

Toward a Typology of Intonation Unit Cues

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Introduction

Intonation Unit (IU)

- a discourse-level linguistic unit
- defined by prosodic rather than syntactic or semantic characteristics
- analytical tool for studying discourse: allows study of correlation of prosodic structure with other grammatical structures (e.g. Chafe 1979, Du Bois 2001, Ford et al. 2002, Shenk 2006)

Locating IUs in the speech stream

- Du Bois (e.g. 2006) provides a series of **prosodic cues** for identifying IUs in American English (AmE)
- based on the cues for AmE, IUs have been described in other languages: e.g. Korean (Kim 1996, Park 2002), German (Schuetze-Coburn 1994), Japanese (Matsumoto 2000), Mandarin (Iwasaki & Tao 1993), Dolakhā Newar (Genetti & Slater 2004), Ahtna (Berez to appear), Wardaman (Croft 2007)
- as of yet, there is **no crosslinguistic typology of intonation units**

Objectives

IU cues in three unrelated languages

- compare prosodic IU cues in three languages – American English, Ahtna, and Sm’algyax

Our hypothesis

- Du Bois’s (2006) prosodic IU cues are universal (that is, all languages exhibit each of the cues to varying degrees)
- languages vary as to how valid any particular IU cue is in indicating an IU boundary, where validity is defined in terms of the frequency of the IU cue and the degree of impact of confounds on it

high validity	strong indicator of an IU boundary – presence of a single high validity cue is often sufficient to identify an IU boundary
mid validity	fair indicator of an IU boundary, especially when it occurs together with other cues
low validity	weak indicator of IU boundaries that may contribute to the identification of a boundary only when it co-occurs with other cues
- In particular, languages vary as to
 - which language features and contexts may act as confounds to obscure the validity of an IU cue
 - how frequent any particular IU cue is, and thus how valid the IU cue is
 - which IU cues tend to cluster together, strongly asserting the presence of an IU boundary, thus asserting as prototypical IU cues for the language

Data

American English

- SBCSAE054 “‘That’s Good’, Said Tiger” (Du Bois & Englebretson 2005)
- 611 IUs of a public storytelling event (T=19:22) recorded after a church potluck in Chicago
- the speaker, a professional storyteller in her mid forties, tells several stories and interacts with the audience

Ahtna (an Athabascan language of south central Alaska)

- 148 IUs of spontaneous monologue (T=06:18) by Martha Jackson, recorded in 1982 in Fairbanks with linguist James Kari.
- topic is an unrehearsed recitation of a traditional narrative and an explication of tribal practices

Sm’algyax (Coast Tsimshian, a Tsimshianic language of NW coast of British Columbia & Alaska)

- 115 IUs of an oral performance (T=05:15) by Dorothy Brown, recorded in 1968 in Kitkatla, BC with linguist John Dunn
- *Sabaan*, a traditional *adawx* ‘legend’, describes the first meeting between the Coast Tsimshian and the crew from a European sailing ship

IU Cues in American English

- two types
 - boundary cues* – indicate the division between IUs
 - unit cues* – recognize how portions of speech hold together into individual units

Table 1. IU cues for AmE (after Du Bois 2006, 2008)

Locus	Cue	Definition
boundary	lag	tempo lag or prosodic (non-lexical) lengthening
	rush	rapid tempo in unstressed syllables
	boundary tone	boundary intonation, especially finality or truncation
	pitch reset	noticeable pitch change resulting in return to baseline
	pause	absence of speech by discourse participants
	breath	audible inhalation or exhalation (and other vocalisms such as (TSK))
	creak	creaky voice on final portion of IU
unit	tune gestalt	coherent intonation contour perceived as a holistic gestalt for the IU
	isotony	repeated intonation contour across sequence of intonation units
	accent count/location	number and location of primary (or primary + secondary) accents
	register	overall shift in pitch or amplitude

- complementary pairs
 - most boundary cues are paired – one member marks where an IU ends and the other marks where the next IU begins

Table 2. IU cues by location ((SBCSAE054, 194.521-197.744)

	<i>A homing star.</i>	(0.8)	(H) <i>The north star.</i>	
BOUNDARY FOCUS				
	END OF IU 1	BETWEEN IUS	START OF IU 2	PROPERTY
	lag		rush	TEMPO
	terminative boundary tone truncation		pitch reset	PITCH
	creak exhalation		inhalation	LARYNGEAL
		pause		PAUSE
UNIT FOCUS				
	IU 1		IU 2	
	tune gestalt		tune gestalt	
	isotony		isotony	
	accent count/location		accent count/location	
	register		register	

- validity of IU cues
 - confounds – the value of an IU cue may be reduced if in the particular context the given prosodic value is open to being interpreted as marking different linguistic information
- prototypical IU cues
 - In AmE, lag, pitch reset, and inhalation cluster together as the most reliable prosodic cues for determining an IU

