Structural and algorithmic geolinguistic complexity. The case of Berber

Mena Lafkioui
Université Sorbonne Paris Cité
LLACAN-UMR 8135 du CNRS
Lafkioui@vjf.cnrs.fr

1. Topic and approach
How certain phonological and morphological innovation processes triggered by the vocalisation of the liquids /r/, /ṛ/, /rr/ and /ṛṛ/ in Tarifit (North Berber/Afro-asiatic, North Morocco) create language variation and change and how these innovations are geolinguistically patterned.

- Qualitative (structural) perspective: synchrony & diachrony
  + quantitative (algorithmic) perspective: computing geolinguistic distance by means of the Levenshtein distance calculating method (pondered)
- Valuable insights into the geolinguistic patterns and their variability; “holistic” point of view in addressing complexity (Léonard et al. 2016, O’Sullivan 2004)
- Functional and social factors interact in the diffusion of language forms
- Language change is gradual and non-linear on an extra-linguistic level (geographical and social variation) as well as on a linguistic one (Tarifit geolinguistic continuum, Lafkioui 2008)
- Data mainly from the Atlas Linguistique des variétés berbères du Rif (Lafkioui 2007) and linguistic/sociolinguistic/ethnographic fieldwork (summer 1992-autumn 2015)

PART I. STRUCTURAL GEOLINGUISTIC COMPLEXITY

2. Vocalisation of the liquids /r/ and /ṛ/ and the vowel system of Tarifit
Pan-Berber comparative perspective, VOC is an idiosyncrasy (Central Rif area)
- VOC of /r/ also in Timimoun (Gourara region, Algerian Sahara)
  - end of a lexeme, /r/ disappears without leaving any trace
  - preconsonantal position, /r/ transforms into /h/ ([h]), /h/ ([h]) and /œ/ ([γ]) (Boudot-Lamotte 1964)
  - less systematic and productive as in Tarifit
- Large geographical distance; contact did not instigate this innovation

2 types of vowel systems in Berber:
a) Basic type with mainly 3 vowels (majority):
  - Closed front vowel /i/ often pronounced as [i]; ex. (1) [izt] ‘fly’.
  - Closed back vowel /u/ often pronounced as [u]; ex. (2) [oul] ‘heart’.
  - Open central vowel /a/ often pronounced as [æ] or [e]; ex. (3) [æmæn] or [eæm] ‘water’.
b) Extended type (minority); e.g. Tuareg and Tarifit (object of the study)
  - Central vowel [ɔ], an epenthetic realisation feature (except in e.g. Berber of Jerba in Tunisia)
2.1. Vocalisation of the tap /r/ and the trill /ṛ/ (VOC)
Diachronic vocalisation process in Tarifit varieties of the Central Rif area (cf. Fig. 1: grey zones) has caused an extension of the vowel system through the creation of units that are distinct from the basic vowels by:
- a changed quality – an apparent compensatory lowering for [i] and [u]
- a considerable quantitative value due to compensatory lengthening

Table 1: Long vowels resulting from the vocalisation of /r/ and /ṛ/

<table>
<thead>
<tr>
<th>Diachronic Form</th>
<th>Synchronic Form</th>
<th>Phonetic Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ir</td>
<td>ȋ</td>
<td>diphthong [eːi]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>monophthong [iː]</td>
</tr>
<tr>
<td>ur</td>
<td>ĕ</td>
<td>diphthong [oː]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>monophthong [uː]</td>
</tr>
<tr>
<td>ar/ər</td>
<td>ǝ</td>
<td>monophthong [eː], [aː] or [aː]</td>
</tr>
<tr>
<td>ɬr</td>
<td>ɬi</td>
<td>monophthong [eːː]</td>
</tr>
<tr>
<td>ɬr</td>
<td>ɬu</td>
<td>monophthong [oːː]</td>
</tr>
<tr>
<td>ɬr</td>
<td>ɬa</td>
<td>monophthong [aːː]</td>
</tr>
</tbody>
</table>

