The Functional Load of Tone in Hausa

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Questions – The nature of phonological systems

1. How do phonological contrasts contribute to the intended meaning of an utterance? How much ‘work’ does a contrast do? This is the question of the **Functional Load** of a phonological contrast.
   There has been much recent interest in this topic as phonologists seek to understand the functional motivation(s) behind the shape of phonological systems, i.e. why do they look the way they do?

2. How much functional load does linguistic **tone** have in tonal languages, e.g. diverse as Chinese and Hausa (Somali, Navajo, Japanese, Yoruba, Swedish, Zulu...?)
Findings for the functional load of lexical tone

• Hausa Language tone system
• Hierarchy of functional load [Highest to Lowest]:
  • ...
  • Vocalic system contrast
  • Tonal system contrast
    • Major oppositions
    • (Voicing, Length, Glottalization, Vowel Height, Secondary Articulation)
  • ...
  • ...

1  Tone in Afroasiatic
What constitutes a tone language?

• **Definition** (Hyman 2001a:1368; Hyman 2006:229):
  - languages ‘in which an indication of pitch enters into the lexical realization of at least some morphemes’

• Three **tonemes** /H/, /M/, /L/ in Yoruba (Nigeria)
  - H /kɔ́/  ‘build’
  - M /kɔ̄/  ‘sing’
  - L /kɔ̀/  ‘reject’

• **Underlying Tone**: the tonemes and tonemic structure inherently connected to a particular morpheme
  - its underlying representation
  - said to have **contrastive tone**
Tone in the Afro-Asiatic Phylum

<table>
<thead>
<tr>
<th>Phylum</th>
<th>No tone</th>
<th>Simplex Tone (e.g. H vs. L, H vs. Ø)</th>
<th>Complex (e.g. H vs. M vs. L)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afro-Asiatic</td>
<td>$n = 72$</td>
<td>$n = 15$</td>
<td>$n = 31$</td>
<td>$n = 118$</td>
</tr>
<tr>
<td></td>
<td>(61%)</td>
<td>(13%)</td>
<td>(26%)</td>
<td>(100%)</td>
</tr>
</tbody>
</table>

• World Phonotactics Database (http://phonotactics.anu.edu.au)
- Chadic family
- Cushitic family
- Omotic families (South Omotic, North Omotic, Dizoid, Mao)
Contrastive tone in Chadic

• For Chadic, Schuh (2017:91) notes that ‘tone has to be overtly specified for each and every noun’ which ‘shows it to be an important, phonological component of the lexicon’

• However, he also notes that exact minimal pairs are uncommon’ (Schuh 2017:93)
  • e.g. /L/ vs. /H/ in Margi [mrt]
  • fà ‘farm’ vs. fá ‘year’
Contrastive tone in Cushitic

• For Cushitic as a whole (Mous 2009), tone has a very small role, with some debating whether certain languages have tone at all,
  • e.g. Somali (Hyman 1981 – it does!)
2 Tone and the Hausa Language
The Hausa Language

- Major lingua franca of West Africa, with millions of 1st and 2nd language speakers
- West Chadic language, mostly within Nigeria
Tone in the Hausa Language

• /H/ , /L/ , and /HL/ tonemes in Hausa (Newman 2000:597)
  • H  <shā> /ʃā/ ‘drink’  <maza> /mázá/ ‘quickly’
  • L  <dà> /dà/ ‘with, and’  <àkwàtì> /àkwà:tì/ ‘box’
  • HL  <shâ> /ʃàa/ ‘drinking’  <kàttâ> /k’àttá:/ ‘huge’ (pl.)

• “Although tone does not have a functional load comparable to that of many West African languages like Igbo or Yoruba, it does serve to distinguish a number of lexical items from one another”
  • [Newman 2000:599]
• < ràìnā > / ràìná:/ LH look after a baby
• < rainà > /ráìnà:/ HL despise, have comtempt for
Functions of tone in Hausa

- **Lexical**: i.e. contrastive, underlying tone
  - nouns, ideophones, functional words, adverbs, among others...

