

# Visual-phonetic cues in the phonology of Toulousain French

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One common historical development in languages with distinctively nasalized vowels is the excrescence of coda dorsal nasals on nasalized vowels. This is a property of the variety of French spoken in Toulouse. We will present data showing that the appearance of dorsal nasal is indeed a perceptual cue of the Toulousain dialect, though it is less common than popular accounts might suggest. Then in two experiments we will consider why the cross-linguistically unmarked place for this post-nasality nasal is dorsal. The experiments compare Ohala's (1975) acoustic explanation - namely that dorsal nasals, having no antiformants, are acoustically more similar to vowels than are labial or coronal nasals - with an explanation of our own based on visual correlates of distinctive features. The "visual correlates" explanation holds that if the perceiver detects a nasal coda consonant but does not see the lips or tongue tip produce a stop closure, then the visually "unmarked" place of articulation must be dorsal. The experiments contrast place of articulation judgments given to tokens ending in nasalized vowels by French- and American English- speaking participants. In one experiment we simply presented monosyllabic CV nonwords with nasalized vowel. Here the evidence argues for a spelling bias for French speakers and no change for audio versus audio-video presentation. Thus, experiment 1 supports Ohala's account. In the second experiment we obscured the last portion of CVN (N = /m/, /n/, or /ng/) and CV~ syllables with white noise. This experiment was designed to force listeners to assume the existence of a final consonant and to rely on visual cues to determine the place of articulation. The paper will present the results of this experiment and conclude with a discussion of phonetic modality and featural markedness.

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## **1. Themes: Phonetic correlates of distinctive features.**

Jakobson, Fant & Halle, 1952 is paradigm case.

Articulatory - lip closure, articulated with the front of the tongue, with vocal fold vibration, etc.

Acoustic - with a prominent mid frequency spectral peak, with low frequency energy, etc. (Stevens, 2002 is epitome of this approach)

Perceptual - JFH = psychoacoustic. Not as much consideration of this perspective on features.

In this talk we will consider some phonetic and phonological aspects of visual correlates of distinctive features.

## **2. Themes: Phonology and perception**

- markedness patterns - associating greater perceptual salience with “marked”

- sound change - seeing patterns of change (and the resulting synchronic phonological patterns) in terms of misperception.

Ohala, J. (1981) The listener as a source of sound change.

### **3. Phonological context for this talk:**

Excrescent [ŋ]

Standard French nasalized vowels -> Toulouse Vŋ

This process is found in many languages and language families:  
Howe (2004) cites cases in Romance, West Germanic, Bantu, Niger-Congo, Austronesian, Papuan, Totonacan, Sino-Tibetan, Japanese, Mongolian.

Phonological explanations of excrescent [ŋ]:

Howe (2004), van der Toore (2003), Rice (1996)

\*\* [ŋ] and vowels share a feature \*\*

e.g. the “dorsal” articulator, as in Sagey (1986), Halle (1995)  
[contra Clements & Hume (1995)]

This is fine, but phonetically unsatisfying -

- the “dorsal” articulation in [ŋ] and vowels is very different
- the relationship is more abstract than a phonetician would like
- is “share a feature” an explanatory mechanism?

## **Two phonetic hypotheses about excrescent [ŋ].**

### 1. Acoustic similarity hypothesis - Ohala (1975)

- a. [ŋ] has no acoustic antiformants and is therefore more vowel-like than other nasals.
- b. Mouth cavity during [m] and [n] add acoustic zeros - antiformants - to nasal spectrum.
- c. Therefore, if a nasalized vowel is misperceived as a nasal segment the place of the segment will be velar because of the acoustic similarity of [ŋ] and vowels.
- d. Problem with this theory: [ŋ] has antiformants due to nasal sinuses. Is it really all that more acoustically vocalic?

## **Two phonetic hypotheses about excrescent [ŋ] - continued**

### 2. Visual similarity hypothesis -

- a. [ŋ] has no visible mouth closure and is therefore more vowel-like than other nasals.
- b. Mouth movement during [m] and [n] has visible closure.
- c. Therefore, if a nasalized vowel is misperceived as a nasal segment the place of the segment will be velar because of the visual similarity of [ŋ] and vowels.
- d. Problem with this theory: lack of data.

#### **4. About visual speech perception.**

##### **a. Visual input influences language acquisition.**

Mills (1987) blind children learn [labial] later than sighted children -

[b]/[d] and [b]/[g] were confused by blind  
[d]/[g] were confused by both blind and sighted

The “markedness” of [labial] for these children is partially determined by the visibility of the lips.