Examples from Ayt Temsaman (Central Rif):
(4) ɬaβrę [ɛθβɪ r] or [ɛθβɪ r] + vocalisation ⇒ ɬaβɪ [ɛθβɛæi] or [ɛθβɛæi] ‘pigeon’
(5) ɜɾtu [ɜɾθʊ] + vocalisation ⇒ ɨɾtu [ɔɑːθʊ] ‘fig tree’
(6) ɜɾyaxe [ɛrɛxe] or [ɛrɛxe] + vocalisation ⇒ ɜɾaxe [ɛrɛxe] or [ɛrɛxe] ‘man’
(7) ɬaɾwa [θΛɾwe] + vocalisation ⇒ ɬaɾwa [θΛɾwe] ‘children’


Table 2: Vowel System of Tarifit (Central Rif)

<table>
<thead>
<tr>
<th>Basic Vowels</th>
<th>Long Vowels</th>
</tr>
</thead>
<tbody>
<tr>
<td>i</td>
<td>ɬi</td>
</tr>
<tr>
<td>u</td>
<td>ɬu</td>
</tr>
<tr>
<td>a</td>
<td>ɬa</td>
</tr>
</tbody>
</table>

VOC, as part of weakening of consonants = essential feature of Tarifit phonetics and phonology (Biarnay 1917; Renisio 1932); e.g.:
- spirantisation of plosives • fricatives • approximants • zero (Lafkioui 2006b, 2007:38-58)
- vocalisation of semi-consonants (Lafkioui 2007: 27-28)
  ➢ Phonetic economy is probably the functional triggering factor

Formal restrictive rule = vocalisation in the syllable coda only:
(8) ɬiðn ⇐ ɬiɾdn  (= ɬi + ɬdn) ‘grain’
(9) ɬamμʊt ⇐ ɬamμʊɾt  (= ɬa + mmʊɾt) ‘land’
(10) ɬaɾɾa ⇐ ɬaɾɾər  (= ɬa + ɾaɾ) ‘mountain’
(11) aɾsðun ⇐ aɾsɾðun  (= a + sr + ɬun) ‘mule’
VOC of /t/ and /t'/ shows a homologous course of transformation:
- functional factor of “economy” has triggered both processes
- /t/-VOC is a formal development created by analogy with /r/-VOC

3. Extended vocalisation (EXTVOC)
Two “extended” vocalisations (EXTVOC) in Berber of the Central Rif area:
1) VOC of the liquids /t/ and /t'/ in onset position, i.e. EXTVOC1
2) VOC of the transformed liquid /l/ (/rΨl/ or /r'/l/), i.e. EXTVOC2

3.1. Vocalisation in onset position - EXTVOC1
EXTVOC1 has a serious impact on the phonetic, phonological and morphological structure of the lexemes in question (Lafkioui 2006a; 2007: 37, 2011).
- Ayt Weryagel varieties (mainly), in prevocalic and intervocalic positions

- Prevocalic position:
(12) abidi [æbiriːd] ← abrid [æbriːrd] ‘way’
(13) agüm [aɣum] ← agrum [aɣrum] ‘bread’
(14) amqaran [æmqqaːn] ← amqran [æmqqrɑːn] ‘big’

- Intervocalic position:
(15) iỳ [iːj], [eːj] or yỳ [iːj] or [iːeːj] ← iri [iːj] ‘neck’
(16) áj [aːj], [eːj] or yày [aːej] or [jeːj] ← ari [aːj] ‘write’
(17) digûy [diɣwːj] ← dîguri [diɣwːri] ‘study’
(18) imzûgh(w) [imzjːw] or [imzjːw] ← imzûgra [imzjːræ] ‘first ones’

/t'/-VOC in intervocalic/onset position:
(19) dû(w) [dɔː(w)] ← dûru [dɔːro] ‘duro’, ‘coin’

/r'/-VOC in onset and coda position (double vocalisation: EXTVOCA1 + VOC):
(20) æû [æːj]: or [æːjːaː] ← æûrur [æːrur:] ‘back’

Formal restrictive sub-rule = no EXTVOC1 in an absolute Anlaut position before a vowel:
(21) *æza ← raža [raːza] ‘wait’ (AOR-IMP-SG)
- Recent data indicate a shift to ignoring this rule in certain varieties (Imzuren)
- EXTVOCA1a [*absolute Anlaut] ⇒ EXTVOCA1b [absolute Anlaut]
(22) æza [aːza] ← raža [raːza] ‘wait’ (AOR-IMP-SG)

