Homophones, Lexical Retrieval, and Sensitivity to Detail

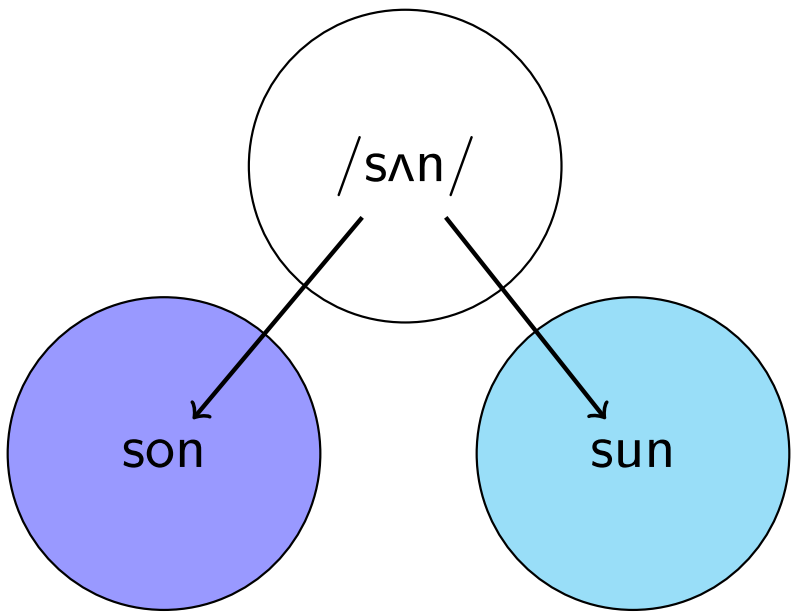
Chelsea Sanker

Linguistic Society of America
Salt Lake City, Utah

6 January 2018

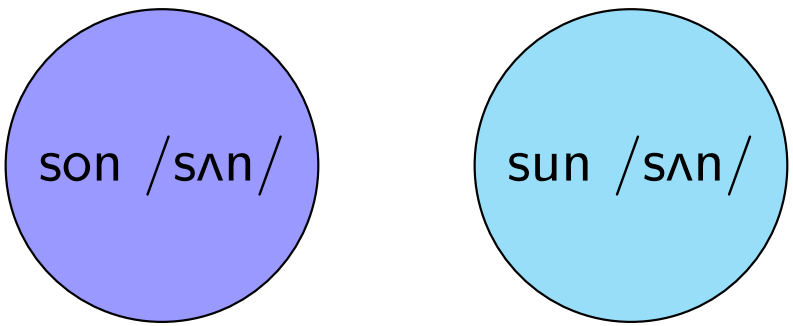
Lexical storage of homophones

- Do homophones have shared phonological representations?



Lexical storage of homophones

- Do they have independent lexical entries that happen to have identical phonological representations?



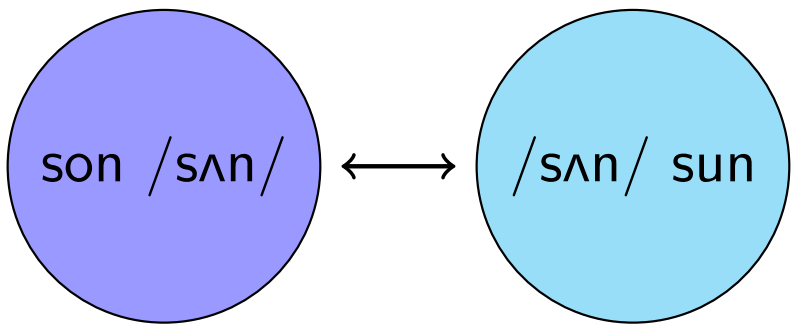
Lexical storage of homophones

Evidence for separate phonological entries:

- Distinct frequency effects in lexical access (e.g. Caramazza et al. 2001, Simpson & Burgess 1985, Grainger et al. 2001)
- Weak or absent priming between homophone mates (e.g. Schvaneveldt et al. 1976, Masson & Freedman 1990)
- Phonetic differences, based on frequency and part of speech (Gahl 2008, Guion 1995)

Lexical storage of homophones

- There is evidence for influence of homophones on each other (e.g. Jescheniak & Levelt 1994)
- But they could interact without having shared representations