- **Grammatical**: expressing grammatical categories
  - Part of plural inflection on nouns
    - LH <̀rìgā> /rì:gá:/ gown → HL <̀rìgunà> /rì:gúnà:/ gowns
  - Marking tense/aspect/mood
    - HL < tàshì> /tá:ʃì/ get up → LH < tàshí> [tà:ʃì] Get up! (imperative)
  - Different verb grades (~ = verb classes)
    - HL <̀rà> /̀ràː/ (gr 1) lend vs. LH <àrà>/àrāː/ (gr 2) borrow (not money)
Functions of tone in Hausa

• The balance between Hausa employing tone for a *Lexical function* (underlying contrasts on morphemes) versus a *Grammatical function* (changes in default tone to cue certain grammatical categories)
• And how do these two ‘get along’ with one another?

• Specifically, can we quantify
  • To what degree is tone used in its *lexical* function?
  • To what degree is tone used in its *grammatical* function?
3 Measuring Functional Load
Definition of Functional Load

• Quantifying the lexical function of tone can be done by assessing its ‘functional load’

• Definition of **Functional Load** (Hall et al. 2016):
  - ‘Functional load is a measure of the “work” that any particular contrast does in a language, as compared to other contrasts’

• Konnerth (2014:76 ): “The idea that different phonemic contrasts may have different degrees of functional load in the overall phonemic system goes back to the Prague School (**inter alia** Mathesius 1929; Jakobson 1931)”
Definition of Functional Load

Discussion of **Functional Load** (Hall et al. 2016):

- In English, ‘the difference between [d] and [t] is used to distinguish between many different lexical items, so it has a high functional load; there are, on the other hand, very few lexical items that hinge on the distinction between [ð] and [θ], so its functional load is much lower’
Shorthand metric – Minimal pairs

- Frequent minimal pairs indicate a high functional load
  - /i/ vs. /ɪ/
    - leave vs. live, read vs. rid, bean vs. bin, heat vs. hit, least vs. list, etc.
  - cf. /ʊ/ vs. /ʌ/
    - put vs. putt, could vs. cud, look vs. luck, ...?

\[\text{← much harder}\]

|    | p | b | m | f | v | k | g | η | θ | ð | t | d | n | s | z | tʃ | dʒ | ʃ | ʒ |
|----|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ʊ  | (*) | * | * | (*) | (*) | * | * | * |   |   | * | ( )* | * | ( )* | * |   |   |
| Λ  |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
Low number of tonal minimal pairs

- In Chadic (interpreted from Schuh 2017:90)

<table>
<thead>
<tr>
<th>Lang</th>
<th>ISO</th>
<th>n = (approx.)</th>
<th>Distinguished by tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bole</td>
<td>bol</td>
<td>2000</td>
<td>139</td>
</tr>
<tr>
<td>Bura</td>
<td>bwr</td>
<td>600</td>
<td>30</td>
</tr>
<tr>
<td>Ngizim</td>
<td>ngi</td>
<td>1900</td>
<td>76</td>
</tr>
<tr>
<td>Miya</td>
<td>mkf</td>
<td>670</td>
<td>6</td>
</tr>
<tr>
<td>Gude</td>
<td>gde</td>
<td>800</td>
<td>4</td>
</tr>
</tbody>
</table>
Previous statements on Functional Load of tone

• Across Afro-asiatic...
• Where tone plays a small role in distinguishing morphemes, tone is said to have a low **functional load**, 
  • claimed for Chadic languages Makary Kotoko [mpi] (Allison 2012:38) and Goemai [ank] (Tabain & Hellwig 2015:91), and for Cushitic as a whole (Mous 2009), e.g. Awngi [awn] (Joswig 2010:23-24).
• However, statements do not provide clear statistics to support their position
Previous statements on Functional Load of tone

- Across the world...
  - “Tone has a high functional load in Supyire. Boys cowherding in the bush often communicate with each other by whistling.”
    - [Supyire - Carlson 1994:32]
  - “Seenku vocabulary is largely monosyllabic with almost exclusively open syllables, resulting in a high functional load for tone.”
    - [Seenku - McPherson 2016:43]
  - “Tone carries a high lexical functional load in Ganza.”
    - [Ganza - Smolders 2016:129]
  - “Unlike some African tone languages, tone is not affected by consonants, tone is stable—it does not shift from one syllable to another, and tone does not down-step or down-drift. The functional load of tone is very high, both in the distinction of words and in the expression of grammatical functions.”
    - [Gaahmg – Stritz 2011:43]
Previous statements on Functional Load of tone

• “The most intriguing aspect of Karbi phonology is the tone system, which carries a **low functional load**.”
  - [Karbi - Konnerth 2014:iv]

