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# SENSITIVITY TO AUDITORY PERCEPTUAL CUES: UNIVERSAL OR LANGUAGE-SPECIFIC?

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## Introduction

Kelantan Malay is known for its unusual presence of a specific phonemic contrast known as the **initial geminate consonants** (i.e., singleton consonant /*tido*/ and geminate consonant /*ttido*/).

A previous study intended to conclude that **pure exposure** was not sufficient to retain or develop the ability to discriminate the Kelantan Malay singleton-geminate phonemic contrast (ethics ID: LX121018). The study had tested speakers with different degrees of exposure to Kelantan Malay in a discrimination task. The participants consisted of:

**KM**: native Kelantan Malay speakers
**KC**: Kelantan Chinese non-speakers
**NK**: non-Kelantanese non-speakers

The results revealed that the KM group performed the greatest on the discrimination task. Despite this, the KC group and the NK group were seen to perform similarly to each other. This may be due to a confounding variable that was identified whereby the NK group participants had the advantage of speaking a similar language (i.e, standard Malay) to the target language (i.e, Kelantan Malay). To rule out the confounding variable, this study recruited participants with different types of exposure to the specific singleton-geminate phonemic contrast instead such as:

**EG:** Arabic native speakers
**NG:** Malaysian Chinese native speakers

With the same procedure to the previous study, this current study aimed to investigate whether exposure with the phonemic contrast in a different language (e.g., Arabic) would help preserve discrimination sensitivity to it in a new language (e.g., Kelantan Malay). This study also aims to examine the effect of language exposure on the retention of phonemic contrast discrimination sensitivity by assessing a non-speaker's (i.e., Malaysian Chinese native speaker) ability to discriminate Kelantan Malay in comparison to native speakers.

## Literature Review

Previous research suggested that infants are born with the **innate ability** to perceive and discriminate all phonetic units of the different languages in the world (Conboy et al., 2008). However, as individuals progress into adulthood, this ability seems to be lost as they begin to acquire their native language (Eimas et al., 1971). Over time, their ability to discriminate non-native speech sounds become more difficult as their discrimination on native language relevant sounds are being more refined and preserved with constant use (Narayan et al., 2010).

**Phonemes** play a crucial role in speech perception as it is the most basic segment of a spoken word. It is a unit of sound that distinguishes one word from another in a language and can be used as an auditory perceptual cue.

In phonology and phonetics, the term "**geminate**" is used when a long or doubled consonant differs phonemically with its shorter or "**singleton**" counterpart and can be found in many languages such as Arabic (Ferrat & Guerti, 2017). Across languages, this phonemic contrast is distinguished primarily by a difference in duration and can also differ in position within themselves such as word-medially, word-initially or word-finally. Cross-linguistic evidences also show that the ratios of duration values for the word-initial geminate consonants were somewhat higher than word-medial geminate consonants (Hamzah, 2010). Addtionally, speakers were also found to have different tendencies of producing and perceiving the different positions of the geminate consonants (Hyltenstam & Abrahamsson, 1991).

Hence, taking the available literature into account, this present study will address the following research questions:

- Are auditory perceptual cues universal or language-specific?
- Will speakers with a native language containing the target phonemic contrast (EG) be better at discriminating it in a new language?
- Will speakers that have never been exposed to the target phonemic contrast (NG) be able to discriminate it at all?

## Methods

**Participants**
16 participants that consisted of 10 Arabic native speakers and 6 Malaysian Chinese native speakers were recruited via convenience sampling.

*COVID-19 Imposed Difficulties in Data Gathering*
Initially, a total of 32 participants were to be recruited. However, due to the enforcement of the Restricted Movement Order (RMO) only half the amount of participants could be collected.

**Design**
The independent variable was the type of exposure to the Kelantan-Malay singleton-geminate phonemic contrast. It consisted of two groups: the exposure group (EG) with speakers who had experience and exposure to the phonemic contrast and the no-exposure group (NG) with speakers who had no prior exposure to the phonemic contrast. The dependent variable was the mean discrimination accuracy percentage (%) of the Kelantan Malay singleton-geminate consonants that was measured by using a same-or-different two-alternative-forced-choice discrimination task.

*Stimuli*
288 auditory stimuli that consisted of 18 minimal pairs of singleton and geminate consonants were used as seen in figure 1. It was produced by 8 different speakers (4 males, 4 females) and contained 3 different types of consonants: voiceless stops (i.e, /*p*/, /*t*/, /*k*/), voiced stops (i.e., /*b*/, /*d*/, /*g*/) and sonorants (i.e., /*m*/, /*n*/, /*l*/) as well as their subsequent vowels (i.e., /*i*/ and /*a*/).

| | Singleton | | Geminate | |
|---|---|---|---|---|
| | **Word** | **Gloss** | **Word** | **Gloss** |
| /p/ | /pitu/ | door | /ppitu/ | at the door |
| | /pagi/ | morning | /ppagi/ | early morning |
| /t/ | /tido/ | sleep | /ttido/ | sleep by chance |
| | /tanɔh/ | land | /ttanɔh/ | outside |
| /k/ | /kiɣi/ | left | /kkiɣi/ | to the left |
| | /kabo/ | blurry | /kkabo/ | a beetle |
| /b/ | /bini/ | wife | /bbini/ | married |
| | /baçɔ/ | read | /bbaçɔ/ | is reading |
| /d/ | /dike/ | song | /ddike/ | sing a song |
| | /dapo/ | kitchen | /ddapo/ | at the kitchen |
| /g/ | /gigi/ | teeth | /ggigi/ | on the teeth |
| | /gaji/ | salary | /ggaji/ | sawing tool |
| /m/ | /misa/ | mustache | /mmisa/ | mustached |
| | /maɣi/ | come | /mmaɣi/ | cupboard |
| /n/ | /nikɔh/ | marriage | /nnikɔh/ | getting married |
| | /nanɔh/ | pus | /nnanɔh/ | containing pus |
| /l/ | /lidɔh/ | tongue | /llidɔh/ | on the tongue |
| | /lapu/ | lights | /llapu/ | on the lights |
| /ŋ/ | /ŋaŋɔ/ | open the mouth | /ŋŋaŋɔ/ | wide agape |

Figure 1. Auditory stimuli from a previous study by Hamzah, Hajek, & Fletcher (2016).

