Stress and Accent in Tunisian Arabic

By Nadia Bouchhioua

University of Carthage, Tunis



Outline of the Presentation

- 1. Rationale for the study
- 2. Defining stress and accent
- 3. Parameters Explored
- 4. Methodology
- 5. Results and interpretation
- 6. Conclusions



1. Rationale

- The acoustic correlates of lexical stress and accent in TA have not been experimentally explored
- The only information were given by Ghazali (1973) stating that stress in TA has three acoustic correlates, duration, F0, and intensity.
- However, the study was not well controlled and there was confusion between stress and accent. In that, the acoustic correlates of lexical stress were measured in words that were accented at the same time, which led to confounding their acoustic correlates as well.

2. Defining Stress and Accent.

Lexical stress

- Stress is an abstract property of a word that serves as an indicator to the syllable within the word that has a potential to receive an accent (Lehiste,1970; Sluijter and Van Heuven, 1996)
- Stress =a structural linguistic property that specifies which syllable in the word is the most prominent.



Phrasal stress (accent, nuclear stress, pitch accent)

- Accent = a property of the utterance that is present in all languages and provides a means for the speaker to express his or her communicational intentions.
 - It helps put in focus the desired constituent by the speaker.
- The focused constituent (word or a group of words) is realized by placing a pitch accent on the prosodic head of the word or phrase
- ⇒Because the prosodic head within the word is generally the lexically stressed syllable, the acoustic correlates of stress and accent have been confounded.



3.Parameters Explored

- In this study, I tried to explore five acoustic correlates of stress and/or accent.
- 1. Duration
- 2. F0
- 3. Intensity
- 4. Spectral balance
- 5. Vowel quality



4. Methodology

4.1.Test material

Two sets of 10 disyllabic TA <u>near</u> <u>minimal pairs</u> of the kind: /'bɛddɛl /, / bɛd'dlɛt/ / 'kɛmmɛl/ , /kɛm'mlɛt /

/'<u>fak</u>kar/ , /<u>fak</u>'kart/

This allows investigating the effect of the factor stress in **the same** consonantal environment.



The word pairs in:

- \rightarrow a focused condition [+Focus]
- \rightarrow A non-focused condition [- Focus] \Rightarrow To assess **the impact** that **focus** may have over **stress** and the
- interaction between them.
- The frame sentences were the same, designed to:
- → Naturally elicit from the speakers the desired prosodic contour,
- \rightarrow Aid in segmentation





- Directing a phrasal stress on the target word,
- Deviating the phrasal stress from the target word

target words placed in non-final position to eliminate any effects of constituent final lengthening.



- The content of the frame sentences was as such that it depicts a semantic relationship between the target word in the experimental sentence, and a foil word in the sentence before.
- \Rightarrow To give prominence to the desired word

Example: initially stressed words [+Focus] condition

[+Focus] condition (lexical Stress+ Phrasal Stress) / qul χ ammam martin/ "say **consider** twice" / qul 'fakkar martin / "say **think** twice"



■ A command + a semantic relationship between the two words in bold (synonyms)⇒ the target syllable in the target word (/'<u>fakkar/</u> in this example) will be **both**, **lexically and phrasally** stressed.

It is focused because it is related to /xammam/ in the sentence before and the pitch accent, therefore, falls on it.



[-Focus] condition

- Example: [-Focus] condition (lexical Stress only)
- /fakkar kilma sɛhlɛ / "Think is an easy word"
 / qul fakkar martin / "Say think twice"
- / £awid 'fakkar martin / "Repeat think twice"



In this condition ([-Focus]), a precursor sentence is used to suggest the likely location of new or unpredictable information on the assumption that unpredictable words are likely to bear phrasal stress.



- In this example, phrasal stress is placed on /qul/ and /⊊awtd/ as opposed to each other and as being the new information in this context.
- Focus is, therefore, deviated from the target word /fakkar/, and the target syllable "/fak/" will be analyzed as being **lexically** stressed only, with **no** focus; hence **no pitch accent** placed on it

4.2. Subjects

- Seven Tunisian students of English
- All perfect native speakers of Tunisian Arabic (no parent who is not Tunisian)
- Three females +3 males, 22 and 26 years old



4.3. Recordings

- a soundproof room using a professional microphone
- The subjects repeated the sentences presented to them **three times**



4.4. Data collected

- The data collected: 20 (words)*2 (focus conditions)
 - *6 (speakers)* 3 (repetitions)
 - = 720 utterances.



