

Categorical effects in production and perception of pitch contours in English

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Categories in intonation

- Perception of acoustic continua mediated by categories of representation
 - True for *suprasegmental* continua as well, cf. categorical effects for fundamental frequency (F0) gradation (e.g. Kohler, 1987; Pierrehumbert and Steele, 1989)
- Assessing categorical effects for F0 continua can help to elucidate phonological representation of intonation

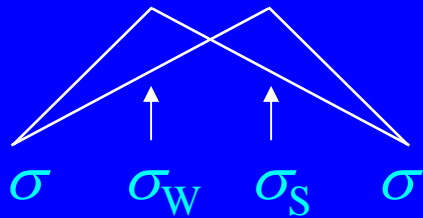
The representation of intonation

- Two kinds of phonological models
 - *Piecewise continuous models*
 - IPO model (ˆt Hart, Collier, and Cohen 1990)
 - British system (Halliday 1967)
 - *Discrete models*
 - Standard autosegmental-metrical (AM) model/ToBI (Pierrehumbert 1980; Silverman et al. 1992)
- Evidence about alignment of target points supports models based on discrete targets (e.g. Ladd et al. 1999, 2000; Arvaniti et al. 1998)

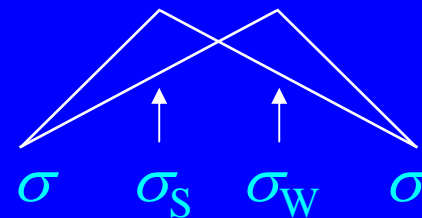
Investigating intonational categories

- **Goal #1:** Determine whether alignment of F0 maxima and minima (i.e., peaks and valleys) constitute phonetic correlates of phonological contrast in English
- **Goal #2:** Test predictions of the AM model regarding categories for intonation (cf. Pierrehumbert 1980)

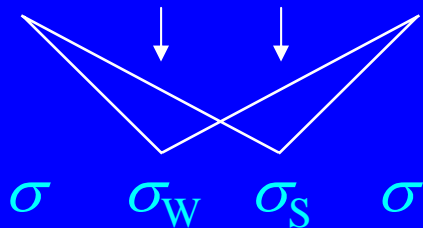
Alignment and pitch accent categories



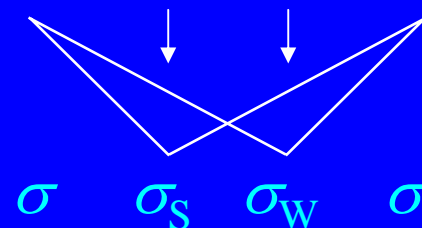
2 categories: H+L* vs. H*



1 category: H*



2 categories: L+H* vs. L*





2 categories: L* vs. L+H*

Stimuli

σ σ_w σ_s σ
“to **Monro**via”
 



A vowel trapezoid diagram with a wide base on the left and a narrow top on the right. The diagram is divided into four sections by vertical lines. The first section is labeled with the symbol σ . The second section is labeled with σ_w in red. The third section is labeled with σ_s in red. The fourth section is labeled with σ . Below the diagram, the text “to **Monro**via” is displayed, with “Monro” in red. Two speaker icons are positioned below the text.

σ σ_s σ_w σ
“too **minglingly**”
 

A vowel trapezoid diagram with a wide base on the left and a narrow top on the right. The diagram is divided into four sections by vertical lines. The first section is labeled with the symbol σ . The second section is labeled with σ_s in red. The third section is labeled with σ_w in red. The fourth section is labeled with σ . Below the diagram, the text “too **minglingly**” is displayed, with “minglingly” in red. Two speaker icons are positioned below the text.

σ σ_w σ_s σ
“to **Monro**via?”
 

A vowel trapezoid diagram with a wide base on the left and a narrow top on the right. The diagram is divided into four sections by vertical lines. The first section is labeled with the symbol σ . The second section is labeled with σ_w in red. The third section is labeled with σ_s in red. The fourth section is labeled with σ . Below the diagram, the text “to **Monro**via?” is displayed, with “Monro” in red. Two speaker icons are positioned below the text.

