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Phonology Seminar  
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On Ballistic Accent in Chinantec

0. - family, dialects  
- presentation of basic Chinantec phonotactics  
- phonetic descriptions of the so-called ballistic accent  
- presentation of Mugele's (1982) phonological representation  
- reanalysis of Mugele, arguing that the ballistic accent is laryngeally based, not stress based  
- presentation of spectrographic evidence from Comaltepec in support of the laryngeal hypothesis  
- reanalysis of the Usila dialect (Skinner 1962) in light of spectrographic evidence
1. Chinantec is spoken in Oaxaca, Mexico. It is an Otomanguean language, a family which also includes Mixtecan, Popolocan, Mazatecan, Amuzgo, Chiapanec-Mangue, Otopamean, and Zapotecan (Rensch 1976).
2. At least fourteen of the twenty three investigated dialects of Chinantec are mutually unintelligible (Rensch 1989).
3. Word order is usually VSO/VOS (Grimes 1988).
4. Proto-Chinantec segment inventory (Rensch 1976):  

p		t	k	k <sup>w</sup>		i	i	u
b	z		( <u>g</u> )	g <sup>w</sup>		e	@	
	s						a	
<u>m</u>	<u>n</u>		<u>ng</u>					
	<u>r</u>							(long or short, nasal or oral)
	<u>l</u>							
		<u>y</u>		<u>w</u>				

?,h
5. clusters: any sonorant, and /g/ may be pre-laryngealized (pre-glottalized, pre-aspirated) -- underlined segments. Note that pre-laryngealized /g/ is very rare, occurring in only two modern dialects.

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codas: /?,ng/ (modern reflex is usually a nasal glide, if present (in Comaltepec (Anderson 1989), Palantla (Merrifield 1963))

onglides: /w,y/

6. Every dialect investigated possesses both phonemic and morphemic tone. The morphology is primarily stem modification, including length, tone, accent, and laryngeal augmentation. True linear affixation is rare (limited to tense-aspect) (Anderson 1989)

Quiotepec (Robbins 1968):

give:

kwo: <sup>L</sup>	I give (something)
kwo: <sup>MHM</sup>	I gave (something)
kwo?o <sup>MH</sup>	thou givest (something)
kwo?o <sup>LH</sup>	thou gavest (something)
kwo?o <sup>M</sup>	I give (something to someone)
kwo?o <sup>HL</sup>	I gave (something to someone)
kwo?o <sup>MH</sup>	thou givest (something to someone)
kwo <sup>H</sup> o?o <sup>LH</sup>	thou gavest (something to someone)
kwo:i <sup>HL</sup> hna <sup>L</sup>	I give (something inanimate)
kwo:i <sup>HM</sup> hna <sup>M</sup>	I gave (something inanimate)
kwo:i <sup>HM</sup> ?nü <sup>M</sup>	thou givest (something inanimate)
kwo:i <sup>L</sup> ?nü <sup>M</sup>	thou gavest (something inanimate)
kwo:i? <sup>HL</sup> hna <sup>M</sup>	I give (something animate to someone)
kwoi? <sup>L</sup> hna <sup>M</sup>	I gave (something inanimate to someone)
kwo:i? <sup>HL</sup> ?nü <sup>M</sup>	thou givest, gavest (something inanimate to someone)

Comaltepec (Anderson 1989):

hit:

transitive, inanimate (e.g. "hit a rockk")

1s                    1p                    2                    3

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progressive	bá <sup>M</sup>	ba <sup>L</sup>	bá <sup>L</sup>	bá <sup>L</sup>
intensive	bá <sup>H</sup>	bá <sup>H</sup>	bá <sup>H</sup>	bá <sup>L</sup>
completive	bá <sup>L</sup>	bá <sup>H</sup>	bá <sup>LM</sup>	bá <sup>L</sup>
transitive, animate		(e.g. "hit a horse")		
	1s	1p	2	3
progressive	bé:n <sup>M</sup>	bé:n <sup>M</sup>	bén <sup>M</sup>	bé:n <sup>M</sup>
intensive	bé:n <sup>H</sup>	bé:n <sup>H</sup>	bén <sup>H</sup>	bé:n <sup>M</sup>
completive	bé:n <sup>M</sup>	bé:n <sup>H</sup>	bén <sup>LM</sup>	bé:n <sup>M</sup>

7. Most investigated dialects are claimed to possess phonemic and morphemic "ballistic accent". Roots are usually monosyllabic, rarely prefixed or suffixed, but usually just "modified" (cf.6), maintaining monosyllabicity, and may bear either "ballistic" or "controlled" accent. (Certain suffixes may also be ballistic.)

