Beats-and-binding topics in the (mor)phonology of {ex-} in English and Spanish

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Abstract

This paper discusses an example of a lenitive scenario in a case study of voicing of the Latinate /ks/ cluster in the prefix {ex-} and the <x> of some other English forms. The analytical problem under discussion is part of a larger issue of /s/ voicing in English, criss-crossing with another intricate topic: English prefixation (cf. Haładewicz-Grzelak 2014a, b, c, 2015a, b). Here I concentrate on the aspect whereby the cluster /ks/ denoted graphically as <x> is voiced [gz] when stress follows, but not in productive <ex-> formations or in certain derivatives of forms with [ks]. The process is contrasted with the homophonic realizations in Castilian Spanish. The analysis proceeds within the paradigm of Beats-and-Binding phonology (cf. e.g. Dziubalska-Kołaczyk 1995, 2002, 2009), which is a syllable-less model in the paradigm of Natural Phonology. I propose that the tonic beat in Prototypical Stress Timed languages contains a stress concentrator (Σ) which can propagate onto a binding to the pre-tonic consonant, causing lenition. In the first stage of the analysis seven phonological algorithms are identified. In the subsequent stages of the study they are narrowed to only four, and in the last stage, to account for the encountered regularities, I show that what actually happens is a question of activating one and the same lenitive process. The database for the study is a corpus of the realizations of prefixes ending with a consonant + /s/ collected from various English and Spanish pronunciation dictionaries (RP English and Castilian Spanish) as well as recorded realizations of two native speakers.

(Mor)phonologie de {ex-} en anglais et en espagnol
dans le cadre de phonologie de battements et liaisons

Résumé

L'article concerne un exemple de lénition dans une étude du
voisement de <x> (/ks/) dans le préfixe d'origine latine {ex-} et dans
d'autres réalisations de ce groupe consonantique dans l'anglais
contemporain. Le phénomène analysé fait partie d'un thème plus
large qui concerne le voisement du /s/ dans la langue anglaise. Par
exemple, quand il y a une voyelle accentuée après le groupe en
question, le /ks/ devient un [gz] voisé, mais cela n'a pas lieu dans le
même environnement phonotactique pour les lexèmes avec {ex-}
qui sont créés en tant que processus synchroniquement actif.
L'interprétation phonologique présentée ci-dessous est basée sur la
phonologie des battements et des liaisons (*Beats and Binding
Phonology*) de Dziubalska-Kołaczyk (p.ex. Dziubalska-Kołaczyk 1995,
2002, 2009) : un modèle phonologique sans syllabes qui s'inscrit
dans le paradigme de la Phonologie Naturelle. Selon la présente
étude, le battement tonique dans les langues accentuelles
prototypiques comporte un concentrateur d'accent (Σ) qui peut être
introduit dans la liaison avec la consonne pré-tonique, en
provoquant sa lénition (adoucissement). Dans la première étape de
l'étude, je propose, en tant qu'un problème descriptif, une typologie
de sept algorithmes phonologiques concernant le thème du préfixe
{ex-}. L'analyse permet de réduire le nombre des types de
changements à quatre et dans un second temps, à deux manières
dont la phonologie réagit à un environnement phonétique donné :
soit la lénition est incluse, soit le processus n'est pas activé. La base
de donnés pour l'analyse est constituée par le corpus des réalisations
des préfixes terminant par une consonne + /s/ recueilli des
dictionnaires de prononciation de la langue anglaise (RP) et espagnol
(castilien). J'utilise aussi deux enregistrements des personnes
anglophones (anglaises).

Mots-clés

Morfonologia przedrostka {ex-} w angielszczyźnie i hiszpańszczyźnie z perspektywy fonologii bitów i wiązań

Abstrakt

W artykule zajmuję się przykładem lenicji w studium udźwięcznienia <x> (/ks/) w przedrostku łacińskiego pochodzenia {ex-}, jak również w innych realizacjach tej zbitki we współczesnej angielszczyźnie. Analizowane zagadnienie stanowi część szerszego kontrowersyjnego tematu udźwięcznienia /s/ w angielszczyźnie. Na przykład, gdy po docelowej zbitce występuje akcentowana samogłoska, następuje udźwięcznienie /ks/ do [gz], jednakże nie ma tego udźwięcznienia w produktywnych derywatach z {ex-} w takim samym fonotaktycznym środowisku. Przedstawiona poniżej interpretacja fonologiczna ugruntowana jest w fonologii uderzeń i wiązań (*Beats-and Bindings Phonology*) opracowanej przez Dziubalską-Kołaczyk (np. Dziubalska-Kołaczyk 1995, 2002, 2009): bezsylabowym modelu fonologicznym, wpisującym się w paradygmat Fonologii Naturalnej. W badaniu postuluję, że uderzenie toniczne w prototypicznych językach taktowanych akcentem zawiera koncentrator akcentu (Σ), który może być wyprowadzony na wiązaniu do spółgłoski pre-tonicznej powodując jej lenicję (osłabienie). W pierwszym etapie badania, jako problem opisowy, wyszczególniam siedem algorytmów fonologicznych odnoszących się do tematu przedrostka {ex-}. Przeprowadzona analiza pozwala na stopniowe zawężenie ilości typów zmian do czterech, a następnie do dwóch sposobów, na jakie fonologia reaguje na dane środowisko fonotaktyczne: włączenie procesu lenicji lub brak aktywacji tego procesu. Bazę danych do analizy stanowi korpus realizacji przedrostków kończących się na spółgłoskę + /s/ wyekscerpowany ze słowników wymowy języka angielskiego (RP) i hiszpańskiego (kastylijski). Korzystam również z własnych nagrań dwóch osób anglojęzycznych (Anglików).