σ σ_s σ_w σ
“they’re **nonlinguistic**?”
 

A vowel trapezoid diagram with a wide base on the left and a narrow top on the right. The diagram is divided into four sections by vertical lines. The first section is labeled with the symbol σ . The second section is labeled with σ_s in red. The third section is labeled with σ_w in red. The fourth section is labeled with σ . Below the diagram, the text “they’re **nonlinguistic**?” is displayed, with “nonlinguistic” in red. Two speaker icons are positioned below the text.

Experimental methods and analysis of data

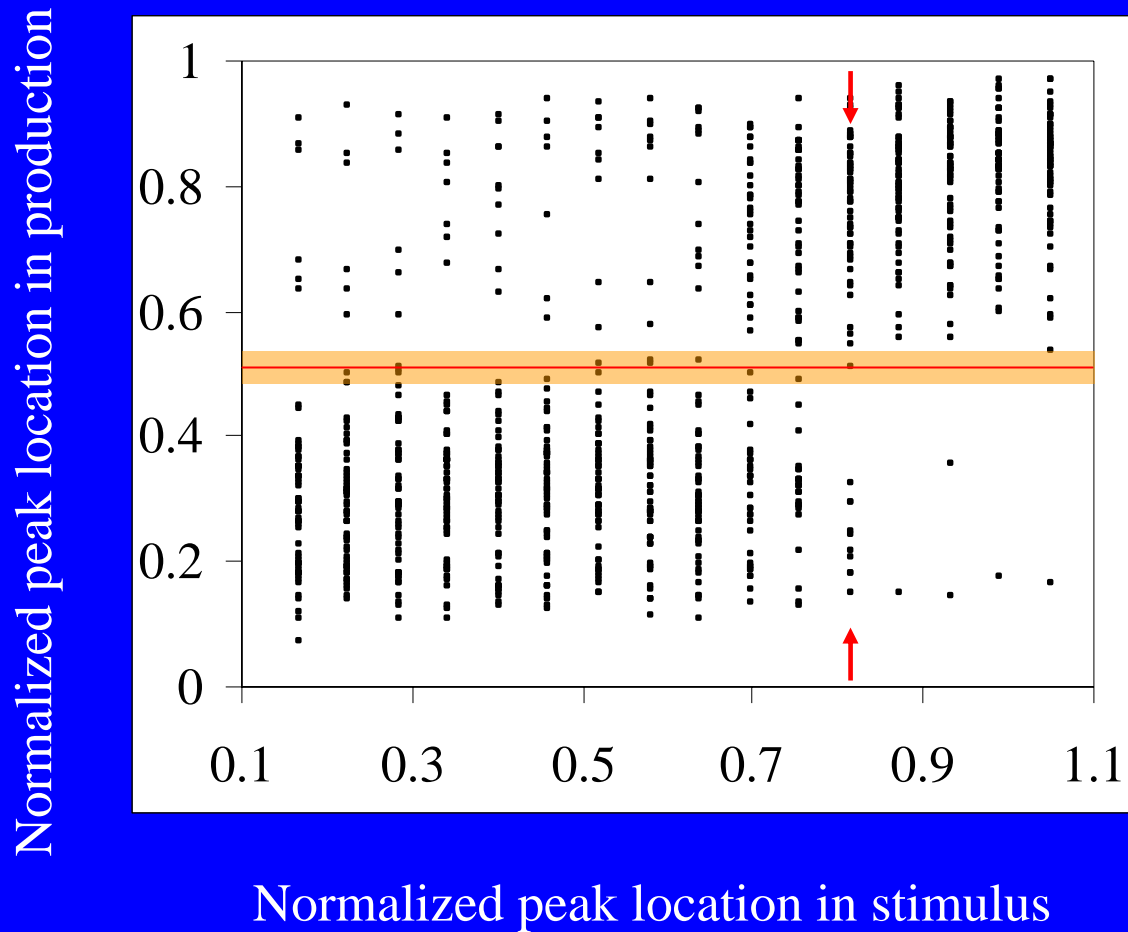
- Production study

- Subjects imitated F0 continua; blocked stimuli presented in random order
- Peak/valley timing expressed as a normalized ratio: $(t-t_0)/(d_1+d_2)$

