Language and Prodosic Performance in Spanish-English Speakers

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INTRODUCTION

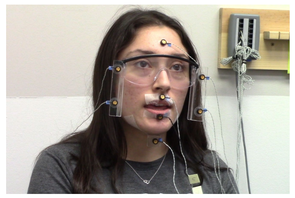
- Statistical learning involves implicit learning of rules; these are important for learning language (Conway et al., 2010). Adults rely on statistical regularities to learn syllable and prosodic sequences (i.e., placing stress on different syllables; Hay & Saffran, 2012).
- Even though Spanish and English both use similar prosodic patterns (e.g., the English phonetic transcription for *panorama* is /'pænə'ɹæmə/ and for Spanish is /'pano'**ɾ**ama/), culturally responsive research is lacking for Spanish-English bilingual speakers.
- We investigated how people may implement prosodic variation over time while listening to monotone nonwords; changes in prosody may index learning (Goffman, 1999).
- We asked: **How do Spanish-English speaking adults with either high or low English proficiency apply prosodic structure in a statistical learning task?**
- We hypothesized that greater prosodic variation imposed on these nonwords would be indicative of statistical learning.

MATERIALS

- 8 diodes were placed on the participant to measure lip and jaw movement when producing speech (See Figure 2).
  - Kinematic data was recorded using NDI Optotrak Certus (See Figure 1).

Figure 1. *NDI Optotrak Certus.*

Figure 2. *Participant with diodes.*

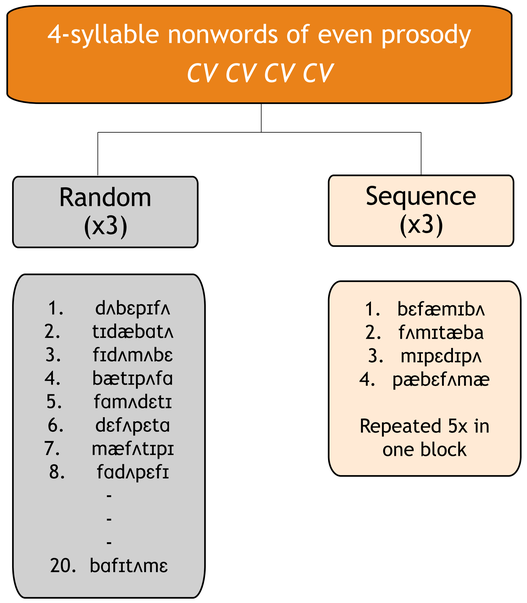


- A video camera was used for visual recording of participants. Speech was recorded via an audio recording of participants.
  - Only acoustic data were analyzed.
- A case history was used to determine language history in both first (L1) and second (L2) languages.
  - With most participants' second language being English, the analysis focused on L2.

METHODS

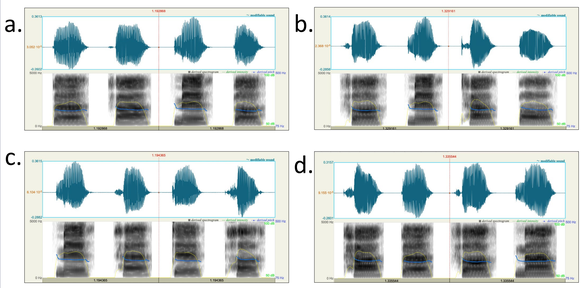
- 31 college students participated in the full experiment.
  - A subset of Spanish-English bilingual adults (*n* = 4) were included in this analysis.
- Participants listened to and repeated four-syllable nonwords. Half of the words followed a repeating sequence of four syllables and half varied randomly.
  - All nonwords were monotone and were free of prosodic variation.
- Participants were unaware of the sequenced blocks in the experiment, allowing for implicit statistical learning to occur.

Figure 3. *Schematic of nonword repetition task.*



Note. The current study focused only on sequenced blocks.

Figure 4. *Waveforms showing the acoustics for each nonword in the sequenced block*: (a) /bɛfæmɪbʌ/; (b) /fʌmɪtæba/; (c) /mɪpɛdɪpʌ/; (d) /pæbɛfʌmæ/



METHODS

- Participants were divided into high and low language proficiency groups based on their performance on a set of language measures: modified token test, word definition, and spelling test (Fidler et al., 2011).
  - These measures are used to identify adults with developmental language disorder (DLD). We adapted these measures to assess English language proficiency.

