Language Input and Language Growth

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This report is concerned with the sources of language development in the child. We have found a substantial relation between naturally occurring variations in children's language environments and their language skills, both at the earliest stages of language development and later, at 5 and 6 years of age. Our studies show that children's language development is related to the speech they hear at home and the speech they hear at school. Although much more work remains to be done, it is clear that differences in language input within the normal range are causally related to the growth of children's vocabularies and their syntactic skills.

This report is concerned with language development. I will present evidence that language input plays a major causal role in the formation of the developing language system in young children. Most existing work on language development focuses on the causal role of innate structure in the formation of the language system. The nature of the argument differs for vocabulary and syntax. For vocabulary, the emphasis is on variability across people and the claims concern the sources of such individual differences. For syntax, the emphasis is on commonalities across people and the claims concern the sources of cross-species differences—the reasons why only humans have language.

It is well known that vocabulary varies among different individuals. The size of a person's vocabulary is regarded as a measure of his or her intelligence. Vocabulary tasks are very widely used on IQ tests; in fact, vocabulary is sometimes the only task on short IQ tests. This use of vocabulary tasks is based on the assumption that what is critical to the size of an individual's vocabulary is his or her ability to learn from incoming language, not the amount of language he or she has been exposed to. But the assumption that vocabulary reflects the ability to learn was not evaluated before vocabulary tasks were included in IQ tests. In fact, there has been a lack of systematic work on the possible effects of language input on vocabulary size. Clearly, however, vocabulary has to be learned, and attaining a large vocabulary is a huge associative learning task.

Consider syntactic skill among different individuals. Syntactic development has been of central interest in linguistic theory. It is claimed that, contrary to vocabulary, there isn't much variation among individuals in syntactic skill. Since language, by which linguists mean syntax, is a species-wide competence reflecting our hereditary structure as humans, it is universal. Although some input is required to "trigger" the innate syntactic device, only extreme deprivation should disrupt normal growth. Across a wide range of environments, development should be invariant. Perhaps because of this prevailing view, few studies have explored individual differences in syntactic skill levels or the possibility that those skill levels might be affected by children's language environments.

In the past several years, my colleagues and students and I have done a series of studies of early language growth [3,5, Cymerman and J. Huttenlocher, in preparation]. These studies show large individual differences in both vocabulary and syntax. In fact, we have found a close relation between the size of a child's vocabulary and his or her level of syntactic skill. This is not what linguists who argue for a universal syntax would expect. Further, contrary to their arguments, both aspects of language development show a striking relation to language input across a normal range.

First, consider our initial study [3]. We examined early vocabulary growth in 22 middle class children over the initial period of word learning, from 16 to 26 months of age. We obtained samples of the verbal interactions of mothers and their children for several hours each month. At 16 months children's vocabulary is small, but over the next months it shows accelerating growth. The rate of acceleration of growth varied widely across children. Figure 1 shows growth curves for 3 children. Note that for 1 of the children, vocabulary at 26 months was under 200 words, whereas for another of the children, vocabulary at 26 months was over 800 words.  

1 This research was supported by a grant from the Smart Family Foundation.
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words. The amount mothers talked also varied widely. The most talkative mother talked about 10 times as much as the least talkative mother—over a 3-hour period at 16 months, the least talkative mother said about 700 words and the most talkative mother said about 7,000 words. We found a striking relation between vocabulary growth and amount of mother speech. Using a statistical model, we estimated this relation at the extremes of talkativeness. There was an effect on children's vocabulary size of 30 words at 16 months, 131 words at 20 months, and 290 words at 26 months.

A question must be raised. The relation between language input and language growth in this study is correlational. Since mother and child are biological relatives, the observed relation might reflect the hereditary similarity of our mother–child dyads. However, there are reasons to argue in favor of language input. First, the words different mothers used were pretty much the same—baby, bottle, and so on. They were words all mothers know regardless of the size of their vocabularies. It was only the frequency with which the words were used that varied. Further, there is no evidence that talkativeness is highly associated with verbal ability. Second, the mothers in our study did not vary much in verbal IQ, so ability differences could not explain the present effects in any case.

In this study, we found that vocabulary size and syntactic development were highly related. However, in the age range we studied, syntactic skills are just emerging. Since children need a body of words before they can combine them into a sentence, it seemed possible that this correlation would not stay high; indeed, the relation of syntax to language input might vanish altogether. Hence we have begun a study of language input and syntactic skill at a later age [Cymerman and J. Huttenlocher, in preparation]. We are examining both vocabulary and syntax in 4-year-olds from low and middle income families. First consider vocabulary. We find that low income children use less than two-thirds the number of different words that middle income children use over a fixed period of time. The number of different words adults use at home to children also differs greatly. The children all attended preschool. Teachers of low income children use fewer words than teachers of middle-income children, but the differences are less marked than at home.

