TRANSCRIBING THE “TUNE”

Prosodic and sociolinguistic properties of the to:nada cordobesa

Grant M. Berry
grantberry.info
grantberry@psu.edu
The Pennsylvania State University
Why study the speech of Córdoba?

- **Numbers**: capital of Córdoba is the second largest city in the country (1.3 million as of 2010 census), but is rarely studied

- **Historical Language Contact**: City was an important hub for westward expansion
  - Implicated in slave trade and transfer of African workers north through Tucumán and silver mines of Potosí (Mellafe 1975:80). At one time Africans outnumbered whites (Vidal de Battini 1964:37)
  - Little influx of indigenous groups (Vidal de Battini 1964:37), but tonal properties have been claimed to originate with the *comechingones* (cf. Vidal de Battini 1964:149).

- Is, and has been, an area of **transition** and intense **variation** (Vidal de Battini 1964:80)
What is the *tonada cordobesa*?

- **Highly salient** dialect of capital city of Córdoba, Argentina and surrounding areas
- Characterized by **pre-tonic lengthening** and perceived **pitch excursion** in pre-tonic syllable (Fontanella de Weinberg 1971; Vidal de Battini 1964:148)
- Used predominately in nuclear accents of phrases, often **phrase-finally**
Previous descriptions of *la tonada*

- In the pre-tonic syllable of the final accented word, there is both vowel lengthening and pitch excursion within the vowel (Fontanella de Weinberg 1971:13, 20)
  - Sometimes produces the **percept of a geminate vowel** (Fontanella de Weinberg 1971) **and a shift in accent** (Vidal de Battini 1964: 148)
  - This is confined to the same lexical word (Fontanella de Weinberg 1971:18)
  - The *tonada* can also be used for emphasis elsewhere in the phrase
- Vidal de Battini also claims that the pre-pre-tonic syllable (when it exists) carries an **additional rhythmic accent** (1964:146)
Vidal de Battini 1964:147

“Estas entonaciones con sus ascensos y descensos de la curva melódica, son completamente extraños a los esquemas rítmicos del castellano.”

These intonational patterns, with their rises and falls in pitch, are completely alien to the rhythmic schemas of Spanish.
Acoustic Studies

- Until this year, **few (if any) acoustic phonetic studies** had been used to test previous claims made about positional, durational, and intonational qualities of the *tonada cordobesa*

- Lang-Rigal (2014) is the first large-scale study to describe acoustic properties of the *tonada* in conjunction with speech perception.

- Since you’ve just heard about it, I won’t describe it here, but it dovetails nicely with the current study.
Research Questions:

1. Is the *tonada cordobesa* preferred or enhanced in certain phrasal positions (e.g. phrase-finally)?

2. Is the pre-tonic syllable the only lengthened syllable in an accented phonological word?

3. Are there any consistencies in overall pitch modulation in pre-tonic syllables which might give the *tonada* a musical quality?

4. How is the *tonada cordobesa* conditioned by sociological or discourse factors?

5. How well do elicited tokens of intonation correlate with real world data regarding the *tonada*?
ELICITATION STUDY

Positional and Gender Effects in Production
Methodology

• Participants (6):
  • 6 Participants from Córdoba with limited experience living elsewhere
  • 3 Male, 3 Female
  • Ages 18-25 (mean 21.8 yrs; sd 2.8 yrs)

• Stimuli (120):
  • 20 Paroxytonic targets in sentences with 3 accented syllables
    • 10 with two pre-tonic accents (pre-tonic and pre-pre-tonic)
    • 10 with one pre-tonic accent
  • Placed in first accented position or nuclear position (phrase-final)
  • 3 Repetitions

• Ex: caminamos (we walk)
  • Initial: caminamos juntos con frecuencia
    (we often walk together)
  • Final: Les sorprende lo mucho que caminamos
    (It surprises them how much we walk)
Procedure:

1. Participants were asked to fill out a demographic and language history questionnaire on Google Drive.
2. They were then fitted with a head-worn dynamic microphone connected to a Macbook Air computer.
3. The experiment was implemented using OpenSesame (Mathôt et al. 2012); http://osdoc.cogsci.nl/
Procedure:

