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Lenition

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Lenition (German *Lenierung*, from Latin *lenire* = weaken) is most commonly defined as "a 'relaxation' or 'weakening' of articulatory effort" (Hock 1991: 80). The term was coined by Rudolf Thurneysen as one "used to describe a mutation of consonants which normally originated in a reduction of the energy employed in their articulation" (Thurneysen 1946: 74) and affects mostly consonants in intervocalic position (Thurneysen 1946).

Below I present the processes that most commonly fall under the label of *lenition* and make some observations that emerge from this list. The similarities between these processes and the way in which they pattern support the mostly uncontroversial view that lenition is indeed a group of similar phenomena. Kirchner writes that to his knowledge "no linguist has ever explicitly maintained the contrary view, that "lenition" is merely an arbitrary collection of unrelated processes" (1998: 5). But while most acknowledge that the processes considered leniting are indeed related and form a coherent group, defining the exact criteria for group membership remains largely controversial and debates about the formalization, motivation, and even goal of lenition abound.

Three main approaches to lenition are presented herein: formal, phonetic and functional. The formal approach is the generative theory-based search to formalize synchronic rules of lenition processes. The phonetic approach seeks to determine what motivates the sound changes in question and what exactly constitutes "articulatory effort". The third, functional take on lenition, looks to matters of contrast maintenance, which exhibit an additional way in which lenitions pattern with great similarity, in its search for what constrains and sometimes triggers lenition phenomena.

1. Leniting processes

In this section I summarize the processes most commonly considered to fall under the cover term *lenition*. There is general agreement in the literature that all the processes listed below may be considered lenitions but there is little agreement regarding the exact criteria required for membership in the lenition group.

In coining the term, Thurneysen suggests that leniting processes are characterized by some reduction in articulatory effort, but to date there is no agreement on exactly what this entails. Among linguists there are intuitions regarding articulatory effort, some more accepted than others. Voicing, for example, has an explanation rooted in the laws of physics, specifically aerodynamics: intervocalically the vocal cords may continue to vibrate after the first vowel, through the consonant, and into the second vowel; but in final position—where final devoicing is encountered—aerodynamic conditions are not conducive to voicing (Westbury and Keating 1986). Other processes listed below have explanations that are more difficult to quantify, such as "some reduction in constriction degree or duration" (Kirchner 1998: 1).

Both open questions, criteria for group membership and how to formalize effort reduction, are reiterated in the discussion of the formal and phonetic approaches to Lenition (§3.1 and §3.2).

1.1. Degemination

Degemination is the shortening of a CC cluster, where both consonants are the same, to a singleton C. Two examples are the diachronic degemination in Numic *kk > k / V_V (Manaster Ramer 1993) and the word-final degemination in Tiberian Hebrew (1).

(1) Word-final degemination in Tiberian Hebrew (Malone 1993: 73)

[qal] 'light (masc.)' vs. [qallɔɔ] 'light (fem.)'

1.2. Deaspiration

Deaspiration is the loss or reduction of aspiration. For example, in the Pattani dialect of Lahaul aspiration of the bilabial voiceless stop is reduced in pre-accented syllables. In medial and final contexts p^h is in free variation with p (2).

(2) Deaspiration in the Pattani dialect of the Sino-Tibetan language Lahaul (Sharma 1982: 48)

a. Reduction of Aspiration

i. aspiration in accented syllable p^hukə ‘body’

ii. reduced aspiration in pre-accented syllable p^hukan ‘flour’

b. p^h ~ p

i. ɖəgɐgp^hi ~ ɖəgɐgpi ‘to tremble/to shiver’

ii. hjup^{h}tʃi ~ hjuptʃi ‘to open’

1.3. Voicing

Voicing involves a change from a voiceless sound to a voiced one and is a very common lenition process, second in prevalence only to spirantization (Gurevich 2004). Voicing usually affects whole series of sounds in the language where it applies. And although voicing can affect fricatives as in Sekani (3), it is much more common with stops, such as the intervocalic voicing in Sanuma (4).

(3) In the Na-Dene, Canadian language Sekani, voiceless initials of noun and postposition stems (s l̥ ç x ʍ) voice (z l j ɣ w) when prefixed or preceded by a nominal possessor or object (Hargus 1985: 270-271)

a. xaɬs	‘planning tool’	səɣaɬseɬ	‘my planning tool’
b. çən	‘song’	səjəneɬ	‘my song’
c. xaɬz	‘windfall roots’	tse ɣaɬz-e	‘Old Friend Mt. (*roots* stem)’

(4) p t ts k → b d dz ɡ / V_V in Sanuma, a Yanomam language (Borgman 1990: 220)

a. ipa	[ipa] or [iba]	‘my’
b. hute	[hute] or [hude]	‘heavy’
c. hatsa	[hatsa] or [hadza]	‘deer’
d. ãka	[ãka] or [ãɡa]	‘tongue’

1.4. Spirantization

Cross-linguistically this is by far the most common lenition process. Spirantization involves the change of a stop to a fricative, most commonly in intervocalic position. This quite often affects whole series of sounds in a language’s inventory, as for example in the Paya dialect of Kuna (5), or in the Tümpisa dialect of Shoshone (6).

