Vowel weakening reveals hierarchical segment structure

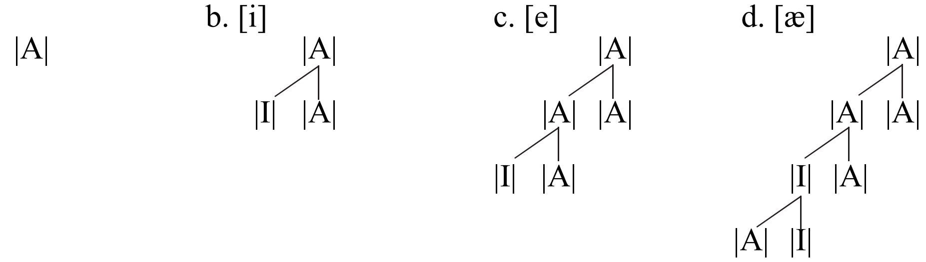
Phillip BACKLEY and Kuniya NASUKAWA
(Tohoku Gakuin University, Sendai, Japan)

In this paper we show how the analysis of vowel reduction (VR) patterns can contribute to our understanding of phonological knowledge in two ways: first, it sheds light on the nature of the VR process itself; and second, it provides new information about the internal structure of the vowels being targeted by reduction. Following the traditions of Government Phonology (Kaye, Lowenstamm & Vergnaud 1990) and Element Theory (Harris & Lindsey 1995, 2000; AUTHOR A 2011), we assume that phonological representations are mental objects which refer only to abstract units of structure—namely, elements. Moreover, because representations are phonological, they are determined primarily on the basis of phonological (cf. phonetic) evidence. Here we demonstrate how VR patterns serve as a useful source of such evidence.

We propose that vowel representations comprise the three resonance elements |I|, |U| and |A|, which are familiar from earlier work in Element Theory (Kaye, Lowenstamm & Vergnaud 1985, Harris 1994, Harris & Lindsey 1995), Dependency Phonology (Anderson & Jones 1974, Anderson & Ewen 1987) and Particle Phonology (Schane 1984, 1995). In a novel departure from these approaches, however, we also claim that the elements are organised into a hierarchical structure, and that this hierarchy emerges by allowing elements to concatenate recursively through the formation of head-dependent relations (AUTHOR B 2014, 2016, 2017; cf. Pöchtrager 2015). It is the use of this hierarchical structure which enriches our understanding of the VR process and of the representations which it targets.

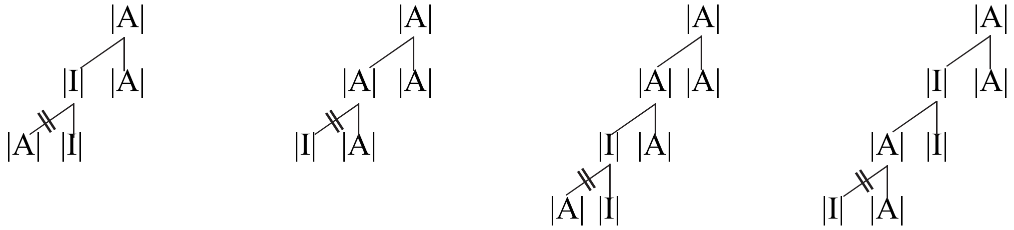
In most languages, the |A| element occupies the head position of a hierarchical vowel structure, where it provides an essential structural base but contributes little in terms of melodic information. (By itself, a bare head element is realised as a default vowel, which in acoustic terms corresponds to an unmodulated (baseline) carrier signal. Bare |A| is pronounced as a schwa-like central vowel.) By contrast, |A|'s dependent elements are not important in structural terms but they make a key contribution to the contrastive melodic properties of an expression (AUTHOR B & AUTHOR A 2015, AUTHOR B 2017). While default vowels are represented by a bare head element (1a), the 'corner' vowels [a i u] incorporate one dependent element in a separate level of structure (1b). The addition of further layers of structure allows for additional dependent elements at successively deeper levels of embedding (1c,d). There is a direct relation between the complexity of a phonological structure and the complexity of the resulting speech signal when that structure is phonetically realised, since each dependent element causes a modulation of the carrier signal away from its baseline pattern (Harris 2005, 2009).

