Causes and Consequences of Variability in Early Language Learning

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Chapter draft: June 16, 2010

When skills related to language proficiency are assessed at any age across a broad population – whether it's at 12 months, 12 years, or in adulthood – there are substantial differences among individuals at every age. Variability in language-related abilities are evident as early as they can be assessed in infancy using parental reports of vocabulary. While some infants from middle-class families show signs of understanding words by 8 months and start speaking before their first birthday, others wait until the end of the second year before they begin to comprehend and produce speech (Fenson et al., 1994). Some "late talkers" catch up in vocabulary a few months later, while others learn new words more slowly and remain at risk for language disorder (Bates, Dale & Thal, 1994) - variability that is typically attributed to endogenous differences among children. However, by the age of 5 years when they enter kindergarten, children from advantaged and disadvantaged backgrounds may differ by more than two years in terms of their language skills, as assessed on standardized tests (Ramey & Ramey, 2004) - variability that is more likely to be associated with differences between groups in children's early experience and access to cognitive and language stimulation. Differences in language proficiency are also robustly evident among adults, as shown in comparisons between groups varying in socioeconomic (SES) status (Pakulak & Neville, 2010) as well as within SES groups - variability that could reflect the cumulative influence of a wide range of endogenous and environmental factors over a lifetime. The goals of this chapter are to offer an historical perspective on research on the causes and consequences of variability in early language proficiency, and then to show how new measures of children's fluency in understanding language in real time enable us to explore such individual differences more deeply, asking where these differences come from and how they are linked to later language outcomes.

The chapter is organized in four sections. First, we provide a brief historical overview of research on variability in children's language development, showing that insightful studies done decades ago were the first to reveal that differences among children in early language experience are related to differences in later language outcomes. But when the field of child language acquisition came to life in the 1970's, the central focus was on common patterns of development across children, with much less attention to questions about how children differ, where these differences come from, and whether and how they matter. Although these questions have been sidelined in current discussions of language learning, we argue that they are critical to understanding the development of linguistic proficiency. Second, to support this claim, we describe recent studies exploring new ways to characterize developmental gains in verbal ability, by assessing infants' fluency in interpreting spoken language in real time. Third, we present research showing that individual differences in early speech processing efficiency predict later language growth, as assessed by standardized measures of lexical and grammatical knowledge. And finally, we show that early language experience is one important contributor to variability in language learning: Infants who hear more and richer language from their caregivers not only develop vocabulary more quickly - they also develop *more efficient processing skills*, and this in turn enables them to learn more language more quickly.

I. Research on variability in children's verbal abilities: An historical perspective

Scientific research on individual differences in cognitive capacities began in Europe in the early 1900's with the development of the first IQ test by Binet, adapted by Terman (1916) for use in the U.S. This new psychometric instrument was put to use in numerous studies exploring differences in mental ability related to race and ethnicity (Goddard, 1917; Brigham, 1923), motivated by theories of genetic determinism that were popular at the time. Faith in the premise that inherited intellectual abilities underlie the superiority of certain ethnic groups was so strong at this time that there was little interest in the possibility that environmental factors could also have an influence on mental development. However, by the 1930's, research on IQ differences began to move in a new direction, stimulated by serendipitous results from studies that had included other information about individuals besides ethnicity (Klineberg, 1935). For example, the finding that IQ actually *decreased* over time in children with minimal schooling (Sherman & Key, 1932; Freeman, 1934) was inconsistent with the claim that intelligence was a predetermined and stable characteristic, suggesting that mental stimulation could be influential in cognitive development. This possibility was also examined in studies of children living in orphanages, whose language development was substantially delayed when compared to home-reared children (Brodbeck & Irwin, 1946; Goldfarb, 1945). Such findings provided further evidence that lack of opportunity for verbal interaction with an attentive caregiver early in life could have detrimental effects on language development.

There were also numerous reports by this time of correlations between SES differences and measures of verbal IQ (Brown, 1944; McCarthy, 1930), which suggested a different framework for explaining how differences in language abilities arise, one that went beyond genetic determinism: If the absence of attentive parenting in institutions resembles the care a child receives in an impoverished family - where numerous hardships make it difficult for parents to meet children's needs – then it could also be the case that lack of cognitive stimulation contributes to language delay in disadvantaged children in low-SES families, as well as in those who are institutionalized. Milner (1951) was the first to examine the benefits of early language experience from this perspective, comparing reading readiness in first graders from higher- and lower-SES black families. Gathering qualitative as well as quantitative data on verbal interactions between parents and child in the home, she found that children in higher-SES families typically experienced a more warm and positive family atmosphere that offered more opportunities to interact verbally with adults.

By the late 1950's, numerous other researchers had begun to explore relations between children's early experience with a responsive caregiver and their later language abilities, motivating new studies designed to identify specific factors in parents' verbal behavior that could enhance or inhibit language development (Raph, 1965). Bernstein's (1961) sociolinguistic theory proposed that differences in language use are shaped by early experience with distinctive 'language codes' in a particular social class: while adults working-class families tend to use a 'restricted code', consisting of language that is structurally simpler and focused on the here-and-now, those in middle-class families more often use an 'elaborated code', consisting of language that is more explicit, abstract, and nuanced in meaning. According to Bernstein, such differential language experience at home affects the development of cognitive and linguistic skills that children in lower- and higher-SES families will have as adults, with important consequences for future academic success.