This study

An AX discrimination task, to determine:

- How listeners' knowledge of homophones influences interpretations of phonological forms
- Listeners' sensitivity to acoustic details, particularly as potential cues for discriminating between homophone mates

Listeners

- 23 native speakers of American English (mean age 21.6; 7 male)
- No reported speech or hearing disorders

Same-Different Task

- Listeners heard pairs of words and pressed a button to decide whether they were the **same** or **different**
- Counter-balanced for right-left responses
- Response time measured from the beginning of the second word

Stimuli

- Words produced in isolation, in randomized order, recorded in a sound-attenuated booth
- Five types of pairs
  1. homophone-homophone pairs (e.g. *sun-son*)
  2. same pairs for a word with a homophone (e.g. *sun-sun*)
  3. same pairs for a word with no homophone (e.g. *cat-cat*)
  4. different pairs, with a single segmental contrast (e.g. *pat-cat*)
- The ratio of apparent 'same' pairs (1-3) to 'different' pairs (4) was equal
- Two speakers; in all word-pairs, the two words were from different speakers

Blocks

- Within a block, differences were always in the same position: Onset (e.g. *pat-cat*), nucleus (e.g. *kit-cat*), coda (e.g. *cap-cat*)
- Each listener completed three blocks, one of each contrast type
- Block order was balanced across participants

Hypotheses: Lexical influence

- Hypothesis 1: Homophones are processed as lexically distinct items, even in non-semantic tasks, and thus will act like competitors in processing
- Counter-Hypothesis 1: Homophones have shared phonological representations, and will behave as a single unit rather than competitors

Hypotheses: Phonetic detail

- Hypothesis 2: Listeners are sensitive to non-contrastive acoustic detail (cf. E.g. Babel & Johnson 2010), and will accordingly respond more quickly and with higher accuracy to phonologically identical pairs that are more acoustically similar
- Counter-Hypothesis 2: Listeners are not influenced by non-contrastive acoustic detail, and thus their response patterns will not be influenced by acoustic distance between items of a pair

Linear mixed effects model for log response times, excluding *different* pairs

	Estimate	Std. Error	t value	p value
(Intercept)	1.3e-01	4.5e-02	2.9	0.0065**
Type Non-hom	-8.7e-02	2.7e-02	-3.2	0.0012**
Type Hph-Hph	-3.5e-02	3.0e-02	-1.2	0.24
ContrastType C	5.5e-02	8.7e-03	6.3	< 0.001***
ContrastType O	-1.2e-02	8.6e-03	-1.3	0.18
Response 'same'	-1.6e-01	2.3e-02	-6.8	< 0.001***
TypeNon-hom:ResponseSame	1.0e-01	2.8e-02	3.7	< 0.001***
TypeHph-Hph:ResponseSame	4.0e-02	3.2e-02	1.2	0.21

Intercept: Type = Same hom; ContrastType = N; Response = 'different'

Contrast type

- Significant differences in mean response time based on contrast type in *different* pairs ($p < 0.001$ for all comparisons)
- Also significant in phonologically non-contrastive items for coda blocks vs. others ($p < 0.001$), but not between onset and nucleus blocks ($p = 0.18$)