Słowa kluczowe

fonologia bitów i wiązań, lenicja, przedrostek {ex-} w angielszczyźnie, uderzenie toniczne, udźwięcznienie

1. Introduction

> Thus in the interface of phonology and morphology, criteria can be used to assign rules either to phonology or morphology, although morphologization of phonological rules is not of an all-or-nothing type
>
> (Dressler 1985: 47)

This article contributes to a wider phonological discussion on the relation between stress and lenition processes (as voicing) in English.[1] The analytical problem that the paper seeks to address is in an attempt to conflate various issues in the morphophonology of {ex-} which have so far not been related in one scenario. In particular, it concentrates on words prefixed with the morpheme {ex-} as a subset of the more complex phenomenon of /s/ voicing in English and the morphophonology of Latinate prefixation in RP English.

The special phonological property that I propose to account for is the lenitive stress-dependent voicing that is implied in English cluster /ks/ denoted by the grapheme <x>. This Latinate cluster is voiced ([gz]) when stress follows, but not in productive <ex-> formations or in certain derivatives of forms with [ks]. This fact means extending the analysis beyond the

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[1] The present discussion is part of a larger project on English Latinate prefixation and on /s/ voicing in English. Some aspects of the research were presented at the Olomouc Linguistic Colloquium (Olinco 2013, 6-8 June) and 47th Annual Meeting of the Societas Linguistica Europaea (11-14 September 2014, Adam Mickiewicz University, Poznań, Poland) and the LXXIV Zjazd PTJ (Zielona Góra, 12-13 September 2016). I would like to thank the participants for their comments and suggestions. This analysis builds on the insights on the pronunciation of {ex-} in English in Sobkowiak (1997: 66). All translations in the paper are mine, MHG.

mere prefixal status of *ex.* Pursuing a hypothesis of lenition of the basic voiceless realization as entailed by the vicinity of the stressed vowel, I collapse the collected data into a set of seven types, which are then reduced into four patterns, based on their phonological behaviour. Finally, I show that in all the observed phenomena only two algorithms are operative: one where stress-dependent lenition is triggered, and one in which lenition does not occur.

This stress-driven lenition is phonologically attributed to the fact that the binding relation in English has an additional property, formalized here as a *stress concentrator*. In other words, it is proposed that Stress-Timed languages (such as e.g. English) are able to propagate certain irregularities in the binding structure (formalized as stress concentrators – Σ) that can influence the phonological behaviour of the cluster in tonic beats. Additionally, the analysis captures some issues of the pronunciation of the glottal fricative in these contexts. The analysis is couched within the Beats-and-Binding framework, a branch of Natural Phonology, and the notion of a stress concentrator is my epistemological proposal for the model.

I am aware that /s/ voicing in English is a vast and controversial topic, in particular when coupled with the conundrum of the stress sensitivity of English prefixes. The work can thus be placed at the intersection of three larger phonological topics: i) lenition and voicing (see e.g. Keating 1984, for an exhaustive cross-linguistic overview of voicing), ii) English prefixation (cf. Chomsky and Halle' s SPE; see also Scheer 2011; Rakić 2007 for an overview) and iii), stress and morphononological change (e.g. Largeberg 1999).[2] There are also implications from diachrony: which patterns have been borrowed from French, which directly from Latin and which are idiosyncratic

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[2] The discussion reported below is purely morphonological, although the results point to the need to pursue the analysis for the phonetic (acoustic) as well as quantitative perspective (e.g. with productivity measures). For phonetic work on the voicing status of fricatives in English, see e.g. Smith (1997); Stevens et al. (1992).

English developments. It is thus understandable that not all
the issues that have arisen can be analytically attended to at
this stage of the research. Crucially, the research has shown
the multilayered nature of the processes affecting Latinate
{ex-}: on the one hand, it seems to be a morphonological issue
(there is definitely no phonological active process in contempo-
rary English that regularly voices obstruent groups in the posi-
tion after the stressed vowel), on the other hand, no other pre-
fix that ends in /s/ shows this pattern of stress-related leni-
tion (as opposed to SPE).

Finally, Chomsky's canonical generative analysis subsumes
/-ks-/ voicing under a more general set of laxing rules for /s/
voicing (cf. *SPE* 229 ff.). Since the relevant SPE rule (119) does
not conflate the three distinct environments into one coherent
explanation, but only lists disjunctive contexts, and secondly,
there have been notable attempts to concentrate exclusively on
the Latin /ks/ cluster (e.g. Hall 1946), so this discussion fo-
cuses solely on the {ex-} prefix as part of a larger project of
B&B insights into English /s/ voicing in the context of English
Latinate prefixation (cf. Haładewicz-Grzelak 2014).