• “…[P]itch accents are contrastive, and other minimal pairs occur (tecénoo ‘door’ vs. técenoo ‘roll it out!’…”). However, such pairs are comparatively rare, and it is **extremely difficult to find minimal pairs of nouns based on pitch accent**, so the pitch accent system is certainly not equivalent to tonal systems in languages such as Mandarin Chinese, where such minimal pairs are pervasive.”
  - [Arapaho- Cowell & Moss 2008:23]

• “**Only a small list of minimal pairs has been recorded for the verbs:**...The rarity of verb stem contrasts, in some cases its total absence, has long since been reported for the Mande languages”

• “Tone is contrastive both grammatically and lexically in Kifuliiru. Lexical roots which differ only in tone can be found in both nouns (**roughly 1%**) and in verbs (**between 1 and 2%**).”
  - [Kifuliiru – van Otterloo 2011:127]
Quantifying Functional Load

- Hall et al. (2016) discussion of ‘Functional Load’
  - **Phonological CorpusTools**
- (Hockett 1955, 1966; Martinet 1955, 1977; Kucera 1963; King 1967; Surendran 2003; Surendran and Niyogi 2006; Wedel et al. 2013a,b; Oh et al. 2013, 2015)
Quantifying Functional Load

- Hall et al. (2016) discuss two primary ways of calculating functional load

  1) **Change of entropy**
     - “Entropy is an Information-Theoretic measure of the amount of uncertainty in a system” (Shanon 1949)
     - What is the change in entropy in a system upon merger of a segment pair or set of segment pairs (Surendran 2003)

  2) **Minimal pair count**
     - “the other is based on simply counting up the number of minimal pairs (differing in only the target segment pair or pairs) that occur in the corpus”
Change in Entropy

• We look at Change in Entropy

• NOTE: “if raw minimal pair count is used, or minimal pairs relativized to the size of the corpus, these will be perfectly analogous to the (non-standard) calculation of functional load based on change in entropy using word types (rather than tokens).”
  • (Hall et al. 2016)
Change in Entropy

• Entropy: \( H = -\sum_{i \in N} p_i * \log_2(p_i) \)

• We get a baseline of the entropy by first running this measurement for the corpus as a whole
  • \( H_1 \)

• We then merge a category and see how much this changes the baseline entropy
  • \( H_1 - H_2 \)

• \( p \) is the probability of a word
  • Token-based: multiple by frequency in a corpus
  • Type-based: multiple by 1 (all equally frequent in a dictionary)
# Change in Entropy – Toy example

<table>
<thead>
<tr>
<th>A</th>
<th>Word (n=6)</th>
<th>B</th>
<th>Meaning</th>
<th>C</th>
<th>No tone (n=4)</th>
<th>D</th>
<th>No Cons (n=5)</th>
<th>E</th>
<th>No Vowel (n=5)</th>
<th>F</th>
<th>No s vs. z (n=6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sălì</td>
<td>eat</td>
<td>sali</td>
<td>tátì</td>
<td>sălá</td>
<td>sălì</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>sălí</td>
<td>talk</td>
<td>sali</td>
<td>tàtí</td>
<td>sălá</td>
<td>sălí</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>zìlá</td>
<td>sleep</td>
<td>zila</td>
<td>titá</td>
<td>zàlá</td>
<td>silá</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>zàrá</td>
<td>know</td>
<td>zara</td>
<td>tàtá</td>
<td>zárá</td>
<td>sàrá</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>zárá</td>
<td>be nice</td>
<td>zara</td>
<td>tàtá</td>
<td>zárá</td>
<td>sárá</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>zàlá</td>
<td>tow away</td>
<td>zala</td>
<td>tàtá</td>
<td>zàlá</td>
<td>sălá</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4 Findings on the functional load of tone in Hausa
Hausa lexicon

