Of clocks, clouds and sound change[1]

Frans Hinskens Meertens
Instituut & Vrije Universiteit Amsterdam

Abstract

The study of sound change has evolved from a heuristic tool for 19th century comparative historical reconstruction into the backbone of the rigid approach to language change developed by the Neogrammarians. In the course of the 20th and early 21st century it has become the main meeting point for a range of subdisciplines of linguistics (historical linguistics, dialectology, sociolinguistics, phonology, phonetics and cognitivist approaches to phonetic variation). This contribution sketches some of the main aspects of the approaches to sound change taken in the various corners of the field. By way of a synthesis a theory will be outlined in which three approaches to sound change dovetail to account for the huge and seemingly chaotic body of insights into the phenomenon. Empirical studies of instances of both historical and ongoing sound change in specific varieties of Dutch will serve to illustrate parts of the theory.

Keywords: Exemplar Theory, generative phonology, hyperdialectism, lexically diffuse sound change, life cycle of sound change, Usage based phonology

1. Introduction

The study of sound change (henceforth: SC) is centerstage in a range of subdisciplines of linguistics and the range keeps broadening.[2] There are two main aspects to be distinguished: the process and the result, i.e. the difference between before and after. On the process-side, analyses concern the origin, implementation and spread of SC, in connection with the result, the focus is on the outcome and its various properties. In both dimensions, three of the main questions are: (cf. Scheutz 2005: 1704)

- what: does the change concern a specific sound or a natural class as in, e.g., the famous Second or High German obstruent shift?
- how: did it develop internally (through *innere Kausalität*, as Moulton 1961 labeled it) or through contact?
- why: did it result from structural forces, co-articulation or prestige-driven borrowing?

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[1] NOTA BENE: this paper is also published in Juan-Andrés Villena-Ponsoda, Francisco Díaz-Montesinos, Francisco Díaz-Montesinos, Antonio-Manuel Ávila-Muñoz & Matilde Vida-Castro (eds, 2018), Language Variation - European Perspectives VII. Selected papers from the Ninth International Conference on Language Variation in Europe (ICLaVE 9) Malaga, June 2017. Amsterdam / Philadelphia: Benjamins.

[2] This contribution overlaps with Hinskens 2019. In most respects the present paper is more compact and goes less deep, but at several points it goes considerably further than the 2019 one. Many thanks to the editors of the volume with a selection of ICLaVE 9 contributions, Antonio Ávila-Muñoz, Francisco Díaz-Montesinos, Matilde Vida-Castro and Juan Villena-Ponsoda, as well as to Manolo Almeida for their invaluable comments and suggestions. Of course, they are not responsible for any remaining shortcomings.

These considerations and the relevant sub-disciplines can be schematically summarized as follows:

	what	how	why
process	sociolinguistics	phonetics, sociolinguistics	phonetics, sociolinguistics
outcome	historical linguistics, dialectology	dialectology	phonology

Table 1: Five sub-disciplines and their division of labour in the study of SC

The time axis is what ties together historical linguistics, dialectology and sociolinguistics: whereas historical linguistics highlights diachronic aspects (extrapolated through juxtaposition of two more synchronic states of the language system at issue), dialectology focuses on the synchronic reflection of diachrony in geography and sociolinguistics is concerned with synchronic variation. Where dialectology (often implicitly) treats dialects as homogenous systems, sociolinguistics approaches intra-dialect variation as structured heterogeneity. Phonetics zooms in at the listener (and the role of (mis-)perception; cf. Ohala 2003) and the speaker; the attention paid to articulatory gestures is growing both theoretically (Browman & Goldstein 1992) and technically (the registration of tongue movements with ultrasound techniques). Whereas phonetics deals with the hardware (physics, anatomy) and looks at speech as a phenomenon which is gradient and continuous in most respects, phonology deals with the software (psychology, cognition) and looks at the organization of the sound structure as a system of categorical phenomena.

2. The Neogrammarian legacy

Nineteenth century linguistics was largely geared towards historical reconstruction and Schleicher (1861) already discussed "exceptionlessly applying laws" (my translation, FH). In the thinking of at least some Neogrammarians, the concept evolved further. The essence of Neogrammarian thinking is laid down in the following oft-cited quote from what has been referred to as the Neogrammarian manifesto: "Every sound change, insofar as it operates mechanically, proceeds according to exceptionless laws, i.e. the direction of the sound shift is always the same for everybody belonging to a speech community, except where a dialect split occurs, and all words in which the sound affected by the sound shift appears in the same context are affected by the change without exception" (Osthoff & Brugmann 1878: xii).[3]

In the Neogrammarian model, the effects of the 'sound laws' or 'rules' can be obscured by competing SC (Wang 1969), including bleeding or counter-feeding rule orderings, analogy or borrowing. An example of a competing SC concerns Medieval and Early Modern Dutch /uː/ > /yː/ > /œy/; the second step in this shift resulted in the rounded front diphthong (of which the first element is prominent). This latter change did not take place before /r/ because of the centralising effect of tautosyllabic /r/ on preceding non-low tense vowels, as in e.g. *zuur* 'sour', *duur* 'expensive', *muur* 'wall';

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[3] Translation in Garrett 2009: 2.

here, centralisation (yielding VV°) bleeds diphthongisation. The following example of an instance of analogy builds on Pre-Latin intervocalic /s/ > [z] > /r/, which applied in e.g. *hono:sis > hono:zis > hono:ris* , 'honor' (sg gen), *flo:sis > flo:zis > flo:ris,* 'flower' (sg gen). Later this SC, which was exceptionless and phonetically gradient, also applied word-finally, i.e. in stems, as in *honos > honor*, but not in *flos > *flor*, hence not exceptionlessly. Finally, an example of borrowing concerns the fact that Latin *rosa*, 'rose', *basis*, 'pedestal' (from Greek), did not undergo rhotacism (/s/ > [z] > /r/), as they were borrowed after the SC had ceased to be productive, i.e. when the speakers had ceased to apply the SC to new words.