The discussion makes use of Spanish cognates for the Eng-
lish target lexemes. There are two main reasons for adducing
Spanish data in the analysis. First of all, both English and
Spanish have a large Latinate component in their respective
lexica, hence there is an opportunity to trace and compare the
divergent phonological processes operative in the respective
languages. Secondly, these two languages stand in opposition
in a variety of accepted linguistic taxonomies, the most crucial
for this study being the division introduced by Dauer (1983)
into stress-based (SB) and non-stress based languages (NSB),
which constitutes a modification of an earlier division into
stress-timed and syllable-timed languages respectively. From
such a perspective English, in all its diachronic development,
has displayed features of being stress-based, achieving in its
modern version the status of a paradigmatic representative of
the group. Spanish, in turn, is placed close to the other end of

the scale, being classified as a typical non-stress based language.

None of the generative phonological studies accessible to me which deal with English affixation mention where they took the data from for their phonological claims. The material for this phonological analysis comes primarily from a variety of dictionaries, in both paper and electronic form. Also used were online sources for checking pronunciation (e.g. Forvo) and for in-depth specialized vocabulary searches. Most of these sources are listed at the end of the References under "other sources". As additional support, recordings of realizations by a native speaker were used for concatenations which did not appear in dictionaries (e.g. *ex-Hitlerian with ex-immigrant*), for nonce words (e.g. *rhinegress*), and to corroborate basic, dictionary versions. Since the research presented here relates to phonology rather than phonetics, dictionaries appeared to offer an ideal source of data, and had the added advantage that the lexicographers' transcriptions indicated whether a given realization was the only acceptable one or whether there were other options as in the case of many items with {trans-}). Besides, asking a native speaker to pronounce such an item would not eliminate the possibility of their producing an idiosyncratic realization at odds with a more valid dictionary entry. For this reason, there was no attempt to solve ambiguities in dictionary entries by checking for idiosyncratic pronunciations from NS informants.[3]

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[3] As proposed during the discussion after this presentation at the SLE session on prefixes, there is a possibility to use material excerpted from corpora. I see two potential problems with this strategy. First, there is a scarcity of spoken corpora which are also accessible in audio format (although, the Forvo website I used, could in a sense be thought of as a sort of a corpus, where volunteers leave recordings of their own pronunciation of lexemes). Secondly, I was interested 'in compliance with the NP tenets' in the existence /absence of process as such, or rather: in preference of the occurrence of a process. This is why 'external evidence' was much more valuable: a list of nonce words I devised, which could not be encountered in any corpus. Also, as Prof. Dziubalska-Kołaczyk suggested, of merit would be preparation of a psycholinguistic experiment to check the assimilations. I fully agree with

2. The analytical problem:
   {ex-} as an instance of /s/ voicing in English

The core descriptive fact in the paper is not new: the fact that in RP English /s/ becomes [z] before stressed vowels has been described in phonological literature before from many different perspectives. An acclaimed example of a diachronic analysis of <ex>, although not on English data, is Hall (1942), who examines the geographical distribution of words whose Latin etyma contained *-ks-* across Italian dialects. In that analysis he uses 11 main etymological types from Italian maps of isoglosses: (Lat.) *axale* – (It.) *sala, axe – asse, coxa coscia, examen – sciame, ex-sūcāre – asciugare, fraxinu – frassino, laxāre – lasciare, saxu – sasso, sexaginta –sessanta, taxu- tasso, tessere – texere* (Hall 1942: 118). Crucially, Hall concludes there is a similarity between the /ks/ cluster and the /kt/ one.

Westbury and Keating (1986) provide an overview and discussion on the natural aspects of voicing as such. These scholars address the question of whether it is more natural for stop consonants to be voiced or voiceless through a breath stream control model ("an explicit model of the articulatory mechanism to simulate the likely effects of voicing of a variety of articulatory conditions" , Westbury and Keating 1986: 146). The key assumption is to consider stops in a variety of contexts (word medially, initially and word finally). For example, "relatively high and steady subglottal pressure in medial position [...], makes voicing more natural than voicelessness" (Westbury and Keating 1986: 157).

A particularly exhaustive coverage of the issue of /s/ voicing in English has been given in SPE (Chomsky and Halle 1968: 228). The rule is stated as follows:

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this comment yet this issue, as a purely phonetic investigation, is left to be pursued in future projects.

[1]

$$\begin{bmatrix} \text{+cor} \\ \text{+strid} \\ \text{+cont} \end{bmatrix} \rightarrow \text{[+voice]} \qquad\Big/\qquad \begin{bmatrix} V = \_V \\ [\text{+tense } \bar{V}] \_ V \\ Vk\_ V \end{bmatrix} \begin{matrix} \text{(a)} \\ \text{(b)} \\ \text{(c)} \end{matrix}$$

Briefly, in [1] Chomsky and Halle basically describe the three environments in which English /s/ can be voiced. One is intervocalically following the "=" boundary - (a), the next context (b) is intervocalically and intra-morphemically following a tense vowel and (c), in the environment:), in the environment vowel /k/ _ and stressed vowel. The rule given here as [1] is nothing but a concise description of the observed facts, without any attempt to find any common denominator of the observed phenomena.[4] The discussion reported below does in-