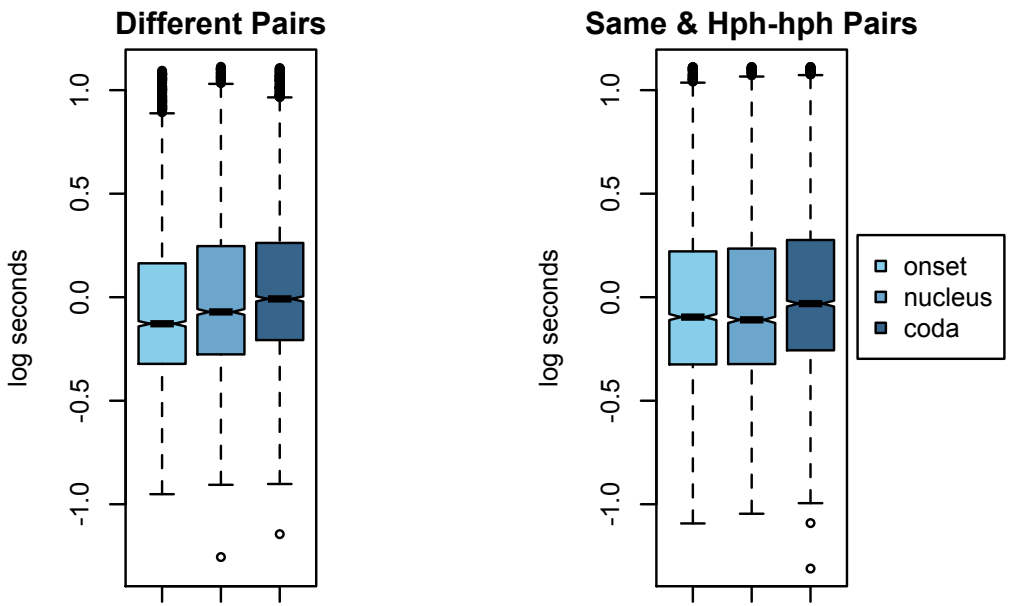


Figure: Response Times by Contrast Type

Homophone mate pairs: Same or different?

Hph-hph pairs patterned like same pairs:

- The majority of responses were 'same' (89.3%; 90.2% for *same* pairs and 4.0% for *different* pairs)
- 'same' responses were significantly faster than 'different' responses (1044 ms vs. 1469 ms, $p < 0.001$), paralleling faster responses of 'same' for same pairs (1058 ms vs. 1354 ms, $p < 0.001$)

Decision patterns by pair type

- Lexically unambiguous (*cat-cat*) *same* pairs were identified as 'same' more frequently (91.1%) than lexically ambiguous (*sun-sun*) *same* pairs (88.3%) or hph-hph (*sun-son*) pairs (89.3%); the latter two types did not differ

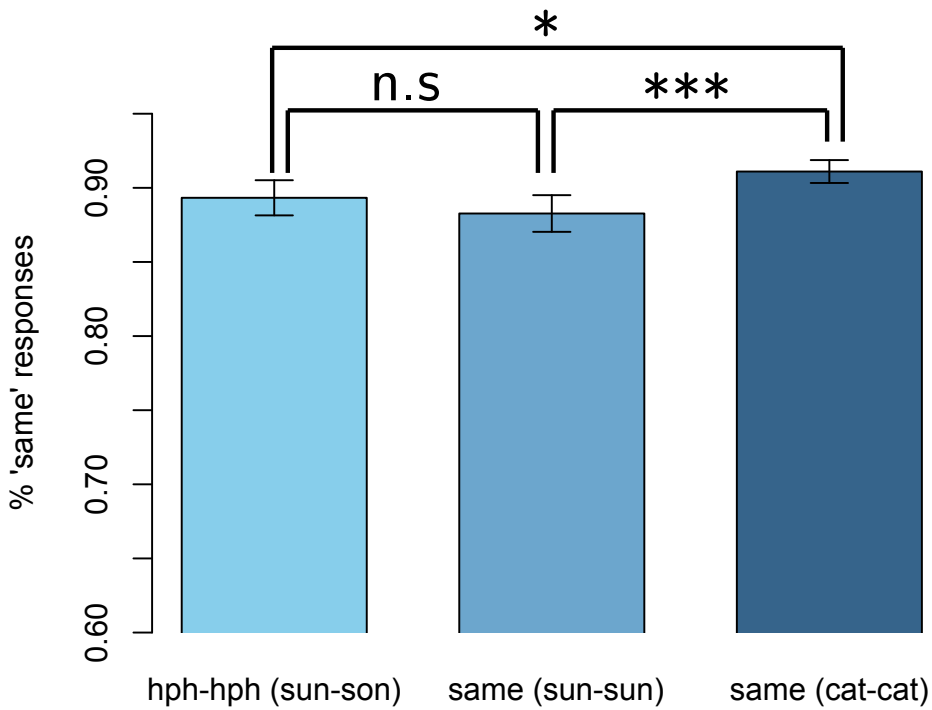


Figure: % 'same' Responses by Type

Response times by pair type

- Response times exhibited the same pattern as responses, largely due to speed of 'different' responses

