A corpus of spontaneous L2 English speech for real-situation speaking assessment

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Context:

- Computer Assisted Pronunciation Training tools rarely deal with **spontaneous speech**, and even more rarely with speech in real **discussion situation**.
- Lack of L2 spontaneous speech corpus.
- Lack of speech in peer dialogue situations.

Creation of a speech corpus:

- We started gathering **L2 spontaneous speech** data recorded in exam situations.
- Our first aim is to **train score prediction models** based on near-real-situation L2 speech, but this corpus can also serve other purposes in L2 acquisition, teaching, testing, or L2 speech processing.

Automated file processing:

- A dedicated **speech processing pipeline** was made to anotate the data, including speaker diarization, speech recognition, word-level forced alignment, syntactic analysis and further prosody-related measures [3].
- In this study, we focused on speech **rhythm measurement** through syllabic prominence of polysyllabic words.

pipeline GitLab

corpus Ortolang

Corpus:

- ✔ The CLES is a state certificate established by the French Ministry of Higher Education an Research, and is designed for university-level language proficiency assessment. [1]
- ✔ It initiated the collection of spontaneous L2 speech recordings elicited during exam sessions.
- ✔ This data comprises 2 types of role-play:

— CLES B2 —	— CLES B1 —
Argumentative discussions (2 or 3 candidates) Mean dur.: 9'35"	Vocal messages (monologues) Mean dur.: 3'20"

- ✔ Each recording is provided with high-quality certification-level proficiency ratings.

Proficiency	Nb. of speakers	%
B2	151	58%
B1	75	29%
non-validated	34	13%

- ✔ Each candidate assumed a specific given role, either advocating for or against the subject.
- ✔ The objective is to negociate and work towards a compromise.
- ✔ 2~5 minutes of preparation before the talk.

Conversation type	Nb. of speakers	Duration
3-speaker	15	1h03'44"
2-speaker	232	18h16'50"
1-speaker	13	39'28"
Total	260	20h00'02"

Public portion:

- 128 speakers
- French as L1: 93%
- 48% F, 52% M
- 62 groups
- Total duration: 10 h. (mean: 9'35", min 5'12", max 14'30")

Note: a similar corpus was made involving native speakers of English, and Japanese-L1 speakers [4]. Results comparisons to come soon!

Processing Pipeline

Neural speaker diarization (Pyannote)

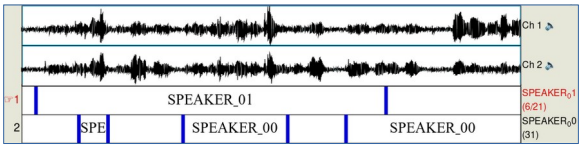
Automatic speech recognition And Word-level forced alignment (WhisperX, Wav2Vec2.0)

Syllable nuclei detection [2]

Syntactic analysis (Spacy, Benepar)

Syllabic parameter extraction (F0, intensity, duration + speaker norm.)
Comparison of words' prosodic shape with a reference dictionary

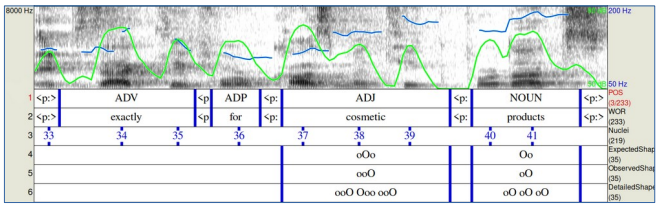
Pause position analysis



◄ Speaker diarization output in TextGrid format.

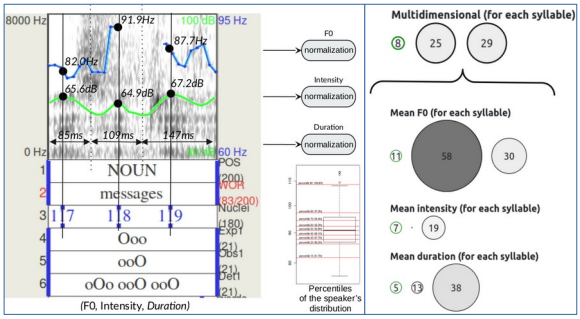
Lexical stress analysis ► anotation example.

Only polysyllabic words with adequat number of syllable nuclei detected are anotated, in order to filter bad word alignments.



Lexical stress analysis:

- Lexical stress is estimated from prosodic measures on syllable nuclei, based on F0, intensity and syllable duration.
- Each prosodic measure is converted in speaker percentile, so that 50 means median prominence level for any speaker, 0 is minimum and 100 is maximum prominence level.