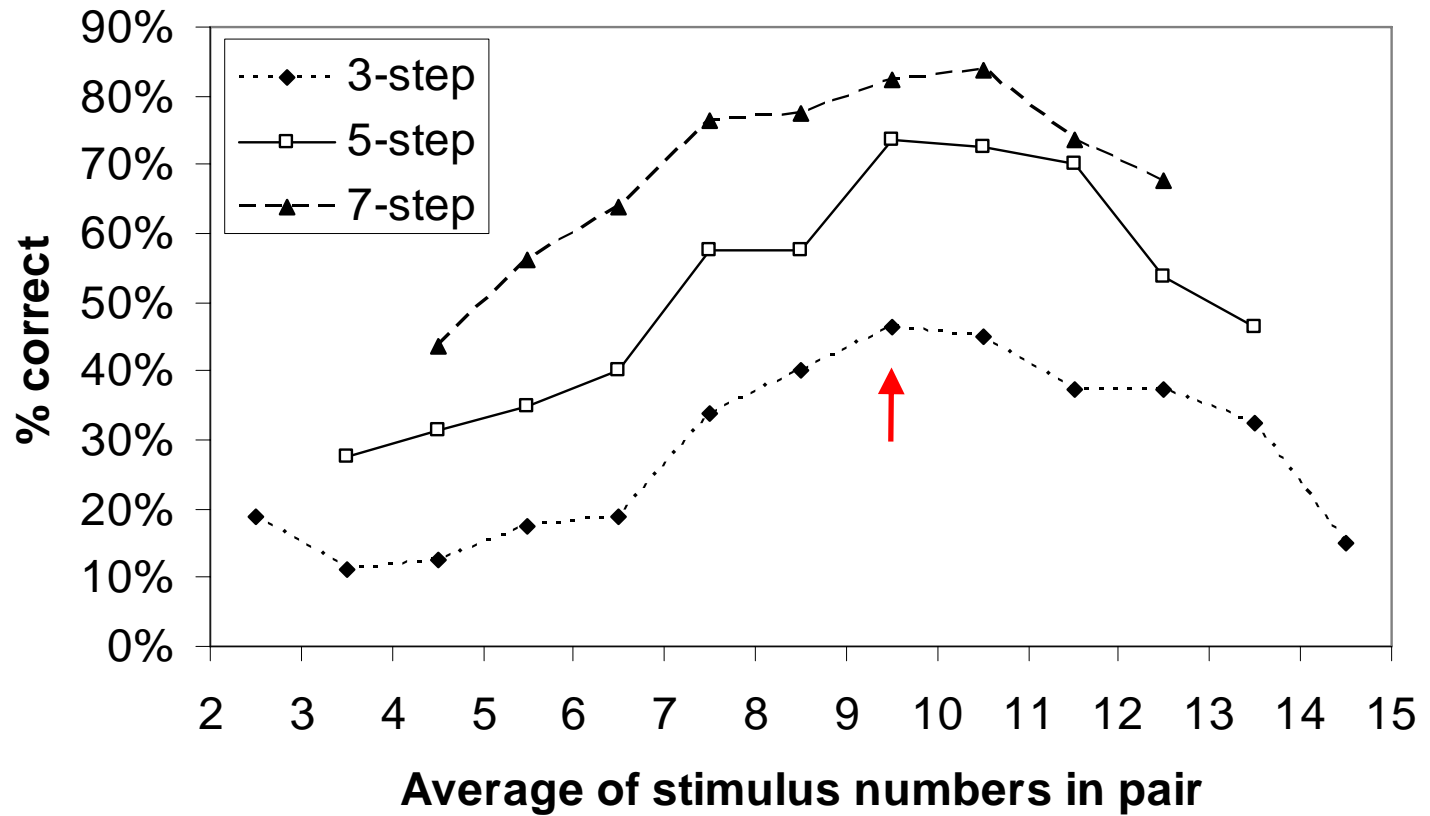
- Perception study

- AX (same-different) task using same stimuli as in production study

WS peak stimuli

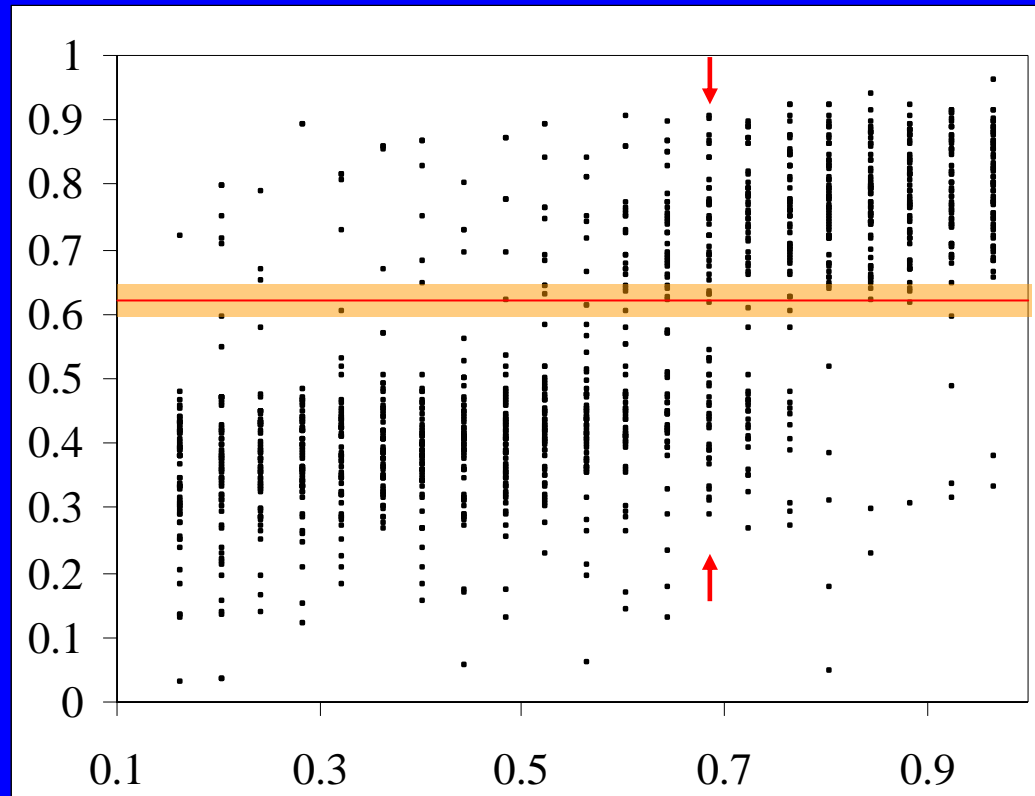


Average percent correct: "monrovia-s" WS peak series



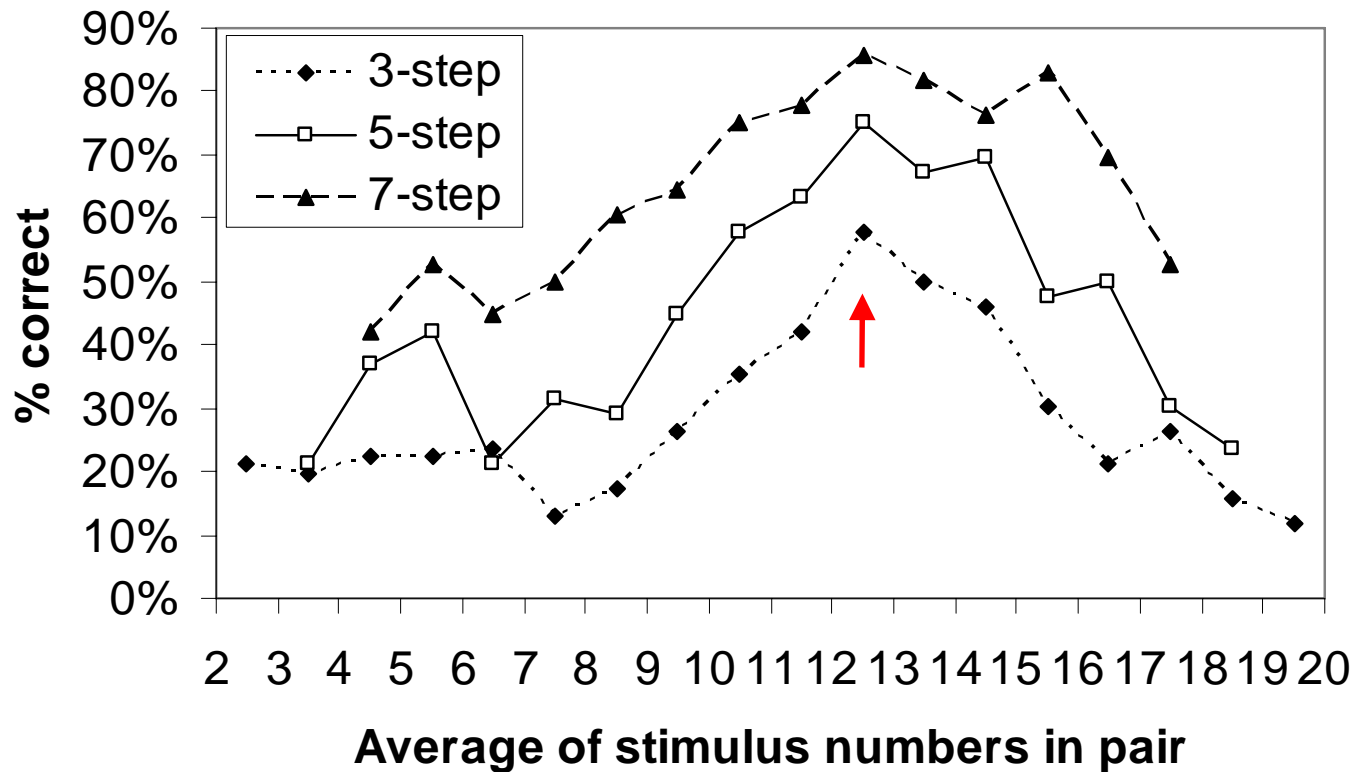
SW peak stimuli