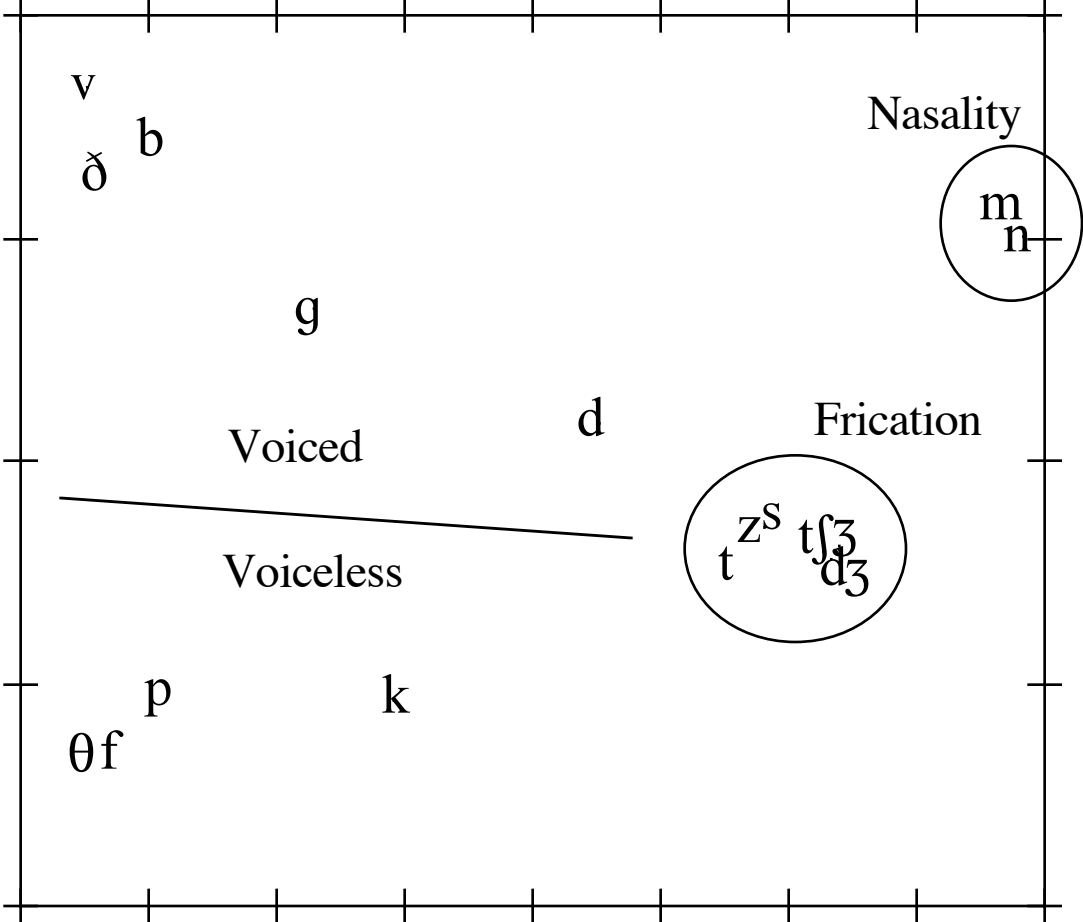
#### **4. About visual speech perception.**

b. Visual phonetic similarity is substantially different from auditory phonetic similarity.

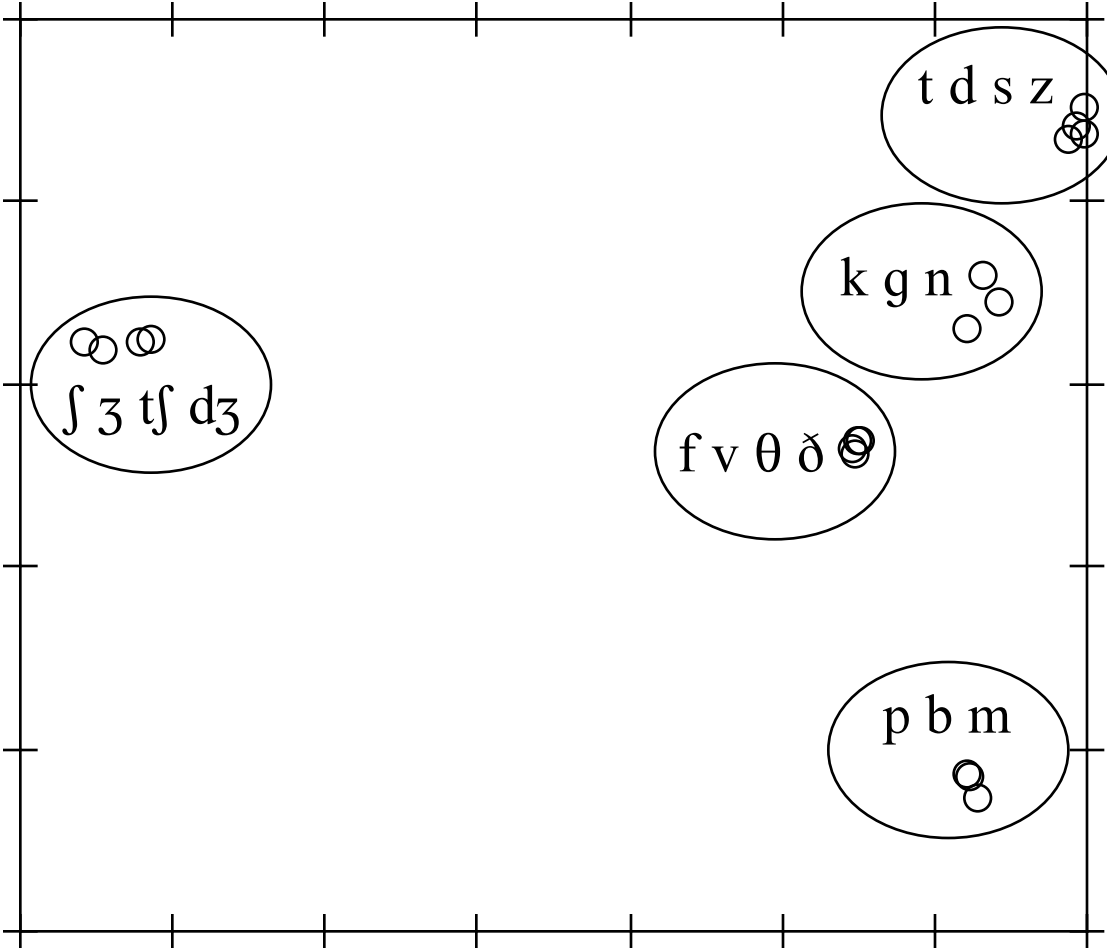
Grant, K.W., and Walden, B.E. (1996). Evaluating the articulation index for auditory-visual consonant recognition, *J. Acoust. Soc. Am.* 100, 2415-2424.

