Note: I named in the article an counterexample to CVX theory, i.e. Fuzhou has a true superheavy (VVN) rhyme which cannot be reduced to nasalised diphthong. A spectrogram of the word /eiŋ/ "free" is available at https://goo.gl/svJk09 Note the visible nasal murmur, as well as velar pinch, suggesting a velar nasal stop.

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San Duanmu

Syllable Structure: The Limit of Variation

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San Duanmu's *Syllable Structure* offers a systematic defence of his CVX theory, whose central thesis is that the maximal syllable format in any language is either CVC (e.g. /kɪk/) or CVV (e.g. /ki:/). Syllables can be smaller than these, but crucially never larger: while CV or V are permissible syllables in languages like Fijian, Duanmu argues that all segments beyond the maximal size of CVX should be reanalysed, largely as fallouts from morphology, and excluded from what Duanmu understands to be a true syllable. The book therefore takes on a considerable challenge, for syllable structures have been shown to exhibit significant cross-linguistic variation (Blevins, 1995). This apparent diversity in syllable shape will clash, throughout the book, with the restrictiveness of the CVX theory, resulting in the use of many interesting, if not entirely satisfactory, explanations for the data-theory discrepancy.

Syllable Structure has 12 chapters, with both language and subject indices. Chapter 1 is a brief introduction to syllable-related concepts from a generative perspective. The next 2 chapters lay out the explanatory devices that will enable the shrinking of large syllables on the surface to CVX. Chapter 2 opens with a discussion of what constitutes a sound, concluding with the following definition (p. 17):

A speech sound is a set of features such that (a) the features are made in one unit of time and (b) no feature is made twice by the same articulator.

Duanmu then proceeds to describe an articulator-based feature scheme and his notion of complex sound (§ 2.6), which is one way of collapsing consonantal clusters into a single C slot in subsequent analyses. A complex sound, according to Duanmu, can be 'the merger of two (or more) sounds' (p. 25), as long as the resulting combination does not violate his 'No Contour Principle'. The principle restates part b of the definition of a sound, preventing one articulator from 'making the same feature twice within one sound' (p. 26). Thus /p/ and /k/ can merge into a complex sound /p^{k}/, as different articulators are used (labial and dorsal, p. 27), while /θ/ and /ɾ/ cannot, as the coronal articulator has to evaluate the (anterior) feature twice in */θ^{ɾ}/. Also mentioned in chapter 2 is the option to analyse vowel + nasal and vowel + [ʔ] sequences as nasalised and glottalised vowels, thus reducing the size of potential rhymes.

Chapter 3 introduces the core of the CVX theory, compares the theory to alternative approaches (sonority sequencing analysis, pp. 41–44; empty nuclei analysis, pp. 38–40), and motivates morphological devices to account for edge segments that exceed the CVX maximum. These devices include 'potential V', 'anti-allomorphy' (pp. 46–47) and the 'affix rule' (p. 50). The first two devices are used to account for edge consonants like the /p/ in *help:* Due to affixed forms like *helping* and *helped*, and the pressure to keep a morpheme in the same shape throughout the paradigm, /p/ is allowed to stay in *help*, while being heterorganic with /hɛl/. The prediction is that, when a language has a vowel-final prefix or a vowel-initial suffix, an extra consonant will be tolerated on the left edge or the right edge of a word. In addition, the 'affix rule' (p. 50) states that affixes or 'affix-like sounds' can always be pronounced, regardless of their syllable affiliation. Thus, English *text* should be syllabified as /tɛk.st/, where /st/ are stray segments, allowed to attach to the word only because coronals like /s/ and /t/ are common suffixes in English. With these morphological devices and the complex sound analysis (chapter 2) in hand, Duanmu concludes that the universal word structure is C_mCSCC_m (p. 40), where *S* stands for the maximally CVX syllable(s), *C* stands for an optional consonant supported by 'anti-allomorphy', and C_m represents any number of consonants that are either affixes or perceived as such.

