DOI: 10.26346/1120-2726-145

Vowel reduction and loss: challenges and perspectives

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This introduction gives an overview of a workshop on vowel reduction and loss held at SLE 2017 and the resulting papers collected here. It also discusses the present state of research on vowel reduction and loss in a number of perspectives and outlines the main themes dealt with throughout the course of this special issue.*

KEYWORDS: vowel reduction and loss, phonetics, phonology, issue overview, linguistic typology.

1. Introduction

Vowel reduction and loss is observed in many languages of the world,[1] but there is much still to be understood about the circumstances under which it occurs, the manner in which it develops, and its interaction with the rest of the language system. Works taking a typological or general theoretical approach to vowel reduction and loss are relatively scarce, and in many language descriptions vowel reduction is stated simply as a fact, with little further interrogation of its causes, phonetic mechanisms or consequences. Meanwhile, ongoing reduction poses challenges for synchronic phonological descriptions and for the elaboration of practical orthographies in the case of non-standardised varieties without a literary tradition. Vowel reduction and loss can also trigger major typological shift in the phonological system of a language, provoking dramatic morphological restructuring.

The core of this collection results from a workshop *Vowel reduction and loss and its phonological consequences* convened by the authors at the 50th Annual Meeting of Societas Linguistica Europea (Zürich, 10-13 September 2017). We especially encouraged submissions that would

* Author contribution: NK drafted the manuscript, subsequently edited by CA and NK.

examine the phenomena of vowel reduction and loss in a cross-linguistic or general theoretical perspective, including proposals investigating the following topics:

I. the phonetic causes and mechanisms of vowel reduction and loss;
II. the phonological contexts in which it is most likely to occur;
III. the typical and atypical trajectories of vowel reduction and systematic constraints which favour reduction or prevent it from occurring;
IV. typological, areal, or diachronic explanations for the cross-linguistic distribution of reduction;
V. asymmetries in reduction and loss of vowels of different quality;
VI. perception and categorisation of reduced vowels by L1 and L2 speakers;
VII. challenges for the description of languages with ongoing vowel reduction;
VIII. the consequences of vowel reduction and loss for phonology and morphology (the gain and loss of phonemic contrasts, innovative phonotactic patterns and morphonological alternations etc.).

The workshop and related general session papers (19 altogether) represented a wide range of approaches: quantitative studies, typological overviews, reconstruction of historical processes, functional and generative perspectives. Vowel reduction was analysed at the interfaces of phonology with phonetics and morphology, and in terms of segmental and suprasegmental phonology. Speakers looked at the positional distribution of vowel reduction and loss with respect to word edges, number and type of syllables, morphological boundaries, consonantal and vocalic context, types and placement of units of lexical prosody (tone, stress). The outcomes of these processes were also discussed, e.g. resulting vocalic contrasts and vowel (sub)systems and changes in morphonological alternations and allomorphy conditioned by vowel loss. Papers with a historical focus dealt with the typology of sound changes, irregularities in L1 and L2 orthographies, and addressed correlations between historical ethnic mobility and observable geographic distributions of vowel reduction patterns, drawing attention to how observable processes in living languages may reflect historical processes in cognate and non-cognate languages.

Some of the presentations at this workshop, supplemented by a number of additional papers, were subsequently selected for publication. Below, we discuss the main trends and challenges in current studies on vowel reduction and loss and briefly summarise the most important topics addressed in this issue.