(5) b d ɡ → β ð ɣ / V_V following a stressed syllable in the Chibchan language Paya Kuna (Pike, Forster & Forster 1986: 459)

a. paβa	‘father’
b. peðe	‘you’
c. naɣa	‘foot’

(6) p t c k k^w → ɸ θ ç x x^w / V_ [voiceless]V in the Uto-Aztecan language Tümpisa Shoshone (Dayley 1989: xxviii-xxix)

a. wisipin	[wiʃiɸi̥]	‘thread’
b. tapettsi	[taβettʃi̥]	‘sun’
c. citoohin	[ciðoːhi̥]	‘push’
d. petɨ$^{-gem}$	[peðɨ] ~ [peθɨ̥]	‘daughter’ (ends with a geminating segment)
e. katɨ$^{-gem}$	[kaɾɨ] ~ [kaɾ̥ɨ̥]	‘sit’
f. miʔak^{w}a!	[mĩʔaɣ^{w}a] ~ [mĩaɣ^{w}a]	‘go away!’

1.5. Flapping

Flapping is a process whereby a sound is replaced by a flap (usually either alveolar ɾ or retroflex ɽ). Two examples are the intervocalic flapping of the trill in Kagate spoken in the village of Phedi (7) and the final flapping of the retroflex stop in Gujarati (8).

(7) Flapping in the Sino-Tibetan language Kagate r → ɾ / V_V (Hoehlig & Hari 1976: 19)

a. /tari/ [ta\ɾi] ‘axe’

b. /tihriŋ/ [t̪i/ɾiŋ] ‘today’

c. /guhri/ [gu̪ɾi] ‘cat’

(8) In the Indo-European language Gujarati, ɖ and ɽ vary freely in final position (Cardona 1965: 24)

[ɟʰaɖ] ~ [ɟʰaɽ] ‘tree’

Quite often the alveolar and retroflex stops undergo flapping as part of a more general spirantization process that affects other stops. For example in the Calabar-Creek Town dialect of Efik (a Niger-Congo language) b d k → β ɾ ɣ non-initially in a word stem and before a vowel: where b and k spirantize the alveolar d flaps (9). In the case of the retroflex, the ɽ appears to be the usual output of a process where the rest of the stop series spirantize. For example in the Afro-Asiatic language of Somali b d ɖ g spirantize to β ð ɽ ɣ intervocalically, especially after a stressed syllable: where b d g spirantize, the ɖ flaps (10). In the case of the alveolar stops, however, there is a discernible pattern: spirantization of the stop series in languages whose inventories include a phonemic trill usually results in a d → ð substitution, while in trill-less languages the alveolar stop flaps (d → ɾ) where the rest of the stop series spirantizes. This happens with regularity in all 33 languages where alveolar stops are affected (Gurevich 2004).

(9) Non-initial in a word stem and before a vowel (Dunstan 1969: 38)

a. /b/ - [β]	dwoꜜβ-eꜜbaꜜ	‘twelve’
b. /d/ - [ɾ]	iꜛko̩ꜛɾ-e̩ꜜkpe̩ꜜne̩ꜛ	‘name of a town’
c. /k/ - [ɣ]	uꜛfo̩ꜜɣ-uꜛdwaꜜ	‘market store’

(10) Spirantization of the Somali stops (Armstrong 1964)

a. ˈlaba	[ˈlaβa]	‘two’
b. ˈbadag	[ˈbaðag]	‘goose’
c. ˈtiɖi	[ˈtiɽi]	‘she said’
d. ˈsagaal	[ˈsaɣaal]	‘nine’

1.6. Debuccalization

Debuccalization is the loss of place of articulation, preserving only glottal constriction, resulting most commonly in either h or ʔ. For example in the Cuisnahuat dialect of the Uto-Aztecan language Pipil, a syllable-final w becomes h in word-final or pre-consonantal position (11). And in the Austronesian language Toba Batak, preconsonantal voiceless stops surface as glottal stops (12).

(11) Debuccalization in the Cuisnahuat dialect of Pipil: w - h (Campbell 1985: 34)

a. kuwa	‘to buy’	-kuh-ki	‘bought’
b. puwa	‘to count’	-puh-ki	‘counted’

(12) Debuccalization in Toba Battak p t k → ʔ / _C (Hayes 1986: 341)

halak	‘person’	halaʔ batak	‘Batak person’

1.7. Gliding

Gliding is the replacement of stops or spirants with a homorganic glide. For example in the Djapu dialect of the Australian language Yolngu, t̪ c ~ j, p k ~ w in word-medial position following a vowel, liquid, or semivowel (13).

