

BACKGROUND

In isolated vowels, speakers with congenital visual deprivation produce smaller displacements of the lips (visible articulator) than their sighted peers, but they compensate by producing larger tongue displacements (non-visible articulator) (Ménard et al., 2009; Ménard, 2015);

Domain-initial prosodic strengthening means that segments that occur in the initial position of large prosodic units (eg., intonational phrases) are produced more strongly than those in the initial position of small prosodic units (eg., words) (Cho et al., 2011; Georgeton, 2014).

Visible and non-visible articulators might contribute to marking prosodic boundaries.

QUESTION & OBJECTIVE

How do congenitally blind speakers, who are known to produce reduced lip movements in isolated vowels, strengthen articulatory gestures and acoustic features in order to mark prosodic boundaries in French?

Our objective was to investigate, in congenitally blind and sighted adults, the acoustic and articulatory effects of domain-initial and domain-final prosodic units (words and intonational phrases):

- F0, F1, F2 and duration
- Upper and lower lip / Tongue tip, tongue blade and dorsum

Participants

8 congenitally blind adults (mean age, 38 y.o.)
 8 sighted adults (mean age, 39 y.o.)

All participants had normal auditory thresholds and were native speakers of Canadian French.

Blind subjects had a complete visual impairment (class 3, 4, or 5 in the ICDWHO).

Task

The experiment consisted of acoustic and articulatory recordings of 10 repetitions of the 4 French vowels /i/, /y/, /u/, /a/ produced in 4 different prosodic contexts.

Each vowel was produced in a /bVb/ syllable and was embedded in a carrier sentence.

The 4 prosodic contexts that were examined are (inspired from Georgeton, 2014) :

Word-initial position :

Il aimerait que Jabob Huberteau soit son nom.
 He would like his name to be Jabob Huberteau.

Word-final position :

Elle aimerait que Marie-Bu Bédard soit son nom.
 She would like her name to be Marie-Bu Bédard.

Intonational phrase (IP)-initial position :

Selon Jacob, Huberteau est un joli nom.
 According to Jacob, Huberteau is a nice name.

Intonational phrase (IP)-final position :

Selon Marie-Bu, Bédard est un joli nom.
 According to Marie-Bu, Bédard is a nice name.

METHOD

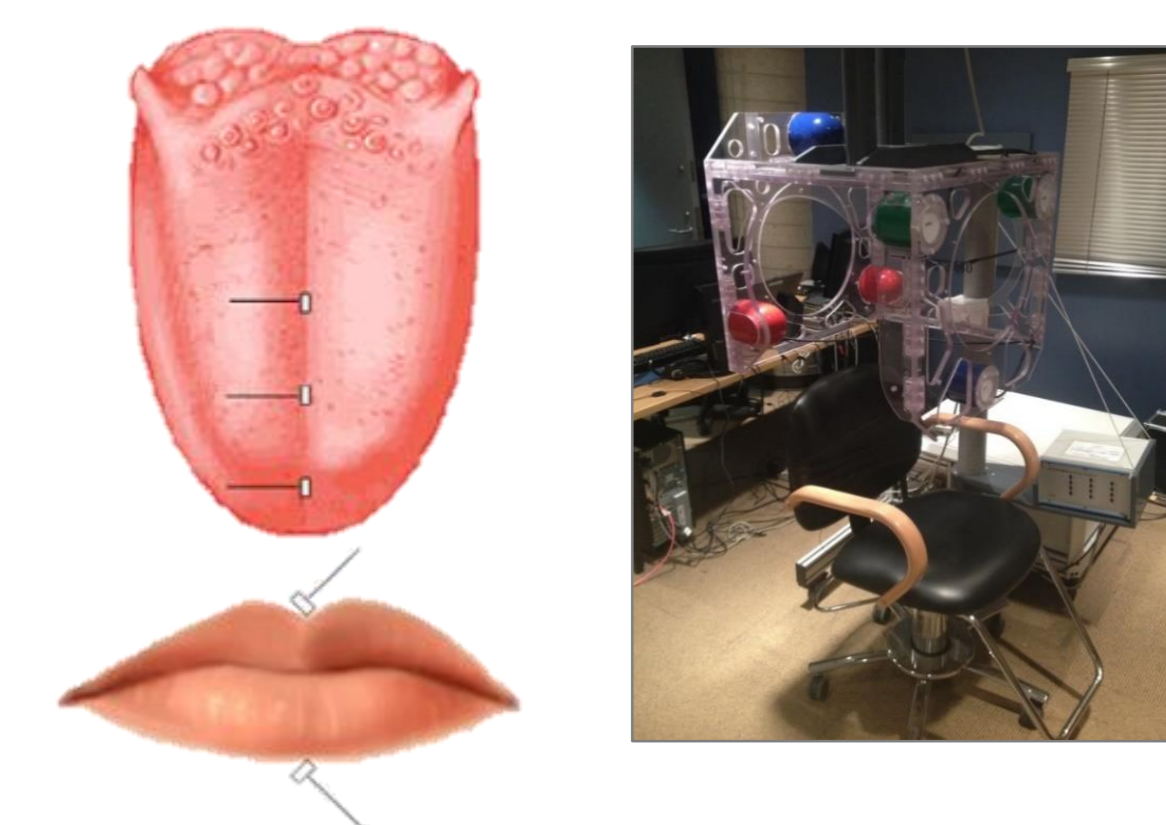
Experimental setup

Synchronous acoustic and articulatory recordings were made using an EMA system (Carsten AG 500).