12 participants, 18 consonants in [a\_\_a] context.

# Perceptual space - Audition only



**Perceptual space - vision only**



For consonants:

Auditory dimensions of similarity: Voicing, manner, nasality

Visual dimensions of similarity: Place

Note: Dorsal and Coronal stop place are distinct  
- except [n]

## **5. Testing the visual similarity hypothesis for excrescent [ŋ]**

### a. Excrescent [ŋ] in Toulouse

Do French listeners associate the [ŋ] with Midi French?

### b. Experiment 1 -

masked final nasal with or without visual information

American English listeners

### c. Experiment 2

Unmasked nasalized vowels

American English and French listeners

### **5a. Excrescent [ŋ] in Toulouse**

Generally it is reported that French nasalized vowels are pronounced [ŋ] in Toulouse. Does the presence of [ŋ] mark a speaker as Toulousian?

- i. One 25 year old male speaker from Toulouse -  
described as having a strong accent
- ii. Audio clips from a 20 minute conversation -  
half with examples of [ŋ] and half without [ŋ].
- iii. One group of listeners (n=10) heard [ŋ] clips,  
another group (n=6) heard the no-[ŋ] clips
- iv. Presented via an experiment web site,  
listeners recruited via e-mail to contacts in Toulouse.

Excrescent [ŋ] is relatively rare in this “strongly accented” talker’s speech.

Preliminary observations from a 20 minute recording

Of the hundreds of underlying nasalized vowels in the corpus, the majority of them did not show an excrescent [ŋ].

The excrescent [ŋ] was produced:

- at the end of a phrase (n=4) or utterance (n=4)
- before a vowel (n=8) [often the pause word "euh", n=6]
- part of the lexical item "enfin"/"fin" (n=11)

This speaker is judged to have a stronger Toulousian accent when listeners hear audio clips with [ŋ].

	strong	weak	none	??
with [ŋ]	30	60	0	10
without [ŋ]	0	83	17	0

## **5. Testing the visual similarity hypothesis for excrescent [ŋ]**

### b. Experiment 1 - Masked final consonant.

*Subjects.* American English listeners (n=18)

*Materials.* Three sets of words

final nasal contrast [m n ŋ], or nasalized vowel

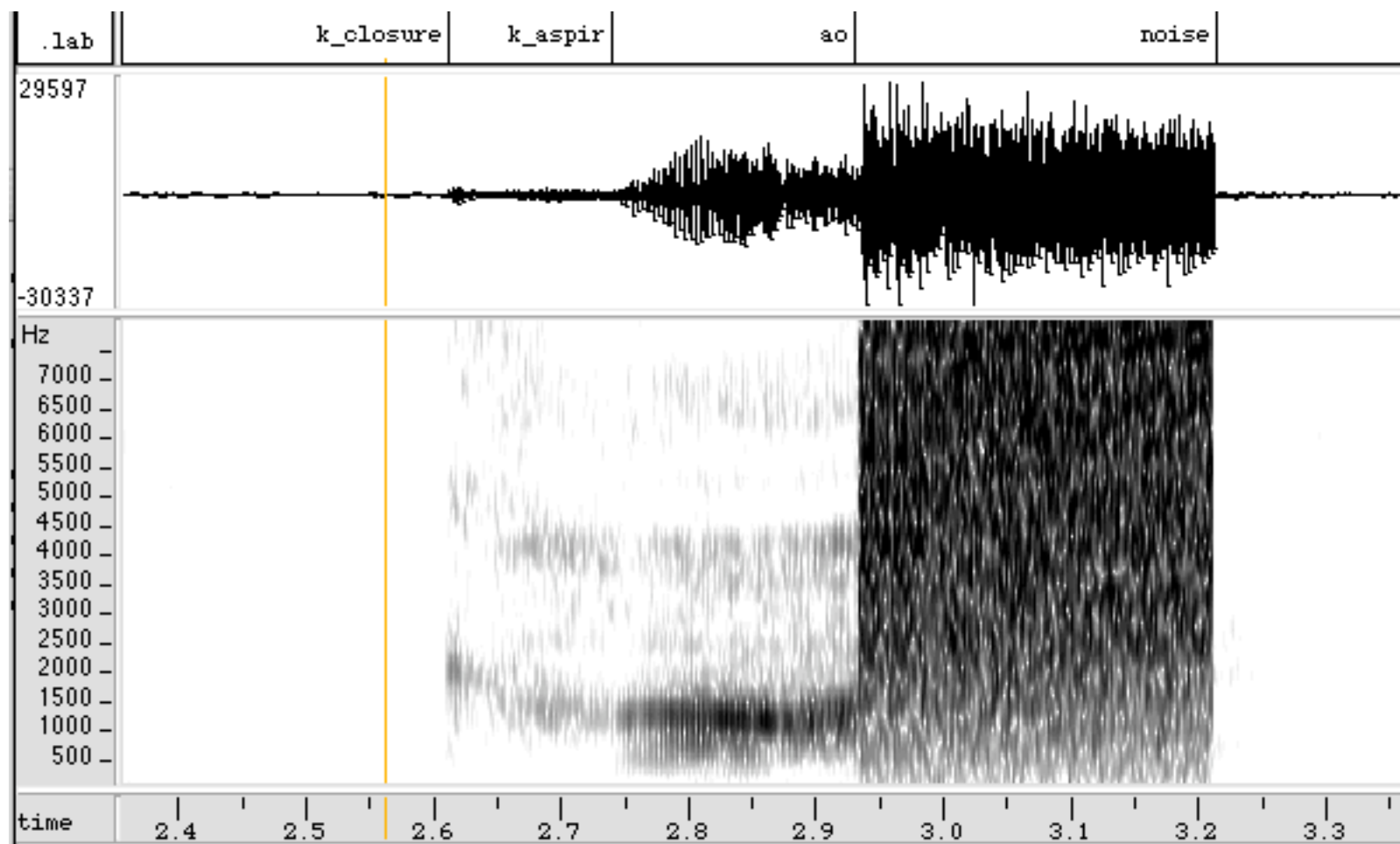
three vowel environments - [ ʌ ɔ e<sup>I</sup> ]