EXTVOC1 provides for syllabic restructuring of the lexeme, with a reduction of the number of syllables (mainly in intervocalic position)
- Formal adaptation strategy of two possible innovation types:
  o Functional triggered innovation in which the economy principle is driven to extremes
  o A formal triggered innovation in which analogy is made between EXTVOC1 and VOC

3.2. Vocalisation of the mutated liquid /l/ - EXTVOC2
EXTVOC1 is in co-variation with another diachronic phenomenon of the Central Rif area, i.e. the phonetic mutation of the lateral approximant /l/ (Lafkioui 2007: 69-71):
Mena Lafkioui - Paris – 30-31/5/2016

a) /r ← l/ = 1) voiced tap [r] with an ultra light friction or 2) a voiced trill [ɾ]
b) /t/ = fricative [ɻ]

The difference between the two taps becomes more apparent when vowels precede them: /v/ + /r ← l/ ≠ /v/ + /t/; only the original tap /r/ has a lowering effect on the vowels that it follows:
(23) arî ← ali ‘climb’: [ɛr̥i] of [ɛr̥i] ≠ [arî]
(24) arî ← arî ‘write’: [arî]

These consonant mutations are in direct correlation with the phonetic restriction that excludes the vocalisation of /r/ obtained from /l/ = formal restrictive rule
➢ Ayt Weryâgel is an exception to this rule; /r ← l/ can indeed be vocalised, following a course of evolution analogous to the original tap /r/, with long diphthongs as maximum transformations = EXT VOC2

Examples of EXT VOC2; Ayt Weryâgel (Central Rif):
(25a) /irs ([irsz], [irsz]) ← ıls/ + vocalisation /r/ ⇒ [ɛæς], [ɛæς] and [ıɛæς] ‘tongue’
(25b) /irs ([irsz], [irsz]) ← ıls/ + maintain /r/ ⇒ [irs], [irs] ‘tongue’

Examples of blocking rule of EXT VOC2; Ayt Wlišek and Iqelciyên (Central Rif):
(25c) /irs ← ıls/ + maintain /r/ ⇒ ırs ([ırs], [ırs] ‘tongue’)
(25d) /ırs ← ıls/ + maintain /ı/ ⇒ ırs ([ıls] ‘tongue’)

4. Vocalisation of the geminate trill /rr/ (Lafkioui 2006a, 2007: 34)
(26) arr ‘give back’:
- No VOC + qualitative timbre change arr ([ɛr̥r], [ɛr̥r])
- No VOC + qualitative and quantitative timbre change, ārr ([ɛr̥r], [ɛr̥r])
- VOC + compensatory lengthening + simplification of articulatory tension, ār ([ɛːr], [ɛːr])
➢ Tap /r/ + intensification ⇒ trill /rr/
➢ Typologically uncommon phenomenon because Tarifit allows for applying a phonetic rule (i.e. vocalisation) to a part of the geminate (first part), which invalidates Kenstowicz & Pyle (1973) and Guerssel (1977)
➢ Development of /rr/-VOC does not necessarily go in parallel with /r/-VOC
➢ Opposition [simple or vocalised /r/] vs [long or reduced /rr/] is used for morphological marking (e.g. TAM, derivation)

5. Vocalisation is a gradual linguistic process
Different transformation stages exist depending on the structure of the variety and the lexeme under consideration.
➢ A case of phonetic driven gradualism is the complementary link between /r/ and its vocalised variants: /t/ can serve as a continuous glide sound when a long vowel precedes another vowel in a quickly articulated utterance, the former being reduced in quantity.
(27) awssā i d-y-usin + high cadence ⇒ awssar i d-y-usin ‘the old man who has come’
(28) awssā i d-y-usin + high cadence ⇒ awssā y i d-y-usin ‘the old man who has come’
(29) uma i d-y-usin + high cadence ⇒ uma y d-y-usin ‘my brother who has come’
➢ Semi-vowel /y/ has taken over the glide function of the etymological /t/; confirms the phonological status of the long vowels in Tarifit.
6. Morphological implications of vocalisation
VOC and ETVOC have caused a number of significant morphological transformations; e.g. restructuring of morphological patterns of its verbal and nominal system.