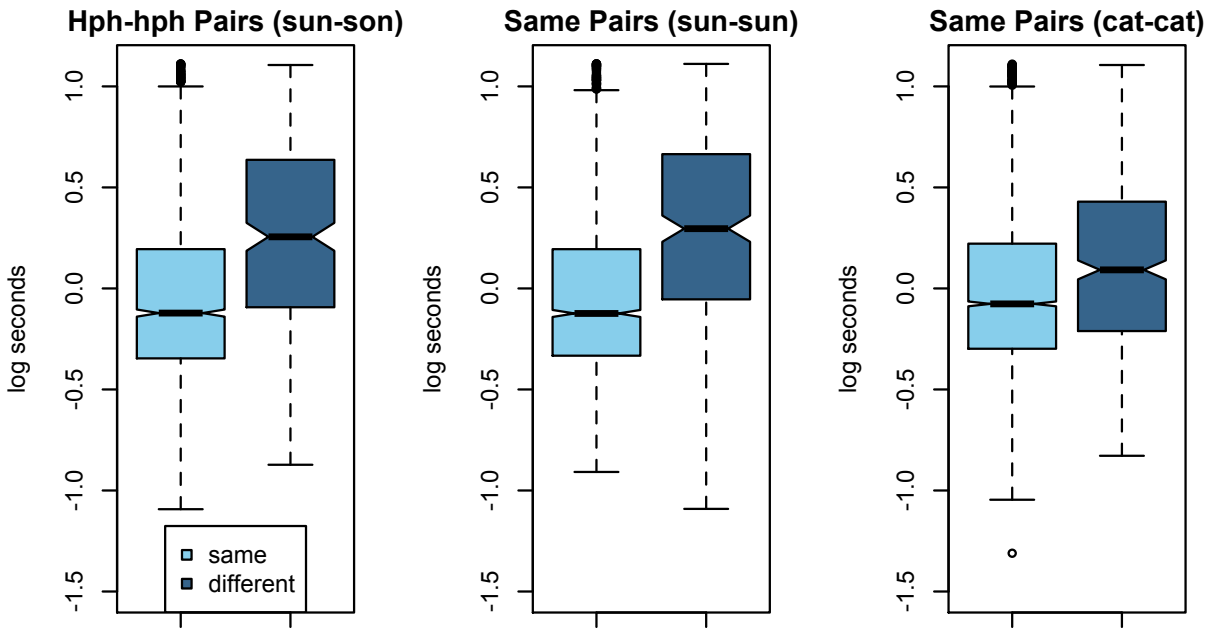


Figure: Response Time by Type and Response

Lexically ambiguous phonologically matching pairs

- Hesitance to identify the same word as 'same' when it was a word for which a homophone exists may reflect uncertainty about whether homophones are identical or just close phonological neighbors
- cf. slower responses for words with high neighborhood density (e.g. Vitevitch & Luce 1999)

Frequency: *same* pairs

- Response time was negatively correlated with word frequency in same pairs (*sun-sun*, *cat-cat*): r(248) = -0.16, p = .01