Table 3. Validity of IU cues for AmE (after Du Bois 2006, 2008)

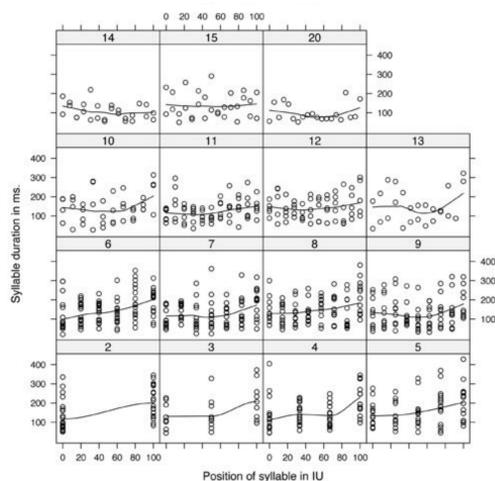
Cue	Validity	Confounds
lag	high	lexical stress, primary accent, truncated IU, rapid speech
rush	mid	lexical stress, primary accent, slow speech, marcato speech
boundary tone	mid	primary accent, continuing boundary tone
pitch reset	high	primary accent, high tone, sequence of unaccented syllables followed by an accented syllable
pause	mid	pause occurring between the words of a single IU (e.g. word search, disfluency, silent activity)
inhalation	high	laughter, bodily exertion, respiratory difficulties
exhalation	low	
creak	mid	truncated word or IU, speaker vocal style
tune gestalt	mid	unit-internal or supra-unit gestalt/isotony, flat or shapeless intonation contours
isotony	high	
accent count/location	mid	lexical stress, unstressed one-word IU (e.g. hesitations, discourse markers)
register	low	VOX (voice of another)

IU Cues – A Sample from Ahtna

Lag (and rush) – a function of relative duration of syllables

- Figure 1: bird's-eye view of raw syllable duration
 - each panel shows all IUs of a particular length in syllables
 - x-axes show linear position of syllable in IU
 - y-axes show syllable duration in ms
 - nonparametric smoothers show increased duration at the ends of IUs
- However, syllable duration is multifactorial. Independent variables include
 - nuclear vowel length (long vs. short vs. reduced)
 - morpheme type (stems vs. prefixes vs. other)
 - genre
- ANOVA confirms **the Ahtna data exhibit lag as an IU boundary cue** (adjusted $R^2=0.04005$; $F=27.05$; $df_1=22$; $df_2=836$; $p<0.001$)
- **Lag is a high-validity cue** in Ahtna: it is highly frequent and rarely impacted by potential confounds

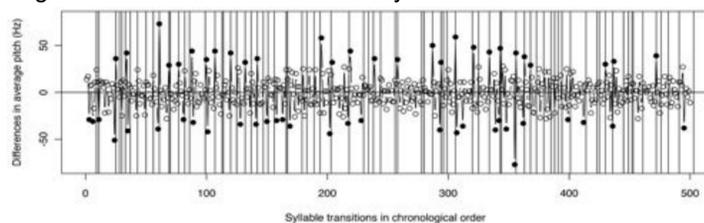
Figure 1. Lag in the Ahtna data



Pitch reset – a pitch excursion between two adjacent syllables that sounds larger than the series of excursions between pairs of adjacent syllables

- Figure 2: adjacent-syllable average F0 transitions in chronological order (**not** F0 values)
- Plotted points are the positive or negative difference in pitch between syllables
- Darkened points are the 5% most extreme transition and vertical lines represent posited IU boundaries
- Significant majority ($\chi^2=12.23$; $df=1$; $p<0.001$) of extreme transitions occur within 1 syllable of an IU boundary
- This confirms **the Ahtna data exhibit pitch reset as an IU boundary cue**
- **Pitch reset is a high-validity cue** in Ahtna: it is highly frequent and rarely impacted by potential confounds

Figure 2. Pitch resets – First 500 syllable transitions in Ahtna



Register – changes in amplitude can contribute to the identification of an IU boundary

- In this example, register change, lag, and continuing boundary tone together assert the presence of an IU boundary.

