Nasalization as a Repair for Voiced Obstruent Codas in Noon

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In the Noon language (Cangin: Senegal), voiced stops have nasal allophones in coda position:

/ɓed/ [ɓen] ‘accompany’
/ɓed-ee/ [ɓedee] ‘accompanied’

/gog/ [goŋ] ‘snake’
/gog-ii/ [gogii] ‘the snake’

This allophonic pattern can be seen as a repair for voiced obstruent codas, which are cross-linguistically marked:

- Why is this pattern noteworthy?
- Why is it so rare in the world’s languages?
Coda devoicing and the Too Many Solutions problem

Voiced obstruent codas are cross-linguistically marked

- Avoided by devoicing (see Myers 2012 for an overview)
- /tab/ → [tap]

But why devoicing? Other potential repairs:

- Nasalization /tab/ → [tam]
- Gliding /tab/ → [taw]
- Deletion /tab/ → [ta]
- Vowel epenthesis /tab/ → [tabə]

...

In OT, a simple re-ranking of faithfulness constraints would be enough to get these other repairs

Yet it is often noted that the only attested repair is devoicing (Steriade 2008, Blumenfeld 2006, Hermans and Ostendorp 2007)

- The Too Many Solutions problem
The P-map

Steriade (2008) proposes the P-map to solve the Too Many Solutions problem.

The P-map is a principled way of ranking the constraints of a language such that repairs change the UR in the most perceptually minimal way.

- “The aim, in any departure from the UR, is to change it minimally to achieve compliance with the phonotactics.” (154)

As the voicing contrast is less perceptible in coda position than a nasality contrast, IDENT[nas]/CODA will outrank IDENT[voi]/CODA.

For a UR /tab/, [tap] is perceptually closer to [tab] than any other conceivable repair.
The P-map and coda nasalization

Because the perceptual distance between coda [p] and [b] is less than that between coda [m] and [b], devoicing is always preferred.

Steriade (2008: 153) on nasalization:

- “...one does not encounter sound systems in which all the final voiced stops, *and only they*, turn to nasals...”

Describes what this “unattested” system would look like:

- before vowel: tib-a  tud-a  tag-a  top-a  tat-a  tek-a
- word final: tim  tun  taŋ  top  tat  tek
The P-map and coda nasalization

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<table>
<thead>
<tr>
<th>before vowel:</th>
<th>tib-a</th>
<th>tud-a</th>
<th>tag-a</th>
<th>top-a</th>
<th>tat-a</th>
<th>tek-a</th>
</tr>
</thead>
<tbody>
<tr>
<td>word final:</td>
<td>tim</td>
<td>tun</td>
<td>taŋ</td>
<td>top</td>
<td>tat</td>
<td>tek</td>
</tr>
</tbody>
</table>

Noon:
- imperative: [yab-a] [bíd-a] [lag-a] [tap-a] [hot-a] [ɓak-a]
- bare verb: [yam] [bín] [lan] [tap] [hot] [ɓak]
- ‘land’ ‘write’ ‘close’ ‘pound’ ‘see’ ‘set aside’
Senegal

http://0.tqn.com/d/goafrica/1/S/_/2/senegal.gif
The Cangin languages
The Noon language

Dialects:
Thiès (Lopis 1981)
Padee (Soukka 2000)
Saawii (Fieldwork with Christine Diop)

Northern Noon
Consonant inventory of Northern Noon

<table>
<thead>
<tr>
<th></th>
<th>labial</th>
<th>coronal</th>
<th>palatal</th>
<th>velar</th>
<th>glottal</th>
</tr>
</thead>
<tbody>
<tr>
<td>vl. stop</td>
<td>p</td>
<td>t</td>
<td>c</td>
<td>k</td>
<td>?</td>
</tr>
<tr>
<td>vd. stop</td>
<td>b</td>
<td>d</td>
<td>j [ɋ]</td>
<td>g</td>
<td></td>
</tr>
<tr>
<td>nasal</td>
<td>m</td>
<td>n</td>
<td>ŋ [ŋ]</td>
<td>ŋ</td>
<td></td>
</tr>
<tr>
<td>prenas. stop</td>
<td>mb</td>
<td>nd</td>
<td>nj [ŋj]</td>
<td>ng</td>
<td></td>
</tr>
<tr>
<td>implosive stop</td>
<td>ɓ</td>
<td>ɗ</td>
<td>ƭ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>vl. continuant</td>
<td>f</td>
<td>s</td>
<td></td>
<td>h</td>
<td></td>
</tr>
<tr>
<td>vd. continuant</td>
<td>w</td>
<td>l</td>
<td>(r)</td>
<td>y</td>
<td></td>
</tr>
</tbody>
</table>