• Fixation dot: 500 ms
• They were told to memorize a sentence which appeared for 2500 ms
• Then, this sentence disappeared and they had to recite it from memory
  • They had four seconds after the sentence disappeared to recite it.
• Participants were given four practice trials
• Order of stimuli was randomized by participant, including repetitions
Coding:

- Each target word, syllable, and vowel was hand-measured in PRAAT (Boersma and Weenik 2014)
- Syllables were coded by position relative to the tonic syllable: (pre-pre-tonic, pre-tonic, tonic, post-tonic)

- By means of a PRAAT script, the following were extracted:
  - Syllable Duration and Vowel Duration (all syllables)
    - Syllable Duration in relation to the tonic syllable
    - Vowel duration in relation to the tonic vowel
  - Syllable type in relation to tonic syllable
  - Pitch range ($\text{pitch}_{\text{max}} - \text{pitch}_{\text{min}}$) within the vowel
  - Position of the target
Tonic ratio for pre-tonic syll’s by position
Absolute Duration by Type and Position:
Tonic Ratio By Type:

Syllable-to-tonic Ratio by Position and Syllable Type (Tonic excluded)
Pitch Range by Type and Position:

Pitch Range by Type of Syllable by Position

Syllable Type

Position

Initial

Final
Tonic Ratios by Type and Gender:

Gender differences in Syllable-to-tonic Ratios, By Position

- Initial
- Final

Syllable Type: ppt, pst, pt, etc.
Analysis:

• Data were analyzed using mixed effects models in the lme4 package (Bates et al. 2014) in R (R Core Team 2014).
• Tokens were referenced to tonic syllables in initial position produced by female speakers.
• Outcome: **Duration Ratio to Tonic Vowel (V/V_{tonic})**
• Model was fit with random intercepts by stimulus.

<table>
<thead>
<tr>
<th>Fixed Effects:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Pitch Range (logHz)</td>
</tr>
<tr>
<td>Gender/Pitch Range Interaction</td>
</tr>
</tbody>
</table>

---

**Intro**
- Description
- Previous Research
- Research ?’s

**Elicitation Study**
- Methodology
- Procedure
- Results
- Discussion

**Corpus Study**
- Methodology
- Results
- Discussion

**Discussion/Conclusion**
MODEL RESULTS

All tokens
## ANOVA Results

### Random Effects:

<table>
<thead>
<tr>
<th>Groups</th>
<th>Name</th>
<th>Variance</th>
<th>Std.Dev.</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulus</td>
<td>(Intercept)</td>
<td>0.0306405</td>
<td>0.17504</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.0022676</td>
<td>0.04762</td>
<td>-0.63</td>
<td></td>
</tr>
<tr>
<td>Pitch Range</td>
<td>0.0001742</td>
<td>0.0132</td>
<td>-0.49</td>
<td>-0.09</td>
</tr>
<tr>
<td>Male:PitchRange</td>
<td>0.0005128</td>
<td>0.02265</td>
<td>0.25</td>
<td>-0.2</td>
</tr>
<tr>
<td>Residual</td>
<td>0.0263235</td>
<td>0.16225</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations: 2129</td>
<td>Groups: Stimulus, 20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Fixed Effects:

<table>
<thead>
<tr>
<th>Estimate (Intercept)</th>
<th>Std. Error</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5370839</td>
<td>0.0407006</td>
<td>13.196</td>
</tr>
</tbody>
</table>

| Male | -0.0339988 | 0.0135224 | -2.514 |
| Pitch Range | 0.010723 | 0.0052557 | 2.04   |
| Pre-pre-tonic | -0.1776673 | 0.0119003 | -14.93 |
| Post-tonic | -0.0608276 | 0.0096482 | -6.305 |
| Pre-tonic | 0.0869207 | 0.0091719 | 9.477  |

| Order | 0.0001163 | 0.0001047 | 1.11  |
| Final | -0.0078355 | 0.007113 | -1.102 |