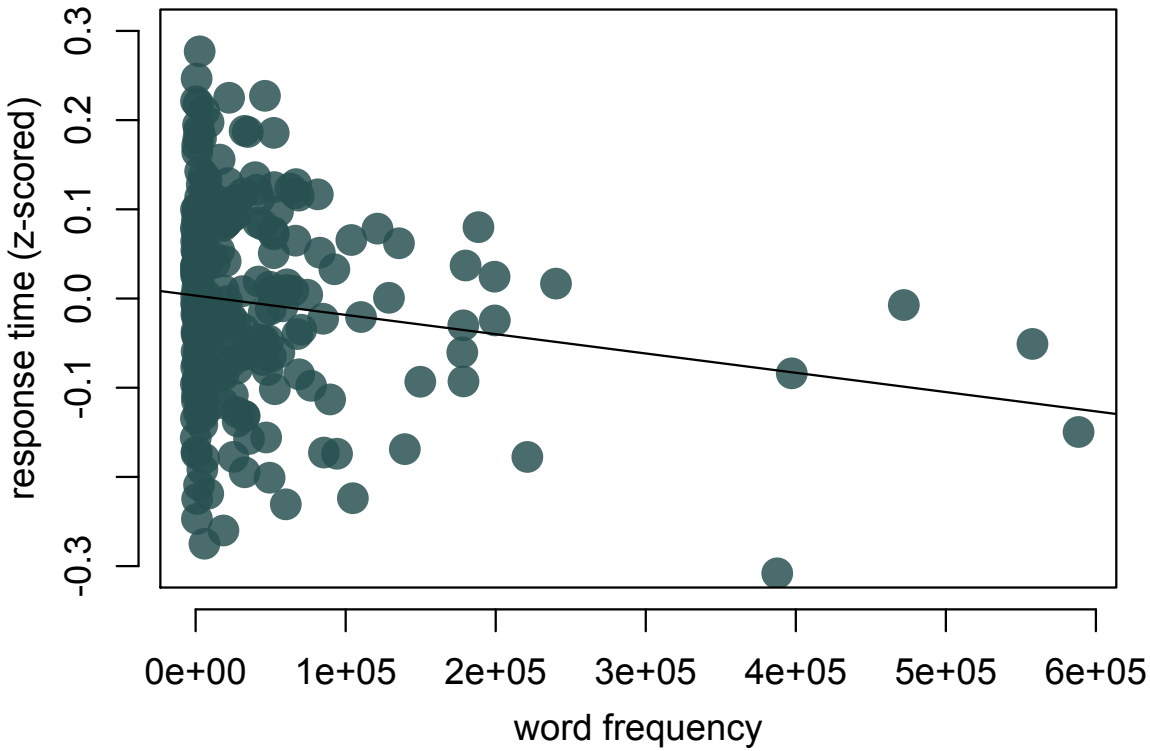


Figure: Response Time by Word Frequency, All *Same* Pairs

Frequency: Lexically unambiguous *same* pairs

- The correlation between response time and frequency was weaker considering only lexically unambiguous pairs (*cat-cat*): r(170) = -0.083, p = 0.28
- May in part reflect duration differences in production, though the correlation between response time and word duration did not reach significance: r(170) = 0.11, p = 0.15
- The correlation between word duration and frequency was also weak: r(170) = -0.086, p = 0.26

Frequency: Lexically ambiguous *same* pairs

- The correlation between response time and frequency was strongest among words with homophones (*sun-sun*): r(78) = -0.22, p = 0.045
- Likely reflects duration differences in production, given that listeners could not discriminate between homophone mates
- There was a positive correlation between response time and word duration: r(78) = 0.26, p = 0.016
- Among words with homophones, there was a negative correlation between word duration and frequency: r(78) = -0.21, p = 0.056

Neighborhood density: Lexically ambiguous items

- Negative correlation between neighborhood density and response time among lexically ambiguous items ($r(158) = -0.29$, $p < 0.001$)

