



2pSC18. The relation between focus effects in production and exemplar locations in perception for stop types in English, Japanese, and Korean.

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Main Points

1. Having a difference in production does not indicate the degree to which that difference is utilized in perceptual classification.
2. The presence or absence of lexical focus effects in production is an inconsistent indicator of cues used in perception.

Background

Multiple Acoustic Dimensions

- Different languages can manifest phonologically similar contrasts in phonetically different ways (Shimizu, 1989).

English, Japanese, and Korean Labial Stops

- **English:** 2 categories (p/b). Voice Onset Time (VOT) considered primary cue (Lisker and Abramson, 1964).
- **Japanese:** 2 categories (p/b). Closely spaced VOT distributions with consistent F0 differences reported (Shimizu, 1989).
- **Korean:** 3 categories (fortis/lenis/aspirated). Overlapping VOT distributions and F0 differences reported (Han & Weitzman, 1970; Shimizu, 1989).

Lexical Focus

- Can be used as a diagnostic tool for identifying contrastive acoustic dimensions (de Jong & Zawaydeh, 2002).

Research Questions

1. What acoustic cues do listeners use for determining best exemplars?
2. How does perceptual usage relate to differences between categories in production?
3. How does lexical focus effect the production of the primary cues used for perception?

Method: Perception Experiment

Subjects

- 3 native-speakers each of English, Japanese, and Korean

Test Stimuli

- Six-dimensional stimulus space containing 229,075 stimuli:

Dimension:	VOT	F0 Register	F0 Initial Contour	Vowel Amplitude Contour ("Ramp")	Formant Transitions	Burst Strength
# of steps:	17	7	5	11	7	5
Range of values	-40 ms prevoicing to 40 ms aspiration	60% to 130% of residual contour after subtracting minimum value	Initial value of -40 to 40 Hz relative to register start point	Initial value from 0.0 to 1.0 of vowel midpoint intensity (rms)	0 to 30 ms removed	0.25 to 0.45 vowel midpoint intensity (rms)

Task: AMBEL

- Regions of best exemplars and sensitivities to stimulus dimensions were identified using AMBEL (Oglesbee & de Jong, 2007).

Method: Production Experiment

Subjects

- Same participants as perception experiment (non-focus data only available for 2 subjects per language)

Elicitation Procedure

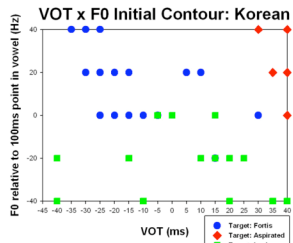
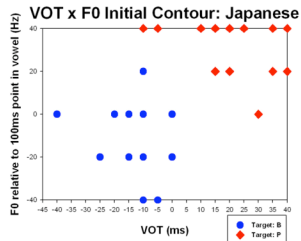
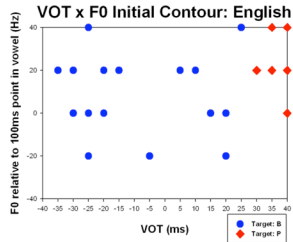
- For each language, two frame sentences elicited non-focus and focused productions of a set of test words (15 productions per category for English/Japanese; 24 for Korean).

Acoustic Measurements

- VOT: voicing lag measured (ms) from burst release until onset of periodic voicing
- F0 Register/Contour: Measured from vowel onset in 10ms intervals.
- Ramp: Intensity (rms) in first half of vowel measured relative to vowel midpoint.

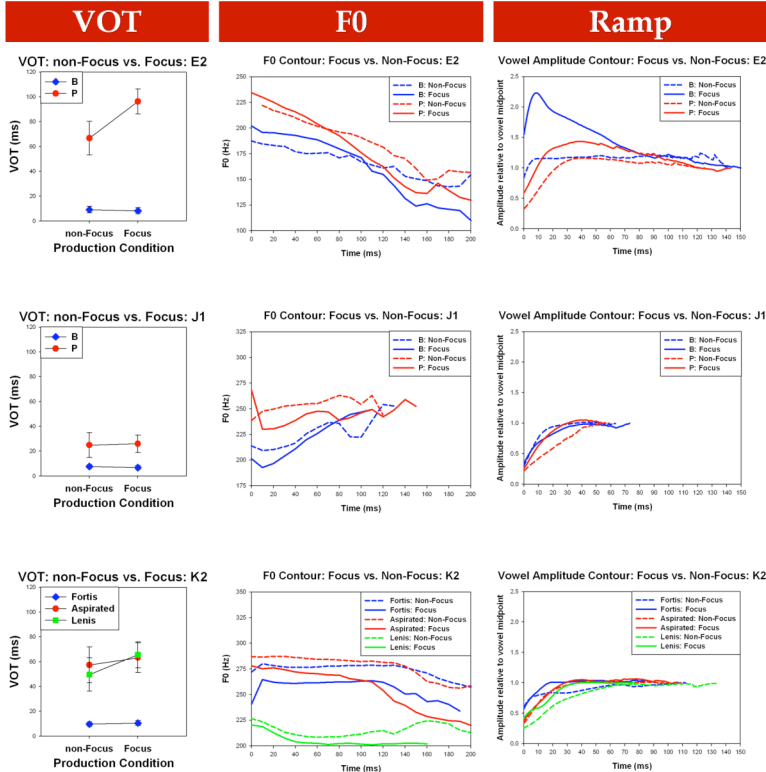
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Results: Perception



Destination Point Plots: Each point indicates the final values of an AMBEL search for the VOT and F0 initial contour dimensions (data is collapsed across the other 4 dimensions). Results are pooled across 3 speakers.