Normalized peak location in production



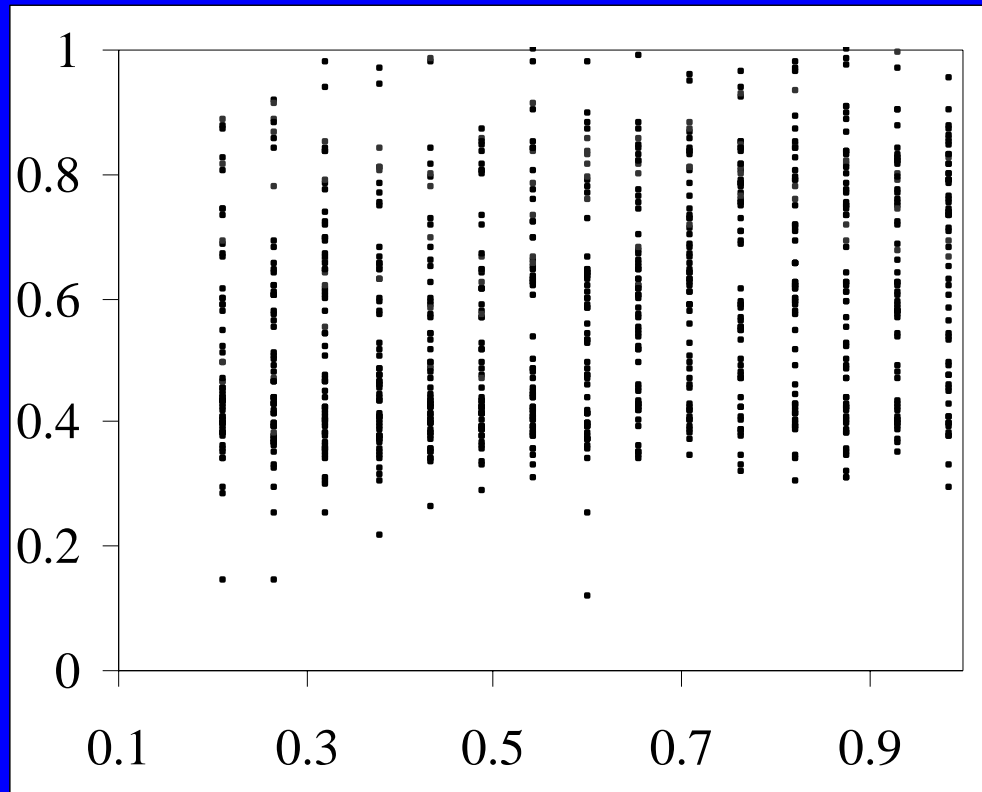
Normalized peak location in stimulus

Average percent correct: "minglingly" SW peak series



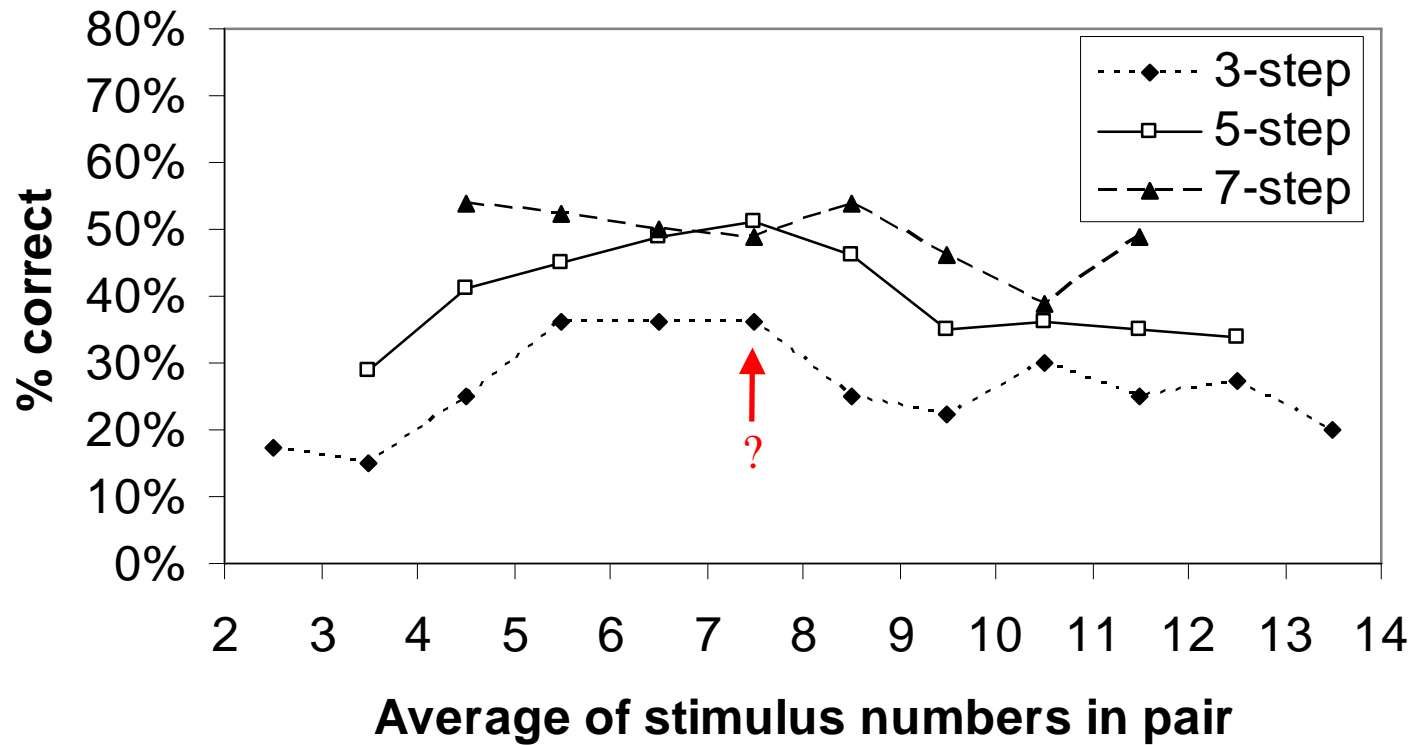
WS valley stimuli

Normalized valley location in production



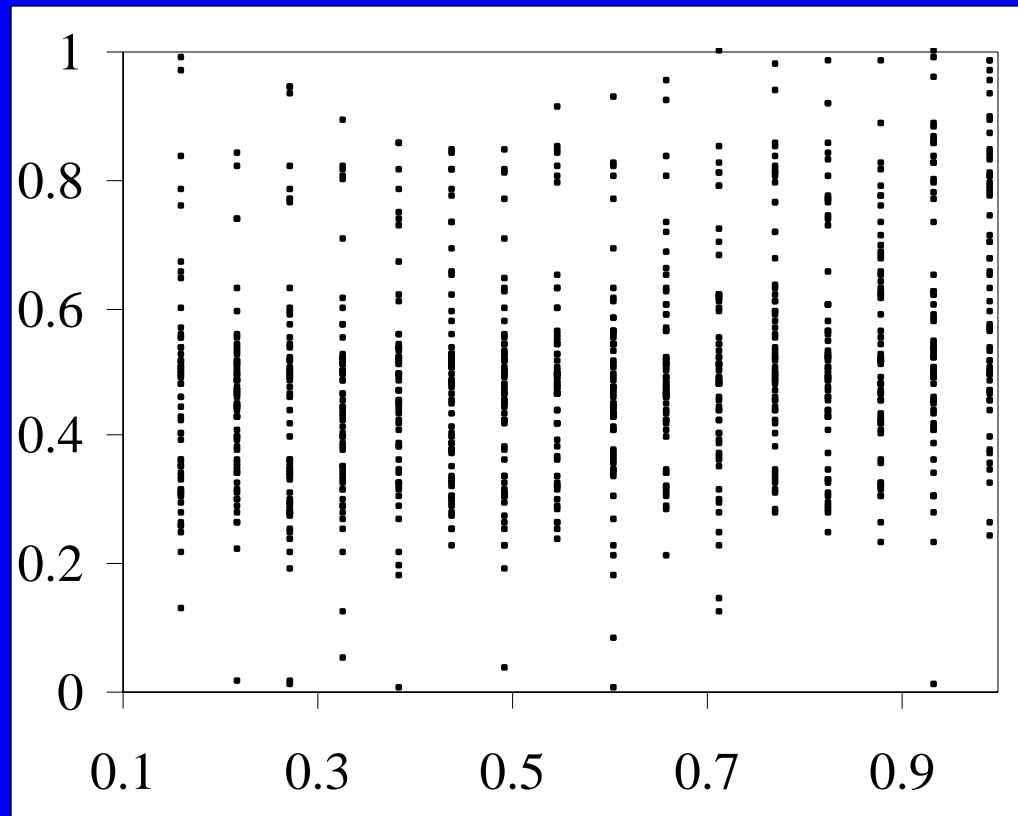