- All voiced obstruents in Noon are stops
- Tautomorphemic prenasalized stops are rare, found only in borrowings

Note: Vowels are irrelevant to this discussion. <ë, é, í, ó, ú> represent [+ATR] vowels in the Cangin languages
Coda nasalization in Northern Noon

The voiced stops /b, d, j, g/ surface as [m, n, ñ, η] in coda position

<table>
<thead>
<tr>
<th>bare verb</th>
<th>punctual -Ca</th>
<th>past -ee</th>
</tr>
</thead>
<tbody>
<tr>
<td>kúb</td>
<td>[kúm]</td>
<td>kúb-ee</td>
</tr>
<tr>
<td>kod</td>
<td>[kɔn]</td>
<td>kod-ee</td>
</tr>
<tr>
<td>paj</td>
<td>[pañ]</td>
<td>paj-ee</td>
</tr>
<tr>
<td>awaag</td>
<td>[awaanj]</td>
<td>awaag-ee</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>bare noun</th>
<th>pl. proximal def. -c-ii</th>
<th>proximal definite -ii</th>
</tr>
</thead>
<tbody>
<tr>
<td>yiib</td>
<td>[yiim]</td>
<td>yiib-ii</td>
</tr>
<tr>
<td>nad</td>
<td>[nɔn]</td>
<td>nad-ii</td>
</tr>
<tr>
<td>bíig</td>
<td>[biïŋ]</td>
<td>bíig-ii</td>
</tr>
</tbody>
</table>

- These alternations are purely allophonic: exceptionless, completely predictable from phonological environment
- Coda /j/ is rare (only 1 known example), but /b, d, g/ are common
- Knowing that voiced obstruent codas are marked cross-linguistically, this allophonic pattern can be seen as a repair for this marked structure
Voiced stop-final roots contrast with nasal-final roots, which show no allophony

<table>
<thead>
<tr>
<th>bare verb</th>
<th>perfect -in</th>
<th>bare verb</th>
<th>perfect -in</th>
</tr>
</thead>
<tbody>
<tr>
<td>ab [am]</td>
<td>ab-in [abin]</td>
<td>ñam [ñam]</td>
<td>ñam-in [ñamin]</td>
</tr>
</tbody>
</table>

- In coda position, the distinction between /b, d, j, g/ and /m, n, ñ, ŋ/ is completely neutralized
- Thus, the alternation must be seen as nasalization of underlying stops, not denasalization of underlying nasals

Voiceless stop codas are common
- There is no general dispreference for stop codas—only *voiced* stop codas
- There is no reason why coda devoicing would not be an available repair
Other evidence for a constraint against voiced obstruent codas

Noon allows no voiced obstruent codas, and exhibits several different repairs depending on the obstruent in question.

- Implosive stops /ɓ, ɗ, ƴ/ have allophones [wʔ, ʔ, yʔ] in coda position:

  /ɗoɓ/   [dowʔ]  ‘bite’
  /ɓúɗ/   [ɓúʔ]  ‘collapse’
  /ay/    [ayʔ]  ‘lean’

- Alternation triggered by vowel deletion:

  /jégíɗ/  [jégíʔ]  ‘teach’
  /jégɗ-oh/ [jéŋɗoh]  ‘teacher’
Other evidence for a constraint against voiced obstruent codas

Voiced prenasalized stops (ND) are never found in coda position.
- Earlier ND-final borrowings show up as voiced stops

Wolof, Sereer *bind* ‘write’ → Noon *bíd* [bín]

- More recent borrowings make use of vowel epenthesis

Wolof *dund* ‘live’ → Noon *dúndú*

- Voiceless prenasalized stop codas are rare, but are borrowed unaltered, despite not appearing in native vocabulary

Wolof *Ngeent* ‘Neighborhood in Thiès’ → Noon *Ngeent*

Coda nasalization is clearly part of a larger conspiracy to avoid voiced obstruent codas in Noon
Coda nasalization in other languages