4.5. Data Analysis

- Praat; speech analyzer software (version 4.3.29)
- Special Praat scripts were then used for automatic measurements of the dependent variables mainly, duration, F1/F2 and spectral balance.
- F0 and Intensity Measurements were totally obtained by hand, but checked and compared with the script used for spectral balance



Example of Praat output Figure 1.Waveform, spectrogra

Figure 1.Waveform, spectrogram and text grid for the word "bed'delt" (2nd syll stresed) in the [-Focus] context by a female native speaker of TA.



5.Results and interpretation

5.1. Duration

- RQ1: is duration a correlate of stress and/or accent in Tunisian Arabic?
- When the target word is focused, (receiving the pitch accent) stressed vowels and syllables significantly differed from their unstressed counterparts (significant t = 6.52, df =17; p<.001).</p>
- However, when no focus is placed on the target word in TA, stressed and unstressed vowels and syllables were not significantly different.

Duration is not a correlate of lexical stress in TA; it is rather a correlate of accent.



≻Phrasal stress

1.To see whether there are any effects of focus or any interaction between syllable position (initial, or final) and focus condition (+Focus, -Focus) a two- way ANOVA is used for **stressed syllables**.



>ANOVA Results

- ⇒Focus affects the duration of both initial and final stressed syllables
- But, The effect of <u>focus</u> on stressed syllables depends on their <u>position</u>.
- ⇒Final stressed syllables are more affected by focus (34%) than initial stressed syllable



2.To find out whether there is a focus effect or any interaction between syllable position (initial or final) and focus condition (+F, -F) for unstressed syllables, a two- way ANOVA was used.



ANOVA results: \Rightarrow

- Focus affects the duration of both initial and final unstressed syllables
- The focus effect on unstressed syllables <u>does not</u> depend on their <u>position</u> in the word.



- Focus lengthens the duration of both initial stressed and final stressed syllables, though final syllables lengthen more (similar to English, (Bouchhioua, 2008, Turk& Sawush, 1997)
- Focus, in TA, lengthens the duration of initial and final unstressed syllables, equally. (Unlike English (Bouchhioua, 2008, Turk& Sawush, 1997, but similar to Dutch (Cambier-langeveld& Turk, 1999)

5.2. F0

- **Research question 2.1**: is F0 a correlate of lexical stress when *a focus* is realized on the word in TA?
- Notice a pitch difference of about 45 Hz bet [+S]& [-S] vowels in the [+F] condition
- Significant paired samples t test (6.45, df =17; p<.001).</p>
- ⇒Lexical stress increases the F0 value of the vowel in the [+Focus] context.





≻Phrasal stress

- Comparing F0 mean values for stressed vowels [+F]& [-F] ⇒ There is a pitch difference of about 82 Hz between the two focus conditions.
- Significant paired samples t test (6.12, df =17; p<.005)</p>
- **Focus** has an **important effect** on the F0 of stressed vowels in TA.



- Comparing F0 mean values for unstreesed vowels [+F]& $[-F] \Rightarrow$ There is also a significant effect of focus on the F0 of unstressed vowels in TA (t= 7.22, df =17; p<.005).
- ⇒ F0 is a correlate of both lexical stress and accent in TA



Interpretation:

- The presence of the vowel under a pitch accent seems to significantly increase its F0 whether it lexically stressed or not.
- ⇒ It is possible that these results have to do with **later alignment** of the peak in TA.



The phonetic literature (Ladd, Faulkner & Schepman, 1999; Ladd, 2003) shows that if pitch alignment with the following consonant is late, then the lowering slope might affect a following unstressed vowel.

Unfortunately, measurements of F0 are limited to recording its value at a mid point of the target vowel and no alignment of peak with the following consonant is measured or tested

5.3 Intensity

- Intensity measured at the peak of the vowel, it is measured for each vowel at a 50-100 dB view range and a window size of 30 ms.
- Lexical stress
- **Research question 3.1:** is intensity a correlate of lexical stress when **a pitch accent** is realized on the word in TA?
- Stressed vowels are produced with a greater intensity than their unstressed counterparts in the [+F] condition.
- Significant paired samples t test (t= 6.18, df =17; p<.001).</p>
- ⇒Intensity is a correlate of lexical stress when the word is focused





- When no pitch accent is realized on the word, no noticeable difference is found between the intensity of stressed and unstressed vowels in TA in the two focus conditions(n.s).
- ⇒ Intensity **is not** a correlate of lexical stress in TA in the absence of focus on the target word.

≻Phrasal stress

- **Research question 3.3**: does focus increase the intensity of stressed vowels in TA?
- Focus does increase the intensity of stressed vowels in TA



Research question 3.4: does focus increase the intensity of unstressed vowels in TA?