Chapters 4–11 are in-depth analyses, based on the CVX theory, of 5 languages in roughly ascending order of syllable complexity: Standard Mandarin Chinese, Shanghai Chinese, English, German and Jiarong. Duanmu makes heavy use of electronic corpora, especially the CELEX lexical database (Baayen et al., 1993)

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for English and German. His analytical procedure is to start with the entire database (lexicon), eliminate items deemed irrelevant (e.g. variants of *empty*, as both adjective and verb), and check if the remaining items can be explained with the devices motivated in chapters 2 and 3. Often an ad hoc explanation has to be provided as a last resort, although in most cases Duanmu adds that the ultimate analysis is left open (a source of frustration for Blevins, 2010). The book closes with a chapter on the theoretical implications of the CVX theory, with the notable qualification that the observed CVX template could be 'an artefact of languages' rather than 'a principle that limits possible syllables' (p. 238). Here, Duanmu leaves open the possibility that languages with larger-than-CVX syllables may yet be found.

While *Syllable Structure* is a book on a phonological object (the syllable) written by a phonologist, it will be of ample interest to experimental phoneticians and psycholinguists, who may wish to challenge some of Duanmu's views, and to typologists, who may have ready counterexamples in mind. This testifies to the book's most laudable quality: the commitment to test the author's highly restrictive theory against the complete lexicons or at least the syllable inventories of several languages. Such an approach to phonological argumentation is most welcome and increasingly feasible. For example, Duanmu predicts (p. 85) that the extra-long rhymes /VVŋ/ in Fuzhou must be phonetically realised as a nasalised diphthong or a monophthong with final nasal closure. In an acoustic examination of my Fuzhou informants' speech, neither possibility was borne out, but we had moved one step ahead empirically. Many similar predictions by Duanmu merit investigation.

Needless to say, Duanmu's approach is not without its pitfalls. As Scheer (2012) has noted, the syllabification practice in the CELEX database is not theory-neutral. For example, CELEX treats the second consonant in *bellen* /bɛlən/ as ambisyllabic, and Duanmu simply excludes consonants tagged ambisyllabic without defending the ambisyllabicity analysis or its application in CELEX. In general, the reader would benefit from a more explicit description of the procedures that Duanmu uses in syllabification.

Moreover, difficulties arise over Duanmu's treatment and interpretation of statistics. An example is the study of the proportion of English word-medial rhymes that exceed VX (e.g. the first rhyme in *council*). Starting with 52,447 items, Duanmu excludes compounds, affixed words and repetitions to arrive at 106 exceptions to his maximal rhyme, or 0.2% of the total. This percentage is erroneously written as 0.00002% (p. 151) and used to make the point that exceptions are 'remarkably trivial'. One may wonder if this is analogous to questioning the existence of English cleft constructions due to their rarity (<0.1% in Roland et al., 2007). Furthermore, it is not entirely clear what the 0.2% figure stands for, since the denominator (52,447) contains items that Duanmu has decided not to treat as 'words' to start with: repetitions, compounds and the like. In short, while the statistics in the book illustrate the imbalance of syllable type in the surface lexicon (CV and CVX are preferred), the reader will need to examine the context and the fine print before drawing conclusions.

More problematic, however, is the often shaky ground on which Duanmu dismisses potential objections to his theory and analysis. The treatment of apparent counterexamples is particularly illustrative of the 'make data fit theory' problem that persists throughout the book. For example, in order to demonstrate the superiority of complex sound analysis over a sonority-based account in explaining English onset clusters (§ 8.5.3), Duanmu tries to show that English does not have word-medial homorganic /θr/ clusters, which have a sufficient increase in sonority but cannot be Duanmu's complex sound, due to the consecutive (anterior) feature made by the coronal articulator. Various counterexamples of words containing word-medial /θr/ are dismissed as the consequences of compounding *(overthrow)* and affixation *(misanthropic)*. In doing so, Duanmu operates on a remarkably liberal interpretation of compounding and affixation: words like *bracelet* and even *Shakespeare* are said to be 'perceived compounds', while *borstal* and *ecstasy* are analysed as having perceived affixes (*-al* and *ex-*), without independent, psycholinguistic evidence. In a separate review, Scheer (2012) wonders why many English words with non-final heavy rhymes, such as *bolster* and *fealty*, escaped Duanmu's attention. The answer is very likely that these have simply been excluded based on an overly permissive definition of affixation.