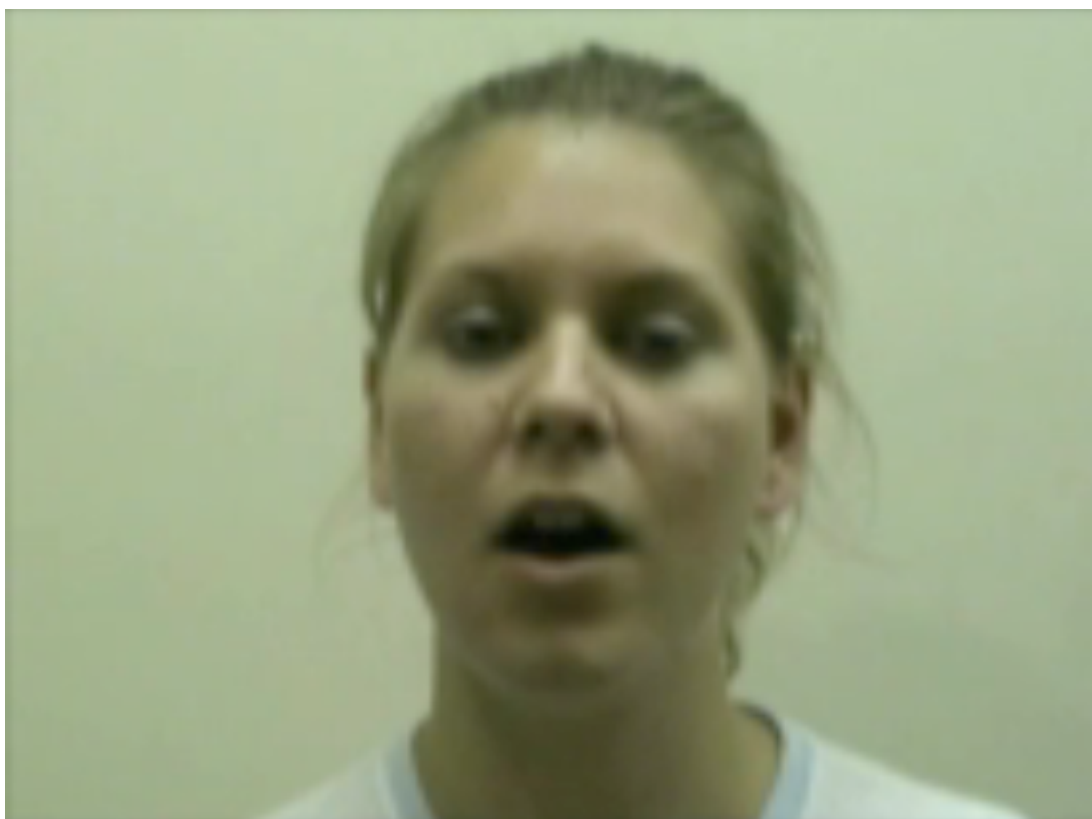
Speaker: Phonetically trained, native speaker of English, French L2 speaker.

[ʌ] dumb, done, dung, [dʌ̃]  
rum, run, rung, [rʌ̃]  
sum, sun, sung, [sʌ̃]

[ɔ] calm, con, kong, [kɔ̃]  
pom, pawn, pong, [pɔ̃]  
rom, ron, wrong, [rɔ̃]

[e<sup>I</sup>] fame, feign, fang, [fɛ̃<sup>I</sup>]  
dame, dane, dang, [dɛ̃<sup>I</sup>]  
same, sane, sang, [sɛ̃<sup>I</sup>]





## **5. Testing the visual similarity hypothesis for excrescent [ŋ]**

### b. Experiment 1 - Masked final consonant.

*Task.* Identify the final consonant in each audio token and then in a second block of trials in each AV token . (i.e. a within-subjects design).