To explore these predictions empirically, Hess and Shipman (1965) examined how the teaching styles of black mothers differed as a function of SES, and how their use of restricted and elaborated codes affected their preschool children's responses and behavior. They found that higher-SES mothers spoke more overall and used longer utterances with more complex syntax. Higher-SES mothers also offered more explanation and elaboration, while lower-SES mothers used more imperatives to control the child's behavior, and such differences in 'cognitive style' were correlated with differences in children's performance. Consistent with Bernstein's theory, they concluded that variability in academic success is grounded in early language experience: Those children who had more exposure to maternal teaching using elaborated speech would develop a cognitive style that made them adept at problem solving and abstract reflection, while those whose mothers used a less effective teaching style would have limitations in these abilities.

In the tumultuous political climate of the Civil Rights movement and the War on Poverty, the new view that SES differences in children's school success resulted from cultural differences in early experience rather than from inherent genetic differences was viewed at first in a very positive light. The idea of 'cultural deprivation' (Riessman, 1962) provided a plausible rationale for the poor school performance of minority children, one that also offered hope that solutions were possible with appropriate interventions. But describing the home environment of minority children as deficient in cognitive stimulation was a double-edged sword. While this notion rallied political support in the 1960's for early intervention efforts in education such as Operation Head Start, characterizing low-SES children as 'culturally deprived' clearly had negative implications, especially since SES differences were increasingly conflated with racial differences between black and white children in the aftermath of school desegregation.

By the early 1970's, as opposition to the idea of cultural deprivation became more intense (Cole & Bruner, 1971), the 'language-deficit' hypothesis was renounced as racist and culturally insensitive (Labov, 1970; Tulkin, 1972). Such political concerns were one factor leading to the suppression of debate about how differences in children's language experience in advantaged and disadvantaged families might contribute to later gaps in achievement. But another powerful factor that extinguished interest in this question, for very different reasons, was the intellectual revolution in the field of linguistics. Chomsky's theory of universal grammar proposed that an innately specified bioprogram specific to language made language learning possible. His assertion that adult speech available to children was inadequate as a model for language learning (Chomsky, 1965) strongly implied that variation in caregivers' speech to infants was of little relevance in language development. Brown's (1973) pioneering book *A First Language* offered a radical new paradigm informed by linguistic theory, in which longitudinal analyses of the language heard and produced by just three children documented universal patterns in syntactic development. Although these children reached various developmental milestones at quite different rates, the focus was squarely on the commonalities in their patterns of language growth. Differences among them were no longer of interest.

Thus by the end of the 1970's, politically and ethically motivated concerns had converged with the emergence of a new linguistic theory, effectively silencing debate on questions that had generated extensive research over the previous two decades – namely, whether variability in children's verbal proficiency is rooted in differences in their early experience with language at home, and whether these differences contribute to the substantial variability in longterm academic outcomes of concern to educators. While a focus on variability was still central to the work of a few influential researchers (Nelson, 1973; Bates, Dale, & Thal, 1994), the emphasis on universal patterns in language growth remained dominant as the new field of language development research expanded over the next 30 years. For example, although hundreds of studies over this period have explored early word learning (Bloom, 2000), almost all of this research has concentrated on children from middle-class families, with very few studies including children from more diverse backgrounds and even fewer examining potential sources of variability in word learning success. This imbalance reflects a questionable implicit assumption - that variability in universal developmental patterns is of little theoretical significance, and that findings based on middle-class infants are generalizable to all human children (Arnett, 2008; Fernald, 2010).

But despite declining interest in variability in language learning since the 1970's, there has also been ground-breaking research that has expanded our understanding of the nature and importance of individual differences in language development. These studies are based on fine-grained analyses of mothers' interactions with infants in the home, using longitudinal designs to determine which features of maternal speech predict well-defined language outcome measures. Huttenlocher and colleagues were the first to show that within a group of middle-class families, mothers differed substantially in how much they talked to their infant, and that variation in the amount of child-directed speech predicted children's trajectories of vocabulary growth (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991). In 1995, Hart and Risley published their landmark study of 'meaningful differences' in children's exposure to language and their vocabulary growth in three SES groups. By 36 months, the higher-SES children knew twice as many words as the lower-SES children - but the most striking finding was the variation in amounts of child-directed speech among families at different SES levels, which correlated with children's vocabulary differences. Hart and Risley estimated that children in professional families heard some 30 million more words over the first three years than did children living in poverty, a stunning difference that was also predictive of children's school performance years later (Walker, Greenwood, Hart, & Carta, 1994). Research by Hoff has also documented SES differences in the quantity of child-directed speech across a range of communicative contexts and in the features of maternal speech that support vocabulary learning (Hoff-Ginsberg, 1991, 1998; Hoff, 2006). Another of Hoff's (2003) noteworthy findings is that the well-established relation between SES and children's vocabulary knowledge is actually *mediated* by differences among mothers in the lexical diversity and grammatical complexity of their speech to children.

