

Mixed methods to examine the acquisition of gradient allophonic variation

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GOALS OF PRESENT STUDY

1. Use a novel mixed-methods approach to explore the L2 acquisition of Spanish voiced stops /b, d, g/ by L1 Am. English learners and better understand the process:
 - Categorical and continuous analyses of realizations
2. Highlight ability of learners to acquire expected pattern:
 - Contrary to previous studies

BACKGROUND

SPANISH AND ENGLISH VOICED STOPS

English has two sets of allophones:

- [b̥ d̥ g̥]/[p, t, k]: utterance-initially, after pause
- [b d g]: elsewhere

Spanish has two sets of allophones:

- [β, ð, γ]: after continuant sounds
- [b d g]: elsewhere

([p, t, k]: allophones only of voiceless stops in Span.)

- **Why is this of interest?** Learners need to acquire a new set of approximant allophones and a new distribution for L1 allophones

PREVIOUS STUDIES ON THE PHENOMENON

Categorical Analyses vs. Continuous Analyses

Early studies use **categorization of realizations** as stop vs. approximant (Zampini 1994, Lord 2010):

- They conclude Span. /b, d, g/ are a challenge for learners.

Studies on L1 Spanish show that approximant production is gradient and best captured by the acoustic **continuous measure of Consonant-to-Vowel (CV)-intensity ratio** (e.g. Carrasco et al. 2012).

- A couple of studies use this measure to explore the L2 phenomenon (Shea & Curtin 2011, Rogers & Alvord 2014).

Our proposal: a new mixed-methods approach, using two measurements: the type of allophone and the CV-intensity ratio, allows for more accurate picture of the learning process.

RESEARCH QUESTIONS

- How do voiced stops categorical realizations change in the acquisition process? (*categorical analysis*)
- How does the degree of weakening change in the acquisition process? (*continuous analysis*)
 - How do these results complement each other?

METHODOLOGY

DATA COLLECTION

Current study is part of bigger project **See your Speech**:

- Data comes from a module presented to students as part of a college-level Spanish Pronunciation class.
- Using a web-based interface, students record themselves reading word lists in Spanish and in English:
 - At the beginning and the end of the semester
- **Pedagogical component:** Instant and in-class feedback



METHODOLOGY (cont.)

STIMULI

Module includes 71 Spanish words presented one by one:

- Words target a variety of Spanish sounds
- /b, d, g/ appear in intervocalic or word-initial position:
 - Word-initial - *doce*, *bebé* (“twelve, baby”)
 - Intervocalic - *comida*, *lago* (“food, lake”)
 - In stressed and unstressed positions

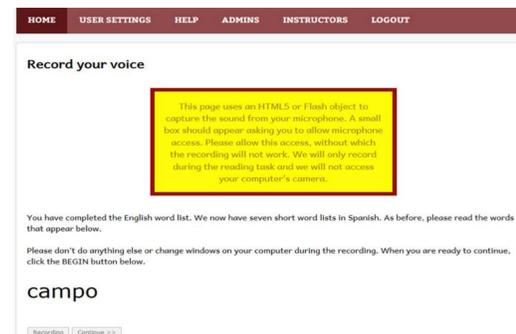


Fig.1 See your Speech interface

PARTICIPANTS

College students taking Spanish pronunciation course at 3000 level:

- 24 participants: 13 females and 11 males

ACOUSTIC ANALYSIS

Each token of /b, d, g/:

- Classified according to type of realization
- CV intensity ratio was calculated:
 - Ratio between C intensity minimum and following V intensity maximum
 - Higher intensity ratio => more weakened production

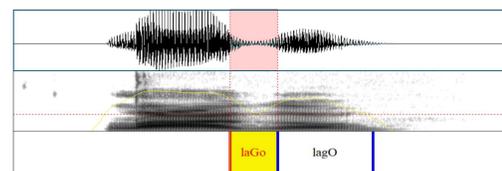


Fig.2 Example of CV-intensity measuring

DATA ANALYSIS

Number of tokens= 1,053

Effect of following factors on stop production reported here:

- Timepoint (beginning T1 vs. end of semester T2)
- Stress
- Word position (initial vs. medial)
- Interactions between timepoint and other factors