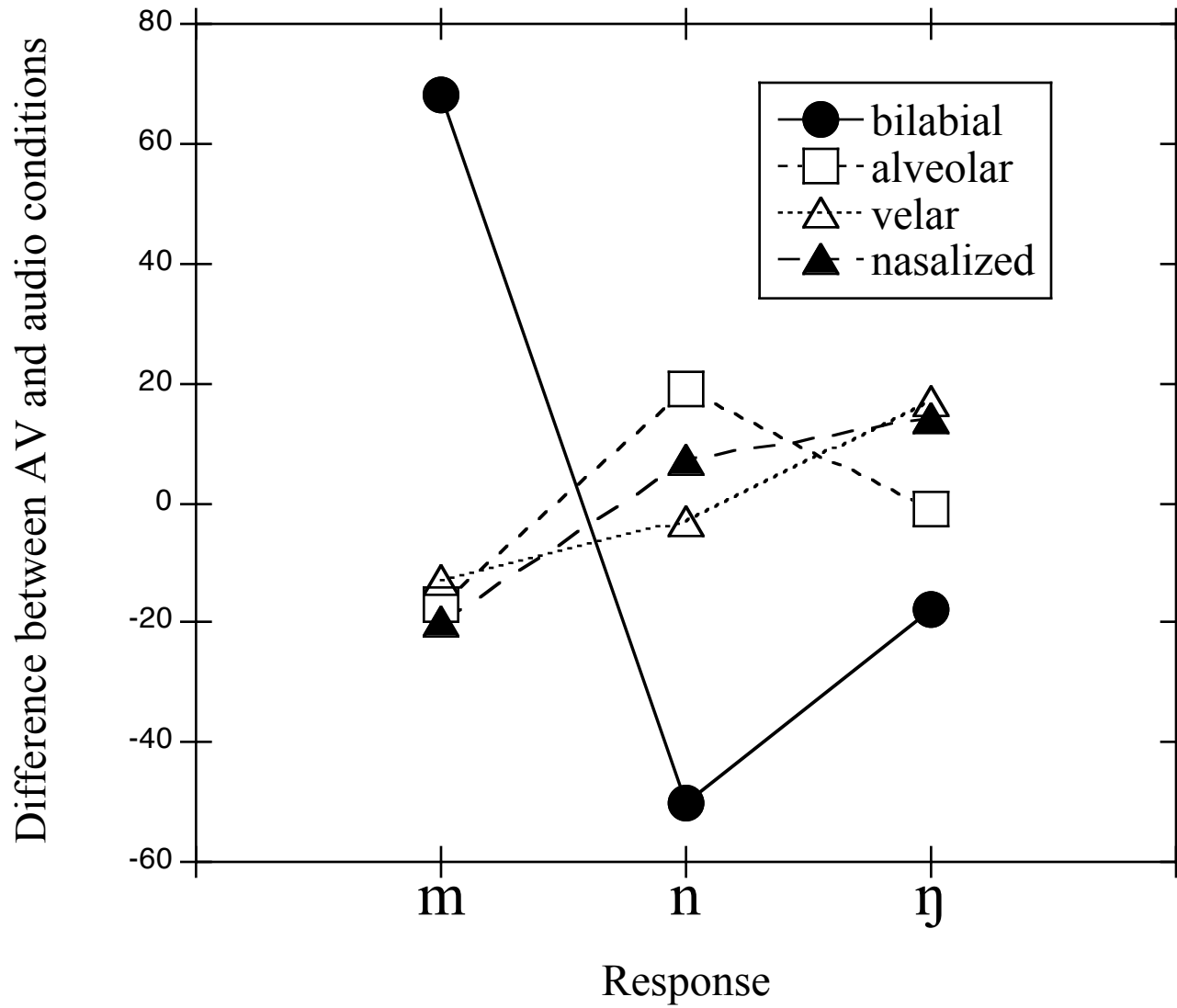
14/18 subjects also participated in experiment 2 (3 trials) at the conclusion of experiment 1.

Overall results of experiment 1.

