BILINGUAL SPEECH SEGMENTATON:
THE ROLE OF FREQUENCY-BASED AND PROSODIC CUES

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The Bilingual Mind

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Background

• Speech segmentation results from the acquisition and integration of various strategies. The weight of these cues in adults is hierarchically organized, i.e., not all cues have the same weight (Mattys, White & Mehlhorn 2005).

» **Statistical and prosodic cues:** Have been proposed as the most salient cues for infants, less salient ones for adults.

• Two specific types of statistical and prosodic information correlate with the basic word order of natural languages (OV/VO), which might help infants segment speech and discover the basic word order of their language(s), i.e., a major feature of the languages' syntax (Gervain et al., 2008; Nespor et al., 2008).

i. Frequency-based cue: Shown to be available to adults and infants (Gervain et al. 2008, 2013; de la Cruz-Pavía et al. 2015).
Frequency distribution of functional and lexical categories.
Functors are highly frequent elements that tend to occur at the edges of phrases.

Verb-Object languages	Object-Verb languages
Phrase-initially	Phrase-finally

ii. Prosodic cue: Shown to be available to infants (Gervain & Werker 2013).
Realization and location of prominence within phonological phrases. (Nespor et al. 2008)

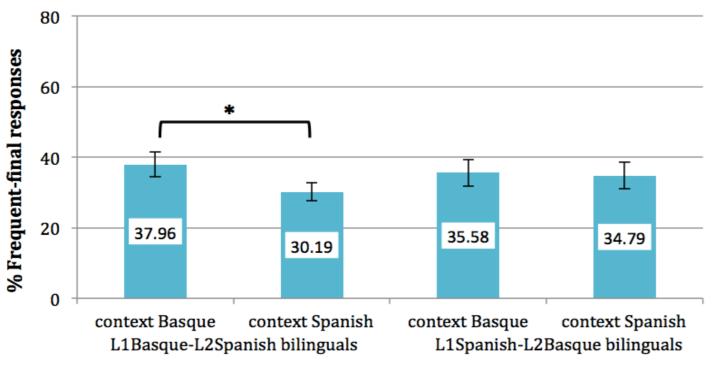| VO languages	OV languages
Rightmost word	Leftmost word
Increased duration:	Higher pitch:
[- —] [- —] [- —] [- —]	[x́ x] [x́ x] [x́ x] [x́ x]

Results
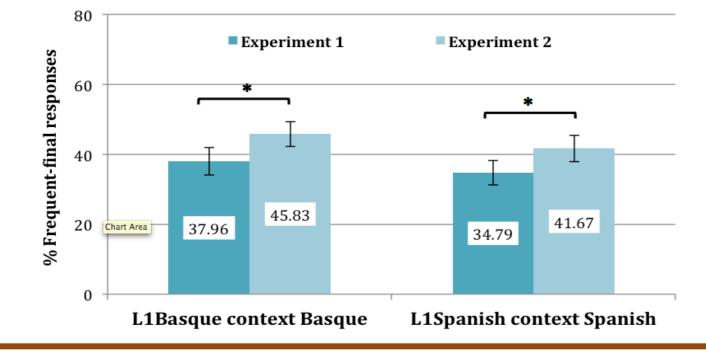
● EXPERIMENT 1:

» A general frequent-initial segmentation preference was obtained.

» Frequency-based cues modulated the segmentation preferences of the groups of L1Basque/L2Spanish bilinguals (p=.006), but not of L1Spanish/L2Basque bilinguals (p=.788), i.e., a context language effect was found in L1Basque bilinguals.

● EXPERIMENT 2:

» A general frequent-initial segmentation preference was obtained.

» The prosodic cue modulated the bilinguals' segmentation preferences (Experiment 2: L1Basque context Basque vs. L1Spanish context Spanish p = .181; L1Basque context Basque Exp.1 vs Exp2 p = .008; L1Spanish context Spanish Exp.1 vs. Exp.2 p = .014).

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Aims

To examine the segmentation preferences of Basque/Spanish bilinguals and determine:

(a) whether these frequency- and prosody-based cues are available to adults,

(a) whether bilingual speakers of a VO (Spanish) and an OV (Basque) language use the frequency-based and prosodic segmentation strategies of the two languages they command and use frequently, or prefer the strategy characteristic of their L1,

(b) whether manipulating the language of the context modulates the bilinguals' segmentation.

Methodology

● **Two artificial language learning experiments**:

EXPERIMENT 1: **frequency-based cue** / EXPERIMENT 2: **prosodic cue**

» **Familiarization**: 9 minute-long concatenation of *aXbYcZ* units, with strict alternation of frequent and infrequent categories:

Frequent categories	Infrequent categories
a, b, c: 3 tokens → 1 per category	X, Y, Z: 27 tokens → 9 per category

» Amplitude of the initial/final seconds increased/decreased gradually, rendering the stream ambiguous. Two potential segmentations:

(a) frequent-initial segmentation : mirroring the order in VO languages.

(b) frequent-final segmentation: mirroring the order in OV languages.

…**aXbYcZ**aXbYcZaXbYcZaXbYcZaXbYcZaXb…	…a**XbYcZa**XbYcZaXbYcZaXbYcZaXbYcZaXb…
…**filunufegemu**fipenutagelifidunupigero…	…fi**lunufegemufi**penutagelifidunupigero…

» **Test stimuli**: 36 pairs of six-syllable long units, one item being frequent-initial (e.g., *fidunupigena*), the other frequent-final (e.g., *bofipanumoge*).

» **Task**: To choose which member in each pair sounds more like the language heard during familiarization.

» **Participants**: 123 proficient Basque/Spanish bilinguals (AoA of L2: 3-5 years), sorted by L1 and context language (i.e., language of the instructions: Spanish or Basque).

▪**EXPERIMENT 1:** four groups

» L1Basque/L2Spanish: context Basque (n= 27) / context Spanish (n = 23).

» L1Spanish/L2Basque: context Basque (n = 21) / context Spanish (n = 21).

→ **Prosodically flat** artificial language: **constant pitch.**

▪**EXPERIMENT 2:** 2 groups

» L1Basque/L2Spanish context Basque (n = 16).

» L1Spanish/L2Basque context Spanish (n = 15).

→ **Changes in pitch** [x́ x] [x́ x] → prosodic cue associated to **OV languages**

120 Hz F0 → **infrequent** syllables / **100 Hz** F0 → **frequent** syllables

» Speakers of **OV languages** (L1Basque bilinguals): **convergent cues**
Frequency-based cue and prosodic cue: frequent-final segmentation

» Speakers of **VO languages** (L1Spanish bilinguals): **conflicting cues**
Frequency-based cue: frequent-initial / Prosodic cue: frequent-final

Conclusions

● Adult bilinguals can deploy the frequency-based and prosodic segmentation strategies characteristic of their languages.

● Statistical and prosodic cues play a minor role in adults speech segmentation.

● The segmentation preference of the L1Basque/L2Spanish bilinguals is modulated by the context language, variable that needs to be controlled in studies with bilingual populations.

● The segmentation preference of L1Spanish/L2Basque bilinguals is not modulated by the context language. Tentative explanation:

→ Differences in L2 proficiency between L1Basque/L2Spanish and L1Spanish/L2Basque bilinguals.