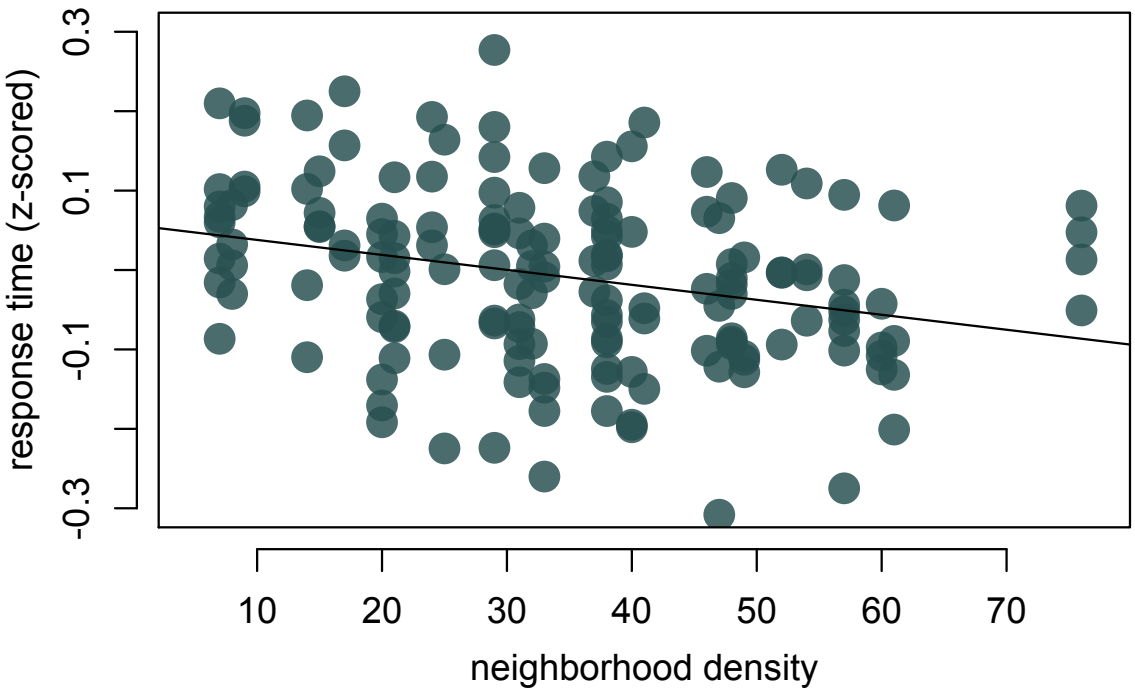


Figure: Response Time by Neighborhood Density

Neighborhood density

- The result for lexically ambiguous items is counter to competition-based explanations of inhibitory neighborhood density effects in other tasks
- Might suggest that more neighbors facilitate faster evaluation of phonological category contrasts in that region due to greater representation
- Weaker correlation among lexically unambiguous items ($r(170) = -0.092$, $p = 0.23$)

Acoustic details: Lexically ambiguous pairs

- Acoustic differences between items had a consistent positive correlation with response time for lexically ambiguous phonologically matching pairs
- Though it only reached significance in some measures

	F0 mean	F0 range	vowel dur.	spectral tilt
hph-hph (*sun-son*)	0.28**	-0.0085	0.13	0.35***
same, hph (*sun-sun*)	0.091	-0.0054	0.045	0.15

Table: Acoustic Correlations with RT

Acoustic details: Lexically unambiguous pairs

- This trend was not present in lexically unambiguous pairs
- Suggests that attention to these details is mediated by listeners expecting differences

	F0 mean	F0 range	vowel dur.	spectral tilt
same, non-hph (*cat-cat*)	0.071	0.011	0.032	0.045

Table: Acoustic Correlations with RT

Lexical Models

- Homophones must be stored as separate lexical items, along with separate phonological entries
- Having separate phonological entries creates some uncertainty about phonological contrasts, resulting in slower decisions and more 'different' responses to lexically ambiguous pairs

Frequency and neighborhood density

- Frequency is negatively correlated with response time, but likely only as a result of the correlation between frequency and word duration
- Negative correlation between neighborhood density and response time – phonological contrasts benefit when supported by lexical contrasts

Attention to detail

- At least when evaluating words produced in isolation, listeners are more influenced by phonological contrasts than phonetic details
- However, greater acoustic distance in multiple measures is correlated with response time, for lexically ambiguous items

References

Babel, M., & Johnson, K. 2010. Accessing psycho-acoustic perception and language-specific perception with speech sounds. *Laboratory Phonology*, 1, 179–205.

Caramazza, A., Costa, A., Miozzo, M., & Bi, Y. 2001. The specific-word frequency effect: Implications for the representation of homophones in speech production. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 27(6), 1430–1450.

Gahl, S. 2008. Time and thyme are not homophones: The effect of lemma frequency on word durations in spontaneous speech. *Language*, 84(3), 474–498.

Grainger, J., Van Kang, M., & Segui, J. Cross-modal repetition priming of heterographic homophones. *Memory & Cognition*, 29(1), 53–61.

Guion, S. 1995. Word frequency effects among homonyms. *Texas Linguistic Forum*, 35, 103–116.

Jescheniak, J., & Levelt, W. 1994. Word frequency effects in speech production: Retrieval of syntactic information and of phonological form. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 20(4), 824–843.

Masson, M., & Freedman, L. 1990. Fluent identification of repeated words. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 16(3), 355–373.

Schvaneveldt, R., Mayer, D., & Becker, C. 1976. Lexical ambiguity, semantic context, and visual word recognition. *Journal of Experimental Psychology: Human Perception and Performance*, 2(2), 243–256.

Simpson, G., & Burgess, C. 1985. Activation and selection processes in the recognition of ambiguous words. *Journal of Experimental Psychology: Human Perception and Performance*, 11(1), 28–39.

Vitevitch, M., & Luce, P. 1999. Probabilistic phonotactics and neighborhood activation in spoken word recognition. *Journal of Memory and Language*, 40, 374–408.