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[4] There is of course a plethora of generative contemporary work on the topic, e.g. proposing that {ex} in hyphenated words is a separate phonological word, or a phase-head. For example, Booij (2012[2005]) says the following: "we might explain this by assuming that the domain of this rule of assimilation is the phonological word. The prefix *in-*can be considered as a cohering prefix and the prefix *non-* as a non-cohering prefix. Hence, the rule of assimilation will apply only to the prefix in- since it forms one phonological word with the stem, a domain in which the assimilation rule can apply" (Booij 2012 [2005]: 303, notations as in the original) (cf. e.g. Scheer 2011; Rakić 2007 for an overview and critique of a phonological word). From an NP perspective, this is not really an explanation but a type of heuristic post hoc description. The statement that a given prefix is a separate phonological word or a phase head, or is cohering / stress-shifting, does not entail at least an attempt to say *why* it should be a separate phonological word or a phase head. The difference between a description and an interpretation is that a description cannot be falsified; a description, however, is not a scientific theory but data seeking an explanation. Zirkel (2010) crucially points out that although prefixes could be assigned to various strata, a number of prefixes, such as for example re-, de-, sub- and others, "are assumed to belong to strata 1 and 2 at the same time. As a consequence, the vast majority of potential prefix-prefix combinations do not violate level ordering and only very few combinations of prefixes can actually be ruled out. Stratal models are not considered any further in the present study, as they are assumed to be even less successful in explaining the distribution of attested versus unattested prefix combinations than they have proven to be with regard to suffixes" (Zirkel 2010: 241). Follow the same reference for an exhaustive review of parsability in English suffixes, as well as a discussion on the relation of the distribution of attested versus unattested prefix combinations via selec-

deed assume that the processes affecting the morpheme {ex-} in English are connected to the topic of English /s/ voicing. This stage of the analysis only concentrates on one small aspect of English /s/ and hopes to capture regularities and generalizations which have so far not been proposed in phonological analyses within this fragment of the /s/ voicing issue.

3. The analytical paradigm

In order to describe the role of rhythm in the behavior of the prefixes under study, I have chosen the Beats-and-Binding model (B&B henceforth) as a functional paradigm which allows for a capturing of preferential shades in phonological processes.[5] Beats-and-Binding Phonology, developed by Dziubalska-Kołaczyk (e.g. 1995, 2002, 2009) is a syllable-less phonological model, grounded in Natural Phonology.[6] As an explanatory model based on Natural Linguistics, it necessarily presupposes a functional epistemology. The model assumes two basic func-

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tional restrictions. Her results suggest that "prefixes are structurally less heavily restricted than suffixes. If two-prefix combinations are problematic in terms of selectional restrictions, this is almost always due to semantic reasons. The vast majority of prefix combinations found to be attested are structurally and semantically acceptable, but as a high proportion of acceptable combinations is unattested, it is assumed that selectional restrictions alone cannot account for the combinability of prefixes. Thus, there must be further factors at work that prevent speakers from combining prefixes" (Zirkel 2010: 260).

[5] The same analytical architecture was used in the studies reported in Haładewicz-Grzelak (2014b, 2015). The following section is a recapitulation of some of the theoretical underpinnings exposed in those works.

[6] A comprehensive account of B&B theory can be found in e.g. Dziubalska-Kołaczyk 2009 (see also Dziubalska-Kołaczyk 1995, 2002), hence I will limit myself here to remarks of a very general nature which will facilitate the understanding of the analytical framework used in this study. For example, B&B assumes that "[t]he structure usually referred to as "the syllable" in standard syllable models here is epiphenomenal or indeed emergent due to principled phonotactic forces. The latter are responsible for different degrees of intersegmental cohesion which, in turn, determines the behaviour of segments and creates the impression of syllable structure" (Dziubalska-Kołaczyk 2009: 57). See also references to classic studies/theories of the syllable within the domain of Natural Phonology in Donegan and Stampe (1978).

tions of language – communicative and cognitive. The communicative function subsumes two main expedients of phonology: perceptibility and pronunciability.

In B&B the diverging phonotactic preferences of languages are regarded as originating at the level of rhythmic preferences – Level 0. Since such preferences constitute the framework of the phonological structure, they are of crucial importance for phonological analysis. According to B&B, the type of isochrony in a given language conditions the binding preferences of that language. "Languages have a wide spectrum of choices ranging from the simplest beat-timing to more complex stress-timing, against the background of a universally preferred trochaic rhythm" (Dziubalska-Kołaczyk 1995: 66). In B&B, Spanish belongs to Non Prototypical Beat Timed languages (henceforth NPBT) while English is a Prototypical Stress Timed language (henceforth PST); this taxonomy will be used throughout the paper.

According to B&B, the smallest functional unit of phonology is the beat. "A beat is a unit rather than a measurement or device (…) and as such needs some referent in phonetic reality (…). In Beats-and-Binding phonology a beat is *a regularly recurring skeletal prosodic unit of phonological representation, of a size corresponding to that of a segment*" (Dziubalska-Kołaczyk 2002: 86). The primary rhythm units are feet, the beats being their constituents. The universal preference is a trochaic pattern consisting of two beats, the first beat being preferably strong and the second weak. The preference for a binary foot pattern can be subsumed under the universal preference for binary paradigmatic and syntagmatic contrasts. The next level beyond rhythmic (Level 0) preferences is that of binding preferences, which are posited as Level 2 of the phonological architecture.