These and numerous other, similar observations have led to the *idée reçue* that in reality exceptionless SC hardly exists. In fact, some instances of SC look rather fuzzy. In 1966 Karl Popper published an essay entitled *Of clocks and clouds*; in this text Popper contrasts neat, orderly and predictable phenomena with messy, chaotic and unpredictable phenomena. Many data from dialectology have made plain that SC may not be as 'clock-like' as the early Neogrammarians conceived, but is it really an epistemic mess? To answer this (admittedly: rhetorical) question, SC will here be looked at from three different perspectives, viz. formal phonological theory, the sociolinguistic study of language variation and change, and cognitive approaches, respectively. For none of these perspectives, anything new will be presented. The innovatory aspect lies in the fact that and the way in which these perspectives will be brought together. Interlocking the three views will result in an integrated and testable theory of the diachronic development of SC and the process of its embedding in both the language system and the speech community. The cloud will not be transformed into a clock, but the mutual synchronisation of the three perspectives may bring the researcher closer to a better insight into the complexity of SC.

3. Formal theory: generative phonology and Optimality Theory

In early linear theory (introduced in and developed out of Chomsky & Halle 1968), the locus of variation –in so far as variation was at all an issue- was conceived to reside in the rule machinery. Dialect variation was accounted for through rule ordering: two rules which are differently ordered constitute either two different (categorical) grammars or inherent, quantitative variation. An early example concerned Umlaut[4] and lowering of back vowels in the German dialects of neighboring Schaffhausen and Kesswill in North-Eastern Switzerland (Kiparsky 1968:178–179).

An issue which is still around and which keeps exciting phonologists is opacity. Opacity comes in two types. The first is residue, i.e. forms which fit the structural description of a given rule, yet do not undergo / have not undergone the rule. The second type concerns forms which do not fit the structural description of a given rule, yet do undergo / have undergone the rule. The first type is clearly related to the concept of exceptionlessness.

In formal theory, phonology is conceived as an autonomous module of the grammar. In this view, phonology is itself, in turn, organized modularly, with interfaces with the lexicon, morphology and syntax. As far as the lexicon is concerned, the segment

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[4] The fronting of a back vowel in a variety of morphologically derived environments, such as noun pluralisation and diminutive formation.

inventory and morpheme structure constraints are relevant issues. With regard to morphology, the distinction between cyclic and postcyclic phonological rules is relevant, and on the level of the syntax, the distinction between post-lexical (or 'late') processes and phonetic implementation applies.

3.1 The life cycle of sound change

A very promising insight that has developed in lexical phonology and related Stratal Optimality Theory is often referred to as the 'life cycle of sound change' (Kiparsky 1995; Bermúdez-Otero 2015; Ramsammy 2015). In this conception of the diachronic development of SC, the cycle is ignited by more or less random phonetic variation. Random phonetic variation can become systematic and from that point onwards it will be exceptionless. An instance of systematic, directional phonetic variation can change into a postlexical process; the main property setting apart post-lexical variation from phonetic processes is the fact that the application of postlexical processes tends to be confined to specific prosodic domains, such as the syllable onset or the end of the prosodic word. Postlexical processes can narrow to become 'lexical rules', rules which apply to morphologically derived words, such as the original version of Umlaut. Another example is e-prothesis in Romance (as in Spanish *escuela*, French *école*, 'school'), which originally had "phrase-level conditioning", but the "purely syllable-structural basis" was weakened "by making it crucially dependent on word boundaries" (Janda 2003: 420). The last step is for processes or rules to be lexicalized, either in free morphemes ('items') or in bound morphemes (affixes) or both. An example is again Umlaut, with or without concatenation. In English it has become marginal (*goose–geese*, *foot–feet*, but *crook–*creek*); in modern standard German, where it has long been productive, Umlaut is no longer synchronically predictable, cf. *Fuss–Füsse*, 'foot–feet', *Grund–Gründe*, 'reason(s)', but *Hund–Hunde*, 'dog(s)'.

Going from systematic phonetic variation to lexicalization, structural predictability decreases. Fig. 1, from Ramsammy (2015), visualises these and closely related insights as well as the cyclical nature of the mechanism. The development of gradient phonetic processes into systematic and directional, cognitively controlled processes is referred to as phonologization. Once these processes stabilize, they become postlexical processes and they can lose their gradient and quantitatively variable nature, becoming categorical, as in the case of allophony. In this phase, rules can narrow down their domain of application to words (*honos*, but *honoris*) or even stems (*honos > honor*), hence becoming lexical (or 'minor') rules. Eventually they lexicalize or morphologise, i.e. they freeze and become stored in the lexical form of specific items or morphemes – and morpheme structure constraints may result.
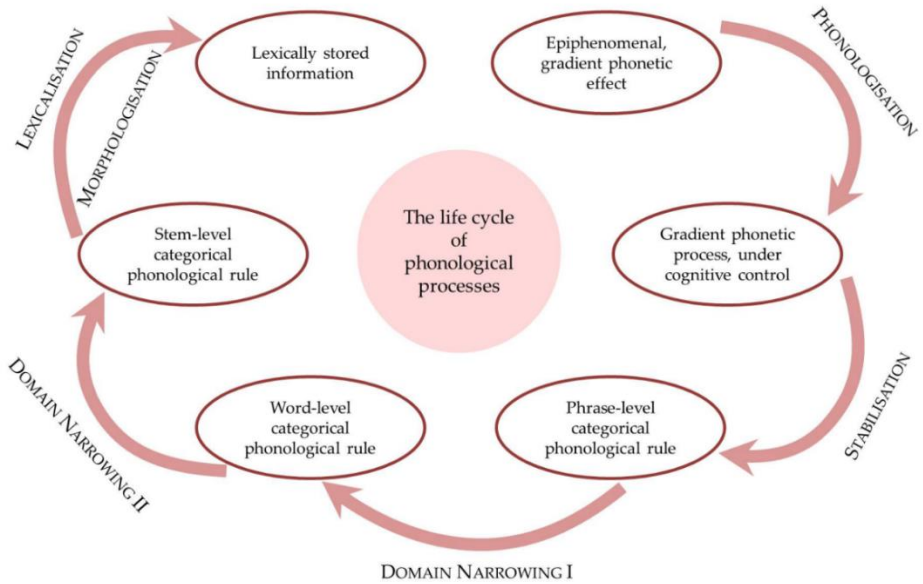
Figure 1: The life cycle of phonological processes (Ramsammy, 2015)