2. Existing accounts and general tendencies in vowel reduction and loss

For some major language groups, there is a long and active tradition of phonetic and phonological research on reduced vowels, within which their phonotactic properties, acoustic features, and relation to stress and full vowels have been studied. This holds, for example, for the Romance languages: Italian (i.a. Baroni 1996; Bertinetto & Loporcaro 2005; Loporcaro 2015; Bucci *et al.* 2018), Spanish (see the overview in Ronquest 2013), Portuguese (e.g. Barbosa 2006; Undolo 2013), French (see e.g. Journées FLORAL-PFC 2016), the Slavic languages (i.a. an overview on Russian in Jaworski 2010), the Germanic group (e.g. Burzio 2007 and Flemming & Johnson 2007 on English; Kohler 1990 on German; van Bergem 1993 on Dutch; Basbøll 2005 on Danish), the Finno-Ugric group (e.g. McRobbie-Utasi 2000 on Skolt Saami; Kuznetsova 2016, Kuznetsova & Verkhodanova 2019 on Finnic varieties), Greek (Arvaniti 2007; Trudgill 2009; Lengeris 2012; cf. also a special issue of the *Journal of Phonetics* (Ernestus & Warner eds. 2011)).

As for general accounts of vowel reduction and loss, there is still more to be learned about the exact changes in the structure of a phonetic pool of variation during ongoing reduction (cf. Padgett & Tabain 2005), as well as the correlation between production and perception or categorisation of reduced vowels (see van Bergem 1995). There are few comparative phonetic studies in this field (but see Delattre 1969; Loporcaro 2015). Much work also remains to be done on the typology of the consequences for phonology and morphonology of vowel reduction and loss (but cf. Easterday 2019). It is yet to be understood what types of vocalic and consonantal systems can emerge in languages which have undergone strong reduction and/or widespread loss of vowels, for example, what effects might this have in terms of the development of secondary localisation (although see Anderson 2016 for some examples) or changes in laryngeal features. The typology of phonotactic patterns and morphonological alternations which emerge as a result of vowel loss also requires further research. Some already established typological trends, as well as phonetic mechanisms of vowel reduction and loss are outlined below.

Existing typological phonological surveys (Crosswhite 2001; 2004; Barnes 2006) mostly tackle qualitative, but not quantitative reduction. The reason for this is likely that "for phonologists, vowel reduction corresponds to the loss of a number of phonological contrasts within the vocalic system of a given language" (Bucci *et al.* 2018: 2). Vowel reduction, therefore, is typically defined in phonological works as the positional neutralisation of a vowel contrast in unstressed positions.

However, reduction does not necessarily result in neutralisation. For example, a contrast of long and short vowels can be transformed into a contrast of short and reduced vowels.[2]

Phonetic accounts of vowel reduction and loss phenomena rely on general articulatory, acoustic and cognitive mechanisms, and, therefore, are essentially functionalist and usage-based. In a pioneering paper, Lindblom (1963) suggested that vowel reduction occurs through formant undershoot, a function of decrease in vowel duration, a position which was mostly supported by later researchers (Delattre 1969; Flemming 1995, 2004; Kirschner 1998; Barnes 2006). However, the causal relation between formant undershoot and shorter duration has also been reversed (Crosswhite 2004).

Lindblom (1990) later proposed a more comprehensive H&H (hypo- and hyper-speech) framework whereby a message is seen as a compromise between hypospeech minimizing articulatory effort and hyperspeech maximizing discriminability. The entire language system, a result of language use, is a trade-off between the needs of the speaker to economise effort and the needs of the listener to be able to decipher the message. This laid the groundwork for a currently widespread functionalist/usage-based view on vowel reduction as "part of planned speech behaviour rather than an accidental by-product of vocal organ inertia" (Harris 2005: 132; cf. also Trudgill 2009; Cohen Priva 2017; Kapatsinski 2018; Hall *et al.* 2018). Specifically, reduction is connected to the low informativity of certain chunks of speech. The motor control theory also linked reduction to increased coarticulation: slower movements of articulators reduce the speaker's effort, but this results in massive overlapping of these movements (Nelson 1983; Mathies *et al.* 2001; Perkell *et al.* 2002). Reduction is also seen as a consequence of language learning: low informativity chunks are usually those which are the most frequent in speech. More frequent elements are better mastered by speakers and, therefore, need shorter time for realisation than less frequent ones (Gahl & Baayen 2019; Kapatsinski *et al.*, *this issue*).

