Why do some phonemes sound similar?

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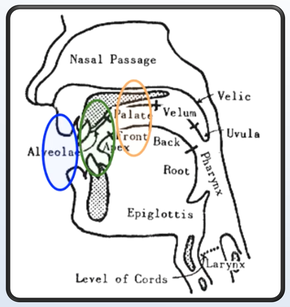
Question

The ability to understand continuous speech stems from the ability to separate the distinct phonemes by means of Categorical Perception. Phonemes are the basic units of speech, viz., “ba”, “da”, ga” etc. It does so by separating continuous sensory information into different categories. Different phonemes are produced distinctly due to their different places of origin in the vocal tract, which is called the Place of Articulation (POA).



The POA of “Ba” sounds are closer to the labial or the lips region, (represented in blue circle) whereas the POA of “Da” sounds are more dental and are located towards the upper part of the mouth (represented in green circle).

Why does categorical perception occasionally fail in identifying phonemes?
- Why do some phonemes sound similar?

Logic

Graph of Percentage ”Ba” vs POA

- Is linear negative slope
  - Categorical perception confusion does not occur between “Ba” and “Da”
- Is not linear
  - A straight line: POA does not affect the percentage of “Ba” sound
  - Random curve: no correlation
  - If spread of responses vary only in certain positions, those positions may be locations in POA that cause confusion in categorical perception.

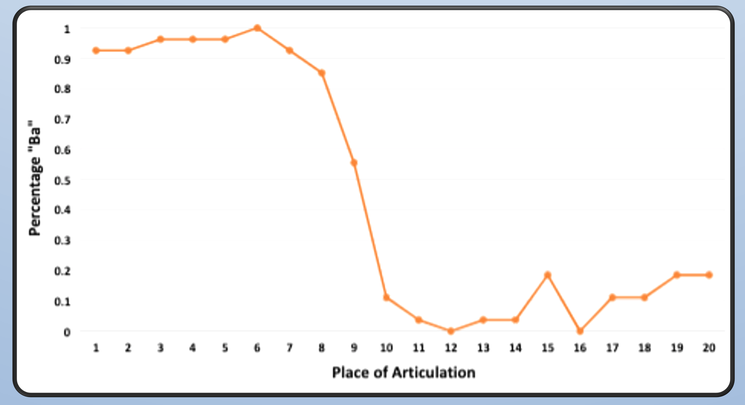
The graph will provide understanding of the relationship between POA and Percentage of “Ba” responses by participants. Depending on the direction of the curve, possible alternatives can be tested.
IV: POA
DV: percentage ”Ba” responses

Methods

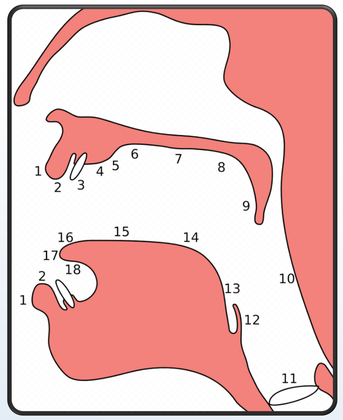
- N=18 students
- Students were given a language task to perform online for course credit.
- The task involved 2 different tasks.
- The first task asked participants to compare two sounds and report if they were the same or different.
- The second task asked participants to report the sound they heard in the recording.
- Each recording was to be played only once and the sounds only used “Ba” and “Da”.
- The experiment was followed by a survey that asked participants to report the number of languages they speak.
- An attention-based question was involved to see if participants paid attention to the instructions. Generally, if participants failed this task, their results would be excluded but due to small number in this experiment, those participants were also included in results.

Results

As observed in the following graph between POA and percentage of “Ba” responses, it is observed that it is a negative curve. However, it is not a linearly reducing graph. There are a few discrepancies when it comes towards the right tail-end of the graph.



Inferences



According to the below figure, POA 1, 2, 3 are used in “BA” phoneme production as those locations are mainly the labial parts of the mouth or vocal tract. IT is also observed from the graph, that these locations have high percentage of “Ba” responses which means that more participants heard the “Ba” sound as the POA was from these locations.

However, it can be observed that in the graph, POA of 15, 17, 18 and 20 (not observed in this image) also have some responses for “Ba”. These locations are POAs for “Da” sound rather than the “Ba” phoneme. It must be noted from this image that the location for 15, 17, 18 are very close to POA of 1, 2 and 3 which produce “Ba” sound. This perspective provides a possible inference as to why there is a slight confusion for the categorical perception to distinctly perceive those two sounds with POA 17, 18 and 15 as either “Ba” or “Da”.

Limitations

- Small sample size
- Participants who didn’t pay attention were also included in the sample so the results may not be accurate
- Participants may have played sound more than once since they had the freedom to do so

Future Research

- Accuracy in differentiation of “Ba” and “Da” sounds by Hindi speakers vs non-Hindi speakers
- Accuracy in phoneme differentiation in infants to understand their sensitivity while learning language