The three phonotactic positions in B&B Phonology – word-initial, word-medial and word-final – cannot be considered on an equal basis due to the semiotic foundations of this model of phonology. Even if the cluster space for finals on Level 2 is

a mirror image of the space for initials, there is a preference for a word initial n→B and word final B←n. The salience of word onset has priority and may also conflict with other preferences, and the morphological structure of the word may subdue binding preferences (Dziubalska-Kołaczyk 2002: 95, 107). The B&B concepts that this presentation will make use of, are:

(i)   Level 0 preferences (rhythmic preferences)
(ii)   Level 1 preferences (binding preferences)
(iii) n →B a rightward binding
(iv) B←n a leftward binding

One of the landmarks of Natural Phonology is the claim that language is "a natural reflection of the needs, capacities, and world of its users" (Donegan –Stampe 1979: 127), rather than a conventional institution. Stampe assumes that the underlying segments "are mental representations of sounds which are, at least in principle, pronounceable" (Stampe 1979: 35). Thus it follows that explanations in phonology cannot be theory internal but must be based on phonetic facts and on the nature of human communication: "if a given utterance is naturally pronounceable as the result of a certain intention, then that intention is a natural perception of the utterance" (Donegan and Stampe 1979: 163). As stated concisely by Nathan,

> Because phonemes are sounds as perceived, this means that they are auditory/ motor images of sounds per se, not abstract specifications for sounds. Thus contrary to what is usually believed in most (but not all) generative phonologies, phonemes are not 'merely' lists of features. And particularly, they are not underspecified lists of features. It is important to how NP works that phonemes are real (although mental) sounds, fully specified. What makes them phonemes, rather than just records of how speakers actually speak, is the existence of processes.
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> (Nathan 2009: 142)

There is also a basic and essential distinction in NP between morphonological rules and phonological processes, which, it

should be noted, were used widely in pre-generative approaches to phonology. Natural Phonology places a strong emphasis on operationalizing these two epistemological categories. The active, living pattern is thus described as a (phonological) process and the (partially) morphologized situation is an example of a (morphonological) rule (as e.g. in the distinction between the umlauted and plain vowel in German). Summarised briefly,

> [w]hile processes are natural, rules are conventions (though they basically originate from processes. Although they both operate on phonological material and produce phonological output, only processes are sensitive to phonological environment: rules must be conditioned outside of phonology. Thus, though both processes and rules have to do with phonology, they have different ontological status. The following differences obtain between processes and rules: *Processes*: 1. Possess synchronic motivation 2. are inborn. *Rules*: 1. Have no synchronic motivation 2. Have to be learned.
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> (Dziubalska-Kołaczyk 2002: 25)

As Dziubalska-Kołaczyk (1995: 46f) points out, "[t]he explanatory model of noncoventionalist, natural linguistic must be functional". Of seven basic properties of such functionalist explanations the scholar mentions, I would like to recall here two, of most direct importance for the present paper: the hierarchy of functions which stipulates that the highest functions of language are its communicative and cognitive function, and the remaining ones subordinated to it, and most important still, "functional predictions have the form of preferences. This means that naturalist linguistic universals, founded on functional and semiotic principles, have the form of preferences and not of absolute statements" (Dziubalska-Kołaczyk 1995: 47). This preferential aspect is of key importance to the analysis that follows.

The phonological interpretation proposed in the paper will rely on my extension to the B&B model, namely a suggestion that the so-called 'stress-basedness' of a language is phonologically grounded in the property of a binding relation prevailing

in a given synchronic state of a language. As Dziubalska-Kołaczyk observes, on the level of Language Universals, each language has the potential to be either stress-timed or syllable-timed. In other words, each language has elements of both types, which are shown, for example, in the differences between casual and careful speech. It is only on language-specific levels that the final type is determined for a given synchronic state (Katarzyna Dziubalska-Kołaczyk, p. c., 2004).

To formalize the difference between binding types, I propose that stress-timed languages, of which English is one, can develop *stress concentrators* as a property of their bindings. The term is borrowed from mechanics, where it is denoted by the letter sigma (σ). In technical terms, σ describes concentrations of high stresses in a given material which arise from the structural features (holes, grooves etc.) of the material. The stress concentration factor (K), which is a dimensionless unit, qualifies how concentrated the stress is. It is defined as the ratio of the highest stress in the element to a reference stress (nominal stress). The reference stress is the 'default' stress in the same element under the same loading conditions but without the stress concentrators (cf. e.g. Pilkey and Pilkey 2008). The term *reference stress factor* will be useful in my analysis because stressed beats occur in both languages. A stressed beat in Spanish can be assumed (with some degree of analytical idealization) to be a nominal one. There is then something additional that 'sits' on an English stressed beat and to which phonology reacts. I propose that this 'something' is a stress concentrator: an irregularity in the binding.[7]

The phonological stress concentrator can be denoted, just like the one used in mechanics, by the letter sigma. To avoid confusion with the already well-established symbol for a syllable, however, it might be better to use a capital letter (Σ). Sigma values are directionless, hence they can be a feature of

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[7] It is possible, if analyzed using a visual speech-analysis program, that not much difference between the intensity of a stressed vowel in English and Spanish would be found. The difference is thus purely phonological: not visible directly, but observable through its effects.

both n→B and B←n bindings. In the case at issue here, it is the B←n binding that carries the Σ. I will denote this binding as B← $^{\Sigma}$n. The sigma is near the nonbeat to denote that it is the consonant that is affected.