Other cases of nasalization of voiced obstruent codas exist (some collected in Flynn 2007)
  • But few truly result in the “unattested” pattern described in Steriade (2008)

Cangin languages
  • Essentially the same pattern found in Northern Noon is found in some of the other Cangin languages
Coda nasalization in other languages

**Southeastern Tepehuán** (Uto-Aztecan: Willett 1991: 17)
- /b, d, g/ have allophones [ʔm, ʔn, ʔŋ] in coda position

- /kaib/ [kaiʔm] ‘it has ripened’
- /kaib-aʔ/ [kaiʔbaʔ] ‘it will ripen’

- /duud/ [duuʔn] ‘it has rained’
- /duud-uʔ/ [duuʔduʔ] ‘it will rain’

- /gaag-gaʔ/ [gaaʔŋgaʔ] ‘he will look around for it’
- /gaag-aʔ/ [gaagaʔ] ‘he will look for it’
Coda nasalization in other languages

**Alabama** (Muskogean: Montler & Hardy 1988)
- The only voiced obstruent, /b/, surfaces as [m] in coda position
- Pluractional verbs are formed by vowel subtraction:

  - łobafka ‘to have a hole’
  - łomka ‘to have holes’
  - bala:ka ‘to lie down (sg.)’
  - balka ‘to lie down (pl.)’

- Gemination of /b/ results in [mb]

  - aba:li ‘high’
  - ámba:li ‘(getting) higher’
  - hajo:ki ‘deep’
  - hájjo:ki ‘(getting) deeper’

- But as words are all vowel-final, this alternation occurs only word-medially
Coda nasalization in other languages

**Stoney** (Siouan: Shaw 1980)

- /b, d/ surface as [m, n] before a word or compound boundary (%)

\[ tʰába \ o wie tʰané%jatʃ \quad \text{‘he went hunting beaver’} \]
\[ tʰám%ôné%játʃ \quad \text{‘lie down (sg.)’} \]

\[ júda \quad \text{‘to eat’} \]
\[ juhjún%maʃ \quad \text{‘I’m going along eating’} \]

- But this does not apply to /dʒ, g/, or voiced fricatives (devoicing is employed)
- And does not apply to all coda positions (never word-medially; here devoicing is employed)
Coda nasalization in other languages

**Japanese** (Kuroda 2006, Inkelas and Cho 1993)
- In native vocabulary, voiced obstruents become nasals in coda position
  
  \[
  \begin{align*}
  \text{asob-ɯ} & \rightarrow \text{asobɯ} \quad \text{‘to play’} \\
  \text{asob-te} & \rightarrow \text{asonde} \quad \text{‘playing’}
  \end{align*}
  \]

- But also affects sequences of a voiceless + voiced obstruent
  
  \[
  \begin{align*}
  \text{tuk-dasɯ} & \rightarrow \text{tundasɯ} \quad \text{‘thrust out’}
  \end{align*}
  \]

- This can be seen as a repair for voiced geminates, rather than a response to voiced obstruent codas
Coda nasalization in other languages

Vimeu dialect of Picard (José and Auger 2004)

- Voiced stops surface as nasals in coda position

  /rɛpɔ̃d/    [rɛpɔ̃n]  ‘to answer’
  /rɛpɔ̃d-y/   [rɛpɔ̃dɪ]  ‘answered’

  /ɡãb/        [ɡãm]  ‘leg’
  /ɡãb-e/      [ɡãbɛ]  ‘action of kicking one’s leg over the head of a young/short/little person’

- But only after a nasalized vowel
- In fact consistent with the P-map

A similar pattern is found in Canadian French (Flynn 2007: 7)
Coda nasalization in other languages

Blust (2005) cites two independent cases of historical coda nasalization in Austronesian

**Northern Batak** (Karo and Dairi-Pakpak)

- Proto-Batak *b, *d, *g > m, n, ŋ / in coda position

<table>
<thead>
<tr>
<th>PB</th>
<th>Karo</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>*abab</td>
<td>abam</td>
<td>‘fine burning ashes’</td>
</tr>
<tr>
<td>*alud</td>
<td>alun</td>
<td>‘to massage’</td>
</tr>
<tr>
<td>*deleg</td>
<td>deleŋ</td>
<td>‘mountain’</td>
</tr>
</tbody>
</table>