• We use a digitized Hausa lexicon of 10,768 lexemes taken primarily from Newman’s 2007 dictionary
• Input into a R-readable spreadsheet by research assistants to Stephanie Shih/Sharon Inkelas
• Again, not possible to get token counts/frequency of individual words – no corpus readily available
<table>
<thead>
<tr>
<th>id</th>
<th>Word</th>
<th>Distilled Tone</th>
<th>POS</th>
<th>Gender (n)/Grade (v)</th>
<th>Definition</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>348</td>
<td>ts'oohoo</td>
<td>H.H</td>
<td>adj</td>
<td>NA</td>
<td>adj Old (psn or thing). — m 1. Old man.</td>
<td>ts'oohoo_H.H</td>
</tr>
<tr>
<td>10481</td>
<td>ts'allakaa</td>
<td>H.L.H</td>
<td>v</td>
<td>v1</td>
<td>Cross over, go from one side to the other.</td>
<td>ts'allakaa_H.L.H</td>
</tr>
<tr>
<td>483</td>
<td>jeere</td>
<td>L.H</td>
<td>adv</td>
<td>NA</td>
<td>In a row, in succession</td>
<td>jeere_L.H</td>
</tr>
<tr>
<td>2648</td>
<td>fants'aree</td>
<td>L.L.H</td>
<td>noun</td>
<td>m</td>
<td>Coarsely ground corn or the grinding process</td>
<td>fants'aree_L.L.H</td>
</tr>
<tr>
<td>3548</td>
<td>jadawalii</td>
<td>H.H.L.H</td>
<td>noun</td>
<td>m</td>
<td>Multiplication table; Class schedule</td>
<td>jadawalii_H.H.L.H</td>
</tr>
<tr>
<td>4348</td>
<td>k'arau</td>
<td>H.H</td>
<td>noun</td>
<td>m</td>
<td>Glass bangle</td>
<td>k'arau_H.H</td>
</tr>
<tr>
<td>4480</td>
<td>k'ungurgumaa</td>
<td>L.H.L.H</td>
<td>noun</td>
<td>f</td>
<td>Kind of wingless beetle.</td>
<td>k'ungurgumaa_L.H.L.H</td>
</tr>
</tbody>
</table>
Hausa lexicon

• From this 10,768 lexeme set, we took out:
  • Words which were transcribed with spaces (phrases) or dashes (compounds)
  • All exclamations
  • Feminine versions which were not defined clearly separately from the masculine counterpart
  • Variants which appears to be predictable phonological variants
  • Verbal nouns which appear to be predictable meanings from verbs
  • Predictable plural forms
  • Predictable ethnonyms
  • Words only found in a certain collocation
Hausa lexicon w/ Mergers