Now consider syntax. Our measure of syntax was the proportion of sentences with more than one grammatical clause. So far we have examined the speech of 10 low income children and 8 middle income children in a variety of speech contexts. The differences are striking. The proportion of complex utterances in the speech of the middle income children is over 25%. A few examples of multicause sentences are "Pretend you saw this break apart." "I'm up here because I want to wait." A few examples of single-clause sentences are "Give me that." "This is my truck." In the speech of the low income children there were less than 10% complex sentences. Correspondingly, there were many fewer complex sentences in the speech of low income caregivers at home.

FIG. 1. Vocabulary size in three children from 14 to 26 months of age. Reproduced, by permission of the publisher, from Ref. [3].

FIG. 2. Vocabulary test item (steeple). Reproduced, by permission of the publisher, from Ref. [4].
What is most striking about these findings, given current views, is that there are marked differences in syntactic complexity at all. With respect to the relation of child syntax to language input, there is clearly more than one interpretation because the study is correlational. That is, even though differences in incoming speech can explain the differences in children’s syntactic skill, it is possible that a similarity of ability between caregivers and children could be a factor.

Finally, I will present findings from a study we did of language growth among kindergarten and first-grade children [5]. As noted above, the interpretation of observed relations between environmental input and children's skill levels is ambiguous in most studies. This is because, in natural environments, people who provide more input and the children they care for may have greater ability, and the greater ability could be the critical factor in the child’s language.

Examining environmental effects on the growth of both vocabulary and syntax by examining the effects of school seems to provide a useful design; teachers and their students are not biological relatives, so hereditary factors cannot explain school effects. Even then, however, a correlational study across schools can be problematic. The behavior of different teachers could be related to the ability levels of families in different school districts. In fact, in the preschool study I just described, there were differences in the amount of speech provided to lower and middle income children at preschool. One exception to the difficulty in studies of school effects is the case of those studies of impoverished preschool children in which an intervention group is compared with a control group with random assignment of children to the two conditions. The work of Campbell and Ramey [1,2] shows long-lasting effects of such a program on verbal IQ.

In our school effects study, we used a design that allowed us to examine naturally occurring effects of variations in environmental input on language growth under conditions in which ability is not a potentially confounding factor. Such problems did not arise in our
study because we compared children from a single population group over time periods that differed in input and examined the amount of growth over those periods. We tested groups of approximately 1,500 children at four time points—October of kindergarten, April of kindergarten, October of first grade, and April of first grade. The time points are 6 months apart. Yet the activities of the children differ over these periods. From October to April children are at school. From April to October there is an extended summer vacation and a period of starting up activities in the fall and of winding down in the spring.

We presented tasks to tap skills in language as well as other cognitive domains [4]. For language, we began with separate vocabulary and syntax tasks. The tasks involved pointing to a picture to indicate the meaning...
of a word (Show me the "steeple," as shown in Fig. 2) or a sentence (Show me "The flowers are being watered by the girl," as shown in Fig. 3). Vocabulary and syntactic skills were so highly correlated that the two tasks were combined into a single language scale.

Figure 4 shows a schematic presentation of cognitive growth as assessed on this language scale. It has four curves, one for each of the four age groups, with test scores on the horizontal axis and the cumulative percentage of children getting those scores on the vertical axis. What is shown here is that there were differences between the range of scores at each point and that the differences between the October and the April tests in both kindergarten and first grade were much larger than the differences between the April and the October scores. Since the same population of children was tested each time, the only explanation for such an uneven pattern is that the environment at school during the first and third of these periods contributed differentially to growth. By way of contrast, consider a comparable schematic figure for another cognitive skill—associative memory—shown in Fig. 5. As indicated by this figure, an uneven pattern of growth is not found for all skills. Here growth simply declined somewhat over age.

Returning to the schematic presentation in Fig. 4, I want to indicate something else about our results. School was equally effective for those children who, at the time of entrance, had low scores and those children who, at the time of entrance, had high scores. That is, children at the 20th percentile increased as much as children at the 80th percentile. These starting levels are no doubt determined, at least in part, by the children's language environments at home. Regardless of these earlier differences, school contributed to the same extent to language growth.

Let me summarize our studies. We have found a substantial relation between naturally occurring variations in children's language environments and their language skills, both at the earliest stages of language development and later, at 5 and 6 years of age. While the studies of language input at home are subject to alternative interpretations, the study of language input at school is not. Although much more work remains to be done, it is clear that differences in language input within the normal range are causally related to the growth of children's vocabularies and their syntactic skills.

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