

## Phonetic Implementations of Pohnpeian Long Vowels

This paper investigates phonetic properties of Pohnpeian long vowels. Vowel length in Pohnpeian is distinctive. Thus, vowel length changes the meaning of a word, such as, *kang* /kaŋ/ ‘to eat’ vs. *kahng* /kaŋŋ/ ‘to dislike, to refuse’. Results of production and perception experiments showed that the ratio of the mean duration of long vowels to short vowels corresponded with the categorical threshold of vowel length. Pohnpeian speakers must acquire the ability of distinguishing vowel length correctly from the ambient language.

I have conducted a production experiment using minimal pairs contrasting vowel length of all Pohnpeian vowels. There were 4 participants (2 female and 2 male) who were native speakers of Pohnpeian. One of the female and male participants were in their early 20s and another female and male participants were in their mid 40s. The material used for the production experiment were 20 minimal and near minimal pairs, such as *kid* /kit/ ‘garbage’ vs. *kihd* /kit/ ‘thousand’ and *lus* /lus/ ‘to jump’ vs. *luhs* /lus/ ‘to lose’. Target words were read in a carrier sentence *Ia wehwehn \_\_\_\_\_ ni lokaiahn Pohnpei* /ja wɛ:wɛn \_\_\_\_\_ ni lokajɛn pɔ:npej/ ‘What is the meaning of \_\_\_\_\_ in Pohnpeian?’ at three different speech rates – fast, normal, and slow. All sentences were randomly ordered. Participants read the sentences in a sound attenuated recording studio. All speech samples were digitized at the sampling rate of 22,050 Hz.

The results of a repeated measures 2-way ANOVA show that the mean duration of long vowels was significantly longer than that of short vowels [ $F(1,3) = 179.624, p = .0009$ ] and the vowel duration was also significantly longer in slow speech than in fast speech [ $F(1,3) = 22.123, p = .0183$ ]. The ratio of the mean duration of long vowels to short vowels was 1.54:1.00 in fast speech and 1.81:1.00 in slow speech.

In order to find out the patterns of vowel length perception by Pohnpeian speakers, I conducted a perception experiment. An ABX discrimination test was used for this experiment. The ambiguous stimuli, X were created from a nonsense utterance *epepepepepe*. A three-syllable segment *epepe* was extracted from the utterance. The duration of the second vowel in the segment, which was the target vowel, was manipulated. The duration of the target vowel in the X stimuli was 1.0, 1.30, 1.40, 1.50, 1.54, 1.56, 1.60, 1.68, 1.70, 1.80, and 2.0 times longer than the duration of the original vowel. The duration of target vowel in the A stimulus was the same as the original one (1.0) and 2.0 times longer in the B stimulus. Each trial had a set of 3 stimuli – A, B, and X, and each block had 22 trials. There were 6 blocks and the order of the trials in each block was different from each other. Participants were asked to determine whether the X stimulus was similar or identical to the A stimulus or the B stimulus. They were 25 native speakers of Pohnpeian living in Hawai‘i. However, only data from 11 participants were used for the analysis. The rest of data were discarded due to the low accuracy of categorizations.

The results showed that Pohnpeian speakers would perceive a vowel to be long once the duration of a vowel reached at the level of 1.7 times longer than short vowels [ $\chi^2(1, N = 11) = 21.000, p = .021$ ].

The duration of Pohnpeian long vowels is not necessarily twice as long as short vowels. The ratio of the mean duration of long vowels to short vowels agrees with the threshold of Pohnpeian speakers’ vowel length categorization. Native speakers of Pohnpeian must have acquired the ability to distinguish phonological vowel length from their acoustic environment.

