

Perceptual features of place assimilation are continuous and contextually determined.



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Goals & Background

Emergence of Features

- The role of features in perception is to provide information to distinguish lexical items.
- We hypothesize that features emerge during perception from an interaction of bottom-up acoustic information and top-down lexical knowledge. Features may not be fixed entities but rather determined by context.
- Deciding whether this is true requires a context in which to assess feature emergence.

Place Assimilation

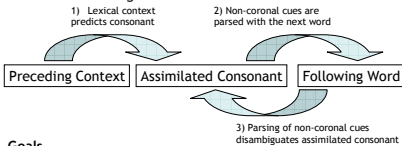
- In place assimilation coronal sounds partially take on the place of following labials or velars (e.g. *brown pig* becomes *brown/m pig*).
- Assimilated speech is gradient in production (Byrd, 1996; Ellis & Hardcastle, 2002; Barry, 1985) and acoustic properties (Gow, 2001; Gow & McMurray, in press).
- Thus, place assimilation is characterized by a graded overlap of gestures (or acoustic cues).
- Place assimilation entails that the information value of a given feature (e.g. labial) will depend on whether it is the underlying feature or arises from assimilation—information value is contextually determined.

Place Assimilation and Word Recognition

- Gow (2001; see also Gow & McMurray, in press) has demonstrated that the perceptual system can harness assimilated segments to facilitate the perception of subsequent words (e.g. *brown/m* facilitates perception of *pig*), suggesting this subtle modification provides information about upcoming material.
- Thus, assimilation does not just create noise (or reduce contrast), but also provides information (that is, labial or velar place cues can be features in the correct context).
- Gow (2003) suggests that this information is used by a parsing process in which overlapping features in the assimilated segment are matched to context.
- The usefulness of the assimilatory information is not present a priori, but rather emerges as a function of both the bottom-up cues and the context.

Parsing

- The Parsing process assigns each acoustic cue to an underlying cause or group and arrives at the parse of a sequence of cues that accounts for all of the cues (Fowler, 1984; Fowler & Smith, 1986; Gow, 2003).
- A parsing process can evaluate multiple overlapping cues, integrate them with context, and arrive at a solution that accounts for all of the available constraints and information sources in the signal.



Goals

- Our experiments aim to demonstrate that:
 - Assimilation facilitates word recognition
 - The feature information provided by assimilation is gradient
 - Lexical knowledge influences the emergence of features

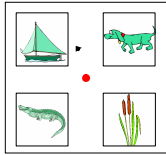
Experiment 1 Design

Design

- Participants saw 16 item sets in which adjectives assimilated to non-words (e.g. *brown pig*)
- 4 pictures on the screen represented a coronal, a non-coronal, and two fillers for each item set.
- Participants heard assimilated and non-assimilated instructions to select pictures.

Procedure

- Experiment uses the visual world paradigm.
- Subjects listen to assimilated and unassimilated speech while looking at pictures on a computer screen.
- Fixations to objects are monitored using an eye-tracker.
- The proportion of fixations to objects reflects lexical activation for those objects.



Stimuli

- Stimuli were constructed by splicing assimilated and unassimilated productions of adjectives (e.g. *brown*) on to the beginning of nouns (e.g. *pig*).
- One assimilated exemplar and one unassimilated exemplar was used for each adjective.

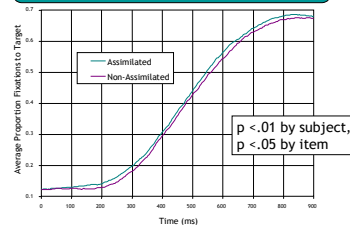
Participants

- 39 University of Iowa students and community members

Predictions

- Participants will use acoustic cues produced by assimilation to facilitate recognition of the upcoming non-coronal word.
- More early eye-movements to the non-coronal picture in the assimilated condition.

Experiment 1 Results



- More early eye-movements to the non-coronal target picture in the assimilated condition
- Non-coronal cues produced by assimilation provided useful information about the following word.
- Lexical knowledge (there is no word *green*) allows listeners to parse the labial cues as belonging to an upcoming (not underlying) labial prior to hearing context, thus facilitating recognition of the upcoming non-coronal word.

