Testing Perceptual Similarity in the Coda Context: Similarity Judgment Experiments

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Introduction

In many of the world's languages, if speakers need to perform a phonological change to a word in order to change its meaning, they consistently choose to devoice the final obstruent.

Examples from German:

[trip] 'drive'   [tribə] 'drives'   [rat] 'wheel'   [radə] 'wheels'

But not: But not:
*[trim]   *[ram]
*[tribi]   *[radi]
*[tri]   *[ra]

Steriade's (2001/2008) P-map hypothesis: speakers produce outputs that are the most perceptually similar to the inputs. When the last consonant is a voiced obstruent, speakers choose devoicing as a way to maximize the similarity between the input and output.

Hypothesis
Given the coda, [ab], speakers will choose [ap] devoicing as the most similar over the other choices given the premise of Steriade's P-map hypothesis:

Perceptual Distance Map

ab ——— ap   devoicing
         am   nasalization
         a   deletion
         abi   epenthesis
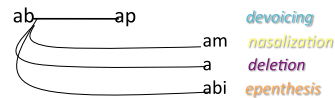
Purpose
Our experiment aims to test the validity of premise that the devoiced form is perceptually closer to the voiced form than any of the other processes.

Method

The target: [ab], [ad], [ag], [itab], [ikad], [itag].

The options: four forms that each represent the outcome of four phonological processes: devoicing, nasalization, epenthesis, deletion. For [ab], [ap]-devoicing; [a]-deletion; [abi]-epenthesis; and [am]-nasalization

Task: choose the option that sounds most similar to the target.

Modes of Presentation
(i) Orthographic Test   Sample questions:
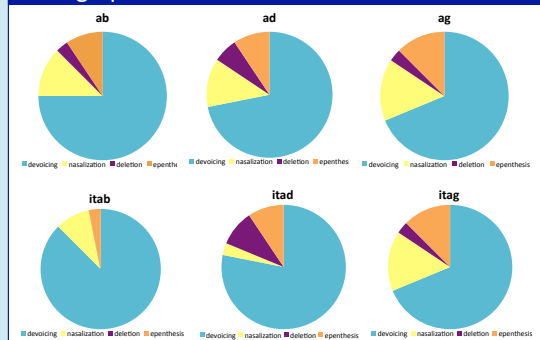Participants: Thirty-two native English speakers

(ii) Auditory Test
Participants: Thirty native English speakers

Auditory stimuli:
Stimuli are based on speech of two native speakers of English. They were edited out at zero-crossing, and resynthesized with a flat pitch at 250 Hz and with a 0.7 amplitude peak.

Orthographic Test: Results and Discussion

If subjects were responding randomly, then we would expect devoicing to be chosen 25% of the time.
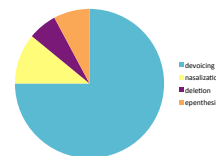
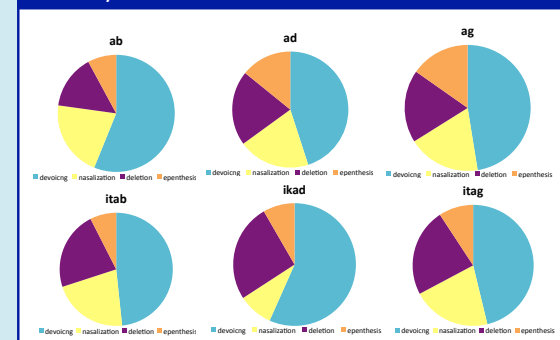| Target	Devoicing
ab	75%
ad	72%
ag	69%
itab	88%
itad	78%
itag	69%

Total Average 75%

A non-parametric Wilcoxon test shows that the preferences toward devoicing did not arise by chance (V = 526, p < .001).

These high percentages support Steriade's premise that the devoiced form of coda obstruents is the most perceptually similar to the voiced coda obstruent when compared to forms that have undergone deletion, nasalization and epenthesis.

Auditory Test: Results and Discussion

An auditory test avoided possible perceptual similarities based on orthography rather than the actual sounds of the tokens.
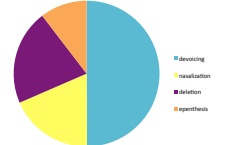
Target	Devoicing
ab	56%
ad	45%
ag	47%
itab	48%
ikad	57%
itag	46%

Total Average 50%

Speakers considered the devoiced forms as the most similar to the target forms (V = 392.5, p < .001).

Although the percentage of participants who chose devoicing as the most similar is not as high as the orthographic test, the percentages are still above chance. A higher preference for deletion compared to the orthographic test may be a result of participants disliking the orthographic option of a single letter as most similar to a two letter target, likewise, a three letter option for a four letter target in the disyllabic stimuli.

Note: Some [ad] tokens had flapped [d] which may have affected perception. Improved token quality in future trials may improve results.

Conclusion

The results are encouraging for Steriade's premise, but they do not unambiguously support it either.

Future research: An alternative test, such as a pair-wise magnitude estimation task may eliminate any cognitive overload after hearing five sounds and also eliminate the possibility that participants are being distracted with the cognitive task of ranking the similarities among options.

If the perceptual similarity map premise is proven correct through experimentation, it will give further evidence that psychoacoustic information has a role to play in phonology.