It must be reiterated here that Σ does not denote simply stress. If that was the case, Σ would be a diacritic. Stressed beats are present in both English and Spanish, but the Spanish stress does not encounter a concentrator within the beat, and thus, as pointed out above, Spanish stress is the nominal, sigma-less one. The concept of sigma can thus make predictions and it can formalize and phonologically explain the well-known distinction between syllable-timed and stress timed languages by resorting to a property which ensues from the B&B model: the property of a binding relation.

4. The data

The first step of the analysis involved compiling a list of Greek and Latinate prefixes in English which end in /s/ to check whether any of them share the same stress-dependent lenitive propensity with {ex-}. A tentative list of such prefixes (formatives) in given under (1).

(1)   a.   {abs-}   /əbˈs, ˈæbs/ 'from', 'away from'
       b.   {as-}   /əˈs, ˈæs/ 'to','towards'
       c.   {bi(s)-} /baɪ/ 'two', 'twice'
       d.   {cis-}   /sɪs/ 'on this side of '
       e.   {dis-}   /dɪs/ 'away from', neg.
       f.   {ex-}   /ɪˈgz, ˈɛks,ɪˈks/ 'out from', 'off', 'away from'
       g.   {hex-}   /ˈhɛks(ə)/'six'
       h.   {mis-}   /mɪs/ 'bad, 'wrongly'
       i.   {sex-}   /sɛks/ 'six'
       j.   {sus-}   /ˈsʌs, ˌsʌs, səsˈ/'under', 'in addition to'
       k.   {tox-}   /tɒks/ 'poison'
       l.   {trans-}/trænz, træns/ 'through'

Next, a database of vocabulary involving these prefixes was created, with the analytical criterion being the presence of the voicing of /s/ in an intervocalic position (or a final prefixal obstruent cluster involving /s/). Relevant examples with {cis-} involve: (Sp.): *cispadana, cispadano, cismontano* (situated in the yonder part of the mountains), *cisalpino*, (E): *cispadane, cisnormality, cisman, cismontane, cisalpine* /sɪs ˈælpaɪn/. Only the last of these examples involves the intervocalic context with the following tonic beat. However, no voicing of /s/ is effectuated. Examples with {dis-} and {mis-} follow basically the same pattern: there is no stress conditioning of the realization (in fact, no item with the prefix stressed was found at all), nor any voice assimilation related to the succeeding obstruents (e.g. *disgruntle, disdain, disbelieve, misjudge, misguide*).[8]

As far as concatenations involving *sex-* as a prefix are concerned (disregarding contexts where it is followed by a voiceless stop, e.g. *sextile, sextet*), I was able to find the following examples with potential relevance for the analysis: (E): *sexes, sexagenarian, sexagenary, sexagesima, sexagesimal*; (Sp.): *sexagesimal, sexagenario, sexagésimo* 'sixtieth', *sexenio* 'six-year period'. Nothing of phonological interest arises here, however: all the Spanish items behave according to the general voicing rules for Spanish (i.e. [s] intervocalically, and before voiceless consonants, and [z] before any voiced consonant). The English pronunciation is equally regular, with /ks/ throughout, regardless of the stress pattern. The compounds with {tox-} fall into the same category: *toxin, toxaemia* and *toxicology* are all pronounced with a voiceless cluster. {hex-} is quite productive, but in fact the allomorph in question seems to be {hexa-} (/ˈhɛksə/ with either primary or secondary stress on the initial /e/), e.g. *hexa· emeron, hexangular, hexapod, hexahedral*, hence it might be of no relevance to the discussion. The realization is voiceless regarding the stress pattern.

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[8] Assuming that English has a lenis-fortis contrast instead of a voiced-voiceless one, we should not expect assimilation here as /g, d, b/ in English are only passively voiced.

Additionally, {sus-} did not produce any clusters of relevance to the analysis.

The phonological situation in the case of {trans-} seems to be different however. First of all, the basic form of this prefix, as given in dictionaries, involves both realizations (a voiced or voiceless alveolar fricative).[9] Sobkowiak explicitly assumes that "the phonetic form of the prefix in isolation is /trænz-/. This form is retained before vowels and voiced consonants (including sonorants) but assimilated to /træns-/ before voiceless sounds with the exception of *transcontinental, transpolar, Trans-Siberian*" (Sobkowiak 1996: 56).[10] Yet, intervocalic contexts in fact involved ambiguities because dictionary entries could give both realizations as possible in particular words (with the voiced and voiceless fricative). [11] Since the variation seems to be in fact independent of stress patterns, this prefix cannot contribute evidence to the argument forwarded. Another fact is that the concatenation is not an obstruent cluster and the focus is on voicing dynamics for obstruent groupings.