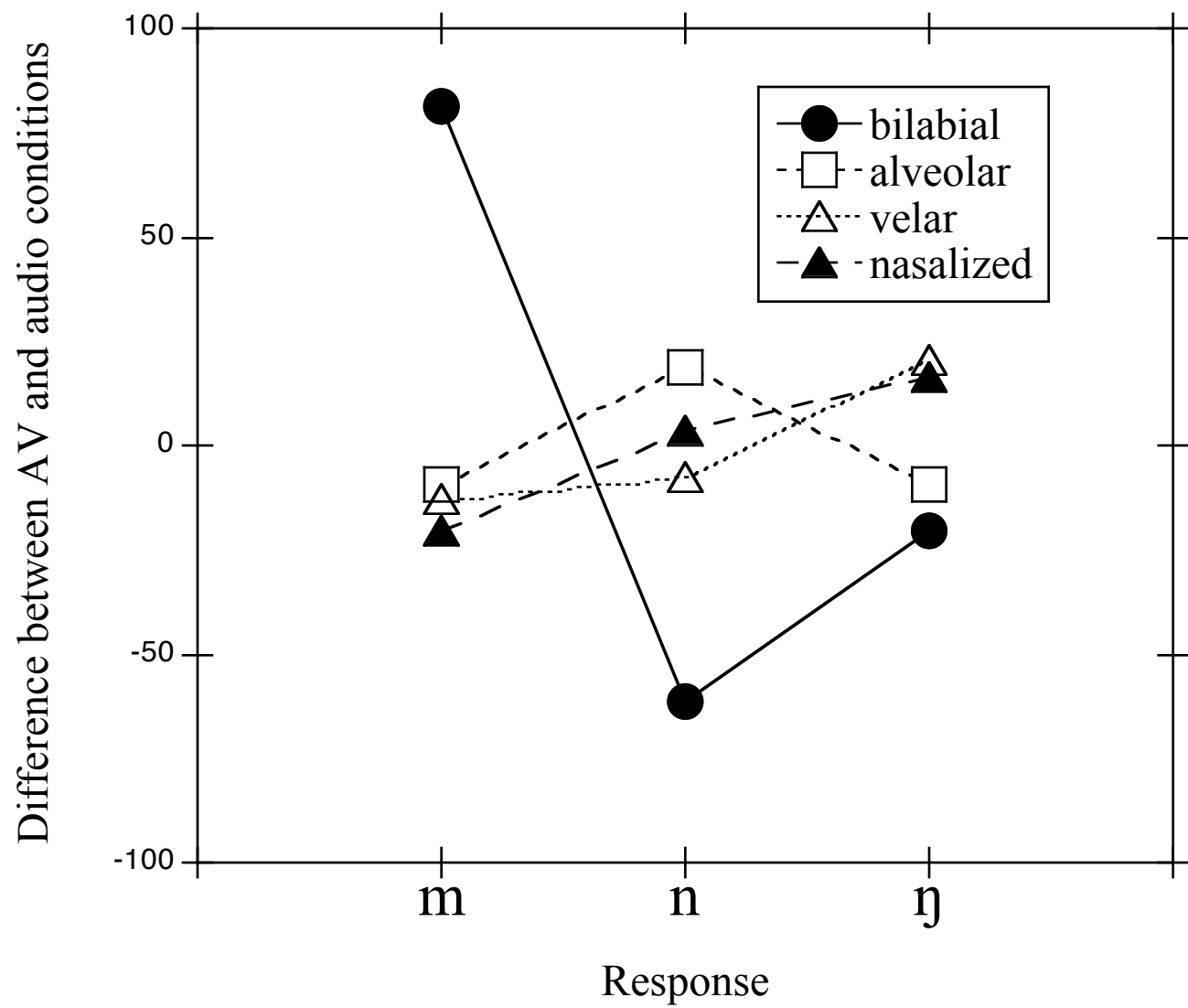
Percent responses for each condition

		[m]			[n]	
	“m”	“n”	“ng”	“m”	“n”	“ng”
Audio	24	<u>55</u>	21	21	<u>56</u>	23
AV	<u>92</u>	5	3	4	<u>75</u>	22
		[ŋ]			[x̃]	
	“m”	“n”	“ng”	“m”	“n”	“ng”
Audio	17	41	<u>42</u>	27	31	<u>42</u>
AV	4	38	<u>59</u>	7	38	<u>56</u>