10 sensors:

- 2 upper and lower lips
- 1 upper incisors
- 2 lower incisors
- 2 mastoids
- 3 tongue (Tip – Blade – Dorsum)

Position and orientation were extracted using the EMA software and were corrected for head movement using a MATLAB procedure developed by Mark Tiede (Haskins Laboratory).



Data analysis

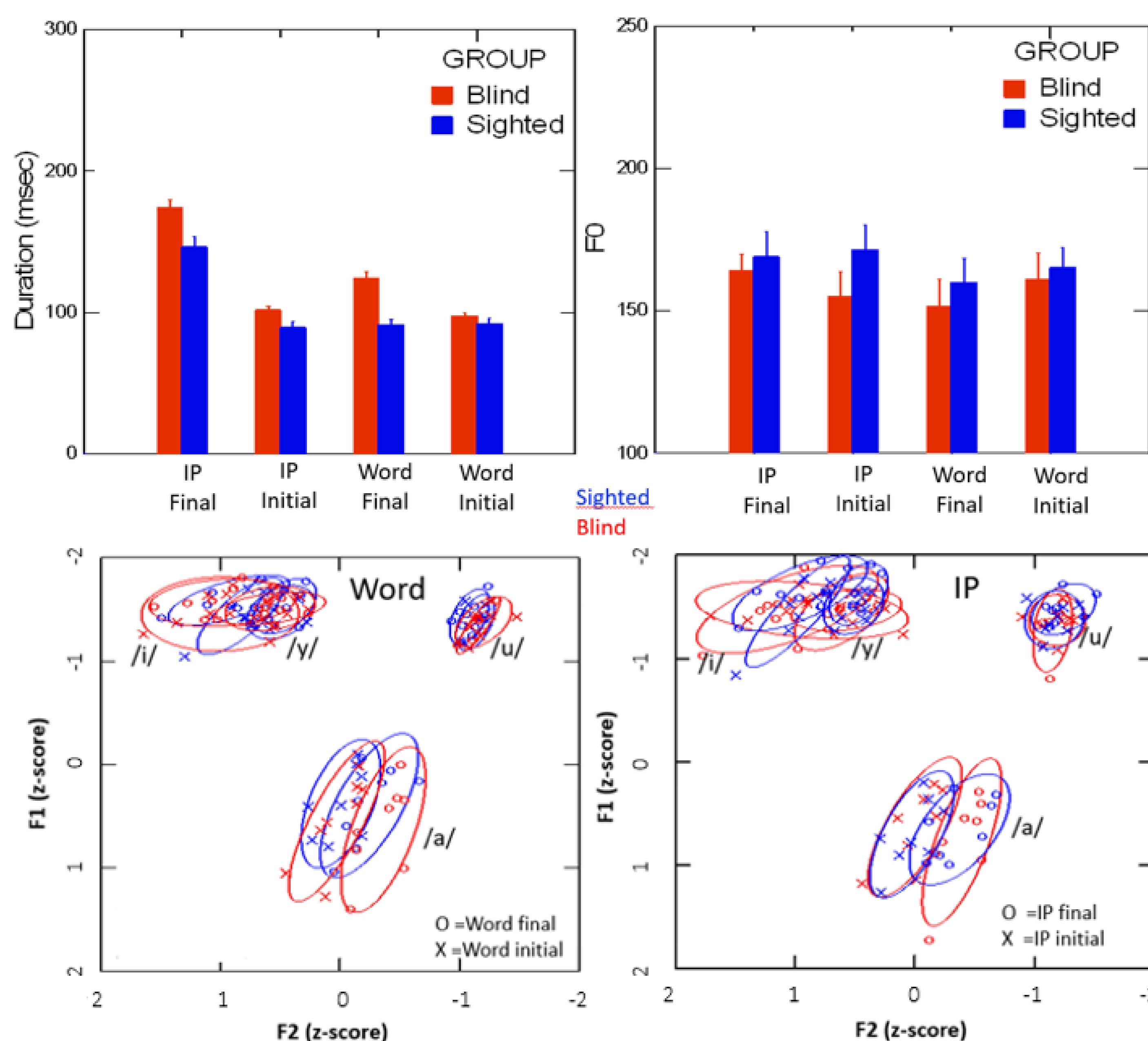
-For each vowel, in both positions (initial and final) and in both domains (word and IP):

- duration and formant values (at vowel midpoint)
- mean position of the sensors in the **horizontal (front-back)** and vertical (high-low) dimensions;

-Z-scored formant and articulatory values;

-Linear mixed effects models built on articulatory and acoustic values, with group (blind and sighted), position (initial and final), domain (word and IP) as fixed effects and speaker as a random effect.