At the beginning, early in the cycle, during its phonologisation and stabilisation, a process can be generalized, typically through the extension of its context of application. An example is the non-standard German fricativisation of /g/ into [j] (Scheutz 2005:1707). The process originated before palatal vowels, i.e. in words such as:

(1) a. /g/iessen ~ [j]iessen   'to pour'
         /g/eben ~ [j]eben   'to give'

as a process of co-articulation and assimilation. Later this process was generalized to include also contexts before non-palatal vowels, e.g.:

     b. /g/abel ~ [j]abel   'fork'
         /g/old ~ [j]old   'gold'

And later even to include liquids as in, e.g.:

     c. /g/raben ~ [j]raben   'to dig'
         /g/lauben ~ [j]lauben   'to believe'

At the end of the cycle, i.e. after a rule has been lexicalized, it can either become extinct or it can spread in a lexically diffuse fashion. As to the first scenario, rule death (also referred to as rule loss) can trigger analogy. An example is pre-Latin rhotacism /s/ > [z] > /r/, sketched above. Another example is from the history of Dutch and it concerns the historical rule of open syllable vowel lengthening (OSL) and the way its effects were undone, later. In Early Modern Dutch, OSL occurred e.g. as a result of pluralization through the suffixation of –ə suffix (orthographically <en>), the final

consonant was resyllabified to become the onset of the new ə-syllable. Consequently, the stem vowel was in open syllable position and was lengthened, as in:

(2)   a.   sch[ɔ]t–sch[o :]ten   'shot(s)'
           b[ɑ]d–b[a :]den   'bath(s)'
           bissch[ɔ]p–bissch[o:]pen   'bishop(s)'

but certain plurals, such as:

      b.   [bissch[o]pen → bissch[ɔ]pen   'bishops'

have been analogically restructured after the model of short vowel nouns such as:

      c.   m[ɔ]t–m[ɔ]tten   'moth(s)'
           r[ɑ]t–r[ɑ]tten   'rat(s)'

which had never undergone OSL. Analogical restructuring can thus undo the effects of the lexicalization of a SC which had fallen in disuse.

In the second scenario, the SC comes back to life, but as a phonological zombie, as it were, i.e. as an 'undead' rule, by generalizing in a lexically diffuse fashion. An example concerns the two-step historical vowel shift discussed in section 2 above, the palatalization and subsequent diphthongization of the West Germanic long high back vowel /u:/ > /y:/ > /œy/. There are ample exceptions for each of the consecutive steps. There is an unshifted /u:/ in items such as:

(3)   a.   smoel   sm[u:]l   'conk, physgog'
           boer   b[u:ᵊ]r   'farmer'

   The second step has also left residue behind, such as:

      b.   beduusd   bed[y:]sd   'bewildered'
           gruzelementen   gr[y:]zelementen   'smithereens'
           ruzie   r[y:]zie   'quarrel'

all of which have the front rounded vowel resulting from the palatalization of /u:/. This evidence shows how both telescoped SC's have been spreading word-by-word. The mechanism has come to a complete stop, hence a recent loan such as 'blues' never surfaces as *[blœys].

So after a rule has ceased to be productive, its lexicalized left-behinds can either undergo analogy (and thus disappear) or, on the contrary, start infecting unshifted items with the former SC, which then enters an afterlife as a zombie rule, i.e. as a lexically diffuse rule (cf. Kiparsky 1995).

There is a third option: the mechanism starts anew. Sometimes an old, lexicalized SC becomes fully productive again. This is what is happening today with the historical vocalization of postvocalic /l/ after low back vowels, which resulted in the diphtong

/ɑu/, where German has retained the back vowel and the liquid. Examples include modern standard Dutch:

(4)   a.   oud [ɑut]   <   ald   'old'
            woud [vɑut] <   wald   'wood'

In many varieties of spoken modern Dutch it has become productive again, also following front vowels, as in (4b):

        b.   Niels [5]   Nie[w]s   'Nils'
              meel   mee[w]   'flour'

        c.   school   schoo[w]   'school'
              solt [6]   so[w]t   'tosses about, make a fool of'
              halt   h[ɑw]t   'halt, stop'

with a vocalized liquid, these variants are nearly homophonous with:

        d.   nieuws   'news'
              meeuw   'seagul'

        e.   schouw   'chimney'
              zout [7]   'salt'
              hout   'wood'

respectively. So postvocalic /l/ vocalization, which took place in Middle Dutch, was there and is back again; it has gone full circle.

    As the case of postvocalic /l/ vocalization clearly illustrates, the life cycle of SC is a continuum, but one in which the two extremes (Neogrammarian SC, targeting 'phonemes', and lexically diffuse SC, targeting lexical items) sometimes meet, hence a cycle; there is no need for a Neogrammarian controversy (Labov, 1981). The life cycle of SC is uni-directional, as the change invariably proceeds from sound structure, via grammar, to lexicon. The idea is highly comparable to Janda & Joseph's (2003) Big Bang theory, "saying that sound changes start as phonetically determined 'events' in very 'small' environments –the big bang– and in the aftermath of a phonetic event there can be generalization along various lines", viz. phonetic trajectory, phonology, morphology, social space and the lexicon (Joseph 2012: 420-421). The life cycle of SC is a common, yet complex process involving physical, cognitive as well as social mechanisms – in short, all dimensions of human nature. Because of its complexity, it proceeds slowly and, because of differences in phasing, it easily results in differences between related dialects and languages. Especially related dialects tend to go through

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[5] When she was 5 years old, the daughter of the present author used to refer to Pippi Longstocking's little monkey, Mr Nilsson, as Ni[ᵘw]sson.
[6] This is an inflected (2, 3 sg) verb form and /t/ is the inflectional ending.
[7] In most varieties of spoken modern Dutch, fricatives tend to be realised voicelessly across the board, hence [s]out.

the same SC's, but they don't necessarily do so at the same rate and this is a cause of micro-variation.

