results presented here are not intended to underestimate the value, nor to replace the use of other parental reports such as the MacArthur CDI (Jackson-Maldonado et al., 2003). Previous international literature has consistently demonstrated its usefulness and application in vocabulary development research (Giammarco, 2020; Peter et al., 2019), both in the laboratory and in digital settings (DeMayo et al., 2021), multiplying its accessibility and benefit. What is intended is to offer a complementary tool that reflects the characteristics and diversity that the infants of central Mexico present and that together with other tools enhance the value of the findings of research carried out with Spanish learners in the first years of life.

One of the main premises revealed throughout this chapter, is that parental education has an impact on infants' language development; therefore, it is very important to consider its study, as well as its control in situations where this is possible. The research described above showed a differential effect on the estimation of infant's vocabulary between mothers and fathers according to their years of education. It is interesting to note differences between mothers with a low level of education and the other education groups studied, and how this discrepancy (or some other) was not observed with the fathers. This implies that, in Latin cultures such as Mexican, the weight of the mother–child relationship goes beyond attachment and emotional development, as it indirectly favors to a greater or lesser extent the lexical development that is known to be fundamental to the optimal subsequent development of other complex cognitive skills (Fernald & Marchman, 2012; Rose et al., 2011; Williams et al., 2008). This finding is in contrast to some studies that report a greater influence of the father on children's vocabulary (Alva, 2004; Zvara & Schoppe-Sullivan, 2010); however, discrepancies with previous research may be due to the methodology used or the age range studied, which is higher than that of the children studied here; thus, more research is suggested in this regard to help to clarify these differences.

The dissimilarities in estimating vocabulary among maternal schooling groups were more evident in verbal production (compared with comprehension). This can be explained in at least two ways:

1. Estimating the words a child understands is harder than estimating the words a child emits or produces. Mothers often tend to assume that their child understands a word without having a clear criterion for making such an appreciation (Styles & Plunkett, 2009) or because they expect their child to get an outstanding score on the instrument and, therefore, please the experimenter. On the contrary, the estimation of the produced words results from a memory exercise of recognition of the expression and quantitatively measurable behavior of the infant; therefore, the parental report is more reliable.

2. When checking a word as produced in the inventory, it is theoretically assumed that this word is also understood by the child (Karmiloff & Karmiloff-Smith, 2001). This produces an effect in which comprehension scores increases with age up to 24 months, and then begins to decrease. Clearly, this does not mean that 2-year olds understand fewer words, but that the score is simply reflected in the production column. Taken together, these facts cause a nonlinear function between variables of comprehension and age; thus, the recommendation is to use parental reports to measure comprehension in infants with typical development younger than 18 months or depending on the age of occurrence of the vocabulary explosion described in each language (because after the appearance of this phenomenon the comprehension variable (score) is not sensitive).

After this age, dyadic interaction activities have turned out to be more informative about the effect caregivers have on their children's verbal development. Illustrated books without text are a great tool when the intention is to study the effect of family context on development, as well as having the advantage that the same material can be used in Spanish and English learners without distinction. In studies with Mexican children, research using joint reading and dyadic interaction tasks (Guerrero & Alva, 2015; Suárez et al., 2016a, b; Valdés, 2015), have contributed to the understanding of language development as well as parenting styles, and are used successfully with families of middle SES.

With regard to gender, it is not surprising that there were no differences between boys' and girls' vocabulary scores (comprehension/production) in any of the four age groups. Although the study of differences in language competency between boys and girls remains of "popular" interest, presumably because of the heritage of the findings of classical studies (Neprash & Anastasi, 1938; Tyler, 1965), little current research considers the analysis of this variable, and even fewer studies find statistically significant differences to report. It is well known that brain development among boys and girls occurs at a different rhythm in the early stages of life. However, the existing accumulated scientific evidence forces us to pay more attention to cognitive and sociocultural variables with greater influence on child development, and whose clearer effects are observed.

Such is the case of the processing speed variable, which, measured through visual reaction times, is related to lexical development in such a way that children with faster reaction times also present more words in their vocabulary (Donnelly & Kidd, 2020; Kidd et al., 2018; Suárez et al., 2015). Studies that use visual attention paradigms represent a breakthrough in the study of early skills in children, both technologically and theoretically, by accepting that different cognitive domains relate to each other in ways that previously could not be detected. One of the advantages is that the results obtained from these paradigms are immune to idiom differences. It is true that most of them require the use of some words or phrases of the infant's native language, but the interpretations and implications of the findings are universal and inherent to human behavior. The power these paradigms have to describe correlations and even predictions between variables in infants is very wide and increases from the perspective of individual differences. Some of the most

representative are those that relate processing speed to academic performance or IQ, and those studies that use these paradigms for the study of children with a disorder such as Autism Spectrum Disorder or Down's Syndrome (Arias-Trejo et al., 2019; Naigles & Tovar, 2012; Potrzeba et al., 2015; Rose et al., 1988, 2011).

Some of the limitations of this research are that groups of different ages were not homogeneous in number, as well as the fact that caregivers tend to want to please the researcher, often causing a bias in their responses. Likewise, the sample only included participants residing in and around Mexico City; thus, it would be desirable for future studies to consider a larger sample that would be representative of the entire country. On the contrary, this study also presents some strengths. Among the most relevant is to establish a parameter of the estimation of the vocabulary of Mexican infants of different ages and SES levels, as well as to contribute to clarifying the weight of the infant's sex variable to the debate of gender differences with regard to linguistic competence.

The results shown here help to better understand the effect of the mother's years of education on the development of infants' vocabulary in Latino families, and build on the findings of previous research regarding the direction of this relationship described in both English and Spanish learners (Montanari et al., 2020; Pace et al., 2017; Teepe et al., 2017). Therefore, it can be said that maternal education is a reliable and useful variable for the study of language development and later cognitive domains. It also highlights the importance of the use of preferential attention techniques for the study of language abilities, which, because of their experimental nature, minimize the biases inherent in "pencil and paper" instruments related to subjective estimation of vocabulary. In the same sense, it is suggested that using experimental techniques should also include more traditional instruments, such as parental reports. In this way, obtaining information about the child from those who are in daily contact with him/her represents an advantage to obtain more accurate observations over child development. What is essential is to use well-operationalized definitions of the variables of interest with views to enabling the replication of findings, as well as allowing systematic comparisons between studies with children from different contexts. Finally, the study of individual differences in any cognitive domain is an approach that is and will remain valid for the study of child development. Its properties help us to determine causal relationships between developmental milestones observed in early stages and subsequent success in adolescence and even adulthood, regardless of the sociocultural profile to which it belongs.

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