(13) Djapu Yolngu gliding (Murphy, cited in Dixon 1983: 29)

a. minjʔci ‘colour, paint’ + d̪arpu-NG ‘pierce’

minjʔci-jarpu-NG ‘paint’

b. ɟarakaɭaʔju-N ‘move in an uncontrolled way’

ɟarakaɭaʔ-jarakaɭaju-N ‘keep moving in an uncontrolled way’

c. d̪aː ‘mouth’ + birkaʔju-N ‘try’

d̪aː-wirkaʔju-N ‘ask’

d. d̪awal ‘country’ + gujaŋi-Ø ‘I think’

d̪awal-wujaŋi- Ø ‘be born’

1.8. Loss

Loss is the deletion of a sound (most commonly a glide or a glottal) in certain contexts. For example the occasional loss of the intervocalic glottals ʔ and h in the Uto-Aztecan language Tümpisa Shoshone (14), where the presence and absence of these sounds is in free variation.

(14) ʔ h - Ø (Dayley 1989: xxix)

a. miʔakʷa!	[mĩʔaɣʷa] ~ [mĩaɣʷa]	‘go away!’
b. soʔoppɨtɨn	[sɔʔɔpːɨɾɨ] ~ [sɔːpːɨɾɨ]	‘much, many’

1.9. Devoicing

Devoicing is the loss of voicing, usually in final positions. For example the final devoicing of obstruents in Standard Bulgarian (15):

(15) Final devoicing in Bulgarian (Scatton 1984: 73)

a. grad-ove ‘cities’

b. grat ‘city’

2. Patterns of Lenition

The list in §1 touches on the cross-linguistic prevalence of some leniting phenomena, how common they are among the worlds’ languages and how widespread their effect may be within the languages where they apply. In this section I elaborate on a few other patterns that emerge from the list of leniting processes. The degree to which each theory of lenition discussed in the following section accounts for these patterns provides added perspective into the differing points of view.

The processes described above operate in two main contexts: syllable/word finally and intervocalically. The bulk of the processes, those that apply in intervocalic context, line up in a discernible sequence: the products of degemination and deaspiration (tt t^h → t) are the sounds that undergo voicing (t → d), resulting in the sound that most commonly undergoes spirantization, flapping, debuccalization, or gliding (d → ð, ʔ/h, ɾ, j), and glides and glottals are the sounds most commonly lost (j, ʔ, h → Ø). This chain-shift alignment of intervocalic lenition processes, where the output of some is the exact input of others, is illustrated in (16). In (17) the processes are listed in the order they could apply if they were to diachronically affect the same phoneme or its correspondent, although in some cases like spirantization and flapping or debuccalization and gliding, this order is arbitrary.

Intervocalic lenition processes:

(16) Hierarchy of input/output sounds

tt t^h > t > d > (θ) ð ɾ > ʔ h j > Ø

(17) The general order in which processes could apply

Degemination	tt → t
Deaspiration	t^h → t
Voicing	t → d
Spirantization	t d → (θ) ð
Flapping	t d → ɾ
Debuccalization	t → ʔ h
Gliding	t → j
Loss	ʔ h j → Ø

If the oft-cited observation that "a segment X is said to be weaker than a segment Y if Y goes through an X stage on its way to zero" (Venneman cited in Hyman 1975: 165) is an accurate diagnostic of intervocalic consonant strength, then (16) lists consonants in order of their relative strength, from strongest to weakest (where tt is stronger than t, which is stronger than d, etc., to the weakest possible outcome of lenition, which is Ø). The resulting 'weakening hierarchy' gives birth to the notion of lenition as gradation towards loss.

There are two ways in which the patterns illustrated in (16) and (17) manifest themselves in language data: as an outline of attested diachronic sound changes of the same phoneme or its correspondent, and as a list of synchronic sound substitutions that occur, often simultaneously, in any given language. Two examples of attested diachronic sound changes where some of the lenition processes listed in (17) sequentially affect the same phoneme are French, where intervocalic stops were voiced then spirantized before eventual gliding (not shown in the example) and deletion (18), and Latin, where there was a similar intervocalic voicing, spirantization/gliding, then loss (19).