3.2. Awareness

Both the productivity and the structural predictability of SCs decrease in accordance with the following cline:

(5)   phonetic implementation > post-lexical process > lexical rule > lexicalized SC

The speakers' awareness (and consequently the 'manipulability') of a given phenomenon, however, increases along the same cline. Lexicalised SC is sometimes targeted by hypercorrection, the second type of opacity: forms which do not fit the structural description of a given rule do undergo / have undergone the rule. An example of correction in this sense is the split or unmerging of Seseo /s̲/ or Ceceo /θ/ in Andalusian Spanish in favour of the Castillian '*distinción*' /s̲, θ/ (Villena-Ponsoda 2001; Regan 2017). Another example concerns lexicalised word-final [t] deletion (henceforth WFtD) in Afrikaans, a partly creolised former daughter language of Dutch. In nouns which have a final cluster of an obstruent followed by /t,d/,[8] the /t,d/ only surfaces in the plural form, where it is followed by schwa, e.g.:

(6)   a.   lig: ligte   'light(s)'
            hoof: hoofde   'head(s)'
Some nouns have two plural forms, one with and one without the etymological plosive, e.g.:

        b.   kors: korste ~ korse   'crust(s)'

Remarkably, in some nouns which do not have an etymological final plosive, the alternation occurs as well, e.g.:

        c.   bos: bosse ~ boste   'wood(s)'

while some nouns only have a plural form with a 'hypercorrect' /t/, such as:

        d.   graf: grafte   'grave(s)' [9]

Until 1925, Afrikaans was not recognized as a legitimate language in South Africa. Till then, standard Dutch (which does not allow WFtD) was the norm, but Afrikaans was the practice of language use. This fact probably underlies these hypercorrections.

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[8] Syllable-finally, the voice contrast neutralises into [t].
[9] The original Dutch plural form is gr/a/v-en. Gr/ɑ/f : gr/a/v-en is thus an instance of OSL, sketched in section 3.1 above.

4. Sociolinguistics

Sociolinguistics has produced a number of highly relevant insights into the rise, embedding and evaluation of SC. One of the main contributions is Labov's (1972) 13 stages model in which language and the speech community are intertwined in the spread of SC.[10] Three main steps in the 13 stage model have become known as indicators, markers and stereotypes; these notions refer to the specific status a variable phenomenon may have in (a sector of) the speech community. Unlike indicators, both markers and stereotypes show socio-stylistic variation and they are thus what Silverstein (2003) has labelled ´enregistered´ and what Johnstone et al. (2006: 82) have labeled 'available for social work'. Unlike indicators and markers, stereotypes are commented on and often stigmatized. Cf. Table 2.

property	indicator = stage 2	marker = stage 6	stereotype = stage 12
socio-stylistic variation	no	yes	yes
comment; stigmatization	no	no	yes

Table 2: Labov's tripartition and two of the main distinguishing properties

Apart from a socially meaningful construct, style can also be a mechanical side-effect of speech rate (e.g. Dressler's 1975 allegro rules) in connected speech – and late phonological and phonetic processes such as reduction and assimilation tend to be style-specific.

To return to Labov's model, going from indicator via marker to stereotype, social meaning becomes more and more explicit. Social meaningfulness (or indexicality) presupposes awareness; the speakers tend not to be aware of indicators, but they are aware of markers and stereotypes. Socially stigmatized phenomena (changes which typically come up 'from below' the level of conscious social awareness) can become prone to (hyper-) correction. An example of the latter mechanism is the replacement of the stigmatized palatal realization of /n/, [ɲ], by the palatalized [nʲ] or Standard Modern Greek alveolar [n] variants in (C)ni(C) syllables, e.g. /paˈni/, 'rag', in the Patras variety of Greek (Pappas 2006).

Speech communities can be cut up (both analytically and by the speakers themselves) in terms of macro-social dimensions such as social class, social mobility, age, gender, ethnicity etc. Also smaller scale, meso-social entities such as social networks and communities of practice have proven to be relevant for the spread of linguistic innovations. SC is usually transmitted in dense, multiplex social networks, where social cohesion is relatively big and where attitudes, norms and behavioral patterns tend to be relatively uniform. Two important mechanisms are incrementation and speaker agentivity. Incrementation results from the fact that, typically, every next generation slightly exaggerates the previous generation's innovative pattern both quantitatively, i.e. in terms of the proportion of use of the new variant, and qualitatively,

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[10] In the variant presented in Labov 2001: 517-518 more attention is paid to language acquisition / socialization and perception.

which may result in rule generalization (cf. section 4.1 below). Agentivity stems from the fact that speakers do not always just react to e.g. linguistic innovations, but sometimes they initiate them.

　　An example of the importance of the speakers' attitudes and, at the same time, the indexicality of an innovation can be found in the work by Haddican et al. (2013) on the rate at which diphthongization of the *face* and *goat* vowels spreads in York (UK).
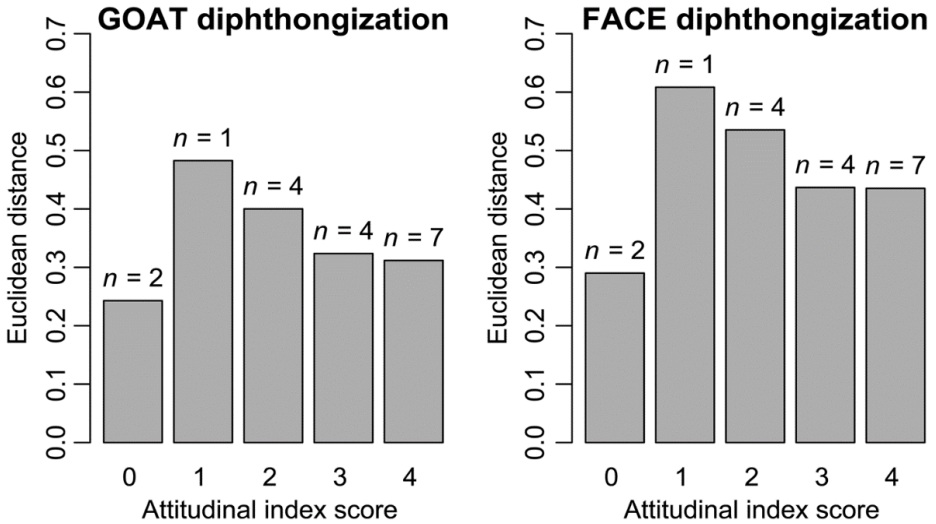
Figure 2: The relation between the proportion of use of new, diphthongised variants of two vowels and the speakers' attitudes towards local community and dialect.11 (Haddican et al., 2013)

　　As the graphs in Fig. 2 show, the stronger a speaker's allegiance to the local community (measured on the horizontal axis), the more conservative, monophthongal variants s/he tends to use (vertical; Haddican 2013:396). So the socio-emblematic meaning can slow down the tempo of the social embedding of a SC – or, in other cases, speed it up.