Normalized valley location in stimulus

Average percent correct: "monrovia-q" WS series



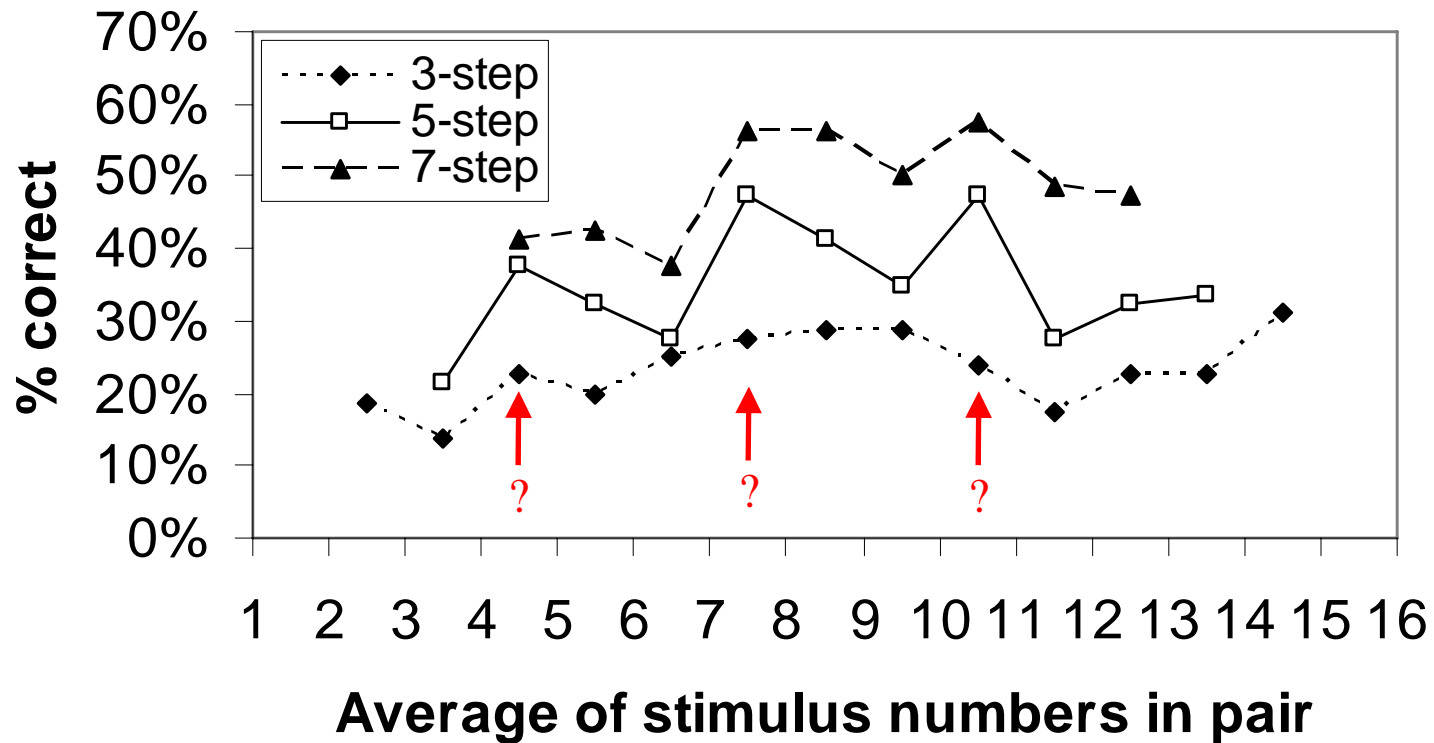
SW valley stimuli

Normalized valley location in production



Normalized valley location in stimulus

Average percent correct: "nonlinguistic" SW valley series



Summary of results

- Results indicate categorical effects for differences in F0 *peak* alignment
 - *WS peaks*: Supports two-way category distinction (cf. H+L* vs. H* in AM model)
 - *SW peaks*: Supports two-way category distinction (cf. single H* category in AM model)
- Results are inconclusive regarding categories based on F0 *valley* alignment

Discussion

- Could the SW peak series have corresponded to L^*+H vs. $L+H^*$?
 - No.
- Is there some other explanation for the categorical effect observed for the SW peak series?
 - Maybe; follow-up study in progress.
- Do F0 valleys give rise to categorical effects?
 - See follow-up study!

Conclusions

- **F0 peak continua** give rise to categorical effects in English
 - Distinction between **H+L*** and **H*** supported
 - Further work needed to determine if **H*** corresponds to more than one category
- More work needed to determine whether **F0 valley continua** give rise to categorical effects in English