Modeling Vowel Quantity Scales in Q Theory

Research on segment strength has recognized that vowels exhibit a range of behaviors with respect to quantity-sensitive stress assignment, faithfulness, harmony, and other phonological phenomena. Previous literature has captured differences in vowel quantity and associated behavior in a binary fashion, drawing upon the representational difference between short (monomoraic) and long (bimoraic) vowels, and/or upon the derivational distinction between underlying and epenthetic vowels. However, we argue that the cross-linguistic range of vowel strength requires a scalar approach with more than two settings. Using Q Theory (e.g., Shih & Inkelas, 2019), we model surface vowel strength quantitatively in terms of the number of subsegments a vowel contains (see also Schwarz et al. 2019). These representations interact with faithfulness and markedness constraints to correctly predict quantity-sensitivity effects.

A 4-way distinction: In Q Theory, a canonical short segment has three subsegments (q q q), roughly corresponding to onset, target, and offset. Segments may deviate from this canon by possessing more or fewer subsegments (Inkelas & Shih, 2017; Garvin et al. 2018). We argue that the four-point scale in (1), ranging from super-light (v) to phonologically long (vvvv), captures the observed scale of vowel strength in ways previous representations cannot.

(1) Shortest (weakest) vowels (v) (vv) (vvv) (vvvv) Longest (strongest) vowels

The Jê language Panãra provides a clear example (Schwarz et al., 2019; Lapierre, 2019) of a language with all four vowel types, as illustrated in (2)-(5). Super light vowels arise between onset consonants (2); light epenthetic vowels resolve a ban on word-final obstruents (3); full vowels (4) and phonologically long vowels (5) differ from one another in length and from super-light and light vowels in their ability to bear stress (Lapierre 2019, Schwarz et al. 2019).

(2) /kɾɤ/ → [kˠɾɤ] (k k k)**(ɤ)**(ɾ ɾ) (ɤ ɤ ɤ) *thigh*

(3) /tɛp/ → [tɛ.pi] (t t t) (ɛ ɛ ɛ) (p p p) **(i i)** *fish*

(4) /pa/ → [pa] (p p p) **(a a a)** *arm*

(5) /paː/ → [paː] (p p p) **(a a a a)** *foot*

While not all languages require all four points on the vowel strength scale, many, like Panãra, exhibit differences between short vowels which elude traditional phonological representations. Turkish (Bellick, 2018) and Moroccan Arabic (Gafos, 2002) share with Panãra the distinction between a) 'excrescent' vowels which, while reliably present, lack a distinct target and are shorter in duration; b) more robust but arguably epenthetic vowels which inhabit a restricted inventory of targets; and c) full, invariant lexical vowels which range over the full vowel inventory. Q Theory represents these vowel types as (v), (vv), and (vvv), respectively. The shortest representation, (v), corresponds to the configuration offered in Articulatory Phonology (see e.g. Gafos 2002, Hall 2006) wherein a vowel gesture overlaps the transition between consonant gestures.

In Q Theory, the vowel strength scale is logically independent of whether a given vowel is epenthetic or underlying. While epenthetic vowels are typically short, and while phonologically long vowels are typically underlying, this is not always the case. Both epenthetic and lexical vowels can, and do, exhibit quantity differences. For example, in both Scottish Gaelic (Hall, 2006) and Axininca Campa (McCarthy & Prince 1993), epenthetic vowels can be phonetically or phonologically long. Furthermore, Trommer & Zimmerman (2018) have argued on the basis of tonal patterns in San Miguel el Grande Mixtex, and Smith (2017) has argued on the basis of harmony triggers in Rejang and Classical Manchu, that underlying vowels exhibit strength differences as well; thus, it is not the case that underlying vowels are equally strong. For these

reasons, a surface-oriented scalar analysis of vowel strength is preferable to one that relies on derivational history to assess strength.

Quantity-sensitive stringent constraints: Q Theory offers representations that correspond to the full observed range of vowel quantity types. But a robust theory of vowel quantity must also derive the observed behaviors from the proffered representations. We propose here by referencing the four-point strength scale in (1), the familiar faithfulness and markedness constraints in OT/HG generate correct typological predictions and model language-internal phenomena in a principled manner. Example (1) provides a faithfulness constraint schema which use de Lacy's (2004) stringency technology to general the scalar prediction that shorter vowels will never be more faithful than longer vowels:

(1) FAITH(vvvv), FAITH(vvv, vvvv), FAITH(vv, vvv, vvvv), FAITH(v, vv, vvv, vvvv)

For example, in Panãra, the ranking in (2) correctly predicts that only the lightest vowel (v) will be inserted into onset clusters (which violate *Com[plex]Ons[et]). The ranking in (3), along with a markedness constraint against (v), predicts that only (vv) will be inserted following coda clusters (which violate *Com[plex]Coda):

(2) Dep(vvvv), Dep(vvv, vvvv), Dep(vv, vvv, vvvv) >> *ComOns >> Dep(v, vv, vvv, vvvv)

(3) Dep(vvvv), Dep(vvv, vvvv) >> *ComCoda >> Dep(vv, vvv, vvvv), Dep(v, vv, vvv, vvvv)

Markedness scales can also be scaled to vowel subsegmental quantity. For example, the constraint family in (4) predicts that stress is more marked on shorter vowels:

(4) *Stress(v), *Stress(v, vv), *Stress(v, vv, vvv), *Stress(v, vv, vvv, vvvv)

In Panãra, the ranking *Stress(v), *Stress(v, vv) >> Align-R(Stress) >> *Stress(v, vv, vvv), *Stress(v, vv, vvv, vvvv) correctly predicts that stress will fall on the rightmost full or strong vowel. In Turkish, a higher ranking of Align-R(Stress) predicts final vowel stress even on inserted or underlying weak vowels (e.g. devoiced high vowels (Jannedy, 1994)). Thus, by leveraging q-theoretic quantitative representations of vowel strength along with stringent constraints such as these, we provide a surface-oriented model of vowel strength, capturing the full range of complexity attested cross-linguistically.

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