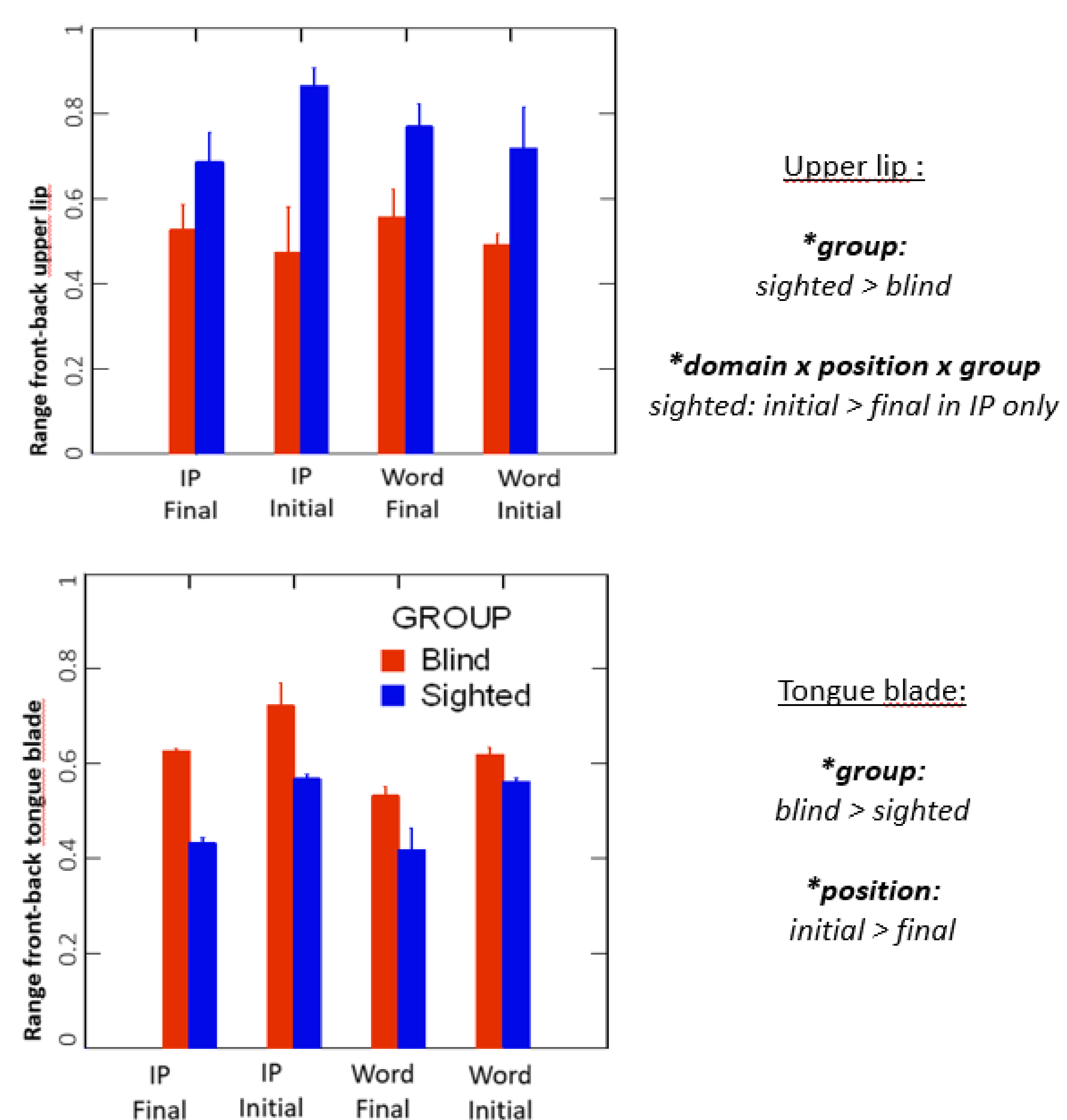
ACOUSTIC RESULTS



F0:
 *domain: IP > word
 Duration:
 *group: blind > sighted
 *domain x position x group:
 blind: final > initial
 sighted: final > initial in IP

F2:
 *vowel x position:
 /a/: initial > final

ARTICULATORY RESULTS



Upper lip :
 *group: sighted > blind
 *domain x position x group:
 sighted: initial > final in IP only

Tongue blade:
 *group: blind > sighted
 *position:
 initial > final

DISCUSSION

At the acoustic level, blind and sighted speakers used vowel duration to mark the edges of prosodic units in French. In sighted participants, vowels produced in final positions were longer than those produced in initial positions in IP only (higher level than words). In blind participants, vowels in word-final positions and in IP-final positions were longer than those in initial positions.

At the articulatory level, blind speakers used larger tongue displacements than sighted speakers (confirming our previous studies). Sighted and blind speakers used enhanced tongue displacements in initial positions compared to final positions (words and IP). Upper lip displacements were larger in sighted speakers than in blind speakers, and only sighted speakers enhanced lip displacements in IP initial position compared to IP final position.

Sighted speakers likely use multimodal cues to mark prosodic boundaries.

REFERENCES

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