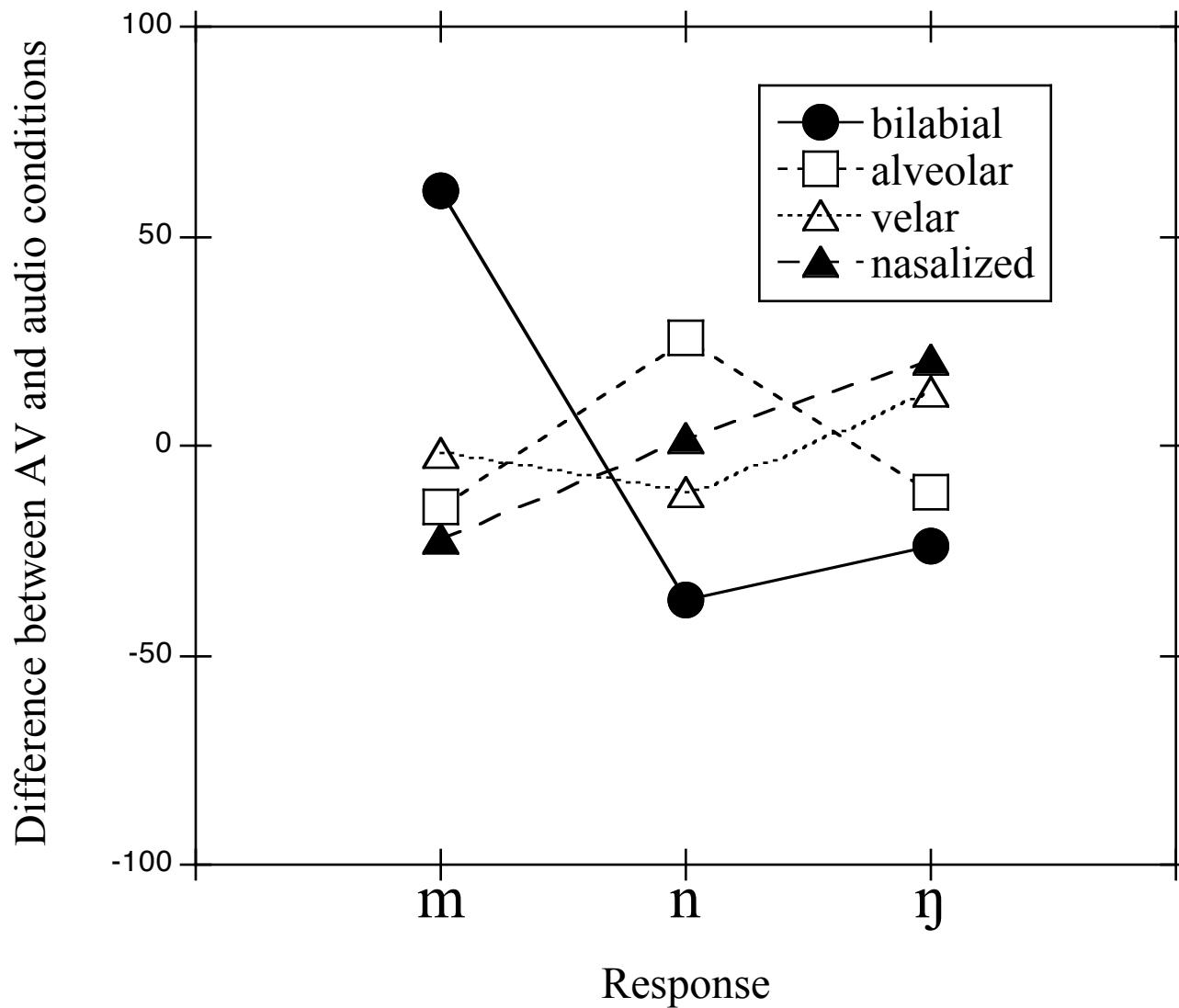
# Overall Result



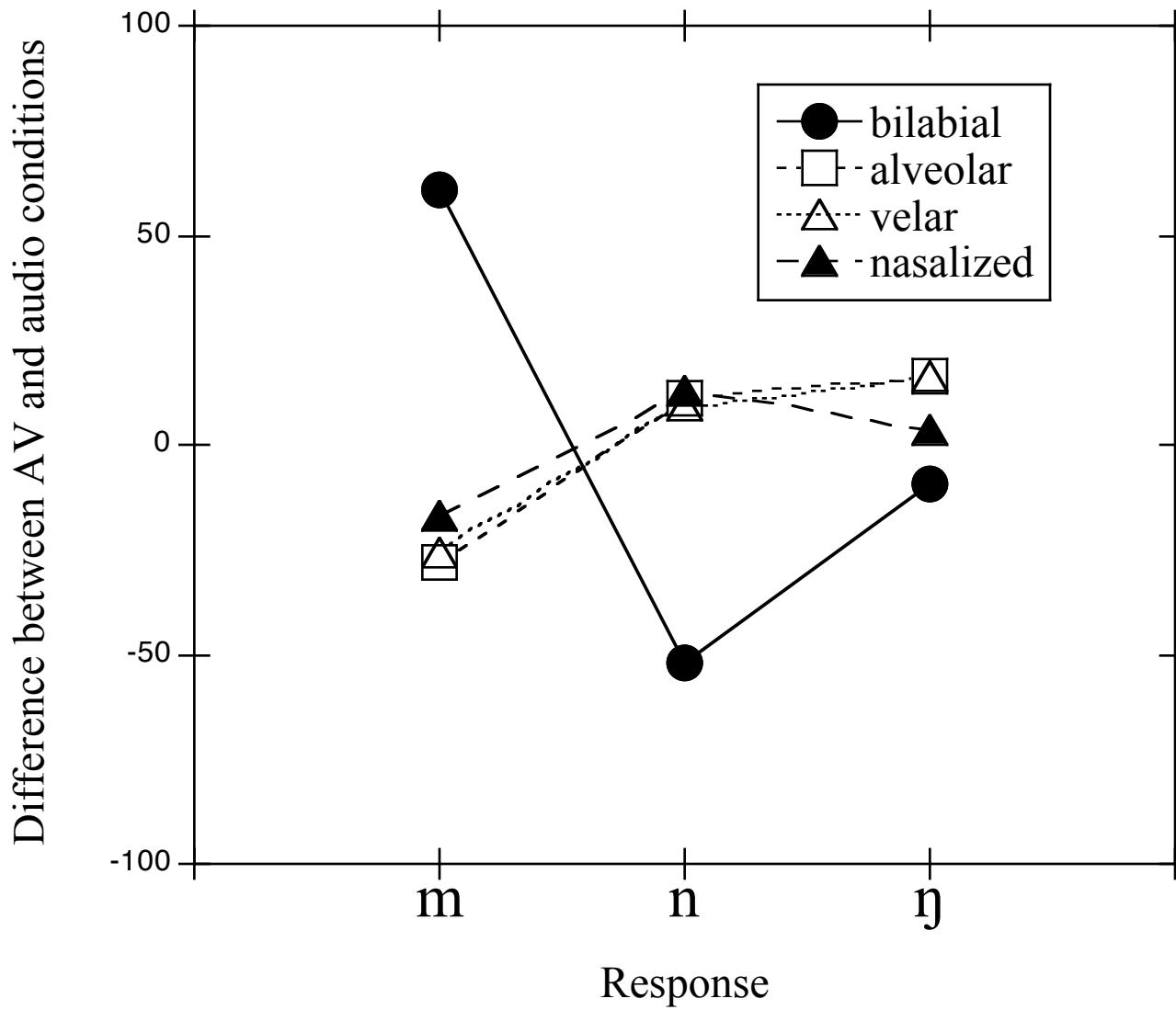
### "sum", "sun", "sung" words



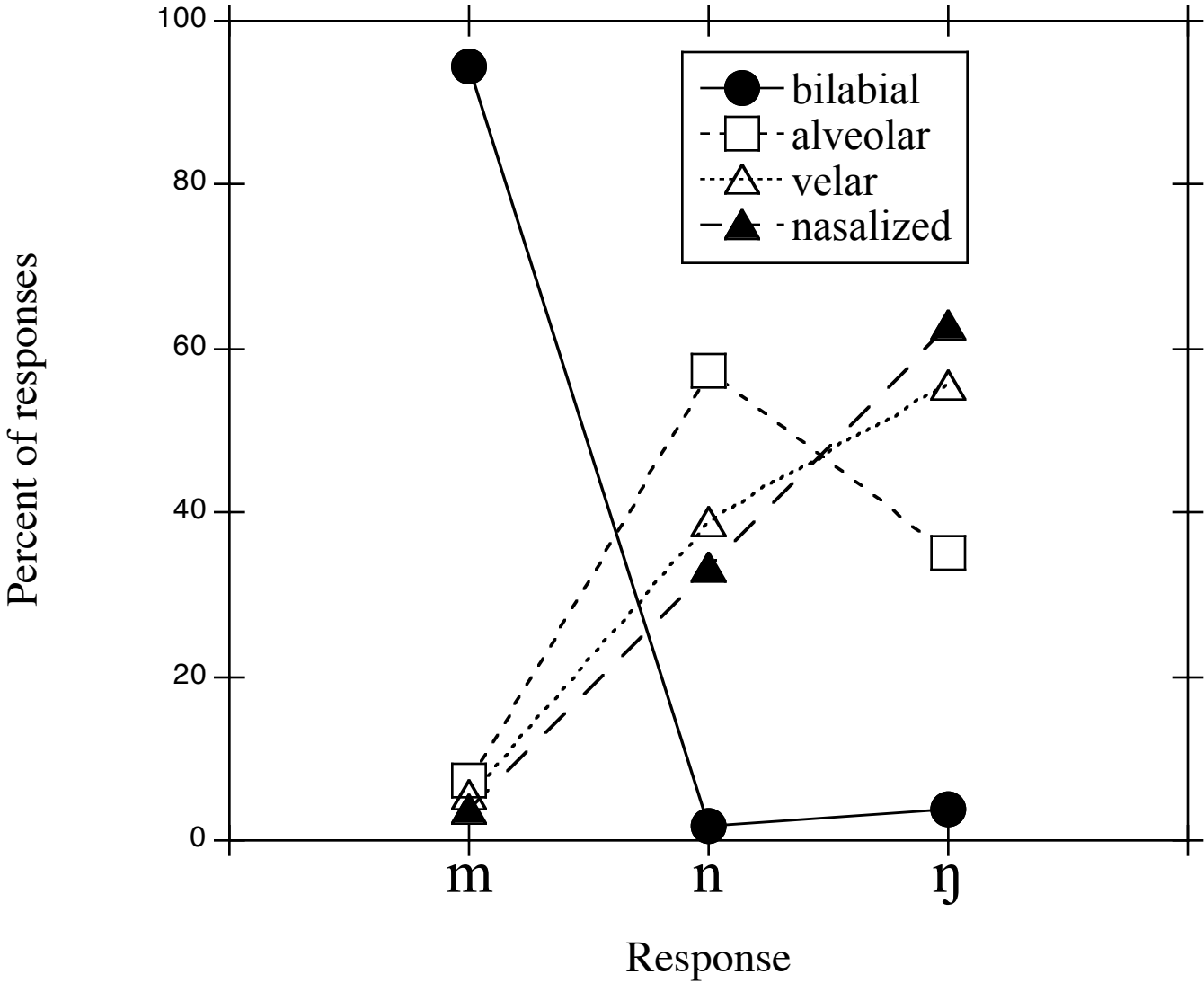
# "rom", "ron", "wrong" words



### "same", "sane", "sang" words



**"same", "sane", "sang" words - AV trials**



*Some conclusions -*

1. Demonstrated visual similarity of [ŋ] and [x̃].
2. When acoustic information is obscured, listeners will use visual information to identify [x̃] as [xŋ].
3. Auditory similarity also exists between [ŋ] and [x̃].
4. Combined effects of auditory and visual similarity may explain excrescent [ŋ].

## **5. Testing the visual similarity hypothesis for excrescent [ŋ]**

### c. Experiment 2 - AV perception of nasalized vowels.

- \* no masking noise
- \* nasalized vowels only
- \* three groups of participants:
  - American English - group one (web experiment)
    - 21 participants,
    - 14 in the audio condition, 7 in the AV condition
  - American English - group two
    - 14 who participated after responding in experiment 1,
    - 7 in the audio condition, 7 in the AV condition
  - French - (web experiment)
    - 23 participants
    - 10 in the audio condition, 13 in the AV condition.

▫ *Stimuli.* A native speaker of English (who has had experience with both French and phonetics) was videotaped speaking each of three CV syllables with a word-initial /h/ followed by a nasalized vowel: /hã/, /hõ/, /hẽ/.

▫ *Task.* Identify the (nonexistent) final nasal segment as “m”, “n” or “ng”.