4.1. Exceptionlessness versus lexical diffuseness in the sociolinguistic study of sound change

Labov (2007) distinguished two different mechanisms for the spread of linguistic innovations, particularly SC. Transmission typically targets internally motivated, change; its vehicle is child L1 acquisition. The change is typically from below the level of conscious awareness, regular and it proceeds through multidimensional waves (cf. Schmidt's 1872 '*Wellentheorie*'). Diffusion, on the other hand, typically targets change from above; here, linguistic change spreads through language contact and the vehicle is

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[11] The Euclidian distance is the distance "between onset and offset using the first and ninth normalized values for F1 and F2" (p.377); the higher the values the more diphthongal realizations. The bars headed by $n = x$ indicate numbers of speakers.

adult L2 acquisition – it proceeds in a lexically diffuse fashion, hence structurally unpredictable ("structural constraints are lost", thus Labov 2007: 344).

In the line of Labov's proposal, there seems to be an older insight regarding the relationship between the internal and external, specifically geographical, extension of the transmission of SC, introduced by Robinson & van Coetsem (1973). According to this insight, in the area of origin a rule reaches eventually the most general application. An example concerns the palatalisation of /s/ in syllable onset across the Limburg dialects of Dutch studied by Goossens (1969); Goossens visualised his findings in the map in Fig. 3 below. In the west-most area, numbered 1, palatal /ʃ/ only occurs in loans such as /ˈʃarəl/, *Charles*, and /mɑˈʃin/, *machine*. In area 2, it applies in loans and non-loans preceding vowels - and so forth. The rule has been generalised the most in area 6. In the classic generative phonological rule format, the original palatalisation rule A→B/C_D reached the largest geographical extension; during the process, the rule gradually was generalised internally into A→B/C_ (which underwent a more limited geographical spread) and subsequently maybe even into A→B, *tout court*, in the area of origin, here the area numbered 6.
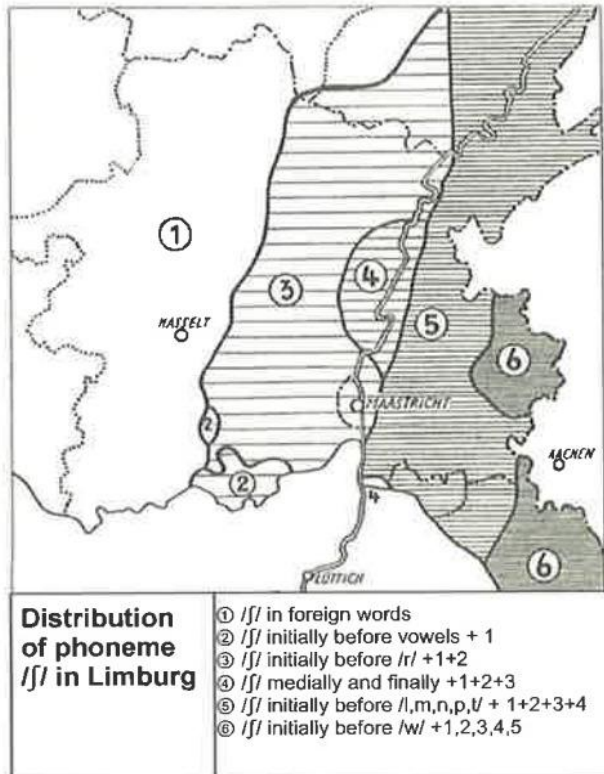
Figure 3: Distribution of /ʃ/ in a dialect cluster in Limburg (Goossens, 1969)

The simultaneous internal generalization and areal spread of a rule, as in the Robinson & Van Coetsem 1973 scenario, may result from incrementation (cf. above). Adding the stepwise internal growth as a dimension to the geographical coordinates, results in a
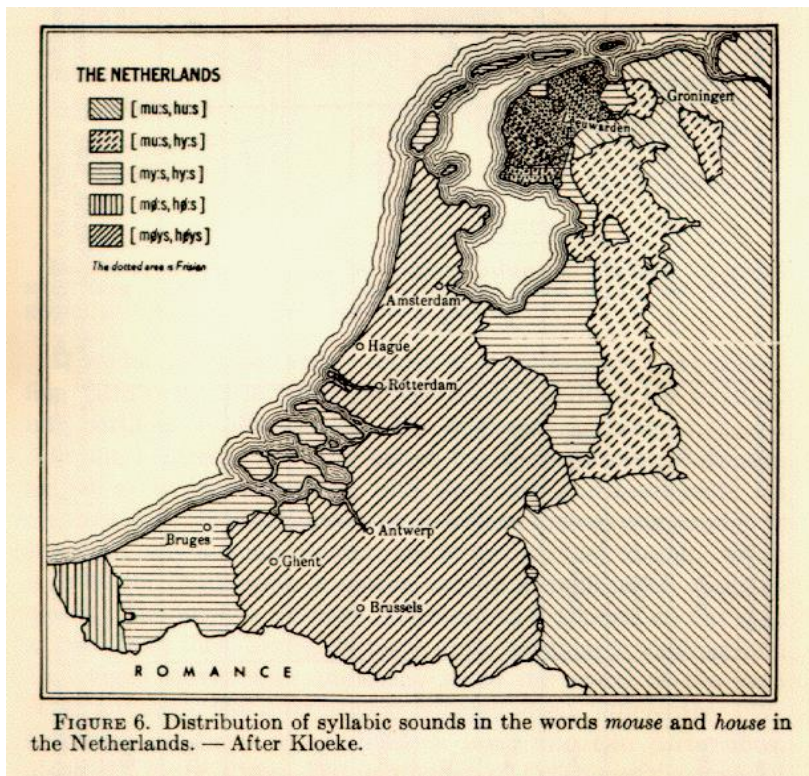
three-dimensional picture which may bear resemblance to that of a cloud formation in Fig. 4.

