

CHARACTERIZING CONTRASTS: FEATURES VS. ACOUSTIC DISTANCE

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26TH MANCHESTER PHONOLOGY MEETING

Background

- Does perception provide evidence for distinctive features *per se*?
- Some work has found evidence for abstract features in consonants, going beyond acoustic similarity (e.g. Studdert-Kennedy et al. 1972)
- Consonants are perceived highly categorically, while vowels can have more continuous patterns (e.g. Fry et al. 1962; Pisoni 1973)
- Vowels do not exhibit the same effects of having shared features (e.g. Blumstein 1974)

Methodology

- Same-different task for pairs of English words (48 listeners, native English speakers)
- Two conditions (24 participants in each):
 - (1) maximizing trials for each word pair (mean = 21.6), with fewer pairs
 - (2) maximizing number of pairs, with fewer trials for each (mean = 8.0)
- Three blocks: within a block, phonological contrasts were consistently in the same position: onsets (e.g. *fan-pan*), nuclei (e.g. *lake-lack*), or codas (e.g. *sum-sun*)
 - Pairs differing in number of segments were excluded from analysis (i.e. diphthongs vs. monophthongs, clusters vs. single consonants)
- The items in all pairs differed by speaker (i.e. testing type contrasts, not token contrasts)

Vowel Contrasts

Table 1: Correlations of acoustic and featural distance with RT and accuracy: Nuclei

Condition 1 (n = 73) Correlations	Condition 2 (n = 358) Correlations	
	RT	accuracy
F1-F2 Euclid. Dist.	-0.20	0.34***
Featural Dist.	-0.14	0.12

- Acoustic distance was a stronger predictor than featural distance for response time and accuracy
- Both response time and accuracy were significantly correlated with Euclidean distance between the F1 and F2 values of the paired items
- Correlations with featural distance had a weak trend in the expected direction, as is predicted by the acoustic grounding of features (Correlation between acoustic distance and featural distance, Condition 1: $r(71) = 0.46$, $p < 0.001$; Condition 2: $r(356) = 0.48$, $p < 0.001$)

Figure 1: Condition 1 correlation between response time and featural distance (green) and acoustic distance (pink)