Kapatsinski (2018: 286) made a distinction between two underlying mechanisms of vowel reduction: "phonetically gradual reduction brought about by automatisation of execution in production... and phonetically abrupt loss of low-salience parts that have been left meaningless by overshadowing in perception". Both mechanisms could actually be plausibly explained by the automatisation of production, if correlated with phonemic categorisation. Vowel reduction and loss, in the same way as other changes in human language, follows the path of the S-curve. Novel variants are gradually accumulated, a categorial reanalysis of values occurs, and finally the remaining old variants disappear (Hyman 1976; Kirby

2010: 148; Blythe & Croft 2012). At the initial stage of this process, segments undergoing reduction are still perceived as vowels, while the automisation of their production brings along innovative reduced variants, so production is more innovative than categorisation. At the final stage of vowel loss, when speakers have already stopped perceiving any segments, certain traces of vowels can be still retained in their production, making categorisation more innovative than production. These remnants are then gradually deleted by the automatisation of production of the new phonemic category (Kuznetsova & Verkhodanova 2019).

Vowel reduction does not affect all vowel qualities or word and phrasal positions equally, nor does it necessarily produce equal outcomes for adjacent consonantal qualities. For example, word- and phrase-final positions manifest both vowel lengthening and articulatory strengthening and vowel weakening (devoicing, laryngealisation, nasalisation, loss). The reason for this is that, in spite of their possible articulatory strength, final vowels are often perceptually weak (Barnes 2006).

Two general paths of vowel reduction are often distinguished: centripetal (centralisation towards schwa) and centrifugal (dispersion towards the three corner vowel qualities *a*, *i*, *u*, which are the most peripheral in F1/F2 space). The corner vowels have been shown to differ from other vowel qualities in various respects, including in terms of reduction and loss. They have been described as the most stable and focalised, the most perceptually salient, the easiest for neural processing due to maximal distinctiveness (Crosswhite 2004, Polka & Bohn 2003, 2011, Harris 2005, Johnson 2015, Manca & Grimaldi 2016, Grimaldi 2018).

However, this distinction between the two reduction patterns still raises certain conceptual issues. First, it is not yet clear whether they can co-exist in the same language system (Crosswhite 2004; Harris 2005). For example, in Kuznetsova & Verkhodanova (2019), both types were observed at different stages of vowel reduction and loss in similar varieties: the initial rise of mid to high vowels and the eventual centralisation of all vowels to schwa.

Second, Kapatsinski *et al.* (*this issue*) suggest on usage-based grounds that patterns which seem centrifugal on the surface (and which are not numerous cross-linguistically), actually do not result from reductive sound change. At the same time, Tomaschek *et al.* (2018a, 2018b) found that vowels in high frequency words were shorter but at the same time more peripheral than those of low frequency words. Additionally, Tomaschek *et al.* (2019) observed that acoustic variability decreased with increased frequency. Advanced reduction and reduced variability in more frequent words is predicted by the usage-based framework. The production of more frequent words is more automatised than that of the less frequent ones and, therefore, more prone to spatio-temporal optimi-

sation (van Bergem 1995; Bybee 2001: 11-12; Bybee *et al.* 2016; Hay & Foulkes 2016; Kapatsinski 2018; Hall *et al.* 2018).

However, F1/F2 position could be a parameter at least partially independent from duration. Gahl & Baayen (2019) show that the position of vowels in F1/F2 space tends to shift towards the periphery with the increasing age of speakers, while duration manifests much less variation. They link this F1/F2 centrifugal effect to automatisation and the mastering of more efficient and precise articulation (p. 42-43), i.e. to the same kinds of usage-based factors which prompt Kapatsinski *et al.* (*this issue*) to deny centrifugal reduction altogether.