Figure 4: What a three-dimensional picture of the simultaneous internal and areal extension of a SC through transmission might look like

Externally, every next wave of internal generalisation has been a bit less powerful and has expanded less. Applying the scenario to the /g/ → [j] change in non-standard varieties of German, sketched in section 3.1 above, the first wave probably concerned the context preceding palatal vowels, the second wave concerned also non-palatal vowels and the third wave additionally concerned complex onsets, in which /g/ precedes a liquid /l, r/.

Examples of diffusion are also available in the historical dialectology of Dutch. One of them concerns the two-step shift /u:/ > /y:/ > /œy/ discussed in sections 2 and 3.1 above. The geographical and lexical distribution of these telescoped SCs of Middle and Early Modern Dutch have been studied in great detail by Kloeke (1927). Kloeke's map (in Fig. 5, in the version in Bloomfield 1933) clearly shows how, during its diffusion, a SC can affect different relevant items at different points in time, rather than simultaneously, thus resulting in lexical exceptions. The main exception here can be found in the group of dialects (in the outstretched northern and central eastern area) where the variants of 'mouse' have retained the long high back vowel /u:/, while those for 'house' have undergone palatalization, yielding /y:/

FIGURE 6. Distribution of syllabic sounds in the words *mouse* and *house* in the Netherlands. — After Kloeke.

Figure 5: Diffusion applies word-by-word; with respect to the number of affected items, the spread of a borrowed innovation often tapers off geographically and this is also visible in Kloeke's map

The transmission-diffusion distinction occurred already in embryo in Schuchardt (1885: 76), where the author writes about "indigener versus verpflanzter Lautwandel", endogenous vs. transplanted SC.

There may be a third type. This option was discussed by the German dialectologist Penzl (1939) as *Entlehnungslautwandel*, 'borrowed SC', and Seidelmann (1972) discussed it under the header of 'rule borrowing'. The concept is comparable to Andersen's (1988) 'adaptive change'. Scheuringer (1992) claims that "real SC requires [...] the absence of exemplary speech forms. [...] Present-day SC is mostly motivated extra-linguistically through the orientation towards exemplary speech forms and it proceeds via sound substitution" (*Lautersatz*), i.e. lexically diffuse SC. But there is a "third possibility for SC, which has properties of both 'real' SC and sound substitution" (my translation, FH). Just like lexically diffuse SC, this third type of SC is prestige-driven and often boosted by its phonological 'naturalness'; it has the latter property in common with regular Neogrammarian SC. The third mechanism of SC hence unites properties of the 'classical' two.

An example of a SC of this third type concerns the ongoing dismantling of the historical deletion of postvocalic /R/ preceding a coronal obstruent.[12] It occurs in

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[12] The remainder of this section is a paraphrase of parts of Hinskens 1992 section 5.3.6.

Ripuarian and East-Limburg dialects of Dutch, which are spoken in the southeastern corner of the language area. Examples are:

(7) a. kort   [kɔt]   'short'
          woord   [wo:ᵊt]   'word'
          worst   [wu:ᵊʃ]   'sausage'
          koorts   [ko:ᵊts]   'fever'
          eerst   [i·əʃ]   'first'
          beurs   [by·əʃ]   'wallet'
          baard   [ba:t]   'beard'

As far as the left-hand environment is concerned, the deletion has occurred after both tense and lax vowels, after back and front vowels, after rounded and unrounded vowels. In many Limburg dialects and in all Ripuarian dialects (including the subset of r-deleting ones), items such as *eerst*, *beurs* and *worst* have a high vowel; hence deletion occurred after high, mid and low vowels. As far as the righthand environment is concerned, the deletion took place preceding both voiced and voiceless stops, preceding fricatives and preceding both single and complex codas. Relatively recent loans such as:

(8) b. mars   [mɑʀʃ]   'march'
          sport   [ʃpɔʀt]   'sport'

never occur r-lessly, which shows that r-deletion has been lexicalised.

To tell from apparent time data for the local Ripuarian dialect of Rimburg, R-lessness is undergoing loss, i.e. /r/ is being restored, resulting in convergence with prestigious standard Dutch and most other dialect varieties – but so far the loss only occurs to a significant extent after short vowels, not after long vowels (F=3.65 df=2,24, p=.041). Thus R-lessness disappears first where it is needed least, namely in heavy (e.g. *kort*) rather than in superheavy syllables (e.g. *woord*) as, generally, super heavy syllables tend to be disprefererred. The dismantling of dialectal R-lessness is prestige-driven and to tell from the internal directionality, it is also boosted by phonological 'naturalness'.

5. Cognitivist approaches

Over the last decades a new paradigm has developed, which is sometimes referred to with the umbrella notion 'cognitivist'. In connection with speech, sound structure, and SC, this includes Usage-based phonology (Bybee 2001; 2006; 2010) and Exemplar Theory (a.o. Johnson 1997; Pierrehumbert 2002).

In this paradigm, grammatical knowledge is claimed to emerge bottom-up and structure is not "given a priori or by design" (Bybee 2010:2). The frameworks do not assume faculties such as the language acquisition device, nor a mental blueprint for grammar, nor a language bioprogram. "The cognitive and psychological processes and principles that govern language are not specific to language but are in general the same as those that govern other aspects of human cognitive and social behavior" (Bybee 2001:17). Language and linguistic behavior embedded in 'domain general' cognitive skills and processes.