Table 1. *Participant raw scores on Fidler et al. (2011) measures.*

	Spelling Test	Token Task	Word Definitions	Total Score
A	13	42	43	98
B	11	38	36	85
C	5	29	35	69
D	10	19	31	60

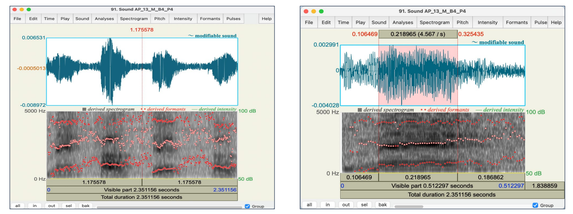
- Praat software (Boersma & Weenink, 2023) was used to assess acoustic changes in prosodic structure during learning.
- Vowels were trimmed using the spectrogram, focusing on complex formant structure.
- The acoustic correlates of stress that were measured in the current study include: syllable **duration** and **mean amplitude.**
  - Difference scores were calculated between adjacent syllables (Syl 1- Syl 2 and Syl 3- Syl 4) to determine if prosodic modulation occurred.
- Out of 4 nonwords, only /mɪ.pɛ.dɪ.pʌ/ and /pæ.bɛ.fʌ.mæ/ were used for analyses.

Scan QR codes to listen to stimuli.

/mɪpɛdɪpʌ/

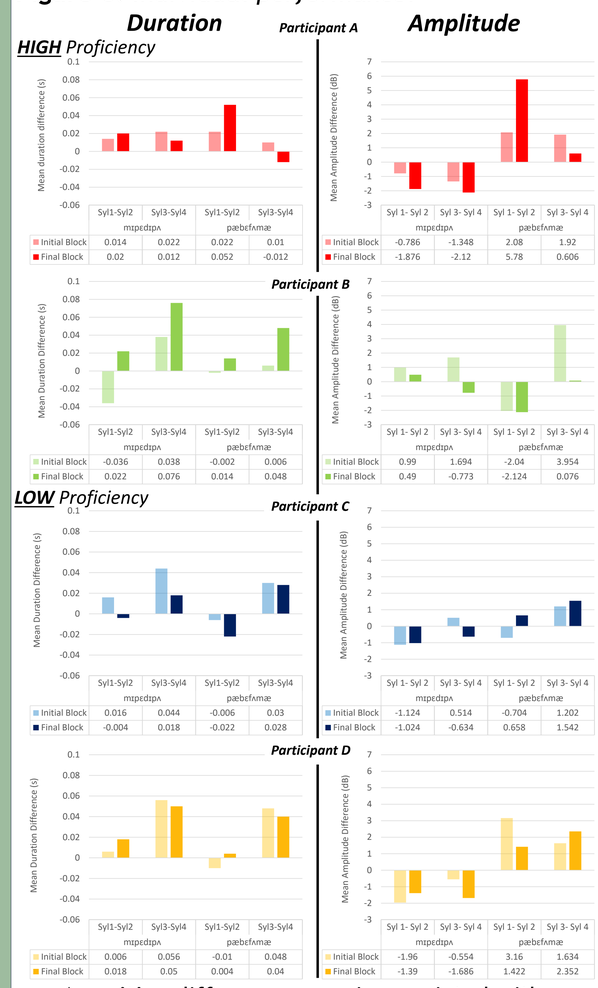
/pæbɛfʌmæ/

Figure 5. *Example of trimmed vowels.*



RESULTS & DISCUSSION

Figure 6. *Individual performance.*



- A **positive** difference score is associated with trochaic (*strong-weak)* modulation; a **negative** difference score with iambic (*weak-strong)* modulation.
- **Duration**: Participants (A, B) in the high proficiency group (red & green bars) were more likely to apply trochaic modulation over the course of learning. In contrast, participants (C, D) in the low proficiency group (blue & yellow bars) were more likely to apply iambic modulation.
- **Amplitude:** Amplitude modulation did not appear to vary systematically.
- While results are preliminary, they suggest that as novel statistical sequences become word-like, prosodic structure is imposed.

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