Our goal in reviewing this earlier literature is to highlight its historical significance and also its current relevance, providing a foundation for more recent discoveries about causes and consequences of variability in children's language proficiency. In the next three sections, we bring new evidence to bear on this critical issue, based on recent discoveries about how children learn to make sense of spoken language from moment to moment. By assessing real-time speech processing by very young language learners, we can gain new insights into variability in language-relevant skills, linking early differences among children to trajectories of language growth and also to early language experience.

II. Using real-time measures to assess the development of fluency in understanding

Because language understanding can only be inferred indirectly from a child's behavior in a particular context, the development of receptive language competence is less accessible to observation than gains in expressive language. Thus reliable assessment of comprehension in infants and toddlers can be challenging for researchers. The use of offline behavioral measures, such as pointing to a picture book, requires that a young child pay attention, follow instructions and execute an unambiguous response. One widely used alternative to offline tasks is the

MacArthur-Bates Communicative Development Inventory (CDI), a vocabulary checklist on which parents judge that a child does or does not "understand" a word such as *dog* or *cup* (Fenson et al., 1994). Although many parents are adept at observing their child's behaviors and have ample opportunity to observe their child in different contexts, concerns have been raised about the reliability and validity of parent report for studying early comprehension (Feldman et al, 2000; Tomasello & Mervis, 1994). In addition, these measures do not tap into the dynamic nature of language understanding and thus reveal little about the child's developing efficiency in interpreting familiar words in fluent speech. But with recent refinements in experimental online methods, researchers now have the tools to chart the time course of language comprehension by young language learners.

The "looking-while-listening" (LWL) paradigm provides an ecologically valid and reliable assessment of early efficiency in real-time language comprehension in children as young as 15 months (Fernald, Zangl, Portillo & Marchman, 2008). In this procedure, infants look at pairs of pictures while listening to speech naming one of the pictures. Eye-movements are videorecorded as the sentence unfolds in time, and the recordings are later coded to reveal patterns of eye movements time-locked to relevant points in the speech signal. In research on language processing by adults, reaction time (RT) is frequently used as an index of speed of lexical access or sentence interpretation, although given the high task demands of these types of procedures, RT measures have not been widely used in developmental studies of young children. However, infants do have extensive experience moving their eyes to an interesting stimulus, and their gaze patterns are revealing as an experimental measure of the speed of spoken language comprehension. In the LWL procedure, RT is defined as the mean latency with which the infant shifts away from the distracter picture toward the target picture, time-locked to a critical point in the stimulus sentence (e.g., noun onset).

Figure 1 presents results from the first study to examine speed of spoken word recognition, showing mean RT in 15-, 18-, and 24-month-old infants ((Fernald, Pinto, Swingley, Weinberg & McRoberts, 1998). These results revealed that infants make dramatic gains in receptive language skill over the second year of life, increasing the speed with which they can identify familiar words and match them with the appropriate referent in the visual scene. It is noteworthy that this same period of development is when most infants also show a "vocabulary spurt" in vocabulary production. Over the last several years, these cross-sectional findings have been replicated in longitudinal samples both with English-learning infants (Fernald, Perfors & Marchman, 2006) and with infants from Latino families in the US learning Spanish as their first language (Hurtado, Marchman & Fernald, 2007).

In order to make sense of speech in conversations with others, skilled listeners must rapidly integrate acoustic information with linguistic and contextual knowledge, processing strings of speech sounds at rates of 10-15 phonemes/second. Many studies show that adult listeners can identify spoken words *incrementally* as the speech unfolds in time and have the ability to listen predictively, anticipating what is coming next in the speech stream by integrating different sources of linguistic knowledge with nonlinguistic information from the visual context (e.g., Tanenhaus & Trueswell, 1995). Research using the LWL procedure has shown that very young children, like adults, are also able to take advantage of contextual information to interpret ongoing speech incrementally from moment to moment. In a classic study by Allopenna, Magnusen, and Tanenhaus (1998), adults were presented with several objects and asked to, for example, *Pick up the can-*. When the array included two possible referents, e.g., a candy and a candle, participants waited to hear the next speech sound before orienting to the appropriate object, postponing their response until the final syllable of the target word clarified which object was the intended referent. A child who hears *Where's the dog?* while looking at a dog and a doll is faced with a similar temporary ambiguity. In the LWL task, 24-month-olds, like adults, also delayed their response by about 300 ms until the point when disambiguating information about the referent became available (Swingley, Pinto, & Fernald, 1999). Even when 18-month-olds heard *only* the initial phonemes in a familiar word (e.g. the isolated first syllable of *baby* or *kitty*), they were able to identify the appropriate referent (Fernald, Swingley & Pinto, 2001). These results demonstrate that young infants were able to use their rudimentary lexical knowledge to identify familiar words as soon as the information became available.