The situation with the {abs-} prefix is somewhat more complicated. All vocabulary items in relevant contexts point to a morphological boundary after /b/ and not after /s/, because there is no voice assimilation at all between the obstruents of the resulting clusters (e.g. in *abscond, abscess, abstergent* the

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[9] /nz/ seems a more 'natural' realization, since there is a common natural process voicing consonants after nasals - /ns/ is rare; usually a stop is inserted, or the nasal consonant is deleted leaving the preceding vowel nasalized.

[10] Although for example *Longman dictionary of contemporary English* 2005 gives both versions under *translation* or *transliteration.*

[11] A good example of the problem is the realization as given at one of the internet pronunciation platforms, Forvo (<http://pl.forvo.com/word/transi tive_verb/#en>, accessed 12 September 2011) for the entry *transitive.* There were two realizations for the *transitive verb*, and one of them was voiceless and another, voiced. The Spanish correspondents are perfectly regular. In clusters such as e.g. *transcendencia*the /n/ is usually elided and the fricative is voiceless (/tra (n)sθen-/). Intervocalically the elision does not apply, and the /s/ always remains voiceless regardless of stress placement (the direction of voicing, as has been mentioned, is regressive in Spanish), e.g. *tránsito*/ˈtransito/, *transído*/tranˈsido/ 'racked with pain'.

realization is unanimously /-bs-/). However, when /-bs-/ occurs in an intervocalic position with the primary or secondary stress falling on the beat following the /s/, as in *absolve*, *absurd*, *absorb*, there is an option for the voiced realization of /s/.

There is no <ex-> in Latinate English vocabulary before voiced consonants for diachronic reasons. Cummings (1988: 182) provides a list of all the possible assimilations that have occurred in these environments for centuries. Not a trace of /ks/ ([gz]) remains, even in the orthography in words of the type, e.g. *ebractate, elegant, event, erudite* etc.: the assimilation into the root consonant has been total. The closest I could find to a vestige of a voiced 'ex-exword' was *eczema*, which seems to follow a stress-dependent lenitive pattern because two pronunciations of the word are licit. If stressed on the first vowel, the realization is /ks/, and when stressed on the penultimate, the /gz/ realization occurs: /ˈɛksəmə/ versus /ɪgˈzimə/.

{exo-} is a Latinate prefix, meaning 'outside' or 'outward'. It is not enumerated in the list in (1) as it does not have a final /s/. Nevertheless, a vocabulary check on items containing this morpheme was also run because, theoretically, <ex> is in an intervocalic position in {exo-}. Obvious examples of the {exo-} prefix are words of the *exoskeleton* type, but sometimes it is problematic to classify <o> as belonging to {exo-}, being an infix, or to the root. This etymological ambiguity, however, turns out to be of minor importance: all the words seem to conform to the pattern presented above. In cases where <o> is under stress, primary or secondary, the cluster is realized as /gz/, e.g. *exonerate, exorbitance, exotic*. Words of the type *exoskeleton* or *exoteric* have secondary stress on *ex* and primary stress on the vowel following <o>, e.g. /ˌɛksoˈskɛlətn̩/, hence no stress occurs on the vowel following <x>and the cluster surfaces as voiceless.

This step in the analysis shows that the focus in the subsequent discussion on {ex-} is not ad hoc as there are morphono-

tactic and morphophonological grounds for excluding other Latinate prefixes terminating in /s/ from the overall discussion.[12] Nevertheless, this stage of the research also reveals a certain ambiguity: in some prefixed words stress-driven lenition is not triggered, even if the metric pattern parallels those forms with triggered voicing, e.g. realizations of concatenations of the type *ex-immigrant* never show voicing, as in *executive.*[13]

5. Analysis

This section attempts to critically address some of the conundrums revealed by the referential research. First, instances of the pronunciation of <x> in {ex-} were inspected (in the types of database sources described in the introductory section), and typologically synopsized in Table 1.

While compiling the database it also became evident that the voicing pattern seems to occur in all instances where <x> is word-initial, in the lexicon involving borrowings from Greek (e.g. *xenophobia).* It must be admitted that all the items that could be found had stress on the vowel following the <x>, either primary (*xylophone*) or secondary (*xenophobia*). These words were also entered in the table.

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[12] On the other hand, there seem to be problems with establishing the exact form of the prefix: it is not entirely certain that dictionary forms such as {abs-} and {hex-} are legitimate, because there may well be basic forms as {ab-} only and {sexa-} and {hexa-} (with an infix). Regretfully, this issue cannot be pursued further within the scope of the present discussion.

