4aSC25. Peripheral and central locus of a non-speech phonetic context effect

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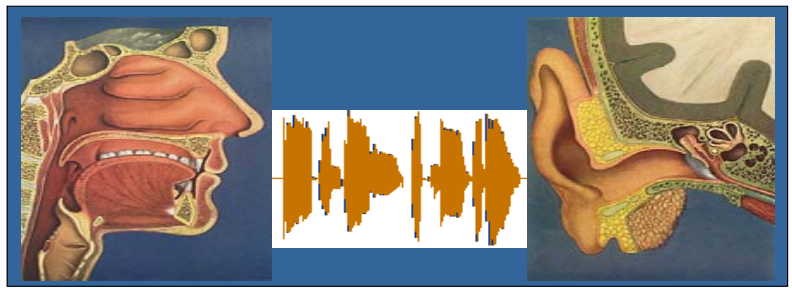
Context Effects



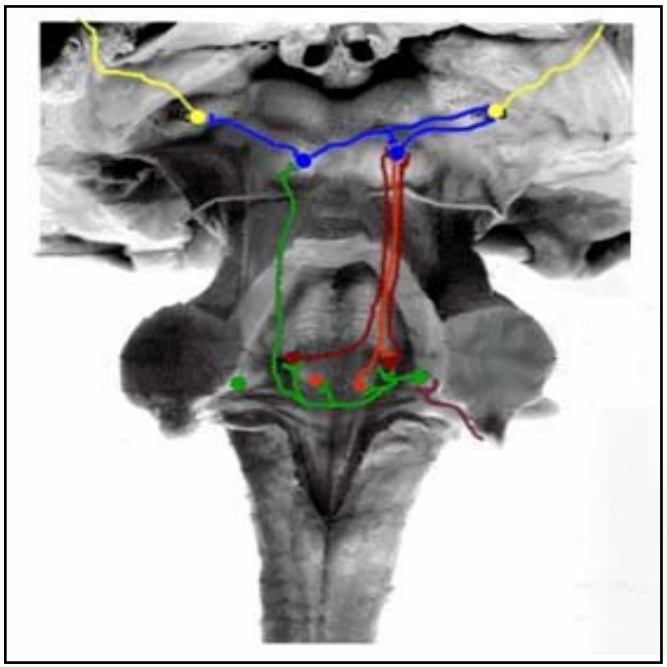
Previous work has demonstrated that speech and non-speech sounds can affect the identity of neighboring speech sounds.

Identical acoustic sounds can be perceived differently depending on the spectral characteristics of the precursor speech or non-speech sound.

These identity shifts are predictable based on the spectral properties of the context sounds.

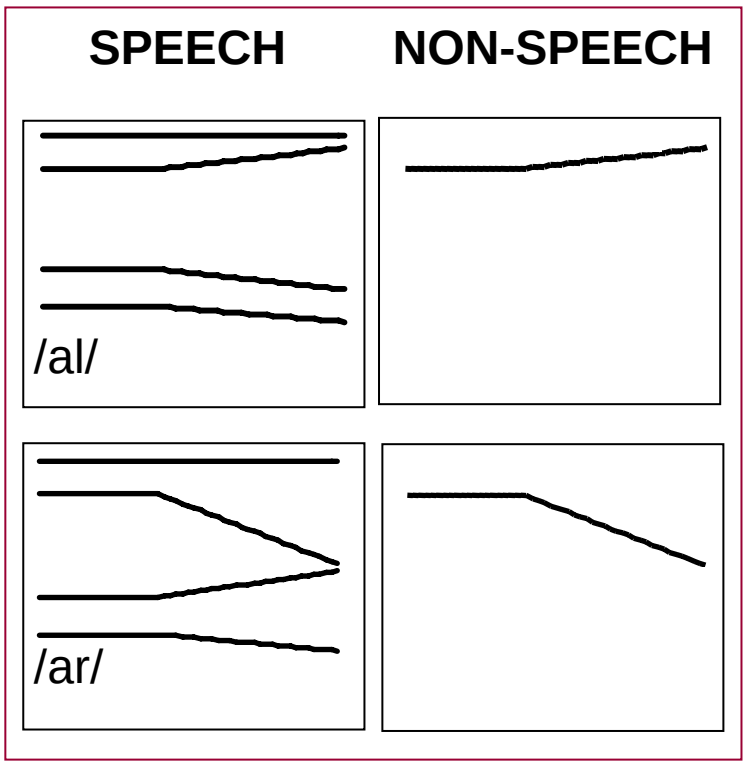
For example, the reported identification of a syllable-initial stop can be changed from /g/ to /d/ by changing the preceding context syllable (from /al/ to /ar/ for speech context and from high- to low-frequency spectral energy for non-speech context).