(18) French lenition t → d → ð → Ø (Jacobs 1994: 2)

fra**t**rem > *[fra**d**re] > [fra**ð**re] > frère 'brother'

(19) Latin lenition (Hock 1991 :81)

pacatum > (*)pagado > Spanish [paɣaðo] > dialectal [paɣaØo] ‘pacified, pleased’

Lenition processes that operate simultaneously in a given language may also exhibit the pattern in which the output of one process is the exact input of another, but in some cases these actually affect different phonemes. For example, in a given language there could be synchronic voicing of voiceless stops and spirantization of voiced ones. In such cases the chain-shift pattern of t → d and d → ð is maintained, but the phone d that is the output of voicing and the phonetically comparable d that undergoes spirantization do not represent the same phoneme. Two examples of such *phonemic overlap*, an intersection of phonemes where “a given sound […] may belong to two or more different phonemes in the same dialect” (Bloch 1941: 93), are the interactions between intervocalic voicing and spirantization in Northern Corsican, and between debuccalization and loss in Nepali. In Northern Corsican intervocalic voiceless stops are voiced (20) while existing voiced stops in the language are spirantized in the same context (21). The phonetic contrast between intervocalic voiceless and voiced stops shifts to spirantization and is maintained. In the Indo-European language Nepali there is intervocalic debuccalization of ts^h to h (Bandhu & Dahal 1971) and in the same context loss of the existing h in normal speech (22). So while the chain-shift pattern of ts^h → h and h → Ø is maintained, the output of the first process and the input of the second are not the same phoneme, and the previous contrast between the phonemes ts^h and h is preserved and shifts to h and Ø.

(20) p t k → b d ɡ/ V_V in Northern Corsican (Dinnsen & Eckman 1977: 6)

a. [peðe]	‘foot’	[u beðe]	‘the foot’
b. [tengu]	‘I have’	[u dengu]	‘I have it’
c. [kaza]	‘house’	[a ɡaza]	‘the house’

(21) b d ɡ → β ð ɣ/ V_V in Northern Corsican (Dinnsen & Eckman 1977: 6)

a. [bokka]	‘mouth’	[a βokka]	‘the mouth’
b. [dentɛ]	‘tooth’	[u ðentɛ]	‘the tooth’
c. [ɡola]	‘throat’	[di ɣola]	‘of throat’

(22) Nepali intervocalic loss of h (Bandu & Dahal 1971: 26)

a./bəhiro/	[bəiro]	‘deaf’
b./məhə/	[məə]	‘honey’

The discussion of phonemic overlap brings up two additional features common to most lenition processes. First, Nepali intervocalic h-loss is reported to occur in *normal* speech. This added dimension to what we know about the context of many lenition processes is rather common cross-linguistically, and many leniting sound substitutions are reported to mostly occur in *relaxed*, *fast*, and *normal* speech.

Second, the matter of contrast maintenance is raised. In both the Northern Corsican and the Nepali examples the phonetic distinction between two phonemes is threatened by a leniting sound substitution (in Corsican the p/b, t/d, k/ɡ oppositions are threatened with the voicing of p t k, and in Nepali the ts^h/h opposition is threatened with the debuccalization of ts^h to h). In both cases however, the distinctions are maintained by an additional leniting sound substitution in the same context (in Nepali the intervocalic spirantization of the existing voiced stops shifts the p/b, t/d, k/ɡ contrast to b/β, d/ð, ɡ/ɣ, and in Nepali the loss of intervocalic h shifts the ts^h/h contrast to h/Ø). As it turns out, lenition phenomena in general very rarely lead to neutralization, and almost never result in homophonic forms. A survey of 230 mostly leniting processes in 153 languages found 92% avoid neutralization, while only 8% could potentially result in the kind of homophony that leads to the loss of lexical distinction that may interfere with communication (Gurevich 2004).

In summary, several ways in which lenition behaviors pattern together have been outlined in this section. These are listed in (23).

(23) Patterns of Lenitions

a. The prevalence of certain processes (that is, how common some lenition processes are cross-linguistically and whether they affect a single sound or an entire series)
b. The fact that many lenition processes are reported to occur in *natural* or *fast* speech
c. The gradation pattern of intervocalic lenition processes
d. Phonemic overlap
e. The strong tendency of lenition phenomena to avoid neutralization

Current debates on lenition focus on formulating a unified description of all leniting processes, isolating what exactly motivates them and in some cases what constrains them. Exploring how, and the degree to which each approach accounts for the patterns presented here sheds light on the foundation of each theory and its capacity to accommodate empirical data.

3. Theoretic Approaches to Lenition

There is somewhat of a general agreement among phonologists about the main processes that can be considered leniting, but formalizing this agreement has proved controversial. In this section three main approaches to the question are explored. The formal approach (§3.1) seeks to define unified rules that would encode all vital information about lenition processes. These rules should form a model that can be used to unambiguously determine which processes are leniting, including all those that are and excluding all those that aren't. The phonetic approach (§3.2) seeks to isolate the underlying physical causes of all lenition processes. The third approach (§3.3) builds on the contrast-maintaining behavior of most lenition processes to identify the forces that may constrain the progress and outcome of such sound changes.