- \* Audio condition - heard sound files of these three productions
- \* AV condition - saw movie files of these three productions

**Results of experiment 2.** Percentage of subjects who responded “m”, “n” or “ng” in each condition.

<u>English listeners</u> - first group	“m”	“n”	“ng”
Audio	19	40	40
AV	10	<b><u>71</u></b>	19
<hr/>			
<u>English listeners</u> - second group			
Audio	14	<b><u>57</u></b>	29
AV	10	43	<b><u>48</u></b>
<hr/>			
<u>French listeners</u>			
Audio	20	<b><u>77</u></b>	3
AV	0	<b><u>95</u></b>	5

## *Experiment 2 conclusion*

French based their responses on spelling conventions.

For the Americans, experience in experiment 1 (with masked consonants that could sometimes - e.g. [m] - be identified clearly in the movies) seems to have affected their use of visual information.

Audio presentation of nasalized vowels did not lead to [ŋ] responses, while in one condition - with sensitized listeners - AV presentation does favor hearing [ŋ] for nasalized vowels.

## 6. Overall Conclusion

Final [ŋ] is visually similar to nasalized vowels.

Acoustic similarities noted by Ohala (1975) seem to fail to predict listeners' behavior in experiment 2.

The visual similarity hypothesis for excrescent [ŋ] is thus supported.

However, the conditions in which visual similarity might be relevant in “the wild” may be limited:

- noisy conditions

- visual contrast with other possible articulations

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