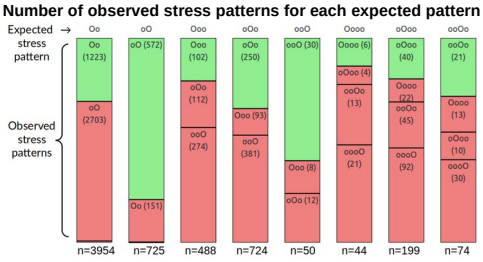
Pipeline Evaluation & Limitations:

- As the pipeline combines several modules, errors can occur at different levels, often leading to incorrect anotations.
  - Whithin the **11 hours of speech** analysed in the present study, only **41%** of polysyllabic words had correct number of syllable nuclei detected within the word boundaries and thus considered as **target words**.
  - Manual evaluation of random 100 target words showed that **17%** were miss-recognized or miss-aligned, potentially leading to wrong judgments that can be problematic in a real assessment context.
  - **Intrinsinc vowel length** and **word ending lengthening** need to be considered in order to improve stress estimation.
  - Some cases of **vowel devoicing** also impacted F0 measures (tackled with linear interpolation for now)

Premilinary results: Lexical stress position accuracy and degree of prosodic contrast in B1/B2 French-L1 speech

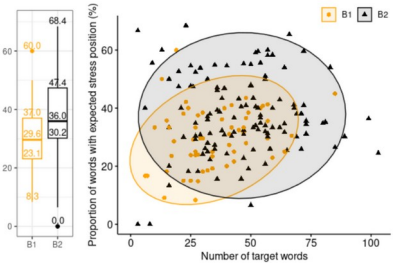
- **Hypothesis:**
  - Position accuracy B2>B1.
  - Shift to last syllable.
  - Stress mainly by duration change.
  - F0 and intensity used mainly by high proficiency speakers.
- **Sub-corpus:**
  - L2 English spontaneous speech from **176 French** learners recorded during CLES certification speaking session.
  - Total **11 hours** of continuous speech (per speaker: mean 3'44'', min 32'', max 6'51)
  - Speaking **B1 level: 34%**, **B2 level: 66%**
  - Speech duration: B1≈B2, Nb tokens: B1<B2, B2 speakers tend to make more but shorter pauses than B1 (median 34.3 pauses/min/speaker vs. 30.7, p<.01; 592ms vs. 615ms, p<.01), Silence proportion: B1≈B2.
  - 6350 polysyllabic target words.

Number of observed stress patterns for each expected pattern

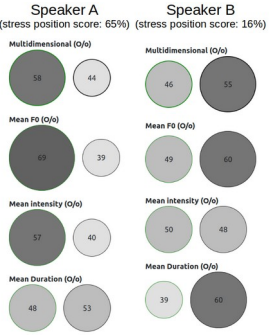


- **Main observations:**
  - Mean stress position accuracy varies greatly among speakers (0–68.4%, mean: 35.4%).
  - B2 speakers perform better than B1 in terms of stress position accuracy (36% vs. 29.6%, rank test p<.001) and prosodic contrast between expected primary stress syllable and mean of other syllables (p<.001).
  - Syllabic prominence is often detected on the last syllable of words, which might be caused by L1 influence.
  - Strong impact of last syllable lenghtening and pitch rise.
  - The better the speaker mean stress position accuracy, the higher pitch and intensity of expected stressed syllable.

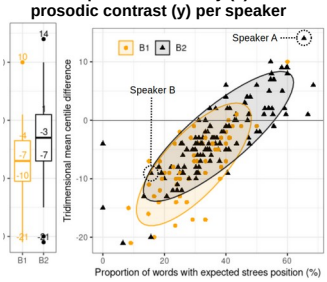
Proportion of target words with expected stress position per speaker



Mean prosodic contrast between expected primary stress (left) and other syllables (right)



Stress position accuracy (x) and prosodic contrast (y) per speaker



SpeakerA SpeakerB

References:

[1] CLES official website: https://www.certification-cles.fr/english/

[2] De Jong, N. H., Pacilly, J., Heeren, W. (2021) "Praat scripts to measure speed fluency and breakdown fluency in speech automatically." Assessment in Education: Principles, Policy & Practice, 28, 456-476.

[3] Coulange S, Kato T, Rossato S, Masperi M. (2024). Enhancing Language Learners' Comprehensibility through Automated Analysis of Pause Positions and Syllable Prominence. Languages 9(3):78

[4] Coulange, S., Konishi, T., Kato, T., Sugahara, M., Rossato, R., Masperi, M. (2024). A corpus of spontaneous dialogues in L2 English by French and Japanese L1 speakers for automated assessment of fluency. 6th International Symposium on Learner Corpus Studies in Asia and the World (LCSAW6), Feb. 2024, Kobe, Japan.