| Male:Pitch Range | 0.0202095 | 0.0085763 | 2.356 |

### Correlation of Fixed Effects

<table>
<thead>
<tr>
<th>(Intr)</th>
<th>Male</th>
<th>Range</th>
<th>PPT</th>
<th>PST</th>
<th>PT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>-0.544</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pitch Range</td>
<td>-0.342</td>
<td>0.148</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-pre-tonic</td>
<td>-0.094</td>
<td>0.007</td>
<td>0.064</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-tonic</td>
<td>-0.118</td>
<td>0.013</td>
<td>0.046</td>
<td>0.385</td>
<td></td>
</tr>
<tr>
<td>Pre-tonic</td>
<td>-0.118</td>
<td>-0.003</td>
<td>0.032</td>
<td>0.398</td>
<td>0.482</td>
</tr>
<tr>
<td>Order</td>
<td>-0.156</td>
<td>-0.015</td>
<td>0.019</td>
<td>-0.009</td>
<td>-0.005</td>
</tr>
<tr>
<td>Final Position</td>
<td>-0.092</td>
<td>-0.003</td>
<td>0.028</td>
<td>0.005</td>
<td>0.047</td>
</tr>
<tr>
<td>Male:Pitch Range</td>
<td>0.173</td>
<td>-0.334</td>
<td>-0.382</td>
<td>0.011</td>
<td>-0.004</td>
</tr>
</tbody>
</table>

**ANOVA Results**

- **Gender**: Chisq 3.3546, Df 1, Pr(>Chisq) 0.067019
- **PitchRange**: Chisq 10.1191, Df 1, Pr(>Chisq) **0.001467**
- **SyllType**: Chisq 565.2273, Df 3, Pr(>Chisq) ***<2e-16***
- **Order**: Chisq 1.2329, Df 1, Pr(>Chisq) 0.266838
- **Position**: Chisq 1.2135, Df 1, Pr(>Chisq) 0.270649
- **Gender:PitchRange**: Chisq 5.5529, Df 1, Pr(>Chisq) *0.018451***
MODEL RESULTS

Only Pre-tonic tokens

Note: Syllable Type was removed from model
## ANOVA Results

<table>
<thead>
<tr>
<th></th>
<th>Chisq</th>
<th>Df</th>
<th>Pr(&gt;Chisq)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>19.7632</td>
<td>1</td>
<td>8.77E-06 ***</td>
</tr>
<tr>
<td>PitchRange</td>
<td>1.7321</td>
<td>1</td>
<td>0.1881</td>
</tr>
<tr>
<td>Order</td>
<td>0.0031</td>
<td>1</td>
<td>0.9556</td>
</tr>
<tr>
<td>Position</td>
<td>22.9262</td>
<td>1</td>
<td>1.68E-06 ***</td>
</tr>
<tr>
<td>Gender:PitchRange</td>
<td>2.0121</td>
<td>1</td>
<td>0.156</td>
</tr>
</tbody>
</table>

### Random Effects:

<table>
<thead>
<tr>
<th>Groups</th>
<th>Name</th>
<th>Variance</th>
<th>Std.Dev.</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulus</td>
<td>(Intercept)</td>
<td>0.0548167</td>
<td>0.23413</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>0.0084896</td>
<td>0.09214</td>
<td>-0.85</td>
</tr>
<tr>
<td></td>
<td>Pitch Range</td>
<td>0.0002598</td>
<td>0.01612</td>
<td>-0.64 0.13</td>
</tr>
<tr>
<td></td>
<td>Male:PitchRange</td>
<td>0.0013543</td>
<td>0.0368</td>
<td>0.64 -0.14 -1</td>
</tr>
<tr>
<td>Residual</td>
<td></td>
<td>0.0300192</td>
<td>0.17326</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>644</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Groups: Stimulus, 20

### Fixed Effects:

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Std. Error</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>7.11E-01</td>
<td>5.57E-02</td>
<td>12.764</td>
</tr>
<tr>
<td>Male</td>
<td>-1.23E-01</td>
<td>2.63E-02</td>
<td>-4.665</td>
</tr>
<tr>
<td>Pitch Range</td>
<td>-4.72E-03</td>
<td>1.04E-02</td>
<td>-0.456</td>
</tr>
<tr>
<td>Order</td>
<td>1.14E-05</td>
<td>2.04E-04</td>
<td>0.056</td>
</tr>
<tr>
<td>Final Position</td>
<td>-6.56E-02</td>
<td>1.37E-02</td>
<td>-4.788</td>
</tr>
<tr>
<td>Male:PitchRange</td>
<td>2.20E-02</td>
<td>1.55E-02</td>
<td>1.418</td>
</tr>
</tbody>
</table>