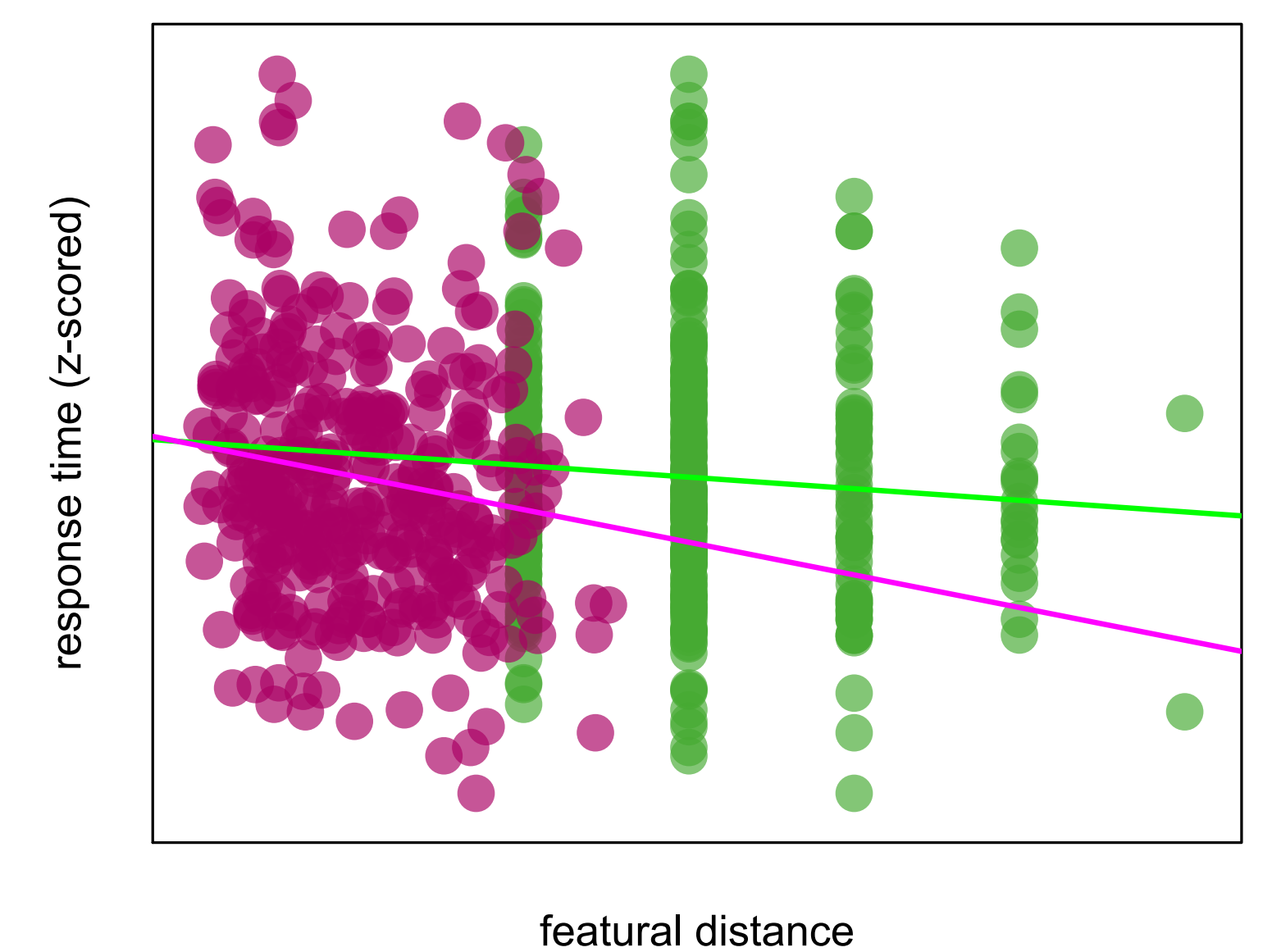
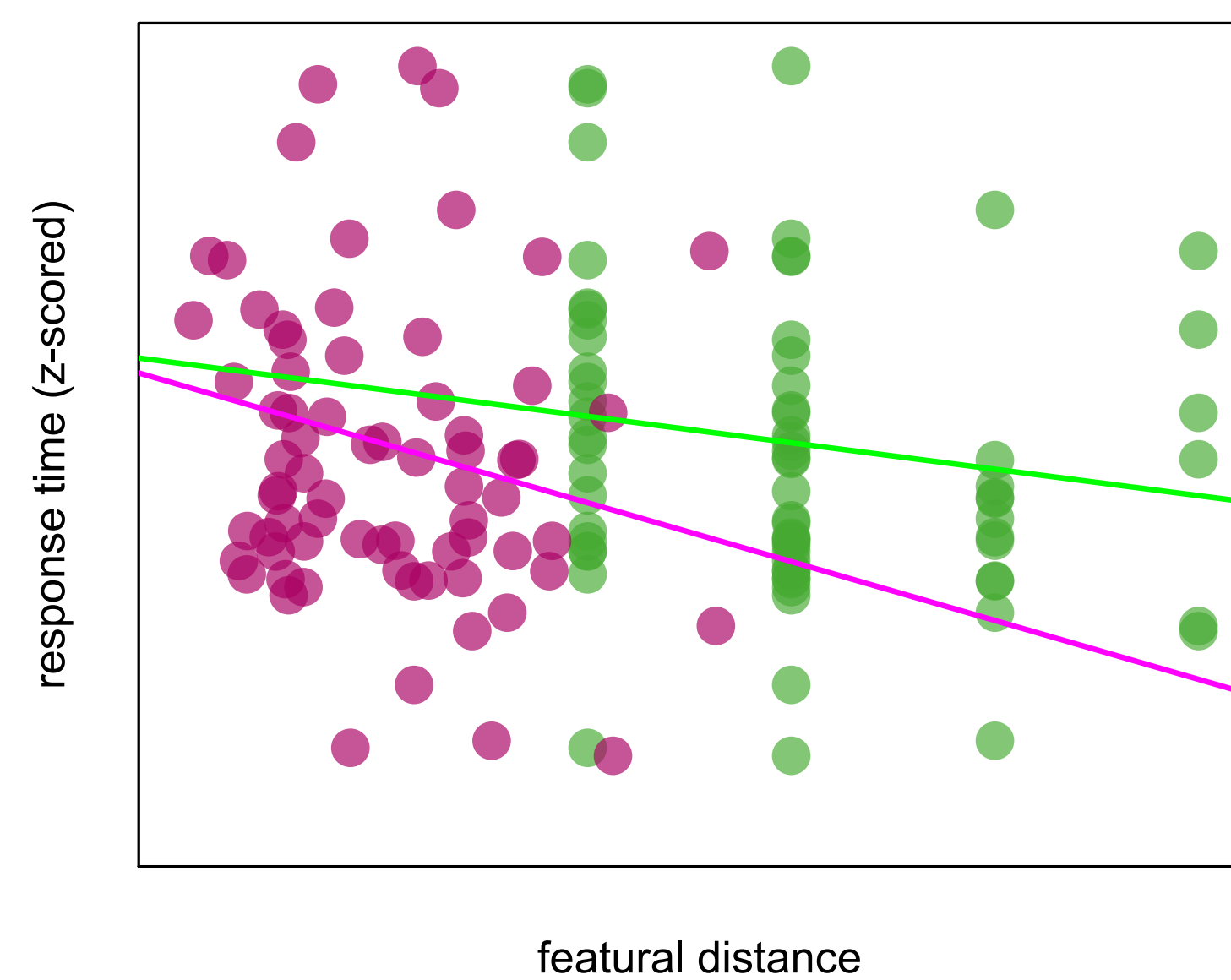