Ballistic accent has been phonetically described as follows:

8. Lalana (Rensch and Rensch 1966):
- post-vocalic aspiration
  - fortis articulation of syllable-initial consonant
  - fortis, breathy articulation of the vowel
  - short duration of the nucleus
  - voicelessness of syllable final /n/
  - variation in pitch
  - late peak of syllable intensity (pp.455-457).

9. Quiotepec (Robbins (1961,8):

1961: four level tones, low to high.

tüh<sup>2</sup> - blind  
 tüh<sup>3</sup> - Peter

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1968: three level tones, plus "accent" (= "ballistic")

tüh<sup>2</sup> - blind  
tüh<sup>2</sup> - Peter

accounts for pitch and stress differences: /tüh<sup>2</sup>/ has slight increase in energy toward the end, accompanied by slight rise, then fall of pitch, though sometimes pitch may be identical with /tüh<sup>2</sup>/, with only difference stress. "aspiration at the end of a...syllable sometimes accompanies the pitch and stress characteristics of accent"(p.25).

### 10. Palantla (Merrifield 1963)

"Ballistic" (vs. "Controlled" syllables):

- "an initial surge and rapid decay of intensity, with a resultant fortis articulation of the consonantal syllable onset and tendency to loss of voicing of post-vocalic elements
- shorter duration than closed syllables"(p.3)

### 11. Tepetotutla (Westley 1971)

- "word stress is either ballistic...or controlled
- ballistically stressed syllables are of shorter duration than controlled syllables
- show a more rapid variation from high to low in both pitch and intensity"(p.160)

### 12. Sochiapan (Foris 19 )

- "stressed syllables are either ballistic or controlled
- ballistically stressed syllables are characterized by an initial surge of intensity with a resultant fortis articulation of the consonantal syllable onset"(p.235)

### 13. Comaltepec (Anderson 1989)

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- "Ballistic stress is a combination of pitch and stress
- It tends to raise high tones and lower low tones" (p..3)

14. Usila (Skinner 1962): no mention made of ballistic accent.

14a. Ballistic accent may be present on oral or nasal vowels, long or short vowels, checked or open syllables, prelaryngealized or non- prelaryngealized onsets:

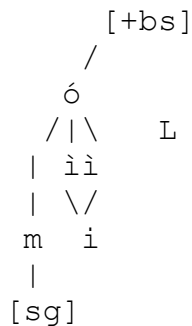
short, oral, plain:	tó <sup>M</sup>	(bamboo)
short, nasal, plain:	ní <sup>L</sup>	(iron)
short, oral, prelar.:	hwí <sup>H</sup>	(horn of an animal)
short, nasal, prelar.:	hniá <sup>H</sup>	(I)
long, oral, plain:	tó: <sup>M</sup>	(brains)
long, oral, checked:	há:? <sup>L</sup>	(animal) etc.

i.e., ballistic accent cross classifies with every syllable type.

15. Phonological characterization of ballistic syllables:

[+ballistic syllable] ([+bs]) (Mugele 1982), characterized by increase in subglottal pressure with enhanced high frequency energy, akin to articulatory correlates of emphatic stress.

hmí:<sup>L</sup> (day -- Comaltepec dialect)



16. Problem for [+ballistic syllable]: [ballistic syllable] is attested nowhere else

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17. Alternative Characterization: ballistic accent is laryngeally based: [spread glottis] ([sg]). (relationship to stress will be discussed below.)

hmí:<sup>L</sup> (day -- Comaltepec dialect)

```
      ó
     /|\  L
    |  ii
    |  \/\
   m i |
    |   |
   [sg] [sg]
```