- Result was a set of **9164 words** in Hausa dataset

<table>
<thead>
<tr>
<th>id</th>
<th>no merger</th>
<th>H vs. L</th>
<th>b vs. d vs. d' ...</th>
<th>i vs. e vs. a ...</th>
<th>a vs. a:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>noVoice</td>
<td>noTone</td>
<td>noCons</td>
<td>noVowel</td>
<td>noVLength</td>
</tr>
<tr>
<td>1aajizii_H.L.H</td>
<td>aajizii</td>
<td>aaxixii_H.L.H</td>
<td>aajazaa_H.L.H</td>
<td>ajizi_H.L.H</td>
<td>...</td>
</tr>
<tr>
<td>2algashii_H.L.H</td>
<td>algashii</td>
<td>axxaxii_H.L.H</td>
<td>algashaa_H.L.H</td>
<td>algashi_H.L.H</td>
<td>...</td>
</tr>
<tr>
<td>3angajeejee_H.H.H.L</td>
<td>angajeejee</td>
<td>axxaxxeexee_H.H.H.L</td>
<td>angajaajaa_H.H.H.L</td>
<td>angajeje_H.H.H.L</td>
<td>...</td>
</tr>
<tr>
<td>4askakkee_L.H.H</td>
<td>askakkee</td>
<td>axxaxxkee_L.H.H</td>
<td>askakkaa_L.H.H</td>
<td>askakke_L.H.H</td>
<td>...</td>
</tr>
<tr>
<td>All words (n=9164)</td>
<td>Merger</td>
<td>Unique</td>
<td>$H$</td>
<td>$\Delta H$</td>
<td>% less compared to tone</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------</td>
<td>--------</td>
<td>-----</td>
<td>-----------</td>
<td>---------------------</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>8913</td>
<td>13.12170</td>
<td></td>
<td></td>
</tr>
<tr>
<td>noAlvPostA</td>
<td>tʃ vs. kʸ</td>
<td>8912</td>
<td>13.12153</td>
<td>0.00016</td>
<td>0% 0</td>
</tr>
<tr>
<td>noR</td>
<td>r vs. ŋ</td>
<td>8909</td>
<td>13.12105</td>
<td>0.00065</td>
<td>1% 0</td>
</tr>
<tr>
<td>noH</td>
<td>h vs. Ø</td>
<td>8901</td>
<td>13.11975</td>
<td>0.00194</td>
<td>2% 0</td>
</tr>
<tr>
<td>noFH</td>
<td>f vs. h</td>
<td>8899</td>
<td>13.11943</td>
<td>0.00227</td>
<td>3% 0</td>
</tr>
<tr>
<td>noFW</td>
<td>f vs. w</td>
<td>8896</td>
<td>13.11894</td>
<td>0.00275</td>
<td>3% 0</td>
</tr>
<tr>
<td>noVel</td>
<td>k vs. kʸ vs. kʷ</td>
<td>8875</td>
<td>13.11553</td>
<td>0.00616</td>
<td>7% 0</td>
</tr>
<tr>
<td>noGlot</td>
<td>b vs. ɓ, ...</td>
<td>8800</td>
<td>13.10329</td>
<td>0.01841</td>
<td>21% 1/5</td>
</tr>
<tr>
<td>nuHMV</td>
<td>i/u vs. e/o</td>
<td>8780</td>
<td>13.10001</td>
<td>0.02169</td>
<td>25% 1/4</td>
</tr>
<tr>
<td>noVoic</td>
<td>s vs. z, ...</td>
<td>8746</td>
<td>13.09441</td>
<td>0.02729</td>
<td>31% 1/3</td>
</tr>
<tr>
<td>noVL</td>
<td>a vs. a:</td>
<td>8701</td>
<td>13.08697</td>
<td>0.03473</td>
<td>40% 2/5</td>
</tr>
<tr>
<td><strong>notone</strong></td>
<td>H vs. L</td>
<td>8393</td>
<td>13.03497</td>
<td>0.08672</td>
<td>100% 1</td>
</tr>
<tr>
<td>noV</td>
<td>i vs. e vs. a ...</td>
<td>7770</td>
<td>12.92370</td>
<td>0.19800</td>
<td>228% 2.3 x</td>
</tr>
<tr>
<td>noC</td>
<td>b vs. t vs. d...</td>
<td>2912</td>
<td>11.50779</td>
<td>1.61390</td>
<td>1861% 18.6 x</td>
</tr>
<tr>
<td>Nouns (n=5781)</td>
<td>Merger</td>
<td>Unique</td>
<td>(H)</td>
<td>(\Delta H)</td>
<td>% less compared to tone</td>
</tr>
<tr>
<td>-----------------</td>
<td>--------</td>
<td>--------</td>
<td>------</td>
<td>---------</td>
<td>------------------------</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>5674</td>
<td>12.47015</td>
<td></td>
<td></td>
</tr>
<tr>
<td>noAlvPostA</td>
<td>tf vs. (k^y)</td>
<td>5673</td>
<td>12.46990</td>
<td>0.00025</td>
<td>1% 0</td>
</tr>
<tr>
<td>noR</td>
<td>r vs. (r)</td>
<td>5671</td>
<td>12.46939</td>
<td>0.00076</td>
<td>2% 0</td>
</tr>
<tr>
<td>noH</td>
<td>h vs. (\emptyset)</td>
<td>5670</td>
<td>12.46913</td>
<td>0.00102</td>
<td>3% 0</td>
</tr>
<tr>
<td>noFH</td>
<td>f vs. h</td>
<td>5668</td>
<td>12.46862</td>
<td>0.00153</td>
<td>5% 0</td>
</tr>
<tr>
<td>noFW</td>
<td>f vs. w</td>
<td>5665</td>
<td>12.46786</td>
<td>0.00229</td>
<td>7% 0</td>
</tr>
<tr>
<td>noVel</td>
<td>k vs. (k^y) vs. (k^w)</td>
<td>5658</td>
<td>12.46608</td>
<td>0.00407</td>
<td>13% 1/8</td>
</tr>
<tr>
<td>nuHMV</td>
<td>i/u vs. e/o</td>
<td>5651</td>
<td>12.46429</td>
<td>0.00586</td>
<td>18% 1/5</td>
</tr>
<tr>
<td>noGlot</td>
<td>b vs. (6, \ ...)</td>
<td>5633</td>
<td>12.45969</td>
<td>0.01046</td>
<td>33% 1/3</td>
</tr>
<tr>
<td>noVL</td>
<td>a vs. a:</td>
<td>5632</td>
<td>12.45943</td>
<td>0.01072</td>
<td>34% 1/3</td>
</tr>
<tr>
<td>noVoic</td>
<td>s vs. z, \ ...)</td>
<td>5602</td>
<td>12.45173</td>
<td>0.01842</td>
<td>58% 4/7</td>
</tr>
<tr>
<td><strong>notone</strong></td>
<td>H vs. L</td>
<td>5550</td>
<td>12.43827</td>
<td>0.03188</td>
<td>100% 1</td>
</tr>
<tr>
<td>noV</td>
<td>i vs. e vs. a \ ...)</td>
<td>5251</td>
<td>12.35838</td>
<td>0.11177</td>
<td>351% 3.5 x</td>
</tr>
<tr>
<td>noC</td>
<td>b vs. t vs. d\ ...)</td>
<td>2291</td>
<td>11.16176</td>
<td>1.30839</td>
<td>4104% 41 x</td>
</tr>
</tbody>
</table>
Findings