A second example illustrates incremental processing of morphosyntactic cues to meaning. In English, a prenominal article like *the* reveals little about the following noun, however, in languages such as Spanish, all nouns have grammatical gender that is obligatorily marked on preceding articles (e.g., *la*$_{[f]}$, *el*$_{[m]}$, 'the'). Hearing *la* or *el* informs the listener about the upcoming noun and adult native speakers can exploit this cue during online sentence interpretation, in some contexts identifying the referent even before the noun is spoken (Dahan, Swingley, Tanenhaus, & Magnuson, 2000). To explore this ability in young language learners, Lew-Williams and Fernald (2007) showed Spanish-learning 2- and 3-year-olds pictures of objects with names that were either the same (e.g., *la pelota*, 'ball$_{[f]}$', *la galleta*, 'cookie$_{[f]}$') or different grammatical gender (e.g., *la pelota*, *el zapato*, 'shoe$_{[m]}$') while hearing a sentence describing one of the pictures (e.g., *Encuentra la pelota*, 'Find the ball'*)*. Children were faster to orient to the correct referent on different-gender trials, where the article was potentially informative, than on same-gender trials, as were Spanish-speaking adults in the same procedure, as shown in Figure 2. With only a few hundred words in their vocabulary, young Spanish-learners already use gender-marked articles to help them more efficiently establishing reference, a language processing advantage characteristic of fluent adults. These and other studies have shown that young language learners become much more efficient in recognizing familiar words over the second and third years of life, and that children's ability to interpret more complex sentence structures also improves dramatically over this period (e.g., Fernald, Thorpe & Marchman, 2010).

III. Using real-time processing measures to study individual differences in fluency of understanding by infants and young children

The experimental results described so far complement and extend research based on more traditional measures, highlighting the major developmental achievements in language learning that characterize the first three years of life. However, it is also well known that there are substantial individual differences in early language development (Bates et al., 1988; Fenson et al., 1994; Goldfield & Snow, 1985; Nelson, 1973). Another goal of our research has been to document the extent of individual differences in children's early efficiency of spoken language understanding, exploring several key questions: Is speed of lexical processing a stable measure across age for individual children? Are those children who are faster on average to identify familiar words early in development also those children who respond relatively more quickly at later ages? And if so, how do individual differences in early speech processing efficiency relate to growth in language knowledge, as assessed by standardized measures of lexical and grammatical development? Does language processing efficiency in infancy predict language and cognitive outcomes at later ages?

In the first study to address these questions, we followed a longitudinal sample of 59 English-learning infants in the LWL procedure at four time points between 15 and 25 months (Fernald et al., 2006). Consistent with the earlier cross-sectional findings (Fernald et al., 1998), children's efficiency in identifying familiar words improved significantly over this period. In addition, the measures of early processing skill were moderately stable from one age to the next, showing continuity across ages in children's efficiency of spoken language understanding. Significantly, the results also revealed robust relations between online measures of speech processing and other measures of linguistic development, including parental reports of vocabulary and grammar on the MacArthur-Bates CDI and a standardized test of lexical knowledge. As shown in Figure 3, those children who were relatively faster in mean RT at 25 months also showed more accelerated growth in vocabulary across the second year.

The next question of interest was to what extent these individual differences in early processing efficiency predicted *long-term* language and cognitive outcomes. Thirty of the children from the original Fernald et al. (2006) longitudinal sample were tested at 8 years on several standardized assessments of cognitive and language skills (Marchman & Fernald, 2008). A series of multiple regression analyses evaluated the predictive validity of mean RT at 25 months as well as CDI production vocabulary. In light of links between efficiency of spoken language comprehension and working memory in older children and adults, we also explored relations between early processing speed and a working memory task administered at 8 years (e.g., Gathercole & Baddeley, 1993). Both vocabulary size and RT at 25 months were correlated with later cognitive and language skills. However, each made a significant unique contribution to outcomes, such that knowing mean RT in addition to CDI *doubled* the predictive power, accounting for nearly 58% of the variance in working memory at 8 years. This prospective longitudinal study was the first to reveal the long-term predictive validity of early measures of real-time language processing efficiency, showing that individual differences in fluency of understanding at two years predict children's cognitive and language outcomes in later childhood.

These longitudinal studies with typically-developing children demonstrate that individual differences in early language processing are robustly linked to variation in language outcomes. Do we see the same relations in children who are showing delays in the onset of productive vocabulary, i.e., "late talkers"? Late talkers are children younger than 3 years who fall at the low-end of the continuum in language production, in the absence of any neurological, sensory or cognitive impairments (e.g., Desmarais, Sylvestre, Meyer, Bairati, & Rouleau, 2008). Although delayed onset of productive language in infancy is a risk factor for later language and academic difficulties (Rescorla, 2002, 2005), nearly two-thirds of late talkers will "bloom", moving into the normal range before preschool. Distinguishing transient from persistent delays has been notoriously difficult for clinicians and researchers (Dale, Price, Bishop & Plomin, 2003), yet there is evidence that LT children who also have receptive delays are at greater risk for poor outcomes than late talkers with normal-range comprehension (Thal, Tobias & Morrison, 1991).