Descriptive statistics on types of realizations

Linear regression & pairwise comparisons on CV-int. ratios

RESULTS

CATEGORICAL ANALYSIS

Table 1. Types of realizations by timepoint

(chi-square p<0.001)	approx.	voiced stop	voiceless stop	deletion	fricative	tap	vowel+ approx
T1	33.46%	47.15%	16.73%	0%	0%	2.66%	0%
T2	53.70%	31.12%	12.14%	0.19%	0.57%	2.09%	0.19%

Effect of stress (Fig. 3):

- More approximants in unstressed positions.
- More voiceless stops in stressed positions
- Same pattern in T1 and T2

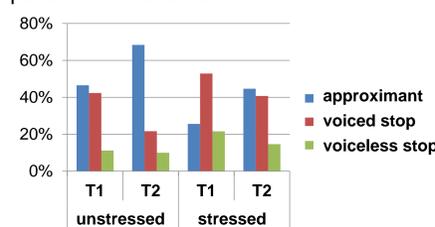


Fig. 3 % realizations by timepoint & stress

Effect of word position (Fig. 4):

- Most voiceless stops occur initially, as expected:
 - Decrease in voiceless stops initially, in favor of voiced stops and **even some approximants**

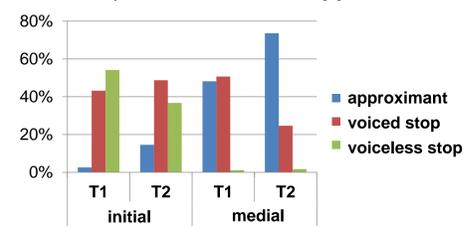


Fig. 4 % realizations by timepoint & word position

CONTINUOUS ANALYSIS

Table 2. Mean and SD CV-intensity ratio results for approximant, voiced stop and tap realizations

Timepoint	intensity ratio (SD)
T1	0.817 (0.1043)
T2	0.839 (0.1044)

Significant factors on intensity ratio:

- Higher ratio in unstressed positions
- Higher ratio in medial positions
- Significant interaction between timepoint & word position (Fig. 5):
 - Only medial positions increase their intensity ratio.

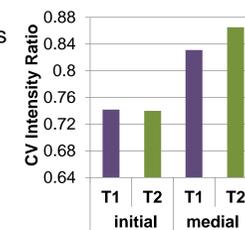


Fig. 5 CV-intensity ratio by timepoint & word position

DISCUSSION

Results show a **range of types of realizations**:

- Some of these realizations have not been considered in previous studies.

There are changes between T1 and T2 but vary depending on the realization:

- Significant increase in approximants vs. decrease in voiced stops productions => evidence of production changes during the learning process
- Voiceless stops show a smaller change.

Linguistic factors affect production and T1-T2 change of realizations:

- More stops in **stressed** than unstressed positions:
 - Expected result given stress tends to strengthen articulations (Gordon 2011)
- Difference in amount of change according to **word position** => Smaller change word-initially than medially:
 - This could suggest that learning a new distribution of L1 allophones is more challenging than learning new allophones
 - Further evidence for this: approximants word-initially in T2!

CV-intensity ratio patterns mirror those of the categorical analysis:

- Higher ratio in unstressed and word-medial positions
 - These results are similar to those found for native speakers (Carrasco et al. 2012) => learners effectively use intensity ratio to pattern weakening
- Intensity ratio only changes in medial positions:
 - Expected since categorical analysis shows word-initial position involves mainly stop productions

MAIN FINDINGS AND CONCLUSIONS

Finding: Difference between learning new distribution vs. new allophones

- Implications for theories of L2 acquisition: *Why do we find an asymmetry?*
 - New allophones might be more salient to learners.
 - It might be harder to reconfigure already-learned articulatory patterns.
- Implications for pedagogy of L2 pronunciation
 - Research-based improvements to teaching techniques

Finding: learners follow a pattern of acquisition that mirrors native speakers' gradient weakening

A mixed-methods analysis allows for a broader and more nuanced understanding of L2 sounds acquisition

NEXT STEPS

- Explore the same research questions in a language class
- Continue our work comparing the acquisition of voiced and voiceless stops