Examining the Locus of the Context Effect



It has been proposed that these spectral context effects may be due to interactions in the peripheral auditory system, for example, as the result of masking at the auditory nerve or auditory enhancement.

Stimuli



Context: /al/ and /ar/ for the speech version; single formant stimuli mimicking the F3 of /al/ and /ar/ for the non-speech version.

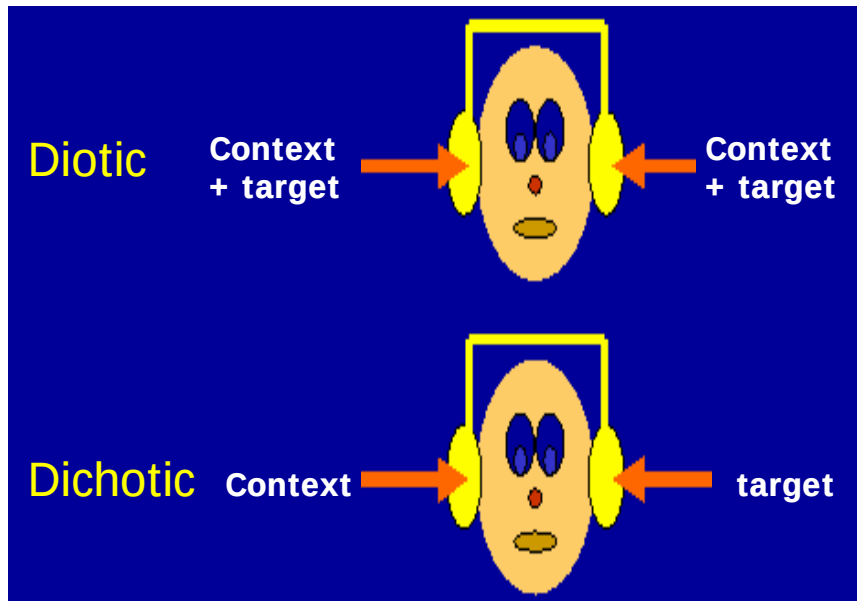
Target: A series of consonant vowel (CV) syllables ranging perceptually from /ga/ to /da/ via manipulation of third formant (F3) onset frequency.

Experiment 1: Dichotic versus Diotic Presentation

- If context effects occur at the level of the auditory nerve (a level where decussation has not yet occurred) then presenting the context and target sounds to opposite ears should result in the disappearance of the effect.

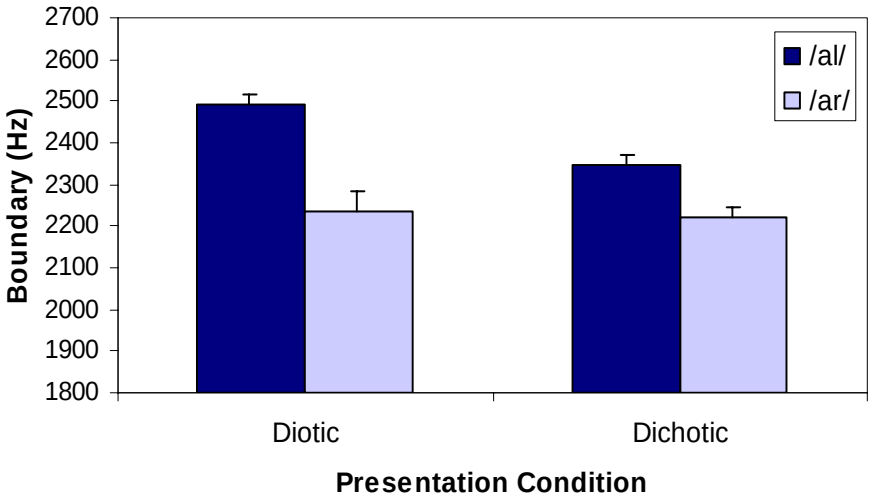
- A series of da-ga syllables were preceded by either /al/ or /ar/ (speech version) and either high- or low-frequency single formants (non-speech version).

