**1. Introduction**

- This paper presents an acoustic study of Ladin, a threatened minority Romance language spoken in northeastern Italy; 31,000 speakers (2013); threatened status[3].
- The focus is on the sibilants of three dialects: Brach, Cazet, and Moenat.

**Main Contributions:**
1. It provides up-to-date phonetic data for younger-generation speakers;
2. It reveals the nature of phonetic variation across dialects;
3. It exhibits a benefit of using statistical methods (SSANOVA) in the study of threatened or endangered languages.

**2. Sibilants in Ladin**

- **Sibilants in Ladin: the problem**
  - Previous research has identified two series sibilant fricatives in Fassa dialects (denti-alveolar and postalveolar).
  - However, the post-alveolar series have been variously characterized as palatal(ized) or retroflex[2], [3], [4], and no consensus has been reached.

- **Acoustic recordings of Ladin words are used to investigate the nature of the post-alveolar series.**

**3. Data Collection**

- **Data Collection:**
  - Four speakers spanning three dialects of Fassa Ladin were recorded: Two speakers of Brach (both F), one speaker of Cazet (F), and one speaker of Moenat (M) (age range: 18-35).
  - The recordings were made onto a laptop computer using a head-mounted USB microphone and Praat software at a sampling frequency of 44,100 Hz and saved as a wav file.

- **Materials**
  - Stimuli for this study were drawn from our database acquired in Vigo di Fassa. (Some examples are given in the table below)

<table>
<thead>
<tr>
<th></th>
<th>Brach</th>
<th>Cazet</th>
<th>Moenat</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>alveolar</strong></td>
<td>6 words, 28 tokens</td>
<td>10 words, 20 tokens</td>
<td>21 words, 41 tokens</td>
</tr>
<tr>
<td>daz</td>
<td>‘give 2.SG.PRS’</td>
<td>‘give 2.SG.PRS’</td>
<td>a.s ens.</td>
</tr>
<tr>
<td>sauch</td>
<td>‘sa.uk’</td>
<td>‘sa.uk’</td>
<td>son</td>
</tr>
<tr>
<td>‘cricket’</td>
<td></td>
<td></td>
<td>‘sound’</td>
</tr>
<tr>
<td><strong>postalveolar</strong></td>
<td>6 words, 25 tokens</td>
<td>8 words, 16 tokens</td>
<td>39 words, 106 tokens</td>
</tr>
<tr>
<td>dasc</td>
<td>‘give 3.SG.PRS’</td>
<td>‘give 3.SG.PRS’</td>
<td>‘give 3.SG.PRS’</td>
</tr>
<tr>
<td>scial</td>
<td>‘laal’</td>
<td>‘laal’</td>
<td>stol</td>
</tr>
<tr>
<td>scial</td>
<td>‘shawl’</td>
<td>‘shawl’</td>
<td>‘proud’</td>
</tr>
</tbody>
</table>

- Words were embedded in a carrier sentence ‘[dime ___ maria] for Brach and Cazet and ‘[dimo ___ Maria] for Moenat (‘say ___ Maria’).
- These analyses are preliminary, since the sibilants were not controlled for syllable position and neighboring vowel quality.

**4. Results and Discussion**

- **Analysis:**
  - The study uses SSANOVA[5] to provide a comparative illustration of the acoustic properties of the sibilants;
  - For each token, a 10-ms window in the middle of the sibilant was selected, and the spectral envelope of the window was extracted;
  - SSANOVA models were fitted to the extracted spectral envelopes of the sibilants.

- **Results and Discussion:**
  - SSANOVA model for each dialect:

**Within each dialect,** the spectral envelope of the alveolar sibilant is different from that of the post-alveolar since only a small portion of overlap can be observed between 5 kHz and 10 kHz in Fig.1, indicating the two sounds are distinctive.

**Across dialects,** the alveolar sibilant in Cazet stands out due to the peak it presents at approx. 7 kHz (Fig.1b); more retracted compared to its counterparts in Brach and Moenat and more similar spectrally to the post-alveolar.

**Also for Cazet:** The post-alveolar fricative shows a plateau between around 3.5 kHz and 7 kHz (Fig.1b). It is possible that post-alveolar sibilant has two allophones characterized by two peaks, one at 3.5 kHz and the other at 7 kHz.

**5. Closing Remarks**

- The results of our study are suggestive that the three Fassa dialects under study have developed post-alveolar sibilants that are each distinct from one another.
- This research provides a basis for future in-depth investigation into the properties of sibilants in Ladin.