• Hierarchy of functional load [Highest to Lowest]:
  • Consonantal contrast
    • Vocalic contrast
    • Tonal contrast
    • Major oppositions
      • (Voicing, Length, Glottalization, Vowel Height, Secondary Articulation)
  • Phoneme contrasts
    • (f vs. h, r vs. ṭ, etc.)
5 Discussion
FL of a contrast as a system-specific property

- Functional load is system-specific (language-specific)
- It is not identical to perceptual or articulatory pressures, although it interacts with them
- Results from the need to maintain contrast in expressing meaning
- We therefore expect to see some cross-linguistic variation across prosodic systems (tone systems or stress systems)
### Null FL of stress – Oh et al. 2015 (Token & Inflected)

<table>
<thead>
<tr>
<th></th>
<th>Cantonese</th>
<th>Mandarin</th>
<th>English</th>
<th>French</th>
<th>German</th>
<th>Italian</th>
<th>Japanese</th>
<th>Korean</th>
<th>Swahili</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{FL}_{\text{Cons}}$</td>
<td>10.64</td>
<td>13.09</td>
<td>20.82</td>
<td>19.41</td>
<td>15.45</td>
<td>11.12</td>
<td>9.39</td>
<td>11.5</td>
<td>20.0</td>
</tr>
<tr>
<td>$\text{FL}_{\text{Vowel}}$</td>
<td>4.55</td>
<td>3.24</td>
<td>6.7</td>
<td>14.83</td>
<td>4.37</td>
<td>7.61</td>
<td>3.76</td>
<td>3.3</td>
<td>4.11</td>
</tr>
<tr>
<td>$\text{FL}_{\text{Tone}}$</td>
<td>4.48</td>
<td>4.13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\text{FL}_{\text{Stress}}$</td>
<td></td>
<td></td>
<td>.005</td>
<td></td>
<td>.01</td>
<td>.24</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Large FL of tone in Chinese

- In contrast to Hausa, previous research in tonal languages Mandarin and Cantonese has shown that while the FL of consonants is similarly much higher compared to vowels, the FL of vowels is largely equivalent to the FL of tone, showing their equal lexical importance.
- Hausa Nouns

<table>
<thead>
<tr>
<th>notone</th>
<th>H vs. L</th>
<th></th>
<th></th>
<th></th>
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<td>12.35838</td>
<td>0.11177</td>
<td>351%</td>
</tr>
</tbody>
</table>
We put forward the Functional Load of Tone (FLT) hypothesis—a hypothesis which remains to be tested.

States that in languages where the functional load of lexical tone is low (e.g., Hausa), the use of grammatical tone is relatively high, and vice versa.

This hypothesis is supported by the large role grammatical tone plays in Afroasiatic tone systems (Mous 2009, Schuh 2017), and its diminished role in these Chinese languages.
Conclusion & Future work

• Lexical tone in Hausa is not as important as in other tonal languages, e.g. Cantonese and Mandarin, but is far more important than in (European) stress languages (lexically at least)
• The next step is to quantify the functional load of grammatical tone in Hausa
• Quantify the functional load of lexical and grammatical tone in many other African languages (Yoruba)
• There is a healthy body written Hausa which could be examined to determine frequency counts ➔ For TOKEN rather than TYPE
• However, the majority of which is not toke marked...
Acknowledgments

• Thanks to the following people for discussions:
  • Larry Hyman, Rikker Dockum, Myriam Lapierre, Andy Wedel

• For crucial assistance:
  • Frank Lin, Daniel Getter, and all the assistants with this project

• NACAL organizers!

• References are available by request