[13] This difference is addressed in e.g. Haładewicz-Grzelak (2015b), who proposes that there is a different cognitive status for Latinate vocabulary. For example, the Latinate {ex-} with all its original plethora of meanings is no longer semantically transparent and there is a synchronically productive prefix, with only the meaning 'former', as in *ex-husband.*

Table 1

Juxtaposition of some general types of the pronunciation
of <x> in English and Spanish

	English		Spanish	
	Types	Examples	Types	Examples
1	V/ks/ S⁻ᵛ**V** (...) **V**	exclude expectations extract	V /(k)s/ S⁻ᵛV S**V**..	excluir extraer expectar
2	V/gz/ <h>**V**S	exhibit exhort exhausted exhilarate	V/(k)s/V S**V**(S**V**)..	exhibición exhorter exhaust
3	V/gz/**V**S (VS)	exam exist auxiliary exiguous	V/ɣs/(**V**)S(**V)** (S**V**)	examen existir auxiliar exiguo
4	**V**/ks/VS(VS)	exodus exile toxic hexagon axiom	**V** /ɣs/VS...	éxodo tóxico
			V /ɣs/ **V** S**V**(S**V**)	exilio axioma hexágono
5	/z/**V**SVS..	xylophone	/s/VS**V**SV	xilófono
6.	V/gz/ ˌ**V**S...	exhibitionism exercitation exemplification		
7	V/ks/<c>V̲	excess excerpt excite	V/(k)sθ....	exceso excitar

The table gives specifications according to stress patterns in
English with their Spanish counterparts, thus illustrating
a phonology that does not react to a stress pattern with
a homophone. In Spanish, as can be seen, the changes are
purely due to phonotactic factors: before a consonant, /k/ is
usually elided orspirantized (e.g. *experto* → /esˈperto/ 'expert')
and intervocalically it is usually realized as [ɣ]. /s/ is always
voiceless in both cases (Navarro-Tomas 1991: 140). Since <h>

is always mute is Spanish, it is not heeded by the phonology of the language at all.[14] This pattern is obeyed by any NAD ratio of this type, i.e. it is decided solely by phonotactics and the optimization of Level 2 preferences.

Let us next consider the English part of the table. For clarity of exposition, I mark the tonic vowel in bold and underline. The data is subcategorized into seven types. [1] describes a situation where <x> is followed by another consonant. Regardless of the placement of stress, (whether it directly follows the cluster or is placed further right), the realization of <x> is always voiceless.[15] [2] involves contexts where the cluster is followed by <h>, which is not realized phonetically. In practice, then, [2] is tantamount to [3]: <x> if placed in intervocalic position in pre-tonic position (the primary stress falls on the beat following the cluster). [4] also involves <x> placed between vowels, but in the post-tonic position (the stress falls on the beat preceding the cluster). [5] includes <x>s which do not come from the prefix, but the situation seems to follow the paradigm operative in the {ex-} case (patterns [2–3]): the stress falls immediately after the cluster (with the prior elision of /k/ due to unpropitious NAD preferences for a word-initial cluster in English) and the remnant /s/ becomes voiced. [6] implies an intervocalic pattern (as in [2–3]), with the difference being that the stress operative in the immediate vicinity of the cluster is secondary and not primary.

I suggest that what happens in data collected as [7] is lenition of the basic voiceless realization.

The data categorized into seven types in Table 1 can be further collapsed into four types (algorithms). They are summarized briefly below:

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[14] In difference to e.g. French, where in some words the underlying /h/ can still influence phonological processes (*h muet* versus *h aspiré*).

[15] Although sometimes two versions are possible, as in the word *exit*, two alternative versions were given in the dictionaries consulted: /gz/ and /ks/. This fact only supports the preferential and natural nature of the phonological regularities.

Algorithm 1. The intervocalic <x> cluster is not in a pretonic position (no information from Level 0 is fed into the phonology), nothing happens. The B←n binding is weak and not able to host any stress concentrators nor, hence, to transfer stress. The realization is /ks/ (type 4, e.g. *toxic*).

Algorithm 2. Worst-case scenario. The <x> cluster is in a pretonic position, which means that /s/ is bound by the n→B binding with the following V. According to my analysis, this binding carries a stress concentrator, to which the phonology reacts.[16] I will denote this binding as n^{Σ}→B. The sigma is near the nonbeat (consonant /s/ in this case) to denote that it is the consonant that is affected. Lenition spreads to the next occlusive as voice assimilation, giving the realization /gz/. This is the case with types (3), (5) and (6) (e.g. *auxiliary* or *xylophone*), where, in the latter, phonotactic preferences additionally enter the picture and the first stop is deleted. If it were to be pronounced, the stop would be voiced. In (6), in all cases (e.g. *exemplification*), the trigger is secondary stress, which confirms the sensitivity to the stress factor of the particular phonological process: in the absence of the 'main' trigger, the algorithm is driven by the secondary one.

Algorithm 3. The cluster precedes the tonic beat, which is bound with the n^{Σ}→B binding, as in the worst case scenario (algorithm 2), but bound with the following voiceless stop, which means the preceding fricative is not bound at all but sustained only by Level 2 preferences. Nothing happens in these cases: the pretonic "worst-case scenario" is neutralized. Hence, algorithm (1) applies (cf. type 1, e.g. *expect*). The data classified in Table 1 under (7) at first glance seem to contradict the results obtained so far: e.g. in *excess* <c> is not pronounced, just as in *exhibit* or *exist*, <x> seems to be intervocalic with the stress following, hence it should be pronounced as voiced (i.e. it should belong to algorithm 2). Assuming compliance with the general thesis of the paper, that orthography

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[16] Stress concentrators