In P-base 3 (Brohan & Mielke 2018: 203-209), the most frequent vowel height changes concerned those between high and mid vowels, in both directions. The only frequent change concerning low vowels (both as input and as output of sound change) was their centralisation. In general, the centralisation of all vowels to schwa was the most typical vowel height change (1.27%). Similarly, Easterday (2019: 228) reported that the most common vowel reduction processes in her data concerned all vowels in a language, but the second most frequently affected category were high vowels. These data indicate that a centrifugal pattern might indeed not result from a unified phonetic reduction process but could be, for example, a combined result of the raising of mid vowels and the preservation of low vowels.

Third, the corner vowels themselves can manifest disparities in their trajectories of loss under the same phonetic conditions, i.a. in the history of Russian (Šahmatov 1915; Kiparsky 1963) and Irish (Greene 1973). Cross-linguistic studies have shown that vowel height tends to be affected before frontness/backness, rounding, or ATR contrasts (Barnes 2002; 2006; Flemming 2004). One reason for this might be a compression of the acoustic space between F1 and F2 through F1 raising, an effect which has sometimes been attributed to reduced jaw opening (Lindblom 1963). The bottom-up direction of the compression suggests that high unstressed vowels would be less marked than non-high ones (Walker 2011: 29). At the same time, reduction-based sonority scales presume that the vowel *a* is less marked, but that schwa is more marked than *i* and *u* (Crosswhite 2004: 209; de Lacy 2006: 286).

Less is known on the differences between *i* and *u*. Data on vowel perception and neuroimaging suggest that the place of articulation and tongue height are 'simple' features: they directly correspond to F1 and F2 values and have direct correlates in regions and types of brain activity. The rounding feature is described as more complex, i.e. requiring higher level information processing, acoustically less reliable, and perceived with a help from the visual channel (Traunmüller & Öhström 2006, Eulitz & Obleser 2007, Vatakis *et al.* 2012, Manca & Grimaldi

2016). That would imply that *u* is less perceptually salient than *i* and more easily reduced. F2-based vowel harmony might also block front vowel reduction (Pearce 2008, Szeredi 2010).

Experimental data on the production and categorisation of corner vowel reduction and loss in cognate Finnic varieties (Kuznetsova & Verkhodanova 2019) have clarified this for these languages. The process goes through several stages including quantitative and qualitative reduction, vowel devoicing, formation of consonantal aspiration, palatalisation and labialisation, and complete loss. This study showed that the markedness hierarchy of corner vowels *a*, *i*, and *u* can differ from the markedness hierarchy of the vowel reflexes on consonants left after vowel loss.

The hierarchy of vowels, from the most to the least innovative, was *a* > *i* > *u*. The vowel *a* underwent strong qualitative reduction into schwa and rapidly disappeared both from the production and the mental categorisation of speakers. The vowel *u*, on the contrary, was the most conservative both in terms of production and categorisation. The vowel *i* was categorised as conservatively as *u*, but was produced in nearly as innovative a manner as *a*, and was accompanied by the development of a robust cluster of consonantal palatalisation. No similar robust cluster of labialisation was formed for *u*, and the segmental vowel was rather directly lost.

Palatalisation changed the primary articulation of consonants towards the palatal region of the vowel tract, while labialisation affected only the final aspirated portion of the consonant, which was subsequently eliminated over the course of ongoing reduction. These differences in the re-phonologisation of *i* and *u* into secondary consonantal localisations stipulated a different markedness hierarchy in the outcomes of vowel loss (from the least to the most salient effects): **a* > **u* > **i*. Palatalised consonants are generally much more frequent in the world's languages than labialised ones. For example, they accounted for 145 (3.18%) cases in the P-Base 3 of sound changes (Brohan & Mielke 2018: 210, 218), while labialisation included just 38 entries.

At the same time, P-base 3 also suggests the hierarchy *a* > *i* > *u* for the corner vowels themselves. Changes of *a* accounted for 102 cases (2.24%), with 95 cases of *i* (2.08%), and just 39 cases of *u* (0.86%) (Brohan & Mielke 2018: 209). It should be noted that these changes comprise all attested changes: not only reduction, but also loss of rounding in *u*, gliding of high vowels etc. However, these data on the general relative stability of different corner vowel qualities conform to the data on reduction in the abovementioned experimental study. These also indicate that one should, therefore, be careful in assessing the markedness of vowels with respect to their susceptibility or resistance to reduction and loss just by the final outcomes of these processes.