(1) a. [ə] b. [i] c. [e] d. [æ]



In the VR literature (e.g. Crosswhite 2001), a distinction has been made between two types of reduction, which are motivated by different forces: centrifugal systems are driven by Contrast Enhancement, whereby vowel contrasts are neutralised in favour of peripheral vowels (typically [a i u]); meanwhile, centripetal systems strive for Prominence Reduction, resulting in reduced vowels with a central quality (typically [ə] or [ɨ]). In this paper, however, we follow Harris (2005) in attempting a unified account of VR in which all cases are subject to the same mechanism—suppression of dependent element structure. Following standard Element Theory practice, after one part of a structure is suppressed, any remaining structure is still phonetically interpretable. This remaining structure could be a bare head element (resulting in a default vowel) or a full contrastive vowel (2a-d).

(2) a. [e] > [i] b. [æ] > [a] c. [ɛ] > [e] d. [e] > [ɛ]
e.g. Romansch e.g. Chamorro e.g. Italian e.g. Slovene



Our analysis makes two basic assumptions. First, it assumes that VR operates blindly and uniformly, targeting the most deeply embedded layer(s) of any vowel's structure. Second, it assumes that VR is always a structure-depleting process, whereby an expression loses some of its structural complexity. On this basis, we arrive at some interesting conclusions about the abstractness of element-based representations (and indeed, of phonetic symbols), as illustrated by comparing (2c) and (2d). In Italian (2c), [e] must be less complex than [ɛ], whereas the reverse is true for Slovene in (2d). Thus, assuming that Italian [ɛ] vs. [e] is phonetically similar to Slovene [ɛ] vs. [e], we must admit that there is an indirect relation between phonological structure and phonetic realisation—something which Element Theory has always maintained. Since element expressions are mental objects, we determine the hierarchical structure of a given vowel primarily by observing its phonological behaviour rather than by analysing its phonetic properties.

This paper develops an account of how the phonological process of VR sheds light on the phonological structure of vowels, regardless of their precise phonetic properties. Assuming that VR operates blindly on any target structure, we infer that typological variation with respect to the outcome of VR (e.g. centrifugal versus centripetal) comes down to the various ways in which individual vowels are represented hierarchically in particular languages.

References

Anderson, J. M. & C. Jones (1974). Three theses concerning phonological representations. *Journal of Linguistics* 10: 1-26.

Anderson, J. M. & C. J. Ewen (1987). *Principles of Dependency Phonology*. Cambridge: Cambridge University Press.

Crosswhite, K. (2001). *Vowel Reduction in Optimality Theory*. New York/London: Routledge.

Harris, J. (1994). *English Sound Structure*. Oxford: Blackwell.

Harris, J. (2005). Vowel reduction as information loss. In P. Carr, J. Durand & C. J. Ewen (eds.), *Headhood, Elements, Specification and Contrastivity*, 119−132. Amsterdam: John Benjamins.

Harris, J. (2009). Why final obstruent devoicing is weakening. In K. Nasukawa & P. Backley (eds.), *Strength Relations in Phonology*, 9−45. Berlin: Mouton de Gruyter.

Harris, J. & G. Lindsey. (1995). The elements of phonological representation. In J. Durand & F. Katamba (eds.), *Frontiers of Phonology: Atoms, Structures, Derivations*, 34−79. Harlow, Essex: Longman.

Harris, J. & G. Lindsey. (2000). Vowel patterns in mind and sound. In N. Burton-Roberts, P. Carr & G. Docherty (eds.), *Phonological Knowledge: Conceptual and Empirical Issues*, 185−205. Oxford: Oxford University Press.

Kaye, J. D., J. Lowenstamm & J.-R. Vergnaud. (1985). The internal structure of phonological elements: a theory of charm and government. *Phonology Yearbook* 2: 305−328.

Kaye, J. D., J. Lowenstamm & J.-R. Vergnaud. (1990). Constituent structure and government in phonology. *Phonology* 7: 193-231.

Pöchtrager, M. A. (2015). Binding in Phonology. In H. van Riemsdijk & M. van Oostendorp (eds.), *Representing Structure in Phonology and Syntax*, 255–275. Berlin: Mouton de Gruyter.

Schane, S. A. (1984). The fundamentals of particle phonology. *Phonology Yearbook* 1: 129–155.

Schane, S. A. (1995). Diphthongization in particle phonology. In J. A. Goldsmith (ed.), *The Handbook of Phonological Theory*, 586–608. Oxford: Blackwell.