3.1. The Formal Approach

The formal approach to lenition is taken by generative grammarians. Its goal is to formalize a set of purely synchronic rules that would model all cases of lenition. Three notable formalizations of lenition under this approach are *feature spreading*, *sonority promotion*, and *simplification*. Additional formalizations exist but they are mostly variations on these three models. All three models attempt to subsume the various sound changes that can be considered leniting, while excluding all other processes, under one formal expression. Success in this endeavor would result in a rule to be included in Universal Grammar (UG).

Lenition as autosegmental *feature spreading* (e.g., Jacobs & Wetzels 1988) involves the spreading of some feature of the surrounding sounds to the element undergoing lenition. For example, the spreading of either the [+voiced] or [+continuant] feature of the vowels surrounding an intervocalic stop to that stop, causing it to either voice or spirantize. This formalization works well for voicing and spirantization, but not for the leniting process of debuccalization which, if anything, involves the delinking of features rather than the acquisition of new ones. Additional rules would be required to predict when a stop is voiced and when it is spirantized since the surrounding vowels possess both features.

Lenition as *sonority promotion* (e.g., Hock 1991, Lavoie 1996) formalizes lenition rules as replacing a sound by a more sonorous version of itself in certain contexts. Sonority is determined based on the principle that "requires onsets to rise in sonority toward the nucleus and codas to fall in sonority from the nucleus" (Kenstowicz 1994: 254). In the scale of sonority, stops are least sonorous, followed by fricatives, nasals, liquids, glides and finally vowels which are most sonorous. Lenition as sonority promotion is descriptively accurate for some of the leniting processes such as spirantization and gliding, but as a unified formalization of lenition it fails to include other processes commonly considered leniting such as deaspiration and degemination, neither of which has a more sonorous output than input.

A third formal view of lenition is one of *simplification*, where segmental complexity is measured by the number of features required to describe a consonant, and lenition is a process that simplifies this complexity by delinking some of the features. For example, deaspiration would involve the delinking of laryngeal features and debuccalization would delink place of articulation features. When this formalization is faced with a leniting sound change that does not appear to reduce the number of basic features of a given element, it turns to *Markedness* for help: *markedness* is used as a measure of some degree of 'naturalness', meant to make phonological features less abstract in terms of their intrinsic content (Chomsky and Halle 1968, Guitart 1976, McMahon 1994, Rice 1999, among others). An element is considered *marked* by definition if it is less natural or more complex than another. In this manner every case that does not immediately conform to the view of lenition as simplification is solved because within this approach the input of any lenition process, by definition, is more *marked* than the output, hence every lenition process is one of a move to the *unmarked*, or less complex state.

Lets examine how the formal models presented here account for the patterns of lenition discussed in §2. Although there is not an explicit concern with the prevalence of some lenition processes over others (23a), the frequency of any element over another can be accommodated within generative theory as part of the UG principles of markedness: the less marked elements are expected to be more frequent. The view of lenition as gradation (23c) is instrumental to both the *sonority promotion* and the *simplification* models: both formalize lenition as a move along a graded scale, either of sonority or of segmental complexity. The sonority scale emulates to a large extent the lenition hierarchy mapped out in (16), and the case of loss especially provides compelling support for lenition as *simplification*. Due to its superlative nature the output of loss is arbitrarily the least complex, least marked and most natural segment, which as the ultimate step in the gradation pattern gives the impression that it is the goal. The remaining three patterns of fast speech (23b), phonemic overlap (23d), and contrast maintaining behavior of lenitions (23e) are not addressed.

The advent of optimality theory (Prince and Smolensky 1993) allows for the incorporation of elements of phonetic and functional detail into the formal grammatical expression of lenition patterns. Kirchner (1998), for example, incorporates notions of "articulatory ease" directly into his formal statement, in the form of so-called "lazy" constraints that are ranked with respect to (presumably "non-lazy") faithfulness constraints. Such a research program provides a very promising link to the phonetic and functional pressures that are demonstrably acting on patterns of lenition. We hold off our investigation of such approaches—despite their formal rigor—until the next section.

To summarize, the formal approach to lenition arises from the generative tradition. Its main goal is to find a unified formal rule that would subsume all the various processes that can be considered leniting. If such a rule is defined it would be recognized as a linguistic universal and the question of lenition would be solved. If a model is posited that does not apply to all processes generally considered leniting then the offending processes are either amended (as in the case of the simplification model's use of *markedness*) or removed from the list of lenitions using the argument that the model is sound, and if it is sound and does not include X, X must not be relevant. For example, degemination does not fit the view of lenition as 'delinking of privative features' (a variation on the *simplification* model) so it is argued that this process should be excluded from the list of unambiguously agreed-on lenition phenomena (Szigetvári 2008).

