Are There Boundaries between Segmental and Prosodic Phonology?

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Introduction This paper discusses Universal Boundary Theory (UBT), a flat, substance-free theory of prosodic representations. The only prosodic representational device is a single boundary symbol, denoted |. The boundary is part of the segmental string, making UBT a flat theory. UBT is substance-free, in the sense that | may be used to mark (m)any different prosodic edges, including units which are not part of traditional prosodic hierarchies. I aim to argue that phonology is remarkably flat, with features such as [stress] and [long] getting us much further than typically thought. Assuming a rule-based theory of phonology, I illustrate how a single | symbol is a powerful tool, allowing us to understand a complex set of prosodic and segmental processes in Makah. It is concluded that despite its representational minimalism, UBT is a promising theory of prosody and segmental-prosodic interactions.

Segmental and prosodic parallelism There appears to be a parallelism between certain segmental and prosodic phenomena; for example, both backness and high tone can spread (harmonize) throughout some phonologically-defined domain. A common way of capturing this insight is to say that *everything* is autosegmental, for example by using separate tiers for [+back] and [-back] segments, just as we use separate tiers for tones and segments. But an alternative way of capturing the same insight is to say that *nothing* is autosegmental, and to consistently use features instead of tiers. This is the approach pursued in this paper. As an illustration, consider first regressive voicing assimilation in Dutch (van der Hulst 2015). In order to explain [œy**db**rɛŋə] 'to bring out' from /œy**t**/ 'out' + /**b**rɛŋə(n)/ 'to bring', we might use a rule of the following type: [-son, -voice] → [+voice] / _[-son, +voice]. Consider now the superficially-unrelated process of high-tone spreading in BCS (Bosnian / Croatian / Serbo-Croatian; Werle 2009). We have words like [m**á**l**í**na] 'raspberry' where the H tone on [á] is due to spreading from high-toned [í] (Werle 2009: 79). This can be accounted for with a rule similar to the one for Dutch: [+syllabic, -H tone] → [+H tone] / _(C)(C)[+syllabic, +H tone]. A feature-plus-rules approach of this type offers a unified way of accounting for segmental and prosodic processes in terms of simple featural changes.

Segmental and prosodic interactions in Makah In order to see whether the single boundary of UBT can handle complex segmental and prosodic data, we will look at a case study from Makah (qʷiˑqʷiˑdiččaq, [myh], United States, Wakashan). Previous analyses of Makah rely on at least three levels of the prosodic hierarchy — moras, syllables, and feet — and the language has a segmental process which interacts with prosodic structure. We begin with a description of the data as analyzed by Werle (2002), and continue to provide a UBT analysis.

Makah constructs exactly one minimally-bimoraic iamb at the left edge of a word. Heavy, bimoraic syllables project their own feet, while light syllables require an additional syllable to make a well-formed foot. In Makah, coda consonants are *not* moraic, so only long vowels make syllables heavy. (1) summarizes the data on stress and footing.

(1) Stress in Makah	Footing	Example word	Translation
a) Light initial syllable	(LL)	(ʔa.ˈtu)bi.tidʃ	'but we (PST) ... '
	(LH)	(ʔa.ˈpaˑ)sap.siˑ.tʃuχ	'I like you'
b) Heavy initial syllable	(H)L	(ˈɬaˑ)χu.wi.qał	'the men'
	(H)H	(ˈtʃʼiˑχ)paˑ.ɬi.tid	'there were six of us'

In addition to this, Makah has an epenthesis process which is sensitive to prosody. If the first syllable is light (i.e. has a short vowel), and the second syllable begins with a voiced

consonant, we epenthesize a long copy of the first vowel between the first and second syllables.[1] Epenthesis always creates an LH iamb, but since the second syllable must begin with a voiced consonant, it does *not* apply in every case where an LH iamb would be created. (2) illustrates epenthesis:

(2) Epenthesis Applying   /tʃˤat-**j**ak/ → (tʃˤa.ˈta:)jak 'pencil'   [+voice] j *is* a trigger
             Non-applying /tʃˤat-**ʃ**itɬ/ → (tʃˤat.ˈʃitɬ) 'write'   [-voice] ʃ is *not* a trigger

In UBT, I assume a featural representation of vowel length with [+long], and I use X to refer to any segment, to the exclusion of |. I also assume that inputs to the phonology are automatically padded with a beginning and ending | symbol. [syll] abbreviates [syllabic].

Rule 1 Mark epenthesis site with | Ø → | / |C[+syll, -long]C(C)_[+voice, -syll]V
Rule 2 Epenthesize at boundary   Ø → [+syll, +long]ᵢ / [+syll, -long]ᵢC(C)|_X
Rule 3 Mark heads of heavy feet with | Ø → | / |C_[+syll, +long]
Rule 4 Mark heads of light feet with | Ø → | / |C[+syll, -long]C(C)(C)_V
Rule 5 Assign stress at boundary   V → [+stress] / |_

Because UBT has only one boundary symbol, the analysis above marks both epenthesis and stress sites with the same symbol. This makes the typologically-unexpected prediction that the epenthetic vowel of Makah is invariably stressed. This prediction is in fact borne out, and derivations illustrating both epenthesis and weight-sensitive stress are given below:

(3) Derivation	Input	|ʔatubitidʃ|	|tʃˤi:χpa:ɬitid|	|tʃˤatjak|
	Rule 1)	------------	---------------	|tʃˤat|jak|
	Rule 2)	------------	---------------	|tʃˤat|a:jak|
	Rule 3)	------------	|tʃˤ|i:χpa:ɬitid|	------------
	Rule 4)	|ʔat|ubitidʃ|	---------------	------------
	Rule 5)	|ʔat|úbitidʃ|	|tʃˤ|í:χpa:ɬitid|	|tʃˤat|á:jak|
	SR	|ʔat|úbitidʃ|	|tʃˤ|í:χpa:ɬitid|	|tʃˤat|á:jak|

Despite having only one boundary, UBT is powerful enough to handle data which previously required at least three levels of the prosodic hierarchy. As the interaction of epenthesis and stress in Makah shows, sometimes having a single | is exactly what is needed to capture the data.

Conclusion Universal Boundary Theory (UBT) is a flat, substance-free theory of prosodic representations. The introduction of a single boundary symbol | is surprisingly powerful. The analysis of Makah reveals that even when traditional analyses refer to multiple levels of the prosodic hierarchy, it is not necessary to use more than one boundary. It also shows that because | is substance-free, and not inherently tied to any particular phonetic interpretation or size of prosodic unit, we can use | to mark multiple edges (e.g. heads of feet and epenthesis sites) within the same language. In conclusion, UBT is a promising model of prosodic data, and of the ways in which segmental and prosodic phenomena interact.

References van der Hulst, H. (2015). Phonological Systems. In K. Allen (Ed.), *The Routledge Handbook of Linguistics*. London: Routledge. Werle, A. (2002). The Southern Wakashan One-Foot Word. *UBC Working Papers in Linguistics*, *9*, 382–397. Werle, A. (2009). *Word, Phrase, and Clitic Prosody in Bosnian, Serbian, and Croatian* (PhD). UMass, Amherst, MA.

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1   Epenthesis is also triggered by ejectives. This detail is irrelevant for our purposes, and is ignored here.