

# Main Point

This paper examines voice onset time (VOT) of the stops /p/ and /k/ in American English according to surrounding prosodic environments. For each type of syllable containing the target stop (the C below), the preceding environment and an example word from the experiment are given.

example	preceding environment	target stop context
<i>goodie</i> <i>cooling</i>	boundary	CV̥
<i>appeal</i>	unstressed syllable	
<i>Peking</i> <i>Rockettes</i>	secondary stress	
<i>Peking</i>	boundary	CV̥
<i>Ogonomowokian</i>	unstressed syllable	

example	preceding environment	target stop context
<i>police</i> <i>gazoose</i>	boundary	CV̥VC̥
<i>Oedipus</i> <i>Connecticut</i> <i>Nebukadnezar</i> <i>Winnepogosis</i>	unstressed syllable	
<i>flapper</i> <i>freaky</i> <i>apodictic</i>	stress (primary or secondary)	

# Background

**HISTORY** (Lisker & Abramson 1964, 1967, 1970, Selkirk 1982):

- importance of VOT for stop voicing distinctions
- VOT usually tends to cluster around three values
  - voiced unaspirated (prevoicing)
  - voiceless aspirated (long-lag voicing)
  - voiceless unaspirated (short-lag voicing)

\*\*and these values are supposed to account for the stops of all languages

- in English, the traditional description for isolated stops is:
  - voiced unaspirated for "voiced" stops
  - voiceless unaspirated for word-medial, unstressed syllables
  - voiceless aspirated for (i) stressed syllables and (ii) word-initially

**BUT** it is known that in individual languages and in certain contexts within a language VOT values vary widely from the archetypal modes

**For Example** (Withgott 1982, Steriade 2000, Jensen 2000, Davis & Cho 2005):

- when flanked on right and left by stressless syllables, American English /t/ resists flapping
- Navrajlova*
- Medjerranean*

**SO...** are the VOT of /p/ and /k/ similarly affected? That is, between stressless syllables, what are the VOT values of /p/ and /k/?

- Oedipus*
- Connecticut*
- Winnepogosis*
- Nebukadnezar*

# 5aSC3. Voice onset time of American English stops with prosodic correlates.

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## Research Question:

- What are the prosodic effects on VOT due to
- word position
  - stress
  - remote stress in long words

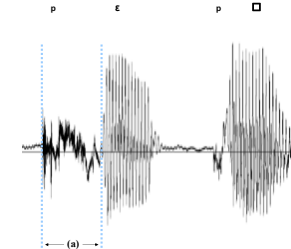
## Methods

CONDITIONS:

	word boundary precedes #C	unstressed V precedes vVC	stressed V precedes VC̥, v̥C̥
stressed syll. initial CV̥, CV̥	<i>goodie</i> <i>cooling</i>	<i>appeal</i> <i>Ogonomowokian</i>	<i>Peking</i> <i>Rockettes</i>
unstressed syll. initial CV̥VC̥	<i>police</i> <i>kazoo</i>	<i>Oedipus</i> <i>Connecticut</i> <i>Nebukadnezar</i> <i>Winnepogosis</i>	<i>flapper</i> <i>freaky</i> <i>apodictic</i>

## MEASUREMENTS

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



One token of *pepper* (approx. 310ms). A transcription is given above the waveform. (a) indicates the approximate VOT measurement points (63ms).

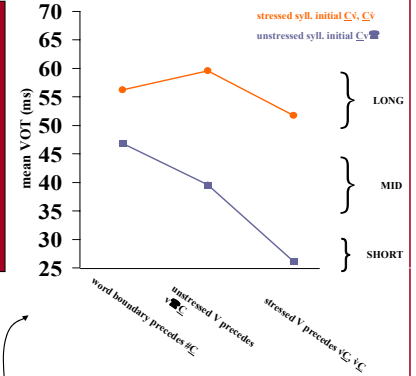
## Results

**SUMMARY:** three different levels of VOT (Long, Mid, Short) were found in the English voiceless stops considered. None of the stops were voiced.

	Long	Mid	Short
where it occurs	in a stressed syllable	in a stressless syll. when <b>not</b> immediately preceded by a stressed syll. (ie., word bound. or stressless syll. precedes)	in a stressless syll. when immediately preceded by a stressed syll.
examples	<i>goodie</i> <i>cooling</i> <i>appeal</i> <i>Ogonomowokian</i> <i>Peking</i> <i>Rockettes</i>	<i>police</i> <i>kazoo</i> <i>Oedipus</i> <i>Connecticut</i> <i>Nebukadnezar</i> <i>Winnepogosis</i>	<i>flapper</i> <i>freaky</i> <i>apodictic</i>

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Deep appreciation goes to Stuart Davis, Ken deJong, and Bob Port, without whose seemingly endless patience and remarkable expertise, none of this work could have been done. Many thanks also to the Intonation and Prosody group who offered many suggestions during the spring of 2003. Errors are the responsibility of the author.



## ANOVA Analysis

Four-way ANOVA of VOT with the following factors:

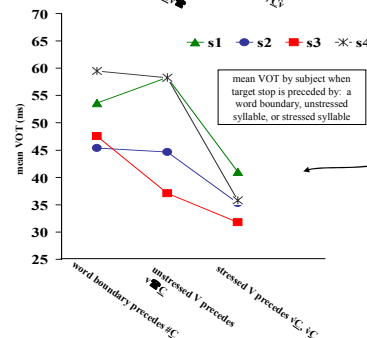
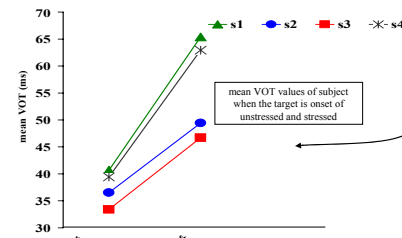
- environment before stop (stress., unstress., boundary)
- syllable containing stop (stressed, unstressed)
- place of articulation (p or k)
- subject (s1, s2, s3, s4)

Main effect of place and a small but significant interaction  
[ $f(1)=11.678$ ,  $F=10.77$ ,  $p=0.002$ ];  
[ $p^2=45ms$ ,  $k^2=48ms$ ].

Main effect of subject is significant  
[ $f(3)=11.678$ ,  $F=81.87$ ,  $p<0.001$ ].

## ILLUSTRATIVE INTERACTION EFFECTS:

	df	F	p-value
preced. env * syll. with stop	2, 678	7.51	< 0.001
preced. env * subject	6, 678	3.05	< 0.007
syll. with stop * subject	3, 678	15.91	< 0.001



## Remote stress in long words as a factor

If a stressless vowel immediately precedes a stop in a stressless syllable (vVC̥VC̥), the VOT is not significantly different when the main stress either precedes or follows (n=101;  $d.f.=1, 99$ ,  $F=1.906$ ,  $p=0.171$ ).

main stress precedes #CVC̥VC̥	main stress follows vVC̥VC̥
<i>Oedipus</i> <i>Connecticut</i>	<i>Winnepogosis</i> <i>Nebukadnezar</i>
37ms	40ms

## Conclusions

- previous (generative) descriptions fail to account for the acoustic facts; at least three categories are needed for voiceless stops in English
- stops before stress tend to have **long** VOT
- stops after stress tend to have **short** VOT
- stops with no adjacent stress (#CVC̥VC̥ or vVC̥VC̥) tend to have **mid** VOT

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