In a recent study, we asked whether efficiency in real-time language comprehension in the LWL task would differentiate those late talking children who "bloom" from those who demonstrate persistent delays in productive language (Marchman & Fernald, in press). Two groups of children were tested: Typically-developing (TD) children ($n = 46$) with reported CDI production scores falling > 20th percentile in CDI vocabulary production at 18 months, and Late Talkers (LT) ($n = 36$) with CDI scores ≤ 20th percentile at 18 months. All children participated in the LWL task at 18 months and parents completed CDIs when their child was 18, 21, 24 and 30 months. Our first goal was to use growth curve analyses to chart patterns of individual variation in vocabulary growth across the four time points from 18 to 30 months. We found that LT children had fewer words in their production vocabularies at 30 months, but they also showed more accelerated rates of growth from 18 to 30 months than the TD children. These findings showed that although LTs were at greater risk for persistent delays than children with TD language, nearly two thirds of the children with early delays made greater-than-average gains in vocabulary around their 2nd birthdays.

Our central question in this study was: Can efficiency of familiar word recognition at 18 months account for this variation in rate and acceleration of vocabulary development from 18 to 30 months? The results shown in Figure 4 indicate that the answer is yes. This figure plots trajectories of vocabulary development in TD and LT children classified as "faster" vs. "slower" in RT at 18 months in the LWL task. For children in both groups, skill in interpreting familiar words in real time was a significant predictor of the rate and shape of lexical growth over the 2nd and 3rd years. Those LT children who were faster and more accurate in identifying familiar words at 18 months showed steeper and more accelerated vocabulary growth from 18 to 30 months, compared to those LT children who were less efficient in online spoken language comprehension. Similarly, because of ceiling effects related to the CDI, stronger processing skills in TD children were associated with slower growth rates over this period. It was those TD children who were less efficient in verbal processing who showed faster rates of vocabulary growth than their more efficient peers.

The link between skill in spoken word recognition at 18 months and vocabulary outcomes is also shown in Figure 5. Here, we plot the time course of shifting from the distracter to the target picture in the 14 LT children who remained delayed at 30 months, compared to their 22 LT peers who had moved into the normal range by that age, i.e. the "bloomers". Note that the time-course of shifting from distracter to target at 18 months is steeper and reaches a higher asymptote in those children who bloomed, as compared to those LT children with persistent delays. In sum, this was the first investigation to use online processing measures with a large sample of infants delayed in the onset of productive vocabulary, many of whom remained delayed at the age of 30 months. These results converge nicely with the Fernald et al. (2006) results and also suggest that time course measures of early language comprehension offer significant promise for improving the identification of children at risk for persistent language disorders.

IV. Early language experience influences processing efficiency as well as vocabulary learning

The strong links we have found between variation in early processing efficiency and vocabulary growth reveal that children who are faster to identify familiar words in fluent speech are also better word learners, with long-term benefits for cognitive skills in later childhood. But, where do these individual differences come from? It is now well documented that early experience with language is one important contributor to individual differences in vocabulary growth (e.g., Hart & Risely, 1995; Huttenlocher, et al., 1991). Is variation in early experience also related to the individual differences we see in real-time spoken language comprehension?

To explore this question, Hurtado, Marchman, and Fernald (2008) assessed Latina mothers' interactions with their Spanish-learning infants and examined the links between features of maternal talk and children's vocabulary growth and comprehension efficiency. As in all of our studies with Spanish-learners, this research was conducted in a community-based laboratory in a low-income Latino neighborhood staffed by bicultural/bilingual Spanish-speaking researchers. Twenty-seven mother-child dyads participated when the children were 18 and 24 months. Most of the mothers were native Spanish-speakers with limited proficiency in English who had recently immigrated from Mexico. At the 18-month visit, mothers and children were recorded as they played with a standard set of toys for 20 minutes. Several measures of mothers' speech were later analyzed, including total number of utterances, word tokens, and word types, and mean length of utterance. At 18 and 24 months, children's efficiency in online comprehension was assessed in the LWL procedure and parents also completed a Spanish-language CDI.

One goal of this research was to extend previous findings based on English-learning infants from high-SES families to children in a very different demographic, i.e. Spanish-learning infants growing up in low-SES Latino families who represent a rapidly increasing proportion of immigrant children in the U.S. population, but who have received very little attention from researchers. Consistent with previous findings with English-learning children (Hart & Risley, 1995; Huttenlocher et al., 1991), there was considerable variability in maternal talk within this low-SES sample of Latina mothers, and these differences in amount of child-directed speech were associated with differences in children's vocabulary outcomes. Those children who had heard more maternal speech at 18 months had larger vocabularies at 24 months and made greater gains in vocabulary, links that remained significant after controlling for vocabulary differences 18 months. We also found that children's vocabulary size was related to their efficiency in identifying familiar nouns in fluent speech, again consistent with previous results with English-learning children (Fernald et al. 2006). Those Spanish-learning18-month-olds who were faster to identify familiar words in fluent speech were also those who made greater gains in vocabulary from 18 to 24 months, compared to children with slower RTs.