6.1. The Berber verbal system
Root-Pattern type, structured around a complex aspectual hierarchical configuration with three levels:
1. Verb = stem + person or participle marker (highest level)
2. Stem = root + vowel pattern (middle level)
3. Root = consonantal radicals (basic level)

\(y\)-ud\(f\) [\(\text{u\d\o\f}\)] ‘he has entered’ (3MSG-PF\(V\)) = PM \(y\)-(3MSG) + stem -ud\(f\) [\(\text{u\d\o\f}\)] (root \(df\) action ‘to enter’ + pattern /u--/)

Predominance of tri-radical roots; use of both consonant length and intraradical vowel alternation (apophony) to indicate aspectual categories; fundamental morphological opposition of Perfective (PF\(V\)) versus Imperfective (IPF\(V\)) for the positive aspects and Perfective (PF\(V\)) versus Negative Perfective (NEGPF\(V\)) for the negative aspects (Basset 1952; Galand 1977; Cadi 1987: 59–65; Chaker 1989; Lafkioui 2007: 174–191).

6.2. Morphological innovations of the verb system

1) Extension of verbal paradigms of the type /ccv/, /vcc/ and /cvc/ at the expense of /ccc/

\(\text{cc} + \text{vocalisation} \Rightarrow \text{ccv} ; \text{m}\d\text{r} [\text{m\d\r}] \Rightarrow \text{m}\d\text{a}[\text{m\d\ae}]\) ‘plough’

\(\text{cc} + \text{vocalisation} \Rightarrow \text{vcc} ; \text{rw}\d[l] [\text{a\w\l}] \Rightarrow \text{\d\a}[\text{a\w\l}]\) ‘run away’

\(\text{cc} + \text{vocalisation} \Rightarrow \text{cvc} ; \text{fr}\d[n] [\text{f\r\n}] \Rightarrow \text{\d\f}[\text{f\ae}]\) ‘sort’

In (32) [\(\text{a}\)] is inserted before /r/:

\(- \Rightarrow [\text{a\w\l}] \Rightarrow [\text{a\w\l}] \Rightarrow \ldots \Rightarrow [\text{a\w\l}] (\d\a\l)\)

In (33) the sequence [\(\text{r}\a\)] undergoes a permutation under the influence of the sonority rule before vocalisation may occur:

\(- \text{cre} \Rightarrow \text{cer} \Rightarrow \d\v\)

\([- \Rightarrow [\text{f\r\n}] \Rightarrow [\text{f\f\n}] \Rightarrow [\text{f\ae}]\) or [f\ae\(\f\)] (\(\d\f\))

2) Reorganisation of the paradigmatic structure of the verb

a) Perfective (PF\(V\)) ~ Negative Perfective (NEGPF\(V\))

Verbs with a vocalised /r/ as second or third consonant display for the NEGPF\(V\) the base /\(c\v\c/ or /c\c\v/ with \(\d\v\) as the same long vowel as in the PF\(V\).

\(\d\f\) ‘sort’ (33) and m\d\a ‘plough’ (31) are forms of both PF\(V\) and NEGPF\(V\)(* expected respective forms *\(\d\f\) ‘sort’ and *m\d\a ‘plough’, NEGPF\(V\) of /\(c\c\c/-verbs have /\(c\c\c/ as their base, e.g. *\(\d\f\) ‘sort’, m\d\a ‘plough’)

Formal re-analysis of the bases /\(c\v\c/ and /c\c\v/ of the PF\(V\) as bases of the NEGPF\(V\), with \(\d\v\) as a long invariable vowel.
Systematisation of the new variants with a morphologically unmarked base for the NEGPFV is related to their widespread diffusion.