### Correlation of Fixed Effects

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>PitchRn</th>
<th>Order</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>-0.728</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pitch Range</td>
<td>-0.341</td>
<td>0.304</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order</td>
<td>-0.227</td>
<td>-0.015</td>
<td>0.051</td>
<td></td>
</tr>
<tr>
<td>Final Pos.</td>
<td>-0.125</td>
<td>-0.006</td>
<td>0.008</td>
<td>0.012</td>
</tr>
<tr>
<td>Male:Pitch</td>
<td>0.405</td>
<td>-0.331</td>
<td>-0.834</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Discussion:

- Females are more likely to lengthen the pre-tonic syllable relative to the tonic syllable than males (p<.001).
- When all syllable types are considered, the only type to significantly increase the tonic ratio is the pre-tonic syllable (p<.001). There is no lengthening effect for other syllables (p<.001).
- Though in aggregate men and women use pitch distinctively with respect to lengthening (p<.05), this is not significant within the pre-tonic syllables.
- There is no independent effect of pitch range within the pre-tonic syllable.
- There is a slight difference in pre-tonic lengthening by position (nuclear vs. phrase-initial), but not in the direction expected.
Discussion

• Pitch results are surprising, given:
  • previous descriptions of pitch modulation (Fontanella de Weinberg 1971: Vidal de Battini 1964)
  • findings of early valleys in the pre-tonic syllable (Lang-Rigal 2014:116)
  • and general attribution of song-like qualities to the dialect by most Argentines.

• Similarly, position results would suggest that the tonic syllable is shortened in initial position.
  • This provides support for the percept of stress shift.

• Questions:
  • Could these be the result of elicitation task demands?
  • Is the gender effect more pronounced in discourse?
CORPUS STUDY

Two speakers from elicitation task
1M, 1F
Methodology:

- Participants were friends and came to do the experiment together.
- They were asked to speak to one another candidly for approximately 30 minutes on any topics they wished.
- The investigator left the room during this time.
- For today, I’ve analyzed 6 minutes of one interview between a male and female speaker who participated in the elicitation task.
Coding Discourse Factors:

• Speech was transcribed in Intonation Units (IUs) in ELAN (Sloetjes and Wittenburg 2008), and then exported as a PRAAT text grid
  • IU: “stretch of speech uttered under a single, coherent intonation contour” (Dubois et al., 1993)
• Following the convention of Dubois et al., each IU was assigned a type of transitional continuity
  • (. ) Final: Indicates that an idea is completed; characterized in part by drop in pitch.
  • (, ) Continuiting: Indicates an idea that is not complete; typically ends in high tone
  • (--) Truncated: Speech was cut off
  • (?) Appeal: Appeal for information or “validating response from the speaker” (Dubois et al. 1993:55); typically high rise in pitch
Breakdown of the data:

• 43 words
  • 23 from male speaker; 20 from female speaker

• Transitional Continuity:
  • 29 had continuing intonation
  • 3 had appeal continuity
  • 10 had final continuity
  • 1 was truncated

• Due to low n, Transitional Continuity wasn’t included in the statistical model
Coding Other Phonetic Factors

• Similar to the elicitation task, a PRAAT script was used to extract the following from the PRAAT text grid:
  • Syllable Duration and Vowel Duration (all syllables)
    • Syllable Duration in relation to the tonic syllable
    • Vowel duration in relation to the tonic vowel
  • Syllable type in relation to tonic syllable
  • Pitch range \((\text{pitch}_{\text{max}} - \text{pitch}_{\text{min}})\) within the vowel
  • Transitional Continuity of the IU
Tonic Ratio by Type
Gender Differences in Tonic Ratio by Type
Pitch Range by Type