But the two most exciting findings from this study went beyond replication of previous results in a new population. First, those children whose mothers spoke more words and used more complex utterances during the play session at 18 months were significantly faster in online comprehension six months later than those who had heard less maternal talk, even after controlling for differences in mean RT at 18 months. This was the first evidence that variability in infants' language experience in day-to-day interactions is related to differences in their early speed and efficiency in language processing. Thus, variation in maternal talk is associated not only with children's vocabulary outcomes but also with more efficient real-time lexical processing.

The second important new result was that these relations represented primarily overlapping influences between maternal talk and child outcomes. That is, two possible models of the relations between input, vocabulary outcomes and processing efficiency had equally good fits to the data. In one model, early efficiency in speech processing mediated the relation between input and vocabulary outcomes. Here, early comprehension is strengthened by infants' early experiences with caregiver speech, accounting for the links between input and vocabulary knowledge reported in earlier studies. However, in another model, vocabulary knowledge mediated the relation between language input and processing speed. In this scenario, the experience of hearing more maternal speech exposes children to more varied exemplars of words in context, yielding a richer database of lexical and morphosyntactic cues to meaning. An increase in processing efficiency could enable faster word learning, while an increase in lexical knowledge could further sharpen the processing skills required to interpret increasingly complex and diverse strings of words. Thus engaging with rich and varied language from an attentive caretaker can provide the infant both with *models* for language learning as well as with crucial opportunities for *practice* in interpreting language in real time, experiences that help the child to fine-tune and strengthen the processing skills that facilitate efficient real-time language comprehension.

In conclusion, we started this chapter by calling attention to a substantial body of research done half a century ago in which the first attempts were made to address some important and challenging questions about human development: How and why do children vary in language proficiency? Where do these differences come from, and in what ways are they consequential? In the 1960's, it was understood that these questions have potentially enormous social implications, as indeed they do. Yet for a variety of reasons ranging from political and moral concerns to the emerging dominance of nativist theories of language learning, debate on these issues was curtailed, and they were no longer seen as central to understanding language and cognitive development. We have argued here that building a strong foundation in language comprehension has enduring consequences for the development of the mechanisms underlying verbal fluency, with cascading benefits for the development of other language and cognitive skills. With new methods leading to new discoveries and insights, it is time to reframe and revitalize this old debate about variability in children's language proficiency.

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Figure 1. Mean latencies to initiate a shift in gaze from the distracter to the target picture, measured from the beginning of the spoken target word, in a cross-sectional study of infants at 15-, 18-, and 24-months. This analysis included only trials on which the infant was initially looking at the incorrect picture and then shifted to the correct picture within 1800 ms of target-word onset. (Adapted from Fernald et al., 1998)

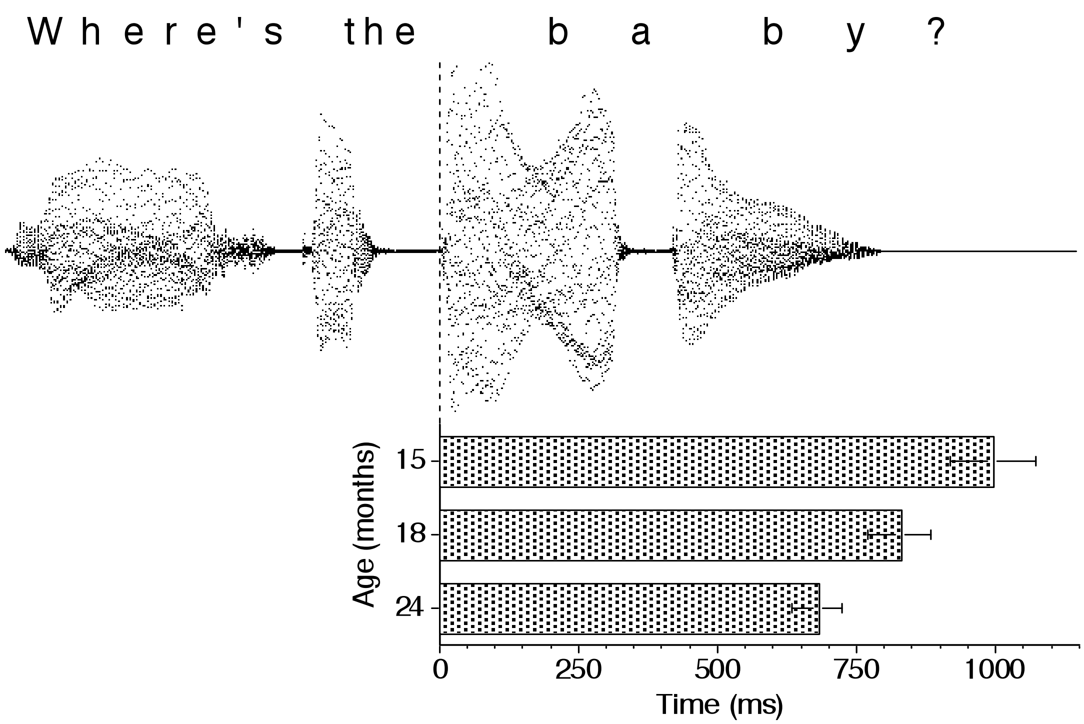
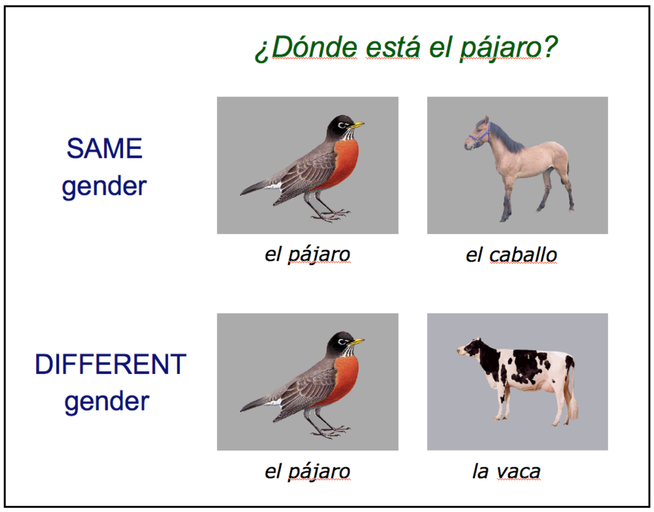


