

Allophonic Space of Malay Vowels

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In this presentation I present a novel acoustic study on the allophonic variation of vowels in Malay within the frameworks of Dispersion Theory and Contrast Preservation Theory. Dispersion Theory asserts that the vowel inventories of languages are arranged such that the distances in acoustic measurements of vowels provide maximized contrast between the vowels (Lindblom 1975). While the vocalic space is maximally contrasted within an inventory, phonemes are defined through minimal contrast in specific environments (i.e. minimal pairs). Contrast Preservation Theory indicates that the maintaining of contrast is an independent property of grammar (Flemming 1995; Lubowics 2003). Within Contrast Preservation, when one sound changes there may be secondary affects that preserve underlying contrast. In Malay there are four phonological processes that show three patterns of allophony. The peripheral vowels are affected by the four processes listed below; the first three also manifest in Indonesian (McCloy 2011) and the fourth is previously unattested in Indonesian or Malay.

1. /u/ → [o]/_C]_σ : /u/ lowers to [o] in non-initial closed syllables.
2. /i/ → [e]/_C]_σ : /i/ lowers to [e] in non-initial closed syllables.
3. /a/ → [ə]/_# : /a/ raises to [ə] word finally.
4. /a/ → [ɛ]/_ [+ant -cont]_σ : /a/ fronts and raises to [ɛ] before alveolar stop codas.

Two questions are addressed: 1. Do the variants of the peripheral vowels in processes 1, 2, and 3 occupy the acoustic space of the respective mid vowels? 2. What is the space that the variant of process 4 occupies? Taking into consideration Contrast Preservation Theory, it is hypothesized that the space of the variants will not be identical to the mid vowel because of a pressure to preserve the underlying contrast. The findings however indicate three patterns in the dispersion of variants. This novel investigation into the interface between Dispersion Theory and Contrast Preservation provides a mapping of the Malay vowel space and addresses the allophonic variations in Malay.

Words containing all phonemes and environments for allophonic variation were elicited from a native Malay speaker from Selangor, Malaysia. Over 600 vowel tokens were collected and analyzed in Praat (Boersma and Weenink 2014) using the fromant_logger script by Mietta Lennes. The measurements of the vowel tokens were charted to map the vowel space of Malay. The mean F1 and F2 measurements for each vowel given in Figure 1 are comparable to previous studies on the vowels in dialects of Indonesian (Zanten and van Heuven 1984).

Figure 1: Mean measurements for all vowels.

Mean (Hz)	a	e	i	o	u	ə
F1	712	424	395	468	395	476
F2	1392	2586	3977	998	1118	1959

Each contrastive vowel category maintains a particular space in the mapping with a little overlap in the spatial boundaries. The preliminary results reveal that the variants of the peripheral vowels pattern in three ways:

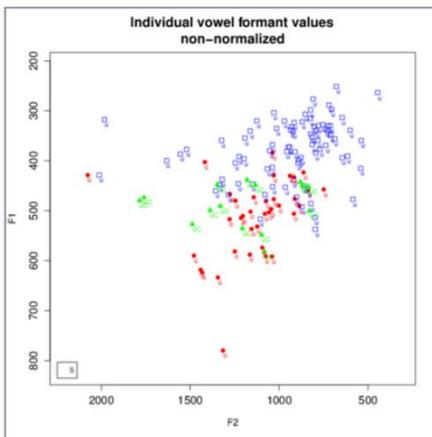
- A. Neutralizing to the boundary of contrastive vowels: the variant of /u/ occupies the space overlapping the boundary of contrastive /u/ and /o/. (Figure 2)
- B. Neutralizing to an existing vowel: the variant of /i/ in allophonic environments occupies the same acoustic space as /e/ and the [ə] variant of /a/ occupies the same space as /ə/. (Figures 3 and 4 respectively)

C. Shifting to an unattested vowel space: the variant of /a/ in the environment with an alveolar-stop coda occupies a space separate from the other vowels. (Figure 4)

The first pattern in the results (A) indicates that contrast is somewhat preserved between the underlying phonemes and the surface representation /u/ in allophonic environments. Pattern B does not follow the hypothesis and contrast is neutralized for variants of /i/ and word final /a/. Pattern C is interesting because the acoustics of this variant of /a/ occupies a distinct space that it is not in the general space of any particular phoneme.

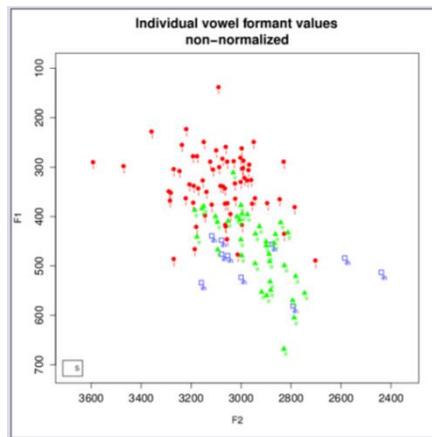
This novel acoustic study displays a variation in the locations of the acoustic space for allophonic variants. The results for pattern A and C support the hypothesis for contrast preservation but result pattern B does not. This leads to questions of why the variants behave differently. McCloy (2014) suggests that morphological boundaries may affect the production of vowels in Indonesian. Macdonald (1976) suggests possible harmony patterns in vowels in penultimate and final syllables in Indonesian. These two possible effects on vowels need to be investigated. Expansions on this preliminary study will compare the acoustics of the variants in root words to words derived with morphemes and will also take into account the other vowels within the word; this will test if morpheme boundaries have an effect on the realization of vowels and if some form of vowel harmony occurs. This study of allophones in Malay is the first step in investigating the interface of Dispersion Theory and Contrast Preservation; this study also provides a map of the vowel space of Malay which has not been given before.

Figure 2: Mapping of /u/ and /o/



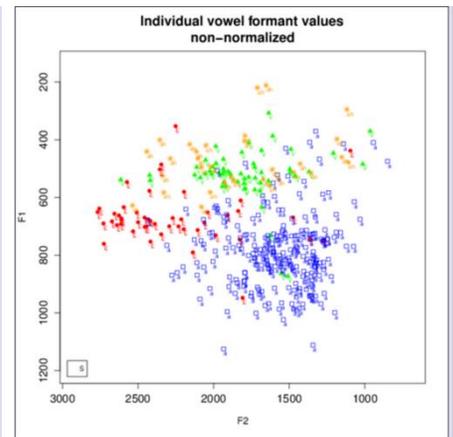
/i/ -> [i] - red
 /i/ -> [e] - blue
 /e/ -> [e] - green

Figure 3: Mapping of /i/ and /e/



/a/ -> [a] - blue
 /a/ -> [ə] - green
 /a/ -> [ε] - red
 /ə/ -> [ə] - orange

Figure 4: Mapping of /a/ and /ə/



Selected References:

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