3.2. The Phonetic Approach

The second approach is more in the spirit of how the term *Lenition* came to be coined: an observation of how common certain processes are in certain environments and that there is some "reduction of articulatory energy" associated with these sound changes. Research in this direction is especially concerned with the physical motivation behind lenition, be it *articulatory effort reduction*, *prosody maintenance*, related to *acoustics* and *perception*, or possibly some combination of these factors.

Ohala (1981) notes that sound changes which are attested in diverse and unrelated languages are likely to have a phonetic origin. The degree to which lenition processes are common cross-linguistically suggests that they are motivated by what is common among speakers, that is biological factors which include the physical shape of the vocal organs, their movement, and their acoustic correlates. However, while it is widely assumed that lenition is conditioned by phonetic properties such as ease of production and perception (e.g., Steriade 2000, Kirchner 1998, Jun 1995, Flemming 1995), how exactly to describe and measure these properties is far from settled.

The concept of *effort minimization* precedes formal generative theories: Zipf, as early as 1935, suggests that the frequency of sounds depends on their degree of articulatory complexity. Rejection of this concept based on the fact that effort is difficult to measure is swift: Trubetzkoy (1939) argues that it is difficult to pin-point the degree of complexity of sounds (e.g., which is more complex: tense vocal cords but relaxed organs of mouth or lax cords and tense mouth organs?). Trubetzkoy's objection to describing sounds in terms of phonetic complexity leads to the introduction of *markedness* values and the eventual move towards formalizing phonology rules completely removed from phonetic information. But interest in characterizing lenition in terms of effort minimization has not waned.

Kirchner's (1998) phonetically-based approach posits an effort minimization model of lenition where greater articulatory movement constitutes greater effort, and the push to reduce this effort results in the reduction of constriction degree or duration of an affected sound. Kirchner incorporates phonetic theory into a formal approach and models it within the framework of Optimality Theory (Prince and Smolensky 1993), where conflicting universal constraints are ranked with respect to each other. Articulatory effort minimization is therefore identified as a constraint (LAZY) that is ranked with respect to the counter-force constraints of *faithfulness* and *fortition.* Lenition is thus viewed as a force, encoded in universal grammar, to reduce articulatory effort by reducing articulatory movement and timing which results in falling short of articulatory targets.

Kingston argues that "the differences in effort between the lenited and unlenited pronunciations are so miniscule that they can hardly be what motivates a speaker to lenite. Both the differences in the distance the articulators travel (mere millimeters) and the time scales (at most tens of milliseconds) are much too small for effort to differ detectably between the two pronunciations" (Kingston 2007: 1). He suggests that lenition's purpose is to *maintain prosodic structure*. He shows that lenition occurs most commonly inside prosodic constituents and argues that it is meant to communicate a continuing constituent, thereby reducing a sound's interruption of the stream of speech. Within this view, lenited pronunciation is the result of achieving a specific target that produces the desired acoustic consequences, such as greater intensity, rather than falling short of the desired target. Kingston also notes that "Lenition is more likely in more frequent words than less frequent ones, because the listener needs less information to recognize more frequent words" (17).

Acoustics and *perception* must also play some role in lenition, even if only as part of the natural interaction between speaker and hearer: "Speaker and hearer are interested in communicating and will pronounce words only as they have heard them (or think they have heard them) pronounced by others" (Ohala 1981: 197). Acoustic considerations may affect the perceived differences between certain sounds in certain contexts, which may facilitate or otherwise influence lenition phenomena. For example, acoustic theory suggests that pre-vocalic distinctions are more perceptible than pre-consonantal ones (e.g., Silverman 1995, Steriade 1999, Ségéral & Scheer 1999). Since lenition processes are most frequent in intervocalic contexts, it is possible that lenition may proceed more easily in contexts where a sound is easier to perceive even when it is lenited. Kaplan (2008) suggests another angle, that in certain contexts the perceptual difference between a sound and its lenited counterpart plays a role in the prevalence of some lenition processes. She has had some success showing that the perceptual difference between intervocalic voiced stops and spirants is smaller than between voiced and voiceless stops, which is somewhat consistent with the frequency of spirantization although it is too soon to draw any broad conclusions based on such a limited study. The interaction between

articulation and perception, speaker and hearer, also plays a role in the functional approach discussed in the following section.