Results: Production



VOT: VOT was measured as the time interval between the burst release and the onset of low-frequency periodicity in the waveform. Each figure is for a representative subject, indicating performance in non-focus and focus conditions. Error bars indicate one standard deviation.

Average F0 contours: Each contour shown is an average contour across all productions in a given condition. F0 measurements were taken using the pitch contour plot in Wavesurfer at 10 ms intervals. Solid lines indicate focused productions; dashed lines indicate non-focused items.

Average ramp contours: Each contour shown is an average contour across all productions in a given condition. RMS amplitude was calculated using a 20 ms Hamming window shifted in 1 ms increments. The plots display the measured RMS amplitude for each time stamp relative to the RMS amplitude of the vowel midpoint.

Results: Focus Effect Summary

Subject Code	VOT		F0 Register		F0 Initial Contour		Ramp	
	E1	E2	E1	E2	E1	E2	E1	E2
Sensitivity	1.43	0.83	0.07	0.11	0.54	0.39	0.28	0.62
Separable Non-Focus	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Focus Effect	=	+	=	-	-	+	=	+

Subject Code	VOT		F0 Register		F0 Initial Contour		Ramp	
	J1	J2	J1	J2	J1	J2	J1	J2
Sensitivity	0.10	0.44	0.32	0.68	0.75	1.07	0.02	0.00
Separable Non-Focus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Focus Effect	=	=	=	=	+	+	-	+

Subject Code	VOT		F0 Register		F0 Initial Contour		Ramp	
	K1	K2	K1	K2	K1	K2	K1	K2
FORTIS vs. LENIS								
Sensitivity	0.47	0.22	0.57	1.41	0.87	0.47	0.02	0.11
Separable Non-Focus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Focus Effect	+	+	=	-	=	=	-	=

Subject Code	VOT		F0 Register		F0 Initial Contour		Ramp	
	K1	K2	K1	K2	K1	K2	K1	K2
FORTIS vs. ASPIRATED								
Sensitivity	0.87	1.75	0.17	0.43	0.39	0.03	0.03	0.02
Separable Non-Focus	Yes	Yes	No	Yes	No	No	No	Yes
Focus Effect	+	=	+	=	+	+	=	=

Subject Code	VOT		F0 Register		F0 Initial Contour		Ramp	
	K1	K2	K1	K2	K1	K2	K1	K2
LENIS vs. ASPIRATED								
Sensitivity	0.40	1.53	0.74	0.98	1.26	0.50	0.05	0.09
Separable Non-Focus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Focus Effect	+	-	=	=	=	=	-	-

Dimensional sensitivity: In addition to identifying best exemplar locations in a multidimensional space, AMBEL indicates how sensitive a listener is to a stimulus dimension for a given categorical contrast. The sensitivity scale ranges from 0.0 to 2.0.

Separable non-focus: The separability of production dimensions in non-focused productions was determined by inspection.

Focus effect: "+", "=", and "-" are used to mark whether or not focus induced an expansion (+), contraction (-), or no change (=) in separability of production dimensions. Effects were determined by inspection.

Discussion

1. Perception

- Best exemplar locations are consistent with what would be expected from previous production data.
- F0-to-VOT relationship for b/p in Japanese is opposite of fortis/lenis in Korean.

2. Production

- Production results consistent with previous studies.
- Based on separability, it is not obvious which cues predominate in perception.

3. Focus

- Focus effects sometimes mirror perceptual sensitivities (J1 & J2); however, this varies considerably from subject to subject (E1 & E2).
 - This means that focus induced production variability (or lack thereof) is not a consistent predictor of perceptual cues.
- Just because something is consistently different in production, that does not mean it is important for perception.

See Handout for References

REFERENCES

- de Jong, K.J. & Zawaydeh, B. (2002) Comparing stress, lexical focus, and segmental focus: patterns of variation in Arabic vowel duration, *Journal of Phonetics*, **30**, 53-75
- Han, M.S. & Weitzman, R.S. (1970) Acoustic features of Korean /p, t, k/, /p', t', k'/, and /b', t', k'/, *Phonetica*, **22**, 112-128.
- Lisker, L. & Abramson, A.S. (1964) A cross-language study of Voicing in initial stops: Acoustical measurements, *Word*, **20**, 384-422
- Oglesbee, E. & de Jong, K. (2007) Searching for best exemplars in multidimensional stimulus spaces, *J. Acoust. Soc. Am.* **122** (4), EL101 – EL106.
- Shimizu, K. (1989) A Cross-Language Study of Voicing Contrasts of Stops, *Onsei kagaku kenkyu Vol. 23*, 1 – 12.