Finally, vowel reduction and loss should be considered within a broader prosodic profile of a language rather than as an isolated process. For example, relatively robust correlations between the degree of vowel reduction, the presence of metrical stress in the language, and the level of complexity of consonantal clusters were established in a cross-linguistic study by Easterday (2019, see especially Chapters 5 and 6). Interaction between reduction and isochrony resulted in the non-initial vowel length patterns observed in many Finnic languages (see the overview in Kuznetsova 2016), where the second syllable vowel is reduced after the heavy syllable but phonetically lengthened after the light one. 'Ballistic', uneven patterns of articulatory energy distribution within a prosodic domain, such as those in Danish or Estonian (Grønnum & Basbøll 2007: 199-200, Eek & Meister 1997: 77, Kuznetsova 2018: 129-130), can result in an extreme prosodic enhancement of stressed syllables correlated with an extreme reduction of unstressed ones.

3. Topics addressed in the issue

This issue on vowel reduction and loss focuses on work conducted within the functionalist and structuralist phonological paradigms, including also field-based, experimental phonetic, and historical studies. The papers were grouped into three main themes: (1) general papers, (2) case-studies on lesser-known varieties, (3) studies on language history.

The first theme includes, aside from the present introduction, a general paper, *Vowel reduction: A usage based perspective*, by Vsevolod Kapatsinski, Shelece Easterday, and Joan Bybee (cf. also Bybee 2001, 2015; Kapatsinski 2018). This contribution actually contains two parts: a general theoretical discussion on mechanisms of vowel reduction and loss in the usage-based paradigm and a typological sample of vowel reduction and loss derived from the AlloPhon database (Bybee & Easterday 2019, Easterday 2019). The observed frequencies of different types of processes serve also as an illustration to the preceding theoretical part. Apart from the issues already mentioned above, an important point of this paper is that vowel reduction is actually challenging for children and is driven, as part of language change, by adult speakers. This hypothesis directly follows from the aforementioned usage-based implications that reduction is connected to the high level of language proficiency and the automatisation of articulatory gestures.

The second part contains a collection of case studies on the phonetics, phonology and morphonology of vowel reduction and loss in a variety of languages from across the world. These represent field-

based research on understudied and endangered varieties, such as non-canonical variants of Russian and Italian, as well as African, Oceanic, and Andean languages. Nearly all papers are based on acoustic phonetic analysis, often enhanced with statistical evaluations of obtained results.

The contributions *Vowel reduction in a North Russian dialect: A case study* by Alexander Krasovitsky and *Vowel reduction in Russian classical singing: The case of unstressed /a/ after palatalised consonants* by Maria Konoshenko are devoted to lesser-known varieties of Russian: dialects and sung language. North Russian dialects used to distinguish /a/ and /o/ also in unstressed positions, but younger speakers influenced by the standard language tend to neutralise this contrast. The paper provides an important insight into the actual dynamics of the formation of a centrifugal reduction pattern, typical of Russian but cross-linguistically rare. The author suggests coarticulation as one of the key mechanisms in this process. Sung Russian also opens a new perspective on the internal phonological structure of Russian vowel reduction, as singers have to choose the full vowels which the reduced vowels will be restored to. While the influence of the orthography is unsurprising, there turned out to be additional factors which affected this choice: the quality of the stressed vowel (interestingly, in a dissimilatory pattern), the relative pitch on the pretonic vowel as compared to the stressed one, and the singer's year of birth.

Antonio Romano's paper, *Vowel reduction and deletion in Apulian and Lucanian dialects with reference to speech rhythm,* raises again the criticism of the widespread metrics of stress-timed *vs* syllable-timed rhythm measurements (cf. also Maddieson 2018). It is shown, using the example of language varieties from the south of Italy with strong vowel reduction, that the results of these metrics can change dramatically depending on whether vowels in the process of being lost are counted as segments or not.