- But voiced obstruent codas were rare in Proto-Batak
- Perhaps for this reason, there are apparently no synchronic D~N alternations
Coda nasalization in other languages

Berawan languages (Long Terawan, Batu Belah, Long Jegan)

- Proto-North Sarawak *b, *d > m, n / in coda position (no information on coda *g)

### Proto-North Sarawak (PNS) vs. Long Terawan

<table>
<thead>
<tr>
<th>PNS</th>
<th>Long Terawan</th>
</tr>
</thead>
<tbody>
<tr>
<td>*ulu eleb</td>
<td>ulo lem</td>
</tr>
<tr>
<td>*kuyad</td>
<td>kuyan</td>
</tr>
<tr>
<td>*sulud</td>
<td>sulon</td>
</tr>
</tbody>
</table>

- ‘knee’
- ‘grey macaque’
- ‘comb’

- These languages are not well documented, and no resulting alternations are recorded.
- But *b, *d > k, r / word-medially, so if alternations do exist, they would not be of the relevant type.
Coda nasalization in other languages

Nasalization as a synchronic repair for voiced obstruent codas is indeed rare
- Only SE Tepehuán and Cangin languages (Noon, Lehar, Ndut) show it robustly

Why should it be so rare?
- The answer (for Cangin at least) lies in the historical origin of these alternations
- This pattern did not arise from the historical nasalization of final stops, but from the development of earlier prenasalized stops
- e.g. the [b ~ m] alternation was once *mb in all positions
The Cangin languages

Sources:
Ndut: Morgan (1996)
Palor: D’Alton (1983)
Safen: Mbodj (1983)
Lehar: Dieye (2010)
Ndut, Palor, and Lehar

Ndut and Palor show the same alternations as N. Noon

<table>
<thead>
<tr>
<th>Ndut, Palor</th>
<th>= N. Noon</th>
</tr>
</thead>
<tbody>
<tr>
<td>bare verb</td>
<td>negative -ay</td>
</tr>
<tr>
<td>som</td>
<td>sob-ay</td>
</tr>
<tr>
<td>man</td>
<td>mad-ay</td>
</tr>
<tr>
<td>paŋ</td>
<td>pag-ay</td>
</tr>
</tbody>
</table>

- However, Palor has developed non-alternating plain voiced stops from some earlier implosives, so coda nasalization is not allophonic

The facts in Lehar seem to be exactly the same as in Northern Noon
Noon Dialects

Northern Noon \([b, d, j, g]\) = Thiès Noon \([mb, nd, nj, ng]\)

<table>
<thead>
<tr>
<th>Northern Noon</th>
<th>Thiès Noon</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>dood</td>
<td>ndood</td>
<td>‘stick’</td>
</tr>
<tr>
<td>baal</td>
<td>mbaal</td>
<td>‘sheep’</td>
</tr>
<tr>
<td>dagal</td>
<td>ndangal</td>
<td>‘scorpion’</td>
</tr>
</tbody>
</table>

- Coda allophones are the same (nasals) in all dialects.
- So Thiès Noon shows a \([mb \sim m]\) alternation for Northern Noon \([b \sim m]\)

<table>
<thead>
<tr>
<th>Northern Noon</th>
<th>Thiès Noon</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>[am \sim ab-a]</td>
<td>[am \sim amb-a]</td>
<td>‘hold’</td>
</tr>
<tr>
<td>[man \sim mad-a]</td>
<td>[man \sim mand-a]</td>
<td>‘resemble’</td>
</tr>
<tr>
<td>[paŋ \sim pag-a]</td>
<td>[paŋ \sim pang-a]</td>
<td>‘do’</td>
</tr>
</tbody>
</table>
**Safen**

In Safen, Northern Noon /b, d, j, g/ correspond to [mb, nd, nj, ng] in all positions.