- In the diotic block, context and target were presented to both ears. In the dichotic block, context and target were presented to opposite ears.

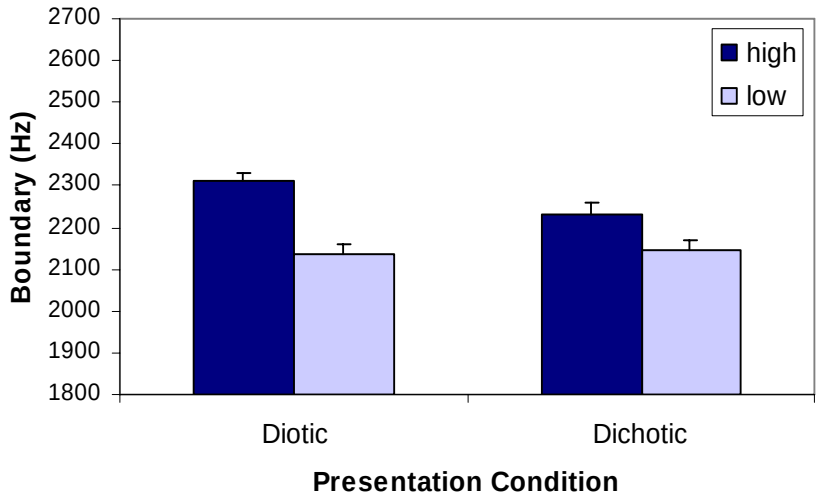


Experiment 1: Results

Speech Version



Non-Speech Version

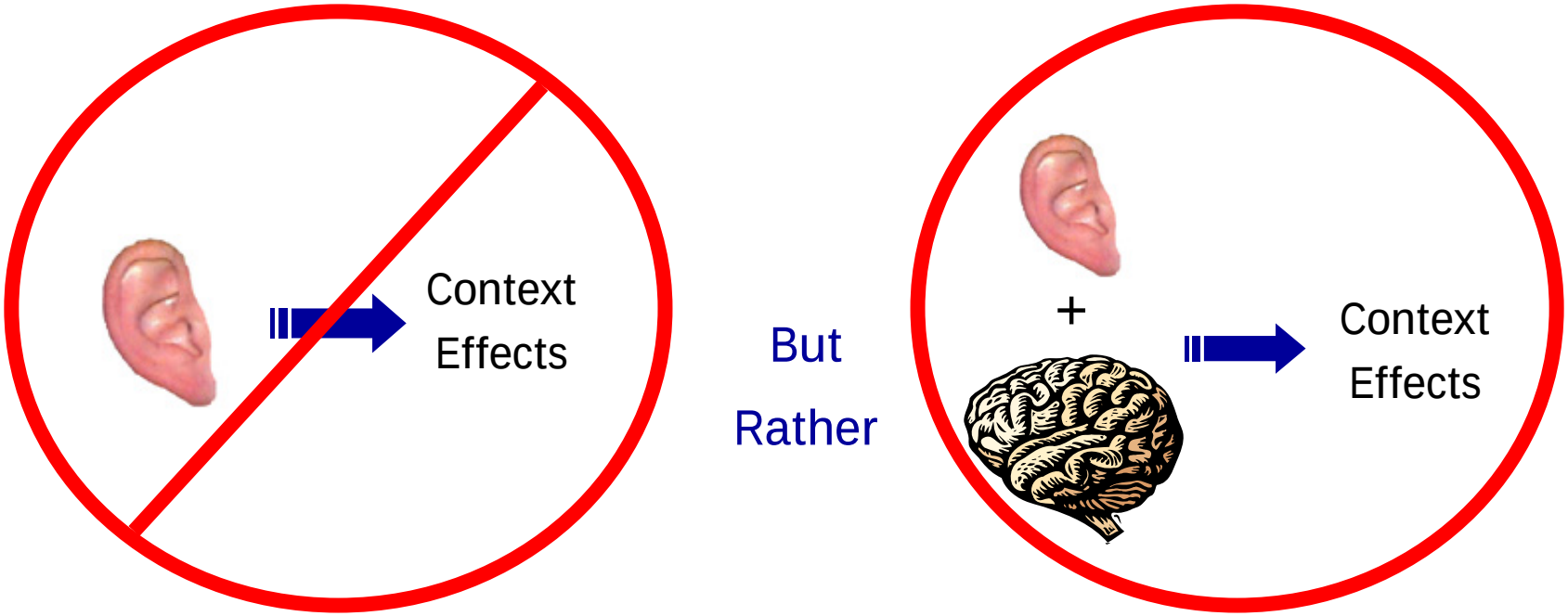


Results:

Diotic presentation led to the usual context effect. That is, more /ga/ responses following the /al/ or high frequency tone.

The dichotic presentation resulted in a similar shift, although smaller. The results are qualitatively equivalent for speech and non-speech contexts.