Turning to the patterns listed in §2, by attributing the sound changes to physical properties common to all speakers, a unified approach to lenition that is based on phonetic considerations accounts for the similarities between, and to some extent the frequency of, cross-linguistic lenition processes (23a) and the fact that many leniting changes are reported to occur in *relaxed* or *fast* speech (23b). In fact, it is these empirical observations that suggest lenition phenomena may be phonetically-driven in the first place. The view of lenition as gradation (23c), and especially the weakening hierarchy in (16), are central to effort-reduction theories. As with some formal models discussed above, the case of loss provides compelling support for the view of lenition as a graded move along a scale of effort-minimization: loss is the ultimate step in lenition and it results in an element that unambiguously requires the least effort to articulate. Phonemic overlap (23d) is not addressed, but the strong tendency of lenition phenomena to avoid neutralization (23e) is inherent in Kingston's observation that lenition is more likely to affect more common words which rely less on acoustic cues to be recognized. Lenition is less likely to proceed unhindered and have widespread consequences if it obliterates meaning distinctions to the point where it interferes with communication (Gurevich 2004). This is also supported by the acoustic studies that suggest distinctions are more perceptible in pre-vocalic contexts, where most lenition phenomena occur. I return to this point in the following section.

3.3. The Functional Approach

The functional approach focuses on the effect that leniting sound substitutions have on contrasts in the languages where they apply, that is, the fact that lenition phenomena very rarely result in contrast obliteration (neutralization). This is the goal of Gurevich (2004) who investigates 230 mostly leniting processes in 153 languages, and finds that 92% of these avoid neutralization. This approach is termed *functional* because the meaning distinction of words depends on the

system of contrasts in a given language, and these distinctions affect communication, which is the primary *function* of language.

This approach to lenition does not stand independently of phonetically-based motivation and does not explicitly contradict any of the models presented in the previous section. It does, however, bear influence on the extent to which physical properties can drive sound changes. If there is a physical "push"—whatever that push may be—to lenite, the degree to which this substitution may affect contrast in a given language may hinder the progress of the sound change. Lenition processes that threaten contrast may lead to loss of lexical distinctions which, in turn, could induce a significant amount of homophony that would result in confusion. And since confusing signals are less likely to be reproduced as listeners become speakers (Silverman 2006), the neutralizing sound substitutions, regardless of the physical "push" to invoke them, are less likely to become widespread.

Gurevich (2004) clearly shows that the progress and outcome of lenition processes is constrained by the functional considerations of contrast-maintenance. The systems of contrast in languages appear to exert a gradual diachronic force over phonetic processes, affecting the progress and outcome of such processes depending on the degree to which they threaten contrast. Lenition processes that do not threaten contrast are far more likely to proceed unhindered with the widespread consequences of affecting entire series of sounds in a language (this most commonly happens with voicing and spirantization). Changes that somewhat threaten contrast pattern according to the shapes of the phonemic inventory of a language. An example of this is the aforementioned flapping that patterns with spirantization discussed in §1.5: in languages where the entire stop series is spirantized, the retroflex stop ɖ always results in a flap ɽ while the alveolar stop d results in a flap ɾ only in languages that do not have a phonemic trill, otherwise it spirantizes to ð. This suggests that flapping may be the preferred outcome of alveolar spirantization, as in the case of the retroflex stops, but is avoided when contrast is threatened. This threat comes in the form of a phonemic trill, a sound that is phonetically similar to a flap (the r/ɾ contrast, exists, but is rare; it is found in only 3 of the 153 languages investigated).

Finally, changes that clearly threaten contrast, such as sound mergers and loss, often induce further changes that reshape phonological systems thereby avoiding contrast obliteration. For example cases of phonemic overlap discussed in §2 (e.g., in (20) where p t k → b d ɡ and (21) where b d ɡ → β ð ɣ intervocalically in Northern Corsican, which results in the avoidance of neutralization between the output of the voicing process and existing voiced stops in the language), or contrast shifts where a sound may be deleted but its absence maintains contrast with Ø, an example of which is provided below in (24).

The fraction of phonetically-conditioned sound changes that are found to be neutralizing (18 of the 230 processes, or 8%) is more common in pre-consonantal positions where contrast is less perceptible and harder to maintain (e.g., the aforementioned Silverman 1995, Steriade 1999, and Ségéral & Scheer 1999). That is, the potential for contrast obliteration to the extent where it could interfere with lexical distinctions occurs more frequently in contexts where contrast is less perceptible already, in which case fewer words should depend exclusively on said contrasts for their distinctions. Hence the potential of these few neutralizing sound substitutions to hinder communication by inducing homophony is reduced, which further suggests that the relationship between leniting sound substitutions and contrast is not arbitrary.

Turning again to the patterns listed in §2, the cross-linguistic similarities of lenition processes are accounted for by relying on phonetically-based motivation, and in addition to this, the prevalence of certain processes, and possible wide-reaching consequences of affecting entire series of sounds within a language's inventory (23a), are accounted for directly by the degree to which these sound substitutions affect contrasts in a given language. That is, the less likely a sound substitution is to induce homophony, the more likely it is to proceed unhindered and have widespread affect on the sound system of a language, as is in fact the case for both voicing and spirantization. Voicing, which comprises 39 cases of the 230 investigated, never results in neutralization and is not only common cross-linguistically but also is most likely to affect whole series of sounds in the languages where it applies. Spirantization, of which there are 76 cases, is

95% non-neutralizing, is the most common cross-linguistic form of lenition, and is also likely to affect entire series of sounds.