In Valentin Vydrin's contribution, *Vowel elision and reduction in Bambara*, the author's previous hypotheses on the prosodic foot structure of an African tonal language are tested with a phonetic experiment. New findings significantly adjusted these. First, some tendency towards phonetic foot isochrony (typical of Germanic and Finnic languages) was discovered, as, at least in one speaker, the duration of the second vowel in a disyllable was in an inverse relation to the duration of the first. Second, the phonological length contrast of the first vowel seemed sufficient to account for all observed reduction and lengthening effects, making stress a redundant category for the purposes of phonological description.

Similar questions related to the status of vowel length and metrical prominence in the context of ongoing reduction are tackled in *Phonetic evidence for phonotactic change in Nafsan (South Efate)* by Rosey

Billington, Nick Thieberger, and Janet Fletcher. Their phonetic studies have confirmed a phonological contrast of long and short vowels and a tendency for prominence to occur at the right edge of a prosodic constituent (whether this constituent is a word or a phrase is not yet clear), which allowed the authors to give a comprehensive account of medial vowel deletion in this Oceanic language.

The paper by Matt Coler, Nicholas Emlen, and Edwin Banegas-Flores, *Vowel deletion in two Aymara varieties,* deals with the outcomes of already completed vowel loss in an Andean language. Phonotactic, syntactic, and morphophonemic factors condition the loss or retention of vowels in the language. This includes typologically rare subtractive disfixation with no obvious phonological or semantic conditioning. Phonotactic deletion, in turn, manifested the $a > i > u$ vowel hierarchy mentioned in §2. Comparison with an older variety of Aymara also allows the authors to make some inferences about the dynamic processes involved in vowel reduction in the language.

The last part of the issue is dedicated to the reconstruction of vowel reduction and loss in historic languages (Indo-European and Afroasiatic). The applied methods included classical comparative methodology, corpus-based statistical analysis, and a reconstruction of L1 phonology based on L2 evidence.

Martin Kümmel's paper *Voiceless high vowels and syncope in older Indo-European* looks into a number of rare cases of vowel loss in Avestan and Hittite, as well as in earlier Common Indo-European. These might appear irregular at the first sight, but several common phonetic traits are revealed upon closer inspection. Namely, these cases always involved high vowels *i* and *u* in the context of voiceless obstruents (especially fricatives), which is established by the author as the conditioning factor in these cases, with the hypothesis of vowel loss occurring through an intermediary stage of vowel devoicing.

The contribution by Andreas Baumann, Christina Prömer, and Nikolaus Ritt, *Reconstructing the diffusion of Middle English schwa deletion,* used a statistical probability analysis of an English poetry corpus from the 12th to the 18th century to evaluate the phonetic development of <e> in final open and closed unstressed syllables. As English orthography does not straightforwardly reflect changes in pronunciation, the authors use assumptions about well-formed metre as a basis to reconstruct actual realisations at various historical stages.

Finally, in her paper, *The system of Coptic vowel reduction: Evidence from L2 Greek usage*, Sonja Dahlgren studied the Greek misspellings by Egyptian scribes from the Roman period onwards to establish vowel reduction patterns typical of their native Coptic varieties. Reconstructed phenom-

ena included word-final vowel reduction to schwa, stress-conditioned allophonic variation in rounded vowels, and word-medial coarticulation effects.

Notes

[1] For example, in a typological database of 630 language varieties, P-base 3 (Brohan & Mielke 2018: 210), vowel shortening accounted for 185 cases (4.04% of all sound changes in the database), while vowel lengthening for only 102 (2.24%).

[2] Shortening of long vowels and devoicing of short ones were the two general patterns which occurred in all types of languages in the cross-linguistic data presented by Easterday (2019: 241), grouped by the complexity of consonantal clusters.

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