As a counterbalancing technique, 8 lists were devised to organize the stimuli by vowel, gender and consonant blocking sequence. The participants were then randomly assigned to a list by using a random number generator.

| LIST 1 | | | | |
|---|---|---|---|---|
| **Vowel** | /i/ | | /a/ | |
| **Gender** | female (f1, f2) | male (m5,m6) | female (f1, f2) | male (m5,m6) |
| **Consonant blocking sequence** | voiceless stops | voiceless stops | voiceless stops | voiceless stops |
| | sonorants | sonorants | sonorants | sonorants |
| | voiced stops | voiced stops | voiced stops | voiced stops |

| LIST 8 | | | | |
|---|---|---|---|---|
| **Vowel** | /a/ | | /i/ | |
| **Gender** | male (m7,m8) | female (f3, f4) | male (m7,m8) | female (f3, f4) |
| **Consonant blocking sequence** | voiced stops | voiced stops | voiced stops | voiced stops |
| | sonorants | sonorants | sonorants | sonorants |
| | voiceless stops | voiceless stops | voiceless stops | voiceless stops |

Figure 2. List of counterbalanced auditory stimuli.

**Procedure**
Before starting the experiment, the participants completed an online form containing an information sheet, consent form & language background questionnaire. All the participants were assessed using a computer and a pair of headphones with a set maximum volume of 80% over one session in a quiet setting. A practice trial phase was also conducted to allow the participants to adjust the volume to a more comfortable level. In the main experimental phase, their task was to listen to two consecutive auditory stimuli (e.g., /*tido*/ and /*ttido*/) and decide whether the pair presented were the same or different by pressing '1' and '0' on the keyboard.

## Hypotheses

It was predicted that:

- EG would perform better than NG but worse than KM.
- When compared across all 5 groups (KM, KC, NK, EG, NG), NG would perform the worst overall.

## Results

This study was an attempt to explore the possibility of any differences between the mean discrimination accuracy (%) of the Kelantan Malay singleton-geminate phonemic contrast on the different types of exposures to the phonemic contrast by comparing the 2 groups from this current study (EG and NG) with the 3 groups from the previous study (KM, KC, NK). In what follows, the results of the data analysis and a reminder of the hypotheses are discussed:

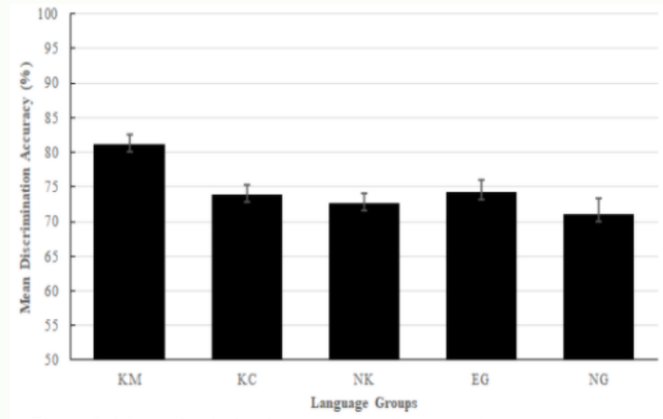


Figure 3. Mean discrimination accuracy (%) of the 5 language groups.

From figure 3, we see that EG performed better than NG. This could be explained by EG's experience with the phonemic contrast in their own language that aided their performance in the discrimination task. However, EG still performed worse than KM and this could be due to context differences as the target language was a new language for them. Consistent with the findings from a previous study, there is a consensus that speakers produce and perceive initial geminate consonants in a significantly different manner from word-medial geminates (Abramson, 1991).

Moreover, when compared across all 5 groups (KM, KC, NK, EG, NG), NG was seen to perform the worst overall. Despite having no prior exposure to the phonemic contrast at all, their ability to even perform the task may be consistent with the claim that there is an innate ability to perceive and discriminate all phonetic units of the different languages in the world. Their low scores give support to the claim that this innate ability could be lost as an individual progresses into adulthood (Eimas et al, 1971) and their native languages are being more preserved and refined.

## Conclusion

It is important to note that the results still followed the direction of all of the hypotheses that were initially suggested despite some of the non-significant findings and limitations to the study. In sum, it can be said that there is an effect of language exposure on the retention of phonemic contrast discrimination sensitivity. Therefore, it can be claimed that the sensitivity to auditory perceptual cues are more language-specific rather than universal.

## Future Work

For future research purposes, it is recommended that the same study be replicated with different degrees of exposure to the language containing the target phonemic contrast as the singleton-geminate consonants exists in a lot of other languages too such as Japanese, Finnish and German. It is also recommended that the same study be replicated while controlling for the type of position for the singleton-geminate consonants as there are many within the gemination phonemic contrast itself (word-initial, word-medial and word-final consonants) that could play an important role in the sensitivity of discriminating it. Hence, by taking into consideration both the different languages and positions of the phonemic contrast, we could create a study that can be generalized to all the different languages of the world and further explore whether sensitivity to auditory perceptual cues are more universal or language-specific.

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