Figure 2: Condition 2 correlation between response time and featural distance (green) and acoustic distance (pink)

Consonant Contrasts

Figure 1: Condition 1 correlation between featural distance and response time (onsets (blue): $r(68) = -0.23$, $p = 0.049$; codas (red): $r(62) = -0.27$, $p = 0.025$)

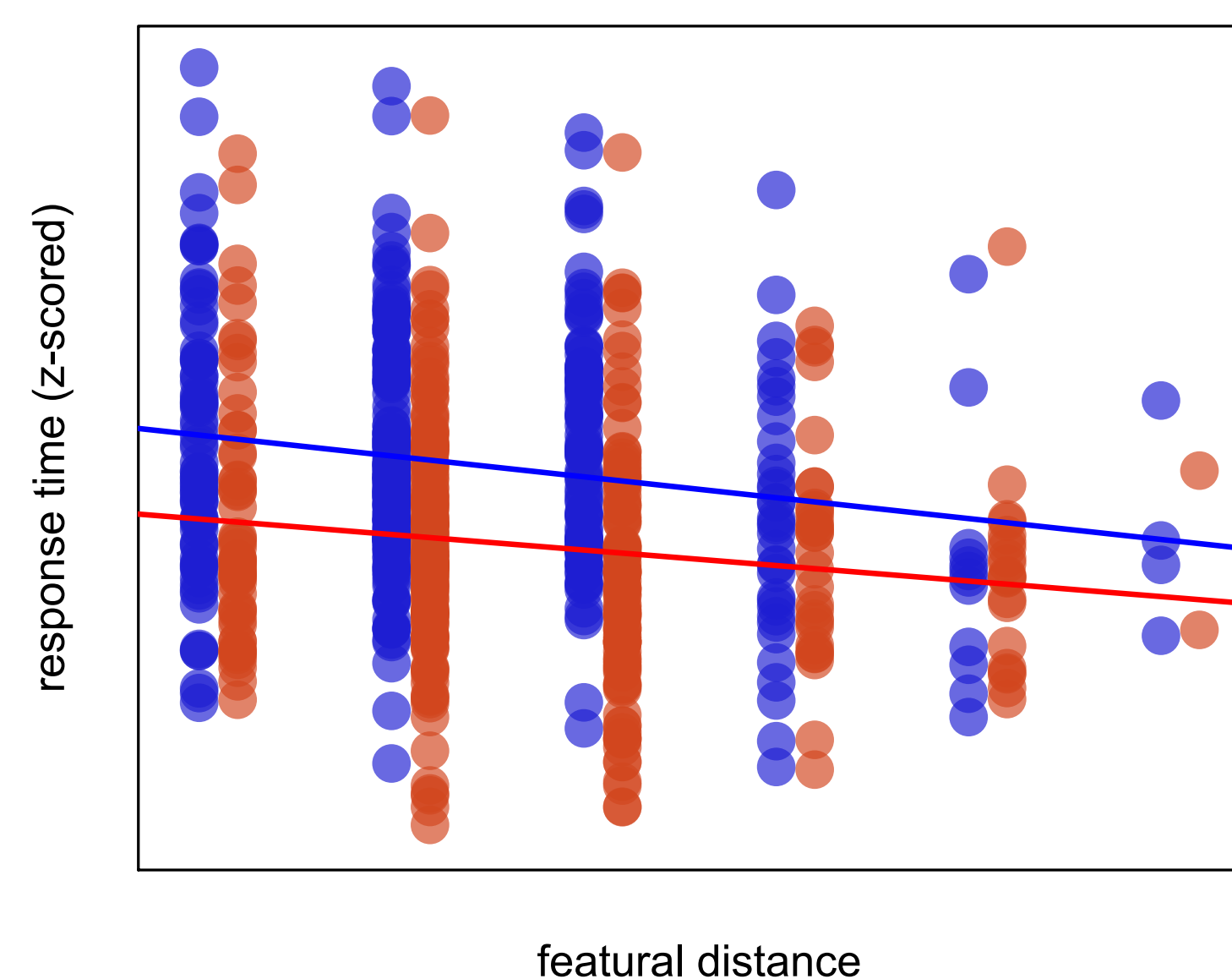
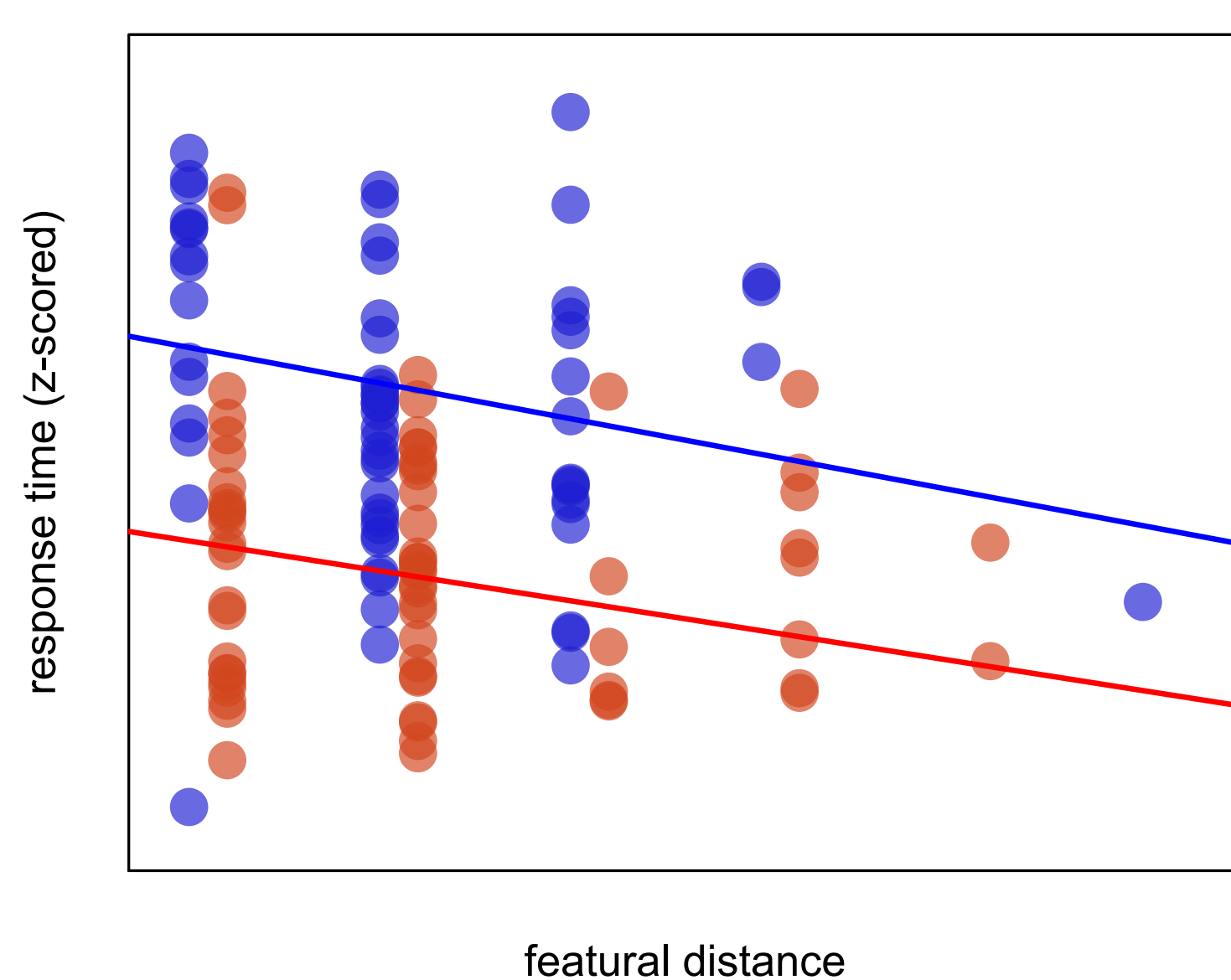