18. If ballistic syllables characterized as [sg], increased subglottal pressure may act as a phonetic enhancer, as heightened subglottal pressure results in an increase in trans-glottal airflow, thus increasing perceived "breathiness".
19. If a spread glottis co-occurs with increased internal intercostal activity, might expect a particularly forceful expulsion of air, resulting in a rapid exhaustion of air from the lungs, hence a shorter temporal duration than usual of an otherwise equivalent prosodic domain.
20. But a spread glottis may also result from increased subglottal pressure.
21. No system which possesses ballistic syllables also possesses breathy voice. Breathly voice is attested in Otomanguan. It is present, for example, in Jalapa Mazatec (Ladefoged, Maddieson, and Jackson 1988), and manifested as interruption in Popoloca (Rensch 1976). This is predicted if the two phenomena are phonologically identical.
22. Acoustically, breathy-voiced vowels have been shown to possess an enhanced amplitude of the fundamental relative to F<sub>1</sub>, as well as enhanced high frequency noise (Ladefoged, Maddieson, and Jackson 1988); qualities not inconsistent with those associated with ballisticsity (cf.15)

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Mugele's prediction of possible syllable contrasts:

plain (controlled)  
[spread glottis]  
[ballistic]  
[spread glottis][ballistic]

plain (hmi:)

ó  
/|\ L  
| ìì  
| \/  
m i  
|  
[sg]

breathy (hmi:)

ó  
/|\ L  
| ìì  
| \/  
m i  
| |  
[sg][sg]

ballistic (hmi:)

[+bs]

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    /  
    ó  
  /|\  L  
  |  ìì  
  |  \/  
  m  i  
  |  
[sg]

ballistic/spread glottis (hmi:)

    [+bs]  
    /  
    ó  
  /|\  L  
  |  ìì  
  |  \/  
  m  i  
  |  |  
[sg][sg]

Present prediction of possible syllable contrasts:

plain (controlled)  
[spread] (or ballistic)

23. Cross-linguistic support: The factors argued to result in the ballistic syllable type are each independently attested elsewhere.
24. spreading of [sg] across the domain of the syllable seems to be present in Oriya (Dhall 1966).

<sup>H</sup>buj        -        realize        <sup>H</sup>pi        -        each

"The realization of aspiration has been found in most cases to affect not a single [segment], but a whole syllable. This suggested the possibility of treating aspiration as a prosodic feature, not tied to a particular place in the syllable" (p.5).

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25. Ladefoged (1958, 1968) reports that English words beginning with /h/ are preceded by "striking increases in the [intercostal -- D.S.] muscular activity".
26. Similar results have been reported for Korean aspirated stops (Lee and Smith 1971).
27. Keating (1990): "...a single feature may have more than one parameter value...languages may differ in how they realize a given value. Such a difference would be related to saliency: the more parameters [that] are used for a given feature, the more robust and salient that feature's value will be" (p.332).
28. Ballistic syllable: [sg] is present both phonologically and *phonetically*, with concomitant phonetic enhancement and perhaps syllabic affiliation, resulting in a particularly salient phonetic manifestation of [sg].
29. spectrographic analysis of (near-) minimal pairs (ballistic/controlled) of native speaker of Comaltepec, recorded in UCLA phonetics lab.



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syllable" (p.69)

ba <sup>H</sup>	(affirmative)	->	ba <sup>VH</sup> ziú <sup>L</sup>	"good (affirmative)"
ho:i <sup>LH</sup>	"look at (it)!"	->	ho:i <sup>LVH</sup> gu: <sup>LH</sup>	"look at the owl!"
hme: <sup>H</sup>	"make (it)!"	->	hme: <sup>VH</sup> guá: <sup>H</sup>	"make a box!"

