

VOT and word duration: effects of frequency

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Main Point

This study investigates how voice onset time (VOT) and word duration are affected by lexical frequency for words read in isolation and in phrasal context. The VOT is shorter for hi frequency words in phrasal context, and the word duration is shorter for both hi frequency words and for words in phrasal context.

	hi-frequency	lo-frequency
isolation	table	tint
phrasal context	a fancy table is made of oak	venom can taint the blood supply

Summary of results:

VOT	average duration (ms)	change in duration (ms)	change in duration (%)
hi-frequency	73.8	-4.0 ms	-5.2 %
lo-frequency	77.8		
phrasal context	71.6		
isolated context	79.9	-8.3 ms	-10.4 %

Word Duration	average duration (ms)	change in duration (ms)	change in duration (%)
hi-frequency	378.3	-21.6 ms	-5.4 %
lo-frequency	399.9		
phrasal context	311.3		
isolated context	466.9	-155.6 ms	-33.3 %

Results can be accounted for in a usage-based model (e.g., exemplar, prototype), but pose substantial theoretical and implementation problems for a traditional linguistic model.

Background

- The traditional linguistic model depends on
 - discrete, invariant features
 - economy of linguistic/phonetic features
 - lexical representation similar to orthography
 - a 'competence' versus 'performance' dichotomy
- The traditional model does not systematically account for variation due to any of the following:
 - non-Neogrammarian diachronic sound or lexical change (Labov 1981, Phillips 1984)
 - sociolinguistic factors such as language contact (Meyers-Scotton 2002), ethnography (Eckert 2000)
 - timing, rhythm, prosody (Browman and Goldstein 1992, Hayes 1995, Goldinger and Azuma 2003, Port 2003)
 - tone and related prosodic phenomena (Goldsmith 1976)
 - linguistic context: phonological (Luce 1985), syntactic (Gahl and Gansley 2004), metrical (Hayes 1995), syllabic (Davis 1984)
 - effects of type and token usage frequency (Bloomfield 1884, Francis and Ku'cera 1982, Bybee 2001)
- The factors above have been observed in several domains: quality (vowels, voicing, etc), alteration (truncation, substitution, assimilation, metathesis, etc), and quantity (elision, shortening, etc)—but relatively little literature on VOT.

Research Questions:

- Is VOT shorter in high frequency words?
- Is overall word duration shorter in high frequency words?
- Is the frequency effect the same for words read in phrasal context as in words in isolation?

Methods

MATERIALS:

hi-frequency (>100)	lo-frequency (<1)
times	task
tell	toke
town	toil
talk	toic
test	tort
ten	tote
table	tuff
take	tier
teeth	tiff
too	tinge
	taint
	teak
	tongs
	tone
	tint
	time

SAMPLE PHRASAL CONTEXT: target words medially in partially redundant phrases:
Knowing task, materials will help you pass any town in that country is small every table by that author is difficult reading oily take is highly prized in Washington

PROCEDURE: materials randomly presented in mixed blocks. Trials consisted of a word or phrase, a 1600 ms of silence, a tone, and the talker's production.

TOTAL CORPUS:
 20 lo-frequency tokens (x8 repetitions)
 + 10 hi-frequency tokens (x8 repetitions)
 x 4 talkers
960 total tokens

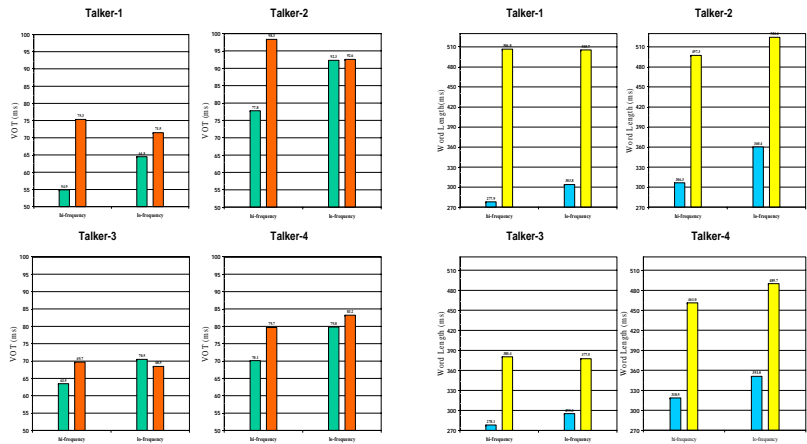
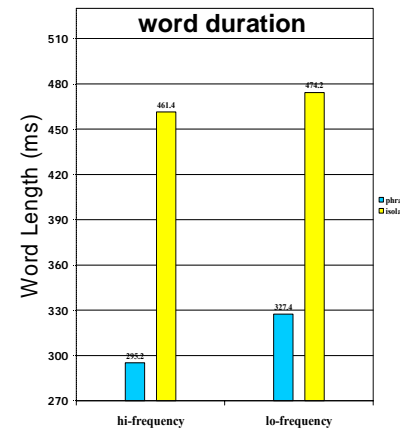
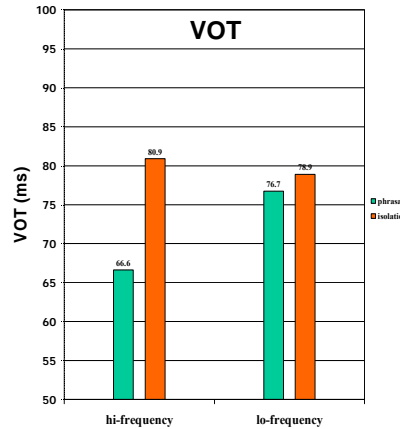
TALKERS:
 -4 talkers: 2 male (age 24, 54), 2 female (age 19, 55)
 -native English with no obvious regional dialect
 -all report normal hearing and speech

MEASUREMENTS: based on waveform, spectral representations, and audio playback. Accuracy was confirmed via random subset sampling.

VOT was measured from release of the stop consonant to onset of voicing.

Word duration was measured from release of the word-initial stop consonant to the final glottal pulse (if ending in a voiced segment) or release burst (if ending in voiceless segment).

Results



Statistical Reports

Items in red are significant, p<.05

ANOVA	d.f.	F-value	p-value
VOT			
all Talkers			
frequency	1, 949	.355	.552
context	1, 949	57.74	<.001
context * frequency	3, 949	31.40	<.001

ANOVA	d.f.	F-value	p-value
Word duration			
all Talkers			
frequency	1, 949	14.87	.001
context	1, 949	706.85	<.001
context * frequency	3, 949	2.63	.105

Conclusions

- The duration of hi-frequency words is slightly shorter than lo-frequency words (about 5%), and much shorter in phrasal context than in isolation (about 30%).
- The VOT of hi-frequency words is not systematically shorter, but was shorter by 18%, or about 12 ms, in phrasal context. We do not know why.
- Since frequency information is apparently stored with each lexical item, these effects support a "usage-based model" that records frequency information in memory.

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