In this approach language use requires little, if any computation. In principle everything is stored redundantly: every realization of every item is stored in anecdotal memory in bundles of maximally concrete articulatory, acoustic, grammatical, semantic and pragmatic information concerning the single occurrences ('tokens' or 'exemplars'). All occurrences are organized in exemplar clouds, around a prototype; the lexicon is a cosmos of multi-dimensional networks.

Token frequency (i.e. frequency of usage) and type frequency (distributional frequency) are the stem cells of grammar. Closely related to type frequency is the concept of 'neighbours' (Luce and Pisoni 1998), i.e. words which have a similar phonological shape, "words that are one sound away from a given word"; similarly, transitional probabilities, e.g. "the probability of a C given a final V" (Coetzee 2008:250). A related concept is the informativity of a sound, i.e. its average predictability across all segmental contexts (Cohen Priva 2017). In this view, the productivity of a phenomenon is influenced by its type frequency. In connection with token frequency mention should be made of local frequency manifestations such as 'recency' / 'audience design' effects (e.g. Schwarz 2012), an instantiation of priming effects. The Information-theoretic tools of probability, entropy and surprisal value (Zampaolo 2016) are also based on token frequency.

It has been claimed that the more frequently a word is used, i.e. the higher its token frequency, the more predictable it is. And the more predictable, the more easily it can be phonetically reduced.[13]   On the other hand, with respect to morphophonology, "analogical levelling affects low frequency words before high frequency words […] sometimes does not affect high frequency forms at all" (Bybee 2012: 216, 225).

In this paradigm SC is always both gradient and lexically diffuse, since there is no such concept as the segment. A rule or process can be partly lexicalised or morphologised, hence lexically stored, while it is still productive; cf. Bermúdez-Otero's Stratal Optimality Theoretical concept of 'rule scattering', through which "a process in one component of the grammar gives rise to a new rule at a higher level […] without ceasing to apply at a lower level" (Bermúdez-Otero 2015: 2).

With respect to phonetic change, an important question is whether token frequency is merely relevant to reductive change (lenition, deletion, assimilation and the like) or to any type of SC, including fortition and the like (e.g. chain shifting); the latter position is held by Pierrehumbert (2002). The changes West Germanic[14] (henceforth Wgm) /u:/ underwent in the history of Dutch are instances of fortition. Van Reenen and Elias (1998: 108) present relevant data for 18 relevant items in the 353 Dutch dialects. They do not, however, take the logically following step of relating stability versus change of Wgm /u:/ with the items' token frequencies.

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[13] Almeida (2013) discusses the relationship between token frequency and phonetic alternation in the realisation of /tʃ/ and intervocalic /d/ in the Santa Cruz de Tenerife variety of Canarian Spanish, concluding that it is conceivable that the frequency effects can be modified by other variables.

[14] The ancestor of present-day English, Scots, Frisian, German and Dutch.

modern st. Dutch	English gloss	n of dialects in which /u:/ has been changed	frequency of oral usage (in two corpora of modern spoken Dutch)
duif	'dove'	201	1
vuist	'fist'	211	1
muis	'mouse'	212	0
duim	'thumb'	216	2
kruipen	'to creep'	221	8
ruit	'window-pane'	228	4
buik	'belly'	237	4
uil	owl'	241	0
bruin	'brown'	242	6
zuigen	'to suck'	246	5
duizend	'thousand'	275	17
buiten	'outside'	276	146
huis	'house'	282	372
uit	'out'	290	658
gebruiken	'use'	300	55
luisteren	'to listen'	325	38
luiden	'sound'	328	2
kuip	'tub'	328	3

Table 3: The retention of Wgm /u:/ in 18 items and the items' token frequencies (after data from Van Reenen & Elias 1998: 108)

The Pearson *r* for the number of dialects in which /u:/ has been changed and the frequency of usage appears to be .294 (two-tailed p=.236) which suggests that token frequency may not have played a role in the fortition type of SCs that the vowel underwent. However, when the token frequencies are log-transformed[15], a significant yet moderate correlation is found (r=.503, two-tailed p<.05); the frequency of usage explains some 25% of the variance in the number of dialects in which /u:/ has been changed. The outcome does corroborate Kiparsky's (1988: 371) and Kerswill's (2011: 229) claim that token frequency does not usually play a role in connection with geographical spread. However, as the data concern historical change, these findings might not be conclusive. Finding indications for lexical effects in historical sound change on the basis of modern frequency data may be even more difficult than reconstructing astronomical phenomena that took place light-years away using data from cosmic background radiation.

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[15] Logarithmic token frequencies were calculated as log (token frequency + 1). Using this formula, a token frequency of 0 remains 0.

6. Towards an integrated theory

SC is obviously too complex a phenomenon to be considered as the domain of one single branch of linguistics. According to Kiparsky (1988: 399), "the same feature, indeed the same rule, [can] be subject to lexical diffusion in one language or dialect and not in another depending on whether the feature is lexically distinctive or not"

An example of a SC which has a different rule typological status in related language systems is WFtD; whereas in the Nijmegen urban dialect of Dutch it is a post-lexical process, in many Limburg dialects of Dutch it applies post-lexically and lexically[16] and in Afrikaans it has been lexicalized.

A theory is needed which can 1/ account for lexical frequency effects with regard to productive processes of phonetic reduction (lenition and the like) and in the course of a SC's lexicalization; 2/ accommodate the insights into the life cycle of SC. The way the theory has been embedded in formal phonological theory (very transparently so by Ramsammy 2015), however, seems to apply only to internally generated SC; 3/ account for the diffusion of exogenous SC. The prestige-driven borrowing of SC (Labov's 2007 diffusion) typically enters the grammar in the lexicalization phase.

In Table 4 the three perspectives and the properties they ascribe to the various types of SC are aligned. Each status of a SC in the rule typology corresponds to a specific set of internal, cognitive and social properties. The combination of properties in three different domains adds dynamics to the constellation.