Figure 2: Condition 2 correlation between featural distance and response time (onsets (blue): $r(326) = -0.14$, $p = 0.01$; codas (red): $r(353) = -0.18$, $p < 0.001$)

Listeners made faster decisions when the two items differed in more features

Greater featural distance was also correlated with higher accuracy, though less consistently:

Condition 1: Onsets, $r(68) = -0.041$, $p = 0.74$; Codas, $r(62) = 0.19$, $p = 0.13$

Condition 2: Onsets, $r(326) = 0.22$, $p < 0.001$; Codas, $r(353) = 0.095$, $p = 0.073$

Beyond how many features distinguished a pair, the particular features also mattered (e.g. slower responses for contrasts of [+voice] than of [+continuant]), suggesting a limitation of equating features

Categoricity

Despite the correlation between acoustic distance and accuracy across pairs, responses were generally categorical

'same' responses for these phonologically distinct pairs (6.2% and 4.2%, in each condition) were infrequent

In comparison, 'same' responses for phonologically matching pairs were very frequent (93.7% and 89.3%)

Conclusions

- For consonantal contrasts, response time and accuracy were both correlated with featural distance between paired items

- But neither response time nor accuracy was significantly correlated with featural distance between paired items with a vowel contrast; they were correlated with acoustic distance

- These patterns suggest different encoding of vowel and consonant contrasts

- Perceptual differences by feature within consonants indicate an issue in featural comparison

Selected References

Blumstein, S. (1974). The use and theoretical implications of dichotic technique for investigating distinctive features. *Brain and Language*, 1: 337-350.

Fry, D.B., Abramson, A.S., Eimas, P.D., & Liberman, A.M. (1962). The identification and discrimination of synthetic vowels. *Language and Speech*, 5(4): 171-189.

Pisoni, D.B. (1973). Auditory and phonetic memory codes in the discrimination of consonants and vowels. *Perception & Psychophysics*, 13(2): 253-260.

Studdert-Kennedy, M., Shankweiler, D. & Pisoni, D. (1972). Auditory and phonetic processes in speech perception: Evidence from a dichotic study. *Cognitive Psychology*, 3: 455-466.