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**Table 1: Material words used for Experiment 1**

| Long vowel l |                                    |                       | Short vowel |  |
|--------------|------------------------------------|-----------------------|-------------|--|
| /a:/         | <i>kahng</i> /ka:ŋ/                | ‘to refuse’           | /a/         | <i>kang</i> /kaŋ/ ‘to eat’                 |
|              | <i>mahs</i> /ma:s/                 | ‘long ago’            |             | <i>aramas</i> /aramas/ ‘person’            |
|              | <i>pahpa</i> /pa:pa/               | ‘father’              |             | <i>pap</i> /pap/ ‘to swim’                 |
|              | <i>sah</i> /sa:l/                  | ‘rope’                |             | <i>lal</i> /la/ ‘to make a sound’          |
| /e:/         | <i>pehi</i> /pe:j/                 | ‘alter’               | /e/         | <i>pei</i> /pej/ ‘to fight’                |
| /ɛ:/         | <i>neh</i> /nɛ:/                   | ‘its leg’             | /ɛ/         | <i>ne</i> /nɛ/ ‘to be distributed’         |
| /i:/         | <i>ihd</i> /i:t/                   | ‘plant (sp.)’         | /i/         | <i>id</i> /it/ ‘to make a fire’            |
|              | <i>kihd</i> /kit/                  | ‘garbage’             |             | <i>kid</i> /kit/ ‘thousand’                |
|              | <i>lih</i> /li:/                   | ‘woman’               |             | <i>lil</i> /li/ ‘to lower a sail’          |
|              | <i>pihl</i> /pi:l/                 | ‘water’               |             | <i>pil</i> /pi/ ‘also’                     |
| /o:/         | <i>dohl</i> /to:l/                 | ‘mountain’            | /o/         | <i>dol</i> /to/ ‘to mix’                   |
| /o:/         | <i>kohri</i> /ko:ri/               | ‘ice’                 | /o/         | <i>korila</i> /ko:ri/ ‘gorilla’            |
|              | <i>tohto</i> /to:to/               | ‘many’                |             | <i>litok</i> /li:to/ ‘hen’                 |
| /ɔ:/         | <i>poahd</i> /pɔ:t/                | ‘individual planting’ | /ɔ/         | <i>poad</i> /pɔt/ ‘to be planted’          |
|              | <i>poahr</i> /pɔ:r/                | ‘to wipe’             |             | <i>poar</i> /pɔr/ (classifier)             |
|              | <i>soahn</i> /so:n/                | ‘wounded’             |             | <i>soan</i> /so:n/ ‘aligned’               |
|              | <i>poahsoan</i>                    | ‘foundation’          |             | <i>poasen kaung</i>                        |
|              | /pɔ:sɔn/                           |                       |             | /pɔ:sɛn kaŋ/ ‘capital’                     |
| /u:/         | <i>luhs</i> /lu:s/                 | ‘to lose’             | /u/         | <i>lus</i> /lus/ ‘to jump’                 |
|              | <i>pwuhng</i> /p <sup>w</sup> u:ŋ/ | ‘rights’              |             | <i>pwung</i> /p <sup>w</sup> uŋ/ ‘correct’ |
|              | <i>uluhl</i> /ulu:l/               | ‘pillow’              |             | <i>lul</i> /lu/ ‘to flame’                 |

**Table 2: Analysis by speakers: Mean duration of vowels and ratio in Experiment 1**

|                     | Long vowel (ms) | Short vowel (ms) | Ratio (Long : Short) |
|---------------------|-----------------|------------------|----------------------|
| Fast speech         | 149.155         | 96.631           | 1.54 : 1.00          |
| Slow speech         | 218.113         | 120.310          | 1.81 : 1.00          |
| Ratio (Fast : Slow) | 1 : 1.46        | 1 : 1.28         |                      |

**Table 3: Chi test: Categorization of X stimuli**

| X stimulus      | PN100 | PN130 | PN140 | PN150 | PN154 | PN156 | PN160 | PN168 | PN170 | PN180 | PN200 |
|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| $\chi^2$        | 21.00 | 11.67 | 8.33  | 9.00  | 18.00 | 11.33 | 11.67 | 18.33 | 21.00 | 19.33 | 22.67 |
| <i>p</i> -value | 0.021 | 0.308 | 0.596 | 0.532 | 0.055 | 0.332 | 0.308 | 0.050 | 0.021 | 0.036 | 0.012 |