INTERNAL				COGNITIVE	SOCIAL	
rule typology	grammatical level	productivity	conditioning	lexical frequency effects	status in Labov's tripartition	style effect
lexicalization	stem	minimal	lexical	token and type freq. effects on lexicaliz. of all types of processes	stereotype or marker	social
lexical	word	↑ ↓	grammatical	none	not applicable	none
post-lexical	phrase	maximal	prosodic or phonological		marker or indicator	social and/or mechanical
phonetic			unconditioned or phonetically conditioned	token freq. effects only on reduction and similar processes	indicator	mechanical

Table 4: The three perspectives and the properties they ascribe to the various types of SC

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[16] At least in the dialects of Ubach over Worms and Rimburg, studied in Hinskens (1992), the rule is also lexical since it is statistically sensitive to morphological structure. Cf. Guy's (1991) 'exponential effects'.

From this integrated theory, a number of empirically testable hypotheses can be derived, including:

(i)   Post-lexical processes can be rudimentarily lexicalised;

(ii)   Usage-related factors only play a role where grammar underdetermines usage (cf. Anttila 2006);

(iii)   Frequency of usage only affects lenition, reduction, assimilation and the like and it does not affect fortition-type phenomena;

(iv)   "High frequency words and phrases undergo phonetic reduction at a faster rate than low- and mid-frequency sequences" (Bybee 2006: 714);

(v)   There is an inverse relation between the productivity of a phenomenon and the degree to which the speakers are aware of it;

(vi)   Indicators are typically phonetic rules and postlexical processes, while stereotyping and hypercorrection will typically involve lexically diffuse SC;

(vii)   The layered organization of SC adds coherence: the closer different SCs are rule-typologically, the more similar they will be in terms of internal, social and cognitive organisation.

For most of these hypotheses, some evidence and/or some methodological considerations will be briefly sketched below; needless to add that more systematic research is called for.

Re-hypothesis 1: post-lexical processes can be rudimentarily lexicalised. This can be exemplified with word-final [t] deletion in the East-Limburg dialect of Ubach over Worms; in this local dialect (and many other Limburg dialects), WFtD is fully productive. Nevertheless, there are words such as the verbs:

(9)   kɔstə ~ kɔsə   'to cost'
        mɛldə ~ mɛlə   'to announce'; 'to register'

where the deletion has been lexicalised.

Re-hypothesis 2: usage-related factors only play a role where grammar underdetermines usage (cf. Anttila 2006). In modern spoken standard Dutch, unstressed full vowels can be reduced to schwa or –depending on phonotaxis– even to deletion. Interestingly, there are structurally similar items which show dramatical differences in this respect, such as e.g.:

(10)   m/i/nuut: m[ə]nuut   'minute'
        but
        p/i/loot: *p[ə]loot   'pilot'

Segmentally, prosodically and stress-wise these words are very similar; yet the vowel in the unstressed first syllable only undergoes reduction in m/i/nuut. This is clearly a case where grammar underdetermines usage. In connection with this reduction process, there are obviously more determinants than formal structure alone.

Re-hypothesis 3: frequency of usage only affects lenition (reduction, assimilation and the like) and it does not affect fortition-type phenomena. On the basis of F2

measurements, Dinkin (2008) studied the centralization of short vowels (an instance of lenition) in dialects of English spoken in the northeast of the USA; it appeared that high-frequency words are more subject to centralization. The outcomes of the analyses of data regarding Wgm /uː/, presented at the end of section 5 above, seem to suggest that token frequency does not necessarily affect fortition.

Re-hypothesis 4: "high frequency words and phrases undergo phonetic reduction at a faster rate than low- and mid-frequency sequences" (Bybee 2006: 714). This implies that high and low frequency items have different slopes. In the data on co-articulatory vowel nasalization in Philadelphia studied by Zellou & Tamminga (2014), however, the effects of the speakers' birth-year and token frequency are independent, showing that high frequency words on the one hand and low- and mid-frequency sequences, on the other, do not have different slopes. This finding is reminiscent of Kroch's (1989) 'constant rate effect'.

Re-hypothesis 5: there is an inverse relation between the productivity of a phenomenon and the degree to which speakers are aware of it. Phonetic phenomena tend to be automatized, hence fully productive and below the level of social awareness. On the other hand, phenomena which have risen so high above the level of social awareness that they have become stigmatized are at best prone to lexically diffuse spread (cf. Labov 2006: 509).

Re-hypothesis 6: indicators are typically phonetic rules and postlexical processes, while stereotyping and hypercorrection will typically involve lexically diffuse SC. Operationally, this hypothesis can be translated into two related claims: 1/ for a process to be subject to style shifting it needs to be at least post-lexical; 2/ (hyper-) correction usually targets lexicalizing or lexicalized processes. Evidence for the second part of the claim includes etymologically hypercorrect plurals in Afrikaans, discussed in section 3.2 above. An interesting source of evidence is the type of hyperdialectisms introduced by non-native (L2) speakers or semi-speakers, who sometimes over-apply a dialect feature in contexts where it does not 'belong' historically. These speakers "do not know any better: their analysis of the target variety is faulty" and for that reason they extend a given phenomenon "into words where it is not historically justified" (Trudgill 1988: 551,553). Realizing the East-Limburg or Ripuarian dialect variants of items such as *mars*, 'march', and *sport*, 'sport', R-lessly (section 4.1 above) would be an instance of hyperdialectism. Hyperdialectisms of this type are common in make-shift dialect varieties. An example (from Swanenberg 2009) is diminutive *clubske* for traditionally well-formed *clubke*, standard Dutch *clubje*, 'little club'. This variant has a Brabantish[17] ring to it and it may well have been used to flag a (claim to) Brabant identity of the speaker. However, the authentic dialect variant of the diminutive would not have the -skə allomorph, which merely occurs following stems ending in a velar.[18]

Re-hypothesis 7: the closer different SCs are rule-typologically, the more coherent they are, i.e. the more similar they are in terms of internal, social and cognitive organisation. And, logically, the bigger the rule typological distance between different SCs, the less coherent they are. This claim can be tested for different SCs within the

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[17] Or Limburg, for that matter.
[18] See Hinskens 2004:17-19 and 2014:114-116 for more considerations and examples.

same language variety and for a SC which has a different rule typological status in different related language varieties.

Future work can consist of interpreting available studies against the background of the present proposal and designing new empirical studies to systematically test all hypotheses.

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