"Although a posttonic syllable is not stressed, it may be lexically marked for ballistic stress, thereby providing the context for tone sandhi" (p.72)

-á<sup>H</sup> (first singular)  
-a<sup>H</sup> (plural inclusive)

/?i <sup>H</sup> kue:? <sup>LH</sup> á <sup>H</sup> /	->	[?i <sup>H</sup> kue:? <sup>LVH</sup> á <sup>H</sup> ]	(I will leave it)
/?i <sup>H</sup> kue:? <sup>LH</sup> a <sup>H</sup> /	->	[?i <sup>H</sup> kue:? <sup>LH</sup> a <sup>H</sup> ]	(we (incl) will leave it)

	accent	ballistic	controlled
roots:	always	yes	yes
affixes:	never	yes	no

conclusion: roots are always stressed (accented)  
suffixes are never stressed (unaccented)  
ballisticity = aspiration

36. Usila (Skinner 1962): reported phonotactic system displays both internal and cross-dialectal peculiarities. Incorporating Comaltepec findings results in a more regular pattern.

37. segment inventory:

p	t	t <sup>y</sup>	k	i	u
b	d	<u>d<sup>y</sup></u>	g	e	o
f	s			a	
<u>m</u>	<u>n</u>	<u>ñ</u>	<u>ng</u>		
	r				

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1

?,h

38. clusters: any sonorant may be pre-laryngealized (pre-glottalized, preaspirated), except /r/. Among the obstruents, only /dʸ/ may be prelaryngealized (all underlined segments).

codas: /?,g/. /g/ only after /a,e/. Coda /g/ =[G] (voiced velar spirant):

/a <sup>4</sup> lá <u>g</u> <sup>34</sup> /	[a <sup>4</sup> láG <sup>34</sup> ]	it was fixed
/a <sup>4</sup> lé <u>g</u> <sup>34</sup> /	[a <sup>4</sup> leG <sup>34</sup> ]	it is finished

39. No other dialect of Chinantec has been unambiguously claimed to possess coda /g/.
40. No other dialect allows the prelaryngealization of a non-velar obstruent ([?dʸ, hdʸ]).
41. Skinner additionally argues that Usila does not possess the glides /y,w/, thus differing again from most other dialects.
42. claim: [dʸ] = /y/

- positing an underlying /y/ results in a segment inventory more typical of Chinantec
- results in the more regular patterning of prelaryngealization attested elsewhere: sonorants (and rarely the velar stop) may be prelaryngealized, while obstruents may not.
- Skinner reports that the aspirated portion of preaspirates is actualized "as the voiceless counterpart of the following phoneme, except before dʸ, where it is actualized as [I] [voiceless [i] -- d.s.]" (p.252).

/ha <sup>4</sup> /	[Aa <sup>4</sup> ]	creature
/he <sup>1</sup> /	[Ee <sup>1</sup> ]	field
/hie <sup>4</sup> /	[Ii <sup>E</sup> ? <sup>4</sup> ]	it is coming
/o <sup>1</sup> huá <sup>3</sup> /	[o <sup>1</sup> U <sup>u</sup> á <sup>3</sup> ]	ashes

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/hmaʔ<sup>3</sup>/ [Mma<sup>3</sup>] only  
/o<sup>1</sup>hd<sup>y</sup>i<sup>3</sup>/ [o<sup>1</sup>Id<sup>y</sup>i<sup>3</sup>] fire

- If [d<sup>y</sup>] = /y/, then the patterning of preaspiration is fully symmetrical across the system, in that it is always realized as the voiceless counterpart of the following (sonorant) segment.

/o<sup>1</sup>hyi<sup>3</sup>/ [o<sup>1</sup>Id<sup>y</sup>i<sup>3</sup>]

- note also, /hua/ may be analyzed as glide-initial, with pre-aspiration, and thus both glides are present in the system

### 43. complex nuclei:

- vowel clusters /ia,io,ua/, the second vocoid is reportedly the syllable peak: [<sup>i</sup>a,<sup>i</sup>o,<sup>u</sup>a].

/kia<sup>34</sup>/ [k<sup>i</sup>æ<sup>34</sup>] ten (inanimate)  
/cio<sup>3</sup>héu<sup>3</sup>/ [tSo<sup>3</sup>Eéu<sup>3</sup>] Ladino, mestizo  
/kua<sup>1</sup>/ [k<sup>u</sup>a<sup>1</sup>] corner

- in /ie,ue/, it is the *first* vocoid that is reportedly syllabic: [i ,u ].