The fact that lenitions commonly occur in *natural* or *fast* speech (23b) is not explicitly addressed within the functional approach except as a natural consequence of its reliance on phonetic motivation as the force that drives most lenitions. The gradation pattern of intervocalic lenition processes (23c) has no implications for the functional approach. Interestingly, although the effect of contrast considerations on lenition is not related to the view of such processes as a trajectory of consonants towards their weakest state, the case of loss—which provides compelling support for the gradation view of several models discussed above—also plays a key role here. This ultimate step in the view of lenition as erosion also has a superlative consequence for contrast: loss always results in phonetic neutralization because the elimination of a phoneme in some context always obliterates the phonetic distinction between that phoneme and Ø. But in 71% of the cases of loss in the corpus of 230 processes meaning distinctions are actually preserved. The most common ways in which contrast is maintained in such cases are phonemic overlap, like the examples in (20-22) above, and contrast shifts such as the one in Bulgarian (24), where nasals are lost between vowels and fricatives, followed by nasalization of the vowel. Here the n is lost, but the nasalization of the preceding vowel maintains the distinction between n and Ø.

(24) Loss of a nasal and nasalization of a vowel in Bulgarian (Scatton 1984: 57)
a. /onzi/ [õzi] ‘that’

Phonemic overlap (23d) is central to the functional approach. It shows how leniting processes that threaten contrast may induce further changes, and suggests that some leniting changes may actually be, at least partially, triggered by contrast maintenance. Finally, the strong tendency of lenitions to avoid neutralization (23e) is, of course, the basis of the functional approach, which posits that this tendency is what constrains the progress and outcome of

lenitions. One could question the significance of a pattern that is so important to one approach but is not addressed by others. However, it is a pattern that is extremely prevalent and something that lenitions have more in common than almost any other characteristic. Its omission from all formal and most phonetically-based models stems in part from the fact that this pattern had not previously been investigated, and in part from the general belief that, because contrasts are language-specific they have no place in universal grammar.

4. Conclusion

Leniting sound changes are common and exhibit similar cross-linguistic behaviors, this much we know. How to formalize this information in a unified model of lenition that all phonologists can agree on has so far eluded us. Depending on one's approach, such strong cross-linguistic similarities must be encoded in the UG and/or grounded in the physical properties of both speakers and hearers. Current debates range from the generative approach of how to encode lenition as purely phonological synchronic universal rules, to isolating the physical driving force that motivates these sound changes, to how the systems of contrasts in a given language play a role in constraining the progress and outcome of lenition processes.

The various models of lenition presented in this chapter have differing approaches to the questions of how to delimit the collection of processes that most everyone agrees are a related. Five general patterns of lenitions—all based to some extent on empirical data—are identified. The relative significance of each tendency depends on the theory one supports. Below is the summary of each pattern's role within the differing approaches to lenition.

(a) The *prevalence* of certain lenition processes as well as their overall cross-linguistic similarity: cross-linguistic frequency of certain lenitions is implicit in the *markedness* constraints of formal models, where the less marked element is more natural and therefore more frequent, and explicit in the phonetic approach's reliance on physical properties which are common to all speakers and hearers. The prevalence of some

processes over others, as well as how widespread their consequence may be, is predicted by the contrast-maintenance considerations of the functional approach, where the less a process threatens contrast the more prevalent it is.

(b) The fact that many lenitions are reported to occur in *natural* or *fast* speech: this pattern is not addressed by the formal models but is inherent to the view of lenition as motivated by physical properties and therefore works with both the phonetic and the functional approaches.

(c) The *gradation pattern* of intervocalic lenition processes: this pattern emerges from the juxtaposition of diachronic lenition processes, and is critical to the sonority scale and simplification models of lenition under the formal approach, and to the view of lenition as consonant erosion within the effort-minimization model. This view of lenition is crucial to the characterization of lenitions as all part of one general process, a notion that is most advantageous to theories concerned with building a UG, whose hypothesized existence is directly tied to encoding rules in their most general and simple manner.

(d) The *phonemic overlap* pattern of some lenitions: this is a pattern that often emerges in languages where two synchronic lenition processes interact in the sense that the output of one is phonetically similar to the input of another. It is only addressed by the functional approach, that views such cases as indication that the threat of contrast obliteration may trigger additional lenitions.

(e) The strong tendency of lenition phenomena to *avoid neutralization*: this recently identified tendency is the foundation on which the functional approach is built. Since this pattern is based on contrast considerations, which are language-specific, formal models do not address it in their search for universals.

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