- **Register is a low-validity cue** in Ahtna: it is uncommon, and is susceptible to potential confounds

138 For ^seventy `days #.
 (1.0)
 <FORTE>Kon!ts'agh xunde`laeyi,</FORTE>
 (0.6)
 139 kugha,
 (0.4)
 140 all,
 141 i`k'e hde^tiis de `yaidu' o`xona,
 142 'In 70(days) it is finished for them and then,'

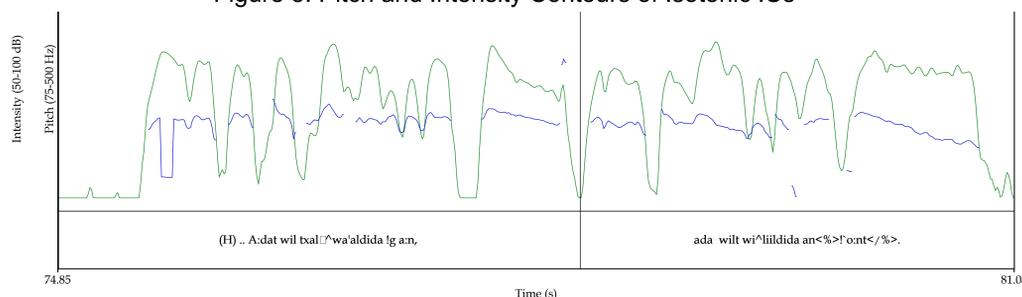
IU Cues – A Sample from Sm'algyax

Isotony –parallelism of intonation contours across IUs can contribute to the identification of an IU boundary

- Lines 23 & 24: same tune, but different boundary tones
 $\sigma \sigma \sigma \wedge \rightarrow \sigma \sigma \sigma ! \searrow \sigma$
- Figure 3: pitch (blue) and intensity (green) contours indicate parallel intonation contours

23 (H) .. A:dat wil txal!^wa^aldida !ga:n,
And he put it on a stick,
 24 ada wilt wi^liildida an<%>!o:nt</%>.
and then he rubbed it in his hands.

Figure 3. Pitch and Intensity Contours of Isotonic IUs



Lag – high-validity cue in Sm'algyax

- highly frequent – marked by [:] in final stem syllable in lines 1, 2, 5 & 7
- confounds include phonemic long Vs and primary & booster accents – low chance of misinterpretation

Pause and Inhalation – high-validity

- highly frequent
- confounds uncommon or readily identifiable

Creak – low-validity

- relatively frequent
- confounds include phonemic glottalised Vs and use as a prominence marker (e.g. line 8) – high chance of misinterpretation

Accent Count/Location – low-validity

- confounds include frequent occurrence of ≥ 2 primary and/or ≥ 1 booster accents per IU, with accents in range of locations (e.g. lines 1, 2, 6 & 7)

- 1 Dm ga gik !maldu ^k'uülda xa'nuuyut gi^k'o:!,
First I will tell again something I heard years ago,
 (0.2)
- 2 (H) (0.6) a^dawx wila ^waalsis na wayt ganii'ya:t<%>gm</%>.
a legend about what our ancestors did.
 (0.4)
- 3 (H) (0.2) Wil gwit !xsoo,
Out in a canoe,
 (0.4)
- 4 (H) .. ndinii^ya na^gwaadu.
was the grandfather of my father.
 (0.2)
- 5 (H) .. ^Waadassaa<%>^ba:n</%>.
Saaban was his name.
 (0.5)
- 6 (H) Ada wil gisi !dawdida !gye'ets,
Now they went away to the north,
 (0.4)
- 7 (H) ada wil ^waa:ldida si^waa:tgadi! Tgwilax^gii:taxsa ,
and they were around what they call Tgwilaxgii'axsa,
 (0.2)
- 8 <%>'ni'nii</%> wila a'ap'axt.
this is now I remember it.

IU Cues across the Three Languages

• Table 4: summary of strength of IU cues in indicating an IU boundary

- high validity strong indicator
- mid validity fair indicator
- low validity weak indicator
- [unable to assess due to recording quality]

- Examination of IU cues across these three languages indicates that
 - frequency may vary (e.g. rush)
 - confounds may vary (e.g. accent)
 - validity of an IU cue may vary (e.g. creak)
 - clustering of prototypical IU cues may vary:
- AmE: lag, pitch reset, inhalation, isotony
- Ahtna: lag, pitch reset, pause, creak, accent
- Sm'algyax: lag, pitch reset, pause, inhalation

Table 4. Validity of IU cues for AmE, Ahtna and Sm'algyax

AmE	Ahtna	Sm'algyax
lag	lag	lag
rush	rush	rush
boundary tone	boundary tone	boundary tone
pitch reset	pitch reset	pitch reset
pause	pause	pause
creak	creak	creak
inhalation	inhalation	inhalation
exhalation	exhalation	exhalation
tune gestalt	tune gestalt	tune gestalt
isotony	isotony	isotony
accent	accent	accent
count/location	count/location	count/location
register	register	register

Conclusion – Toward a Typology of IU Cues

- our findings suggest that there is a set of prosodic IU cues that is universal, in that all languages exhibit each of the cues to varying degrees, but that languages vary according to how valid any particular cue is in indicating the presence of an intonation unit boundary
- the approach we have taken here can be operationalized as a methodology for determining the prosodic IU cues for a particular language
- we propose that this methodology can be used to test our predictions across languages

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