Experiment 2 Design

Question

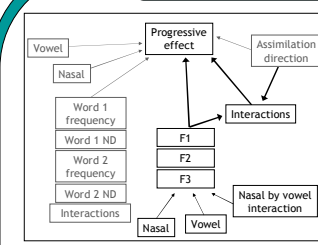
- Do listeners show gradient sensitivity to the acoustic cues underlying the progressive effect?

Methods and Design

- Design was the same as Experiment 1 except multiple assimilated exemplars of each adjective were used.
- Stimuli were constructed as in the first experiment.
- Five assimilated exemplars and one unassimilated exemplar were used for each adjective.
- Acoustic measurements of the first three formants made over the last three pitch pulses were made in Praat (Boersma & Weenink, 2007).
- 33 University of Iowa students and community members participated.

Predictions

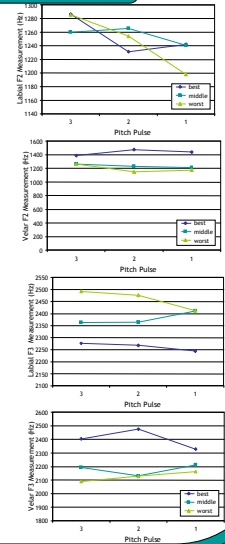
- The degree of facilitation seen for assimilated speech should depend on the gradient acoustics.



Step	Variables	R ² change	F change	p
1	Assimilation direction	.02	.76	.39
2	Vowel identity	.12	1.78	.17
3	Nasality	.16	8.69	.005
4	Frequencies, NDs	.08	1.46	.24
5	F1, F2 and F3 residuals	.09	1.79	.17
6	Residuals x assim dir.	.11	2.54	.075

Variables	Beta	t	p
F1 resid x assim dir	-.13	-.12	.91
F2 resid x assim dir	1.25	2.08	.046
F3 resid x assim dir	-.61	-2.20	.036

Experiment 2 Results



Total R² = .57

Experiment 3 Design

Goal

- Does lexical knowledge participate in the parsing process?

Methods & Design

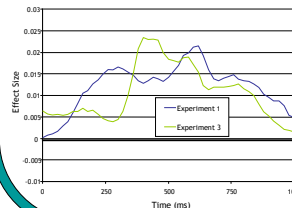
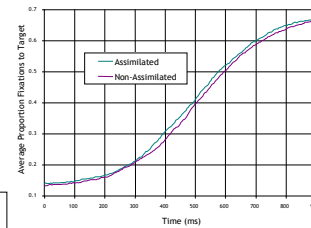
- Design was identical to Experiment 1 except that adjectives assimilated to words (e.g. *heart breaker* became *harp breaker*).
- Stimuli were constructed as in Experiment 1.
- 40 University of Iowa students and community members participated.

Predictions

- If lexical structure participates in parsing, progressive facilitation should be slowed when assimilation creates ambiguity—there is no way to determine if the non-coronal cue is underlying or upcoming until context arrives.
- The acoustic changes due to assimilation provide no useful information until listeners hear the onset of the target word and can determine the status of the coronal.

Experiment 3 Results

Participants showed the same pattern of eye-movements as in Experiment 1, again indicating that non-coronal cues from assimilation provide useful information about the upcoming word.



A comparison of the two experiments showed the effect to be earlier in the first-lexical knowledge affects the usefulness of non-coronal cues produced by assimilation.

Experiment 1: 160 ms
Experiment 2: 360 ms

Conclusions

Evidence for place assimilation cueing word recognition

- There was faster word recognition in the assimilated condition, a progressive effect, indicating that assimilation provides useful information about the following word.

Evidence for gradient information content

- The size of the progressive effect was dependent on the degree of acoustic change (in F2 and F3) in the assimilated adjectives.

Evidence for lexical influence on information content

- The progressive effect was delayed when assimilated words were ambiguous, indicating that lexical knowledge affects the usefulness of non-coronal cues produced by assimilation

Features are Emergent

- The usefulness of non-coronal acoustic cues depends on their context, features are not fixed entities.

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