Figure 2. (**A**) Examples of stimuli on Same-Gender and Different-Gender trials in Spanish. (**B**) Curves depict changes in the proportion shifts from distracter to target picture by Spanish-speaking 3-year-olds and adults as the article and noun unfold, measured from article onset (in ms). Filled squares show responses on Different-Gender trials, when the article was potentially informative; open squares show responses on Same-Gender trials when the article was not informative. Vertical dashed lines indicate offsets of article and target word. (Adapted from Lew-Williams and Fernald, 2007).

(A)



(B)

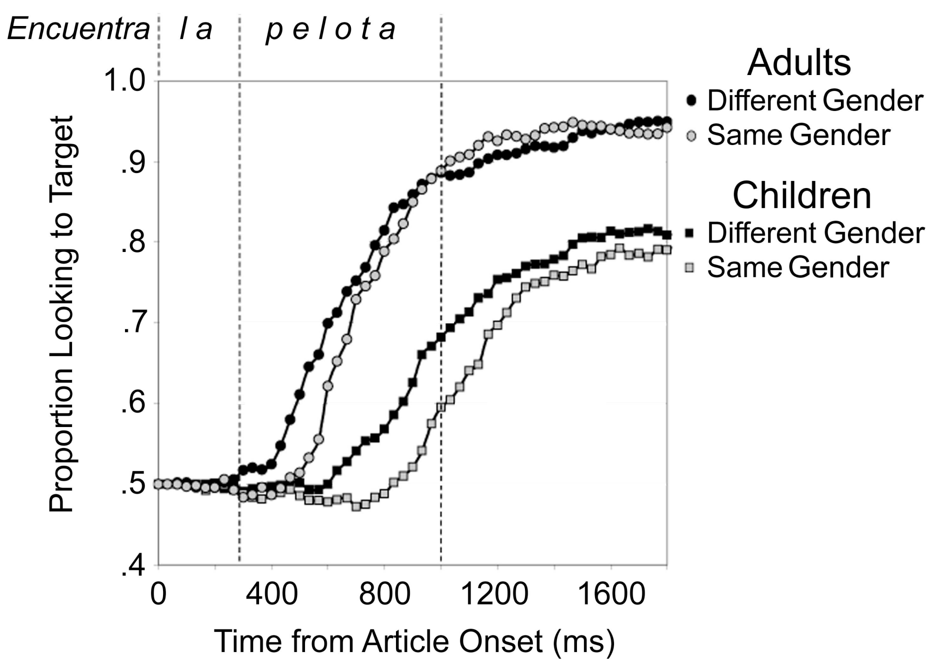


Figure 3. Mean trajectories of growth in vocabulary production across the second year as a function of reaction time in spoken word recognition at 25 months of age. Groupings are based on a median split of mean RT at 25 months to shift from the distracter to the named target picture. (Adapted from Fernald et al., 2006).