After dubious exclusions of this kind, Duanmu is still left with *arthritis* (p. 177), a hard lexical exception. Rather than acknowledging it as such, he proposes to syllabify it as /ɑ:θ.raɪ.tɪs/, without any argument for the theory-external merits of this analysis. In fact, Duanmu's syllabification represents a sharp departure from previous approaches: both the stress principle of *Longman Pronunciation Dictionary* (Wells,

2008) and the maximal onset principle will treat /θr/ as a homorganic cluster; further, /θ/ cannot be ambisyllabic by coda capture (Kahn, 1976). In fact, the first syllable in *arthritis* is arguably the least attractive site for an intervocalic consonant – it contains a tense vowel, the main stress falls on the following syllable, and the intervocalic consonant is an obstruent (per experimental studies like Ishikawa, 2002). In the end, whether *arthritis* constitutes a 'compelling counterexample' or not, it is deserving of a more careful analysis for a theory with universality aspirations.

In the case of Jiarong, the author requires all sonorants in consonant clusters to serve as syllable nuclei, with no independent evidence (p. 229). Without this assumption, the CVX theory crumbles in the face of clusters like /znd/ and /vrd/. When 4 Jiarong onset consonant clusters (e.g. /mtsr/, /ndzr/, p. 230) emerge unexplained after the application of a string of morphological devices, Duanmu cites Lin's [1993] observation that a schwa is often inserted to break up Jiarong consonantal clusters. This is then taken to have 'explained' the remaining clusters, overlooking the fact that Lin clearly intends schwa insertion to be variable, and that there are genuine cases of /mtsr/ clusters uninterrupted by vocalic elements; otherwise, there would be no reason for Lin to posit such clusters in the first place.

While the languages analysed in the book reflect the availability of lexical corpora (English, German, Mandarin and Shanghai Chinese) and the author's specialism and interests, the force of Duanmu's arguments will be strengthened by testing his theory against languages with famously unusual syllable structures. Jiarong is a fine inclusion, but one would also like to see how the CVX theory fares against the likes of Georgian (Blevins, 2004, p. 214) and Tashlhiyt Berber (Ridouane, 2008). This is not an unreasonable thing to ask, either, since Duanmu concludes his analysis of Jiarong in just 13 pages, in one of the shortest chapters of the book (chapter 11). The chapters on Mandarin Chinese and Shanghai Chinese (chapters 5–7), on the other hand, make a gratifying read for readers interested in Sinitic languages but seem rather tangential to the thesis of the book. For example, Duanmu draws an interesting association between tonal stability and syllable weight in chapter 7, but the reader is left wondering how this enhances the empirical record of the CVX theory.

In conclusion, *Syllable Structure* represents a serious effort at reducing the varied shape of syllables in languages of the world to an invariant template in CVX. Based on quantitative examination of entire lexicons, Duanmu provides important insights into the distribution and imbalance of syllable types in several languages, while making highly testable predictions. While the CVX theory did not pass the empirical test with flying colours, Duanmu should be commended for an intellectually stimulating monograph that questions the freedom of languages to vary in syllable structure. I also recommend the reviews by Scheer (2012) and Blevins (2010), which raise important points both about the CVX theory itself and wider issues in the literature, such as complex segments, syllable variability and the use of distributional evidence in phonological argumentation.

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