Pitch Range by Syllable Type

- Syllable Type: pppt, ppt, pst, pt
Pitch Range by Gender in Pre-tonic Syll’s
Tonic Ratio by Gender in Pre-tonic Syll’s
Tonic Ratio by Gender and Transitional Continuity

Gender differences in Pre-tonic lengthening by Continuity in Naturalistic Data
Analysis

- Data were fit to Type II ANOVAs in R’s car() package (Fox and Weisberg 2011)
- Dependent Variable: Tonic Ratio ($V/V_{tonic}$)
- Fixed Effects:
  - Gender
  - Pitch Range
  - Gender/Pitch Range Interaction
- The analysis was done with all data in aggregate to see if there were global trends in production which differed by gender, as well as on pre-tonic syllables only.
All data:

<table>
<thead>
<tr>
<th></th>
<th>Sum sq</th>
<th>Df</th>
<th>F-value</th>
<th>Pr(&gt;F)</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PitchRange</td>
<td>0.3014</td>
<td>1</td>
<td>3.3539</td>
<td>0.0695</td>
<td>.</td>
</tr>
<tr>
<td>Gender</td>
<td>0.6715</td>
<td>1</td>
<td>7.4727</td>
<td>0.0072</td>
<td>**</td>
</tr>
<tr>
<td>PitchRange:Gender</td>
<td>0.4037</td>
<td>1</td>
<td>4.4932</td>
<td>0.0361</td>
<td>*</td>
</tr>
<tr>
<td>Residuals</td>
<td>10.7828</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ANOVA
## Analysis on Pre-tonic Syllables

<table>
<thead>
<tr>
<th></th>
<th>Sum sq</th>
<th>Df</th>
<th>F-value</th>
<th>Pr(&gt;F)</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PitchRange</td>
<td>0.00767</td>
<td>1</td>
<td>0.1333</td>
<td>0.71741</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>0.26446</td>
<td>1</td>
<td>4.5943</td>
<td>0.03954*</td>
<td></td>
</tr>
<tr>
<td>PitchRange:Gender</td>
<td>0.1695</td>
<td>1</td>
<td>2.9446</td>
<td>0.09554</td>
<td>.</td>
</tr>
<tr>
<td>Residuals</td>
<td>1.8995533</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Discussion

• While in aggregate males and females use pitch range distinctly when applied to relative syllable duration, this is not a significant predictor of pre-tonic lengthening.

• The corpus findings are distinct from laboratory findings in the gender effect
  • Male exhibits higher pre-tonic lengthening (p<.05)
  • Female uses more pitch excursion

• While not included in the analysis due to low n, it seems that men and women may be using the *tonada* distinctively, as well.
  • The male never used the *tonada* in an appeal, for example
GENERAL DISCUSSION

Gender effects
Intonation Research in Elicitation vs. Corpus Studies
Merits of studying the *tonada cordobesa*
Research Questions:

1. Is the *tonada cordobesa* preferred or enhanced in certain phrasal positions (e.g. phrase-finally)?  
   - NO

2. Is the pre-tonic syllable the only lengthened syllable in an accented phonological word?  
   - YES

3. Are there any consistencies in overall pitch modulation in pre-tonic syllables which might give the *tonada* a musical quality?  
   - NO

4. How is the *tonada cordobesa* conditioned by sociological or discourse factors?  
   - Gender differences?

5. How well do elicited tokens of intonation correlate with real world data regarding the *tonada*?  
   - Well, up to gender effects
Discussion of Findings:

- The lack of an effect for position could either be an artifact of the elicitation task, or an indicator that the tonada has expanded to other prosodic contexts.
  - Possibly due to ability to use it emphatically?

- Despite a consistent pitch percept, pitch range is not significantly correlated with pre-tonic lengthening
  - Because longer syllables are correlated with stress, and stress is often enhanced with pitch modulation, perhaps this is a perceptual illusion (but see Ortega-Llebaria and Prieto 1996).

- Genders seem to be behaving differently, but more work is needed to establish just how gender modulates pre-tonic lengthening.
Thanks to:

• Marianna Nadeu
• John Lipski
• The InToSpan Organizing Committee
• The Institute of International Education/ Fulbright Program
• The population of Córdoba