But this diffusion is not wholesale; gradual pattern related to combinatorial opposition: conditions:

\[(34)\]

- \( \text{mžā (PFV)} \sim \text{ur (NEG)} + \text{mžā (NEGPFV, -mark)} \); optional frequent opposition in varieties with complete vocalisation (core area)
- \( \text{mžā (PFV)} \sim \text{ur (NEG)} + \text{mžā (NEGPFV, +mark)} \); optional frequent opposition in all vocalisation areas
- \( \text{mžr (PFV)} \sim \text{ur (NEG)} + \text{mžā (NEGPFV, -mark)} \); optional frequent opposition in vocalisation areas
- \( \text{mžr (PFV)} \sim \text{ur (NEG)} + \text{mžā (NEGPFV, +mark)} \); obligatory opposition in areas without vocalisation

\[b) \text{Perfective (PFV)} \sim \text{Imperfective (IPFV)}\]

Marking diversification for /cr/-verbs; solutions counterbalance the eroded aspect markers:

- New morphemes are created from vocalisation (/ø/ for PFV; /är/ and /ärr/ for IPFV);
- The existing IPFV marker /t/ is prefixed to the base of the PFV without any changes;
- A combination of both developments (/t/-+/ärr/ or /t/-+/ärr/ for IPFV).

<table>
<thead>
<tr>
<th></th>
<th>PFV</th>
<th>IPFV</th>
</tr>
</thead>
<tbody>
<tr>
<td>/t/- frn</td>
<td>/t/- frn</td>
<td>/ärr/ färn</td>
</tr>
<tr>
<td>/t/- fān</td>
<td>/t/- fān</td>
<td>/ärr/ fārn</td>
</tr>
</tbody>
</table>

New variants are compensatory adjustments for eroded morphological configurations of the PFV and the IPFV (Lafkioui 2011).

The structural adequacy of these specific and central morphophonemic oppositions has been a significant factor in their general diffusion in the vocalising Rif areas.

PART 2. ALGORITHMIC GEOLINGUISTIC COMPLEXITY

See PPT

7. Complex geolinguistic aggregates

7.1. VOC-diffusion

- Varieties with the highest phonetic diversity for /t/ and /t/ are mostly located in contact areas: border zones, transit areas and socio-economic centres.
- The innovated vowels are most likely engendered in a particular location from which several variants are distributed (diffusion model, Chambers & Trudgill 1998: Chapter 11).
- The great size of the diffusion area points to social acceptance.
- The functional factors of economy and code conformity also contribute to the transmission of the vocalised variants; they may explain the absolute preference in the core area for
complete vocalised variants, which cannot be directly associated with specific social functions

7.2. EXTVOC-diffusion
- Functional trigger of “economy” exerts such a strong pressure that the functional properties of “transparency” and “intelligibility” – of crucial importance for the form-function balance of language structure – are in jeopardy.
- From a formal perspective, these innovations have a great impact and are sometimes even pernicious because of their significant eroding effect on the basic syllable and lexeme structure of Tarifit. Nevertheless, they are adopted by the Ayt Weryaël.
- Onset-vocalisation in particular has had a remarkable success in this region.
  - Functional factor of code conformity is a probable functional explanation
  - Formal factors also play an important role in their development and diffusion. Ex. of the recent innovation ağûm (=< agrum ‘bread’; ex. 13) which is an extension by analogy with older innovations like abîd (=< abrid ‘way’; ex. 12) and amqqân (=< amqran ‘big’; ex. 14); Lafkioui (2011).

8. Conclusion
- Language is constantly modulated in the form of innovations that may emerge in structurally layered and causal formations mainly dictated by system-based properties.
- Functional and social factors interact in the selection and hence diffusion of language forms and in some cases (e.g. restructuring of the verbal paradigm) system-internal properties may dominate.
  - evidence against the language evolutionary claim that only social factors are responsible for variant selection (Milroy 1992: 201–202; Croft 2000: 38, 39, 54)
- Language change is gradual (and non-linear) not only on an extra-linguistic level (geographical and social variation) but also on a linguistic one. Therefore, it is important to consider the continuous selection process of variants not solely from a social perspective (“propagation” as in Croft 2000: 38, 178) but also in terms of how the variants are formally and functionally integrated into ever-changing linguistic structures (Lafkioui 2011).

9. References