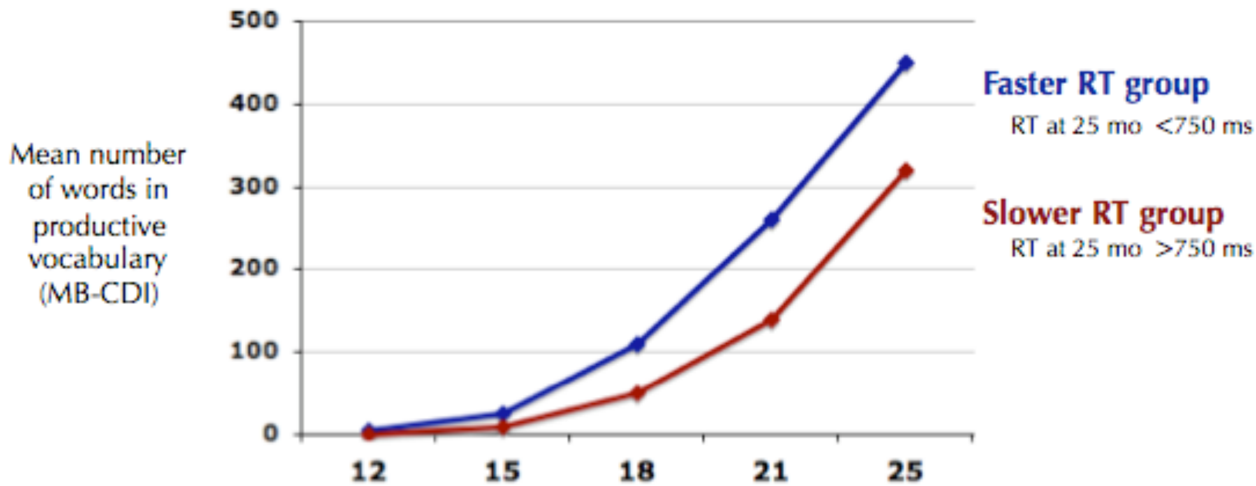


Figure 4. Predicted mean trajectories of quadratic growth in vocabulary from 18 to 30 months as a function of TD (dark lines) and LT (grey lines) group and faster (+1 SD, solid lines) vs. slower (-1 SD, dashed lines) mean RTs at 18 months. (Adapted from Marchman & Fernald, in press).

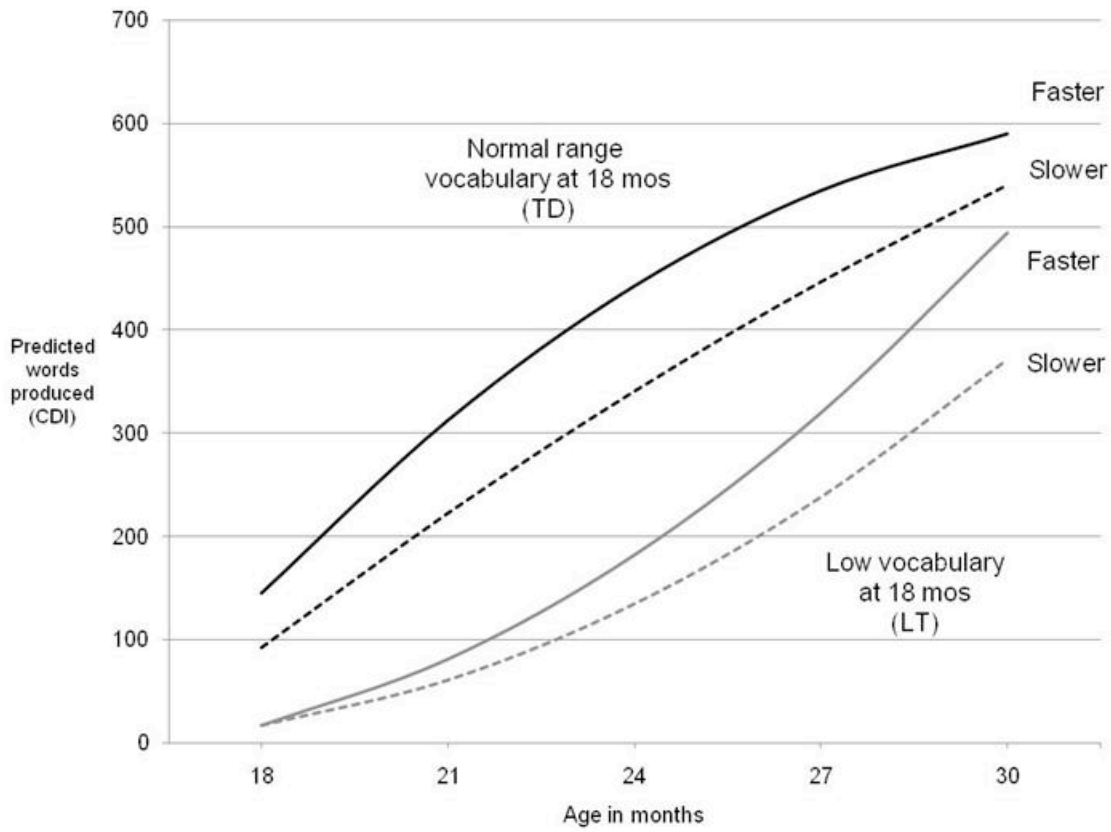


Figure 5. Time course of the mean proportion fixating the target picture on distracter-initial trials at 18 months as a function of vocabulary outcomes at 30 months in late-talking children (LTs) who bloomed vs. those who remained delayed at 30 months; Error bars represent SEs of the mean. (Adapted from Marchman & Fernald, in press).