

The Relationship of Input Word Frequency and Prosody to Word Production in Dense Longitudinal Data

What is the relationship between the input that children hear and the words that children acquire? We investigate the role of input word frequency and prosody in one child's lexical acquisition using an ecologically valid, high-density, longitudinal corpus. The corpus consists of high fidelity recordings collected from microphones embedded throughout the home of a family with a young child. We analyze data collected continuously from ages 9 – 24 months, including the child's first productive use of language at about 11 months and ending at the child's active use of more than 500 words.

Although the corpus as a whole contains more than 70% of the child's total language input (an estimated 16 million words), we analyze an evenly-sampled 400,000 word portion that has been hand-transcribed using new, semi-automatic methods and for which the speaker has been automatically identified with high confidence. The corpus contains both the child's productions and what we refer to as "child-available speech"—speech during which the child was present.

We attempted to predict the age at which the child first produced a word (a conservative estimate of age of acquisition, or AoA) based on the word's frequency in our sample. Replicating previous results in the literature (Huttenlocher et al., 1991), there was a highly significant negative correlation between log frequency and AoA, indicating that words that were more frequent in the child's input were acquired earlier (all correlations in Table 1). This correlation was mediated by the syntactic category of the words being examined (Goodman, Dale, and Li, 2008). Nouns were highly correlated with AoA; verbs were considerably less so, likely due to other factors mediating acquisition (e.g. Gleitman, 1990). Correlations did not shift significantly when frequencies were computed based on speech prior to the acquisition of a word.

Our next analysis investigated the relationship between prosody and AoA. As a first proxy for prosodic emphasis, we used a standardized measure of mean word duration (Kochanski et al., 2005). We calculated this measure by extracting duration for all vowel tokens, converting these to normalized units for each vowel separately, and then measuring the mean standardized vowel duration for the tokens of a particular word type. For example, a high score on this measure for the word "dog" would reflect that the /o/ sounds that occurred in tokens of "dog" were often long relative to /o/ sounds that appeared in other words. Mean standardized duration was significantly correlated with AoA only for nouns, indicating that nouns that were often spoken with relatively greater emphasis were acquired earlier. In future analyses we hope to incorporate measures of energy and fundamental frequency.

The combination of duration information and frequency information resulted in overall predictions that were more accurate than those produced by either alone, likely

due to the independence of the two information sources ($r = .04$, $p = .41$). These results suggest that prosody and word frequency are complementary sources of information and that children may be able to leverage both in the service of early word learning.

500 words

Table 1. Pearson's r values measuring the correlation between age of acquisition and total log input frequency, standardized duration, and their best linear combination for each category in the child's speech.

Category	Log Frequency	Duration	Log Frequency + Duration
Nouns	0.54 ***	0.27 *	0.56 *
Adjectives	0.36 **	0.03	0.36
Verbs	0.13 *	0.00	0.12
Closed Class	0.35 **	0.11	0.38
People	0.47 *	0.13	0.52
Total	0.28 ***	0.17 ***	0.32 ***

Note. ' $p < .1$, * $p < .05$, ** $p < .01$, *** $p < .001$. Significance values for the frequency + duration model reflect increases in model fit over the frequency model.

References

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