<table>
<thead>
<tr>
<th>Safen</th>
<th>N. Noon</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Onset:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>njol</td>
<td>jol</td>
<td>‘cricket’</td>
</tr>
<tr>
<td>paangi</td>
<td>péegí</td>
<td>‘grass’</td>
</tr>
<tr>
<td>pambi</td>
<td>pabi</td>
<td>‘chicken’</td>
</tr>
<tr>
<td>ngul</td>
<td>gúl</td>
<td>‘pierce’</td>
</tr>
<tr>
<td><strong>Coda:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>kunng</td>
<td>kúng</td>
<td>[kúŋ]</td>
</tr>
<tr>
<td>amb</td>
<td>ab</td>
<td>[am]</td>
</tr>
<tr>
<td>pang</td>
<td>pag</td>
<td>[paŋ]</td>
</tr>
<tr>
<td>rang</td>
<td>lag</td>
<td>[laŋ]</td>
</tr>
</tbody>
</table>
Historical origin of coda nasalization

These correspondences must be reconstructed as prenasalized stops

- External evidence: Proto-Cangin *ding = Sereer ding ‘fence in,’ PC *mbaal = Sereer mbaal ‘sheep’

<table>
<thead>
<tr>
<th>Proto-Cangin</th>
<th>Ndut, Palor</th>
<th>Safen</th>
<th>Lehar</th>
<th>N. Noon</th>
<th>Thiès Noon</th>
</tr>
</thead>
<tbody>
<tr>
<td>*hang</td>
<td>haŋ ~ hag-</td>
<td>ang</td>
<td>aŋ ~ ag-</td>
<td>aŋ ~ ang-</td>
<td>aŋ ~ ang-</td>
</tr>
<tr>
<td>*hamb</td>
<td>ham ~ hab-</td>
<td>amb</td>
<td>am ~ ab-</td>
<td>am ~ amb-</td>
<td>am ~ amb-</td>
</tr>
<tr>
<td>*pang</td>
<td>paŋ ~ pag-</td>
<td>pang</td>
<td>paŋ ~ pag-</td>
<td>paŋ ~ pang-</td>
<td>paŋ ~ pang-</td>
</tr>
<tr>
<td>*yoond</td>
<td>yoon ~ yood-</td>
<td>yoon ~ yood-</td>
<td>yoon ~ yood-</td>
<td>yoon ~ yood-</td>
<td>yoon ~ yood-</td>
</tr>
<tr>
<td>*ndangal</td>
<td>dagal</td>
<td>ndangal</td>
<td>dagal</td>
<td>dagal</td>
<td>ndangal</td>
</tr>
<tr>
<td>*cangin</td>
<td>cigin</td>
<td>cangin</td>
<td>cēgin</td>
<td>cēgin</td>
<td></td>
</tr>
<tr>
<td>*nd-</td>
<td>d- (Ndut)</td>
<td>nd-</td>
<td>d-</td>
<td>nd-</td>
<td>nd-</td>
</tr>
<tr>
<td>*mboos</td>
<td>boos (Ndut)</td>
<td>mbuus</td>
<td>boos</td>
<td>mboos</td>
<td>mboos</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>

- Safen retains the original prenasalized stops in all positions
- ND > N in coda position in all other languages
- ND > D in onset in all but Safen and Thiès Noon

Crucially, Proto-Cangin did not have plain voiced stops
Historical origin of coda devoicing vs. coda nasalization

Historical precursor to each alternation:
  Devoicing: voiced stops in coda position
  Nasalization: prenasalized stops in all positions, no plain voiced stops

Sound changes required to yield each alternation:
  Devoicing: devoicing of coda obstruents
  Nasalization: ND > N in coda, ND > D in onset

• The precursor for coda devoicing is much more common
• Coda nasalization requires two sound changes rather than one
• Unconditioned ND > D is found elsewhere, e.g. Kayan (Austronesian) dialects (Blust 2005: 259), but is not common

The historical facts explain the rarity of the nasalization alternation
  • There may be other pathways to coda nasalization, but it cannot arise from a single common sound change
Conclusions

If we accept that sound change is phonetically natural

- ‘Unnatural’ alternations cannot arise from a single sound change
- Broadly, the more perceptual distance in an alternation, the more sound changes must have occurred
- The P-map is generally successful because it accounts for those alternations which result from a single sound change

But series of sound changes do sometimes result in unnatural alternations which have no synchronic phonetic motivation (Stausland Johnsen 2012)

The test for the P-map: If such an unnatural alternation effectively repairs a marked structure, will a language tolerate it despite the availability of a more ‘natural’ repair?

- Noon suggests that it will

Any mechanism which limits the possible constraint rankings of a language must then allow for some degree of arbitrariness, and not rely entirely on perceived similarity effects
Thanks to Larry Hyman, Nico Baier, and Christine Diop!
References