/kie<sup>4</sup>/ [ki <sup>4</sup>] twenty (inanimate)  
/kue<sup>3</sup>/ [ku <sup>3</sup>] long (inanimate)

- peculiarity: in high - non-high vowel sequences, the high vocoid is considered the syllabic peak when the mid vowel /e/ follows, but is considered an onglide when the mid vowel /o/ follows.

- claim: /íe,úe/ = /ih,uh/. That is, the non-syllabic non-high off-glide is merely a weakly articulated vowel, perhaps voiceless (cf. reported rapid decrease in intensity toward ballistic syllable terminus)

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kih<sup>4</sup>

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      ó      4
      /|\
      |  ìì
      |  |/\
      k i [sg]
  
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- recall so-called coda /g/ occurs solely after /a,e/ nuclei, phonetically implemented as a velar spirant.

- claim: /ag,eg/ = /ah,eh/. That is, what is perceived as a velar spirant by Skinner, again, is a weakly articulated vowel, i.e., "a central-tending offglide" (p.253).

- results in complete symmetry of system, consistency with other dialects:

44. Skinner's analysis: present analysis:

<u>coda /g/</u>	<u>complex nuclei</u>	<u>post-vocalic</u> <u>aspiration</u>
/ag/ [aG]	unreported	/ah/
/eg/ [eG]	unreported	/eh/
*/ig/	/ie/ [i ]	/ih/
*/og/	??	/oh/ (?)
*/ug/	/ue/ [u ]	/uh/

45. patterning of the velar stop, an irregularity both within and across systems, is no longer problematic: these segments are considered to be post-vocalic aspiration.

46. asymmetrical patterning of high - non high nuclei does not arise, as such sequences are also considered to possess post-vocalic aspiration. The gaps in both irregular systems are accounted for when positing the presence of post-vocalic

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aspiration.

47. recall Skinner's analysis does not mention ballistic accent. Assuming phenomena reanalyzed as aspiration would be considered the ballistic phenomenon, Usila patterns exactly as other dialects in this respect.
48. onglides /i,u/ occurring in so-called complex nuclei are the missing glides /y,w/: /u/ may serve as a onset ([w]), and thus, as other sonorant onsets, may be preaspirated (/o<sup>1</sup>huá<sup>3</sup>/) or, presumably, preglottalized. It may also serve as a syllable nucleus (/ku<sup>4</sup>/ - cold (inanimate)). /i/ may also serve as onset, where it is phonetically implemented as [d<sup>y</sup>]. As other sonorants, it may pre preaspirated and preglottalized in this position. /i/ may additionally serve as syllable peak, where it is phonetically [i].

49.	<u>Skinner's UR</u>	<u>reanalyzed UR</u>	<u>gloss</u>
	/d <sup>y</sup> ie <sup>4</sup> /	/yih <sup>4</sup> /	(day after tomorrow)
	/ʔd <sup>y</sup> a <sup>3</sup> /	/ʔya <sup>3</sup> /	(he beats, mixes)
	/o <sup>1</sup> hd <sup>y</sup> i <sup>3</sup> /	/o <sup>1</sup> hyi <sup>3</sup> /	(fire)
	/hie <sup>4</sup> /	/hih <sup>4</sup> /	(it is coming)

50. reanalyzed Usila inventory

p	t	k	i	u
b	d	g	e	o
f	s		a	
<u>m</u>	<u>n</u>	<u>ng</u>		
	r			
	<u>l</u>			
	<u>y</u>	<u>w</u>		
?,h				

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51. Proto-Chinantec (again)

p	t	k	k <sup>w</sup>	i	i	u
b	z	<u>g</u>	g <sup>w</sup>	e	@	
	s				a	
<u>m</u>	<u>n</u>	<u>ng</u>				
	<u>r</u>					
	<u>l</u>					
		<u>y</u>	<u>w</u>			

?,h

52. all sonorant consonants may be preaspirated or preglottalized, while none of the obstruents may. The only allowable codas are /?/ and /h/.

54. overall conclusions:

- evidence from several sources support the claim that ballistic accent is best considered a laryngeally based property of roots/stressed syllables
- cross-system evidence
- articulatory phonetic theory (Keating 1990)
- acoustic data (Comaltepec)
- stress/ballistic dichotomies (Lealao)
- streamlining of aberrant systems (Usila)