Experiment 1: Conclusions

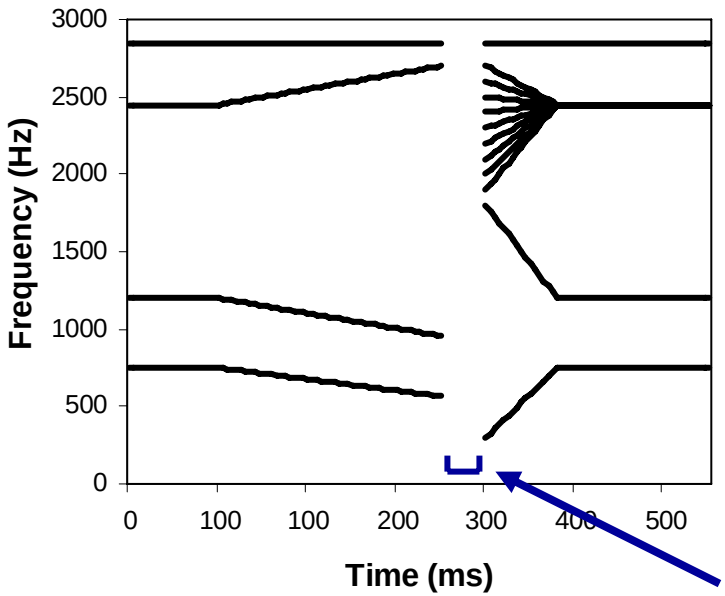


- It is unlikely that identification shifts are caused **solely** by peripheral masking or auditory enhancement since both are monaural in nature by (Summerfield & Assmann, 1989).
- Peripheral mechanisms, however, may play some role in context effects since both effects are smaller when context and target cannot interact in the periphery.

Experiment 2: Silent Gap Duration

- Experiment 2 examines the time course of context effects by varying the duration of the intervening silence gap between the context and target sounds.

