The effect of word segmentation and phonological neighbours on spoken word recognition in Mandarin Chinese

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Background

- **Phonological neighbours** (PN) in English are determined based on the **phonemic segmentation of words**
- Mandarin Chinese uses whole syllables as *proximate units* [1]
  - Currently no uniform approach to count PN in Mandarin Chinese yet [2]

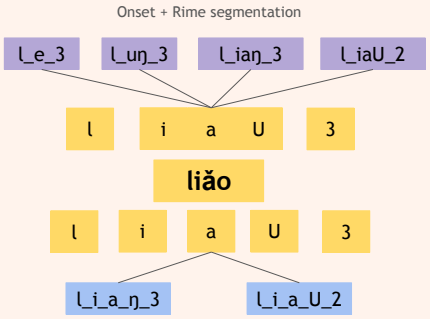


Fig1: The number of direct neighbours to "liǎo" changes depending on how the word is segmented, example adapted from [2]. Segmentation patterns based on [4]

→ **What is the basis for PN in Mandarin Chinese?**

Findings 1

- **Open-set speech-in-noise spoken word recognition task**
  - Participants typed out what they heard in pinyin
- Mixed Effect Regression and AIC/BIC to find which pattern could predict participants' accuracy best:

Yao & Sharma 2017	Our Findings
Lexical Decision Task (Reaction time ~ Pattern)	Open Set Recognition Task (Accuracy ~ Pattern)
Onset + Rime + Tone	**Onset + Rime + Tone**
Onset + Rime	Onset + Rime
Phonemes + Tone	Phonemes + Tone
Phonemes	**Phonemes**

1. Tone seems only relevant when using Onset+Rime segmentation
2. Tone seems irrelevant when using a phonemic segmentation

Why is Phonemes better than Onset + Rime?

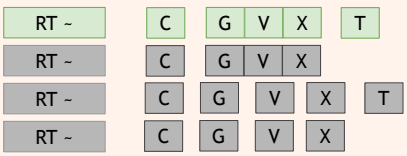
- **Fig.1** shows that Onset+Rime segmentation treats distant neighbours the same as immediate neighbours
- Onset, rime and phoneme carry different amounts of information: The current definition of neighbours based on one-edit distance favours phonemic representation

Why are Phonemes better without Tone?

- **Redundancy**: segmental information might be correlated with tone making tone redundant
- **Tonal neighbours** might be weighted differently (specifically less) from **Segmental neighbours**

Previous Findings

- Number of PNs influence reaction time in lexical decision tasks
  - **More neighbours = Longer reaction time**
- Analyses on lexical decision tasks showed that the **Onset+Rime+Tone pattern captures participant answers the best** [3]



→ **Onset+Rime+Tone is the better segmentation pattern when counting PN in Mandarin Chinese**

Does this conclusion hold for a different experiment task type?

Findings 2

- **Regression analysis** on PN counts between patterns
  - "Which words have particularly more/less neighbours, when including/excluding tone information?"

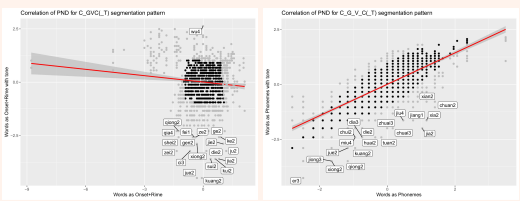


Fig2: Correlation of phonological neighbourhood density (PND) in onset+rime segmentation (left) and phonemic segmentation (right). **Greyed points are residuals SD > 1.** Top 20 Words, whose PND differed the most for each pattern are labeled. The greyed points were selected for model refitting.

→ Refitting regression models with only those words showed that **patterns with tonal information always predicted participants' accuracy best.**

This supports the redundancy explanation for phonemes+tone performing worse than phonemes only

- Tonal information is more relevant to words with many direct tonal neighbours

1. We find similar results to [3]: Onset-Rime-Tone representation is the better basis for PN in Mandarin Chinese
2. More in-depth investigation on the finer differences between the segmentation patterns and the information content of their units is needed
3. The definition of PN may be too strict: A more perceptual approach to tone [5] instead of numeric, or the Generalised Neighbourhood Model instead of One Edit Distance as alternative ways to count and represent PN

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