- The intensity of unstressed vowels in TA is not affected by focus.
- ■⇒Intensity can be said to be a cue to phrasal stress in TA and not to lexical stress



Fic

5.4 Spectral balance

The effects of stress and accent on H1-A3 and H1-A2 as measures of closure rate and skewness glottal pulse were measured and analyzed.

Research question 4.1: is spectral balance a correlate of stress and /or accent in TA?



H1-A3 measure

- Unstressed vowels in the [+Focus] have higher H1-A3 values, indicating a more high frequency emphasis for stressed vowels.
- TA unstressed vowels in the [-Focus] context have higher H1-A3 values than stressed vowels
- Stress, vowel type, and focus have significant main effects on H1-A3 (through ANOVA tests)



H1-A2 measure

- Unstressed vowels in the [+F] context have much higher H1-A2 values, indicating higher frequency emphasis for stressed vowels
- Unstressed vowels in the [-F] context have much higher H1-A2 values, too.
- vowel type, stress, focus all have significant main effects on H1-A2 (through ANOVA)

Figure



5.5 Vowel Quality

Research question 5: is vowel quality a correlate of stress and /or accent in TA?

- Mean values for F1 and F2 for stressed and unstressed vowels in the [+Focus] and [-Focus] conditions were measured and compared.
- 5.5.1 The effects of lexical and phrasal stress on F1
- A four -way ANOVA test for F1 showed that:



The first formant (F1) of TA vowels is highly affected by focus, stress, and by vowel type. The effect of stress on F1 depends on

the nature of the vowel and the sex of

 \Rightarrow **F1** can be used as a predictor of

the speaker

male speakers.

stress and focus in TA, especially for

5.5.2 The effects of lexical and phrasal stress on F2

- A four- way ANOVA For F2 showed that:
- ✓ Stress and focus had n.s effects.
- \checkmark All types of interaction between the different fixed effects were found to he n s
- ⇒Stress and focus affect the first formant of TA vowels, but not their second formant



Interpretation

- Although TA vowels undergo some changes due to stress and focus, the degree of F2 change under stress and focus differs from vowel to vowel and from male to female speakers.
- Extreme cases of reduction, where vowels lose their quality and become schwa like are scarcely observed in this experiment, especially in the [+Focus] condition
- ⇒ The results allow claiming that <u>only</u> <u>gradient vowel height</u> is a correlate of stress in TA.

General Conclusions

- A) In the absence of focus, the only phonetic characteristics of **lexical stress** that come in the foreground are:
 - 1. F0
 - 2. Spectral balance:
 - 3. F1 lowering (gradient vowel height):



Duration is not a cue to stress in TA either

✓ TA belongs to the languages where length is phonemic. These languages are less likely to use duration as a cue to stress.





B) In the presence of a pitch accent, Tunisian speakers used <u>four cues</u> to signal accent

1. Duration :

- ⇒The temporal expansion of accented items, here, is meant to highlight the word and draw the listener's attention to it. A linguistic communicational function
- 2. F0: a strong acoustic correlate of accent in TA as it is in many other languages (English, Dutch).
- **3.Intensity**: a strong a cue to <u>accent</u> rather than stress in TA
- **4. Spectral balance**: A reliable acoustic correlate of both stress and accent (Similarly to English and Dutch)

<u>Références</u>













Braham, AF. (1997). The temporal organization of speech in Arabic (a perceptual study). *PhD thesis*. Faculty of letters: La Manouba, University of Tunis I Ben Slama, N. (2002). The factors influencing syllable structure in Standard Arabic. *Unpublished DEA thesis*, ISLT, University of Carthage, Tunis Turk, A., & Sawusch, J.R. (1997). The domain of accentual lengthening in American English. *Journal of Phonetics*, 25, 25-41. Bouchhioua, N (2008) The acoustic correlates of stress and accent in TunisianArabic: a comparative study with English. *Journal of Phonetics*, 25, 25-41. Cambier-Langeveld, T.& Turk, A. (1999). A cross-linguistic study of accentual lengthening: Dutch vs. English. *Journal of Phonetics*, 27 (3), 255-280



- Turk, A., & Sawusch, J.R. (1997). The domain of accentual lengthening in American English. *Journal of Phonetics*, 25, 25-41.
- Turk A., & White, L. (1999). Structural influences on accentual lengthening in English. *Journal of phonetics*, 27, 171-206.
- Ladd R.D., Mennen, I., & Schepman, A. (2000 b). Phonological conditioning of peak alignment in rising pitch accents in Dutch. *Journal of the Acoustical Society of America*, 107, 2685-96
- Turk A., & White, L. (1999). Structural influences on accentual lengthening in English. *Journal of phonetics*, 27, 171-206.