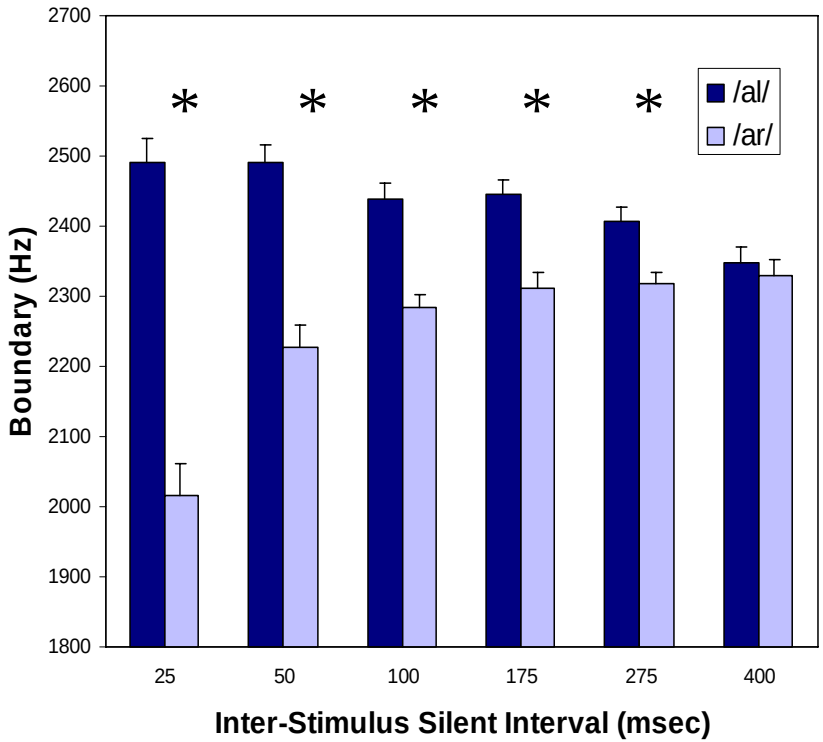
Example: /al/ + /ga – da/



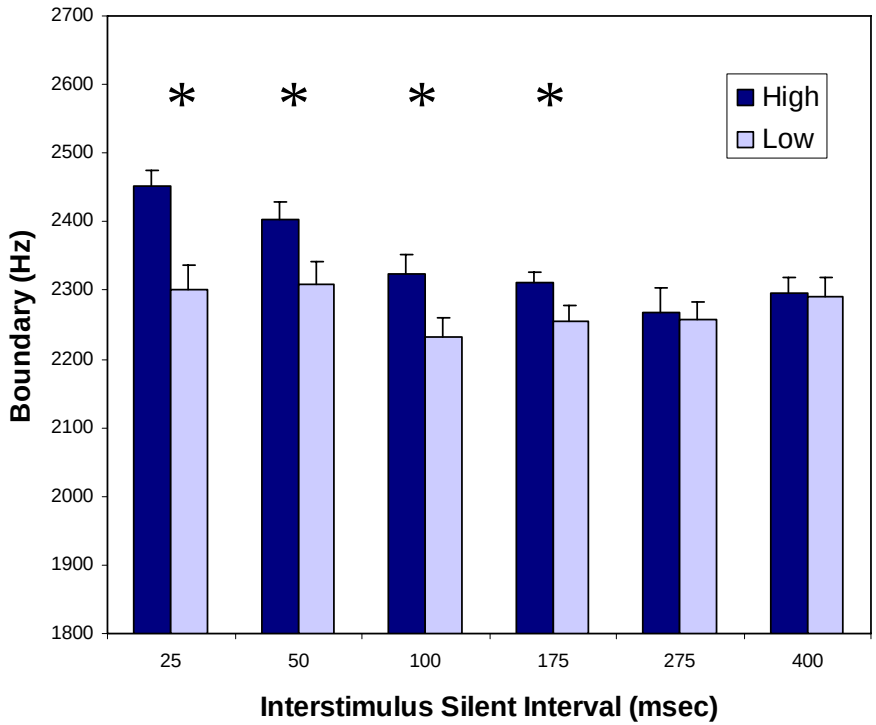
- A series of da-ga syllables were preceded by either /al/ or /ar/ (speech version) and either high- or low-frequency single formants (non-speech version).
- The stimuli were separated by silent intervals of 25, 50, 100, 175, 275, and 400 msec.

Experiment 2: Results

Speech Version



Non-Speech Version



Results:

Identification shifts were apparent for all silent gap durations up to and including 275 msec for the speech version and 175 msec for the non-speech version.

Experiment 2: Conclusions

- These results demonstrate that it is unlikely that context effects are the consequence of **solely** a peripheral mechanism such as auditory enhancement, a phenomena whose effects disappear with silent intervals beyond 100 msec (Viemeister & Bacon, 1982). A more central locus is likely since temporal windows at this level in the auditory system allow for longer periods of interaction.

However,

- In both the speech and non-speech context experiments, the size of the context effect decreases monotonically with increasing gap duration, leading us to believe that peripheral mechanisms may play some role in identification shifts.

Final Conclusions

The pattern of results from these experiments indicates that contextual effects are quite robust and occur even in dichotic presentation conditions as well as in the presence of substantial silent gaps.

Contextual effects appear to be the result of not just the peripheral system, but a combination of many processes (both peripheral and central) at different levels within the auditory system.

The substantial agreement between speech and non-speech results implicate similar mechanisms underlying both effects. These results emphasize the role general mechanisms of the auditory system appear to play in regard to phonetic context effects.

References

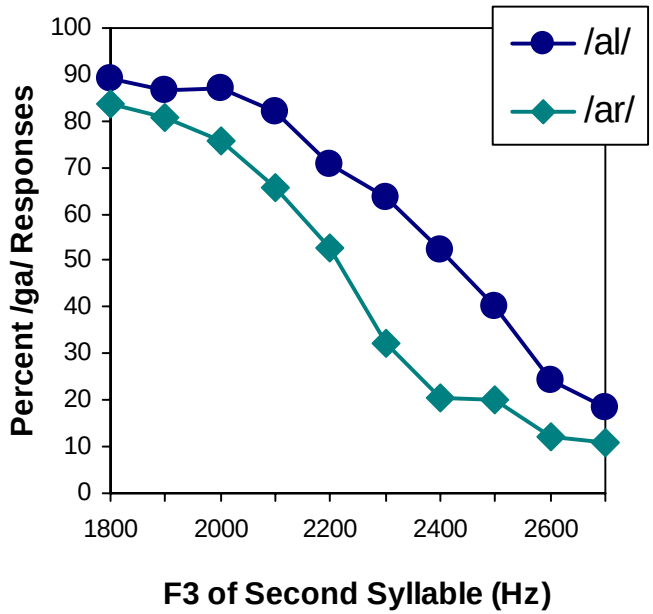
Holt, L. L., & Lotto, A. J. (in press) Behavioral examinations of the neural mechanisms of speech context effects. *Hearing Research*.

Summerfield, Q., & Assmann, P.F. (1989). Auditory enhancement and the perception of concurrent vowels. *Perception & Psychophysics*, **45**(6), 529-536.

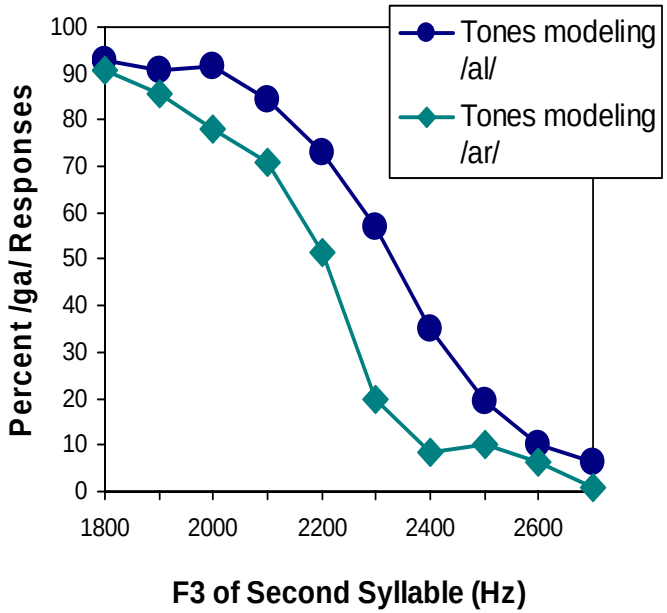
Viemeister, N.F., & Bacon, S.P. (1982). Forward masking by enhanced components in harmonic complexes. *Journal of the Acoustical Society of America*, **71**(6), 1502-1507.

Context Effect: Examples

Speech Version



Non-Speech Version



Results:

Following /al/ and tonal version of /al/ → More often identified as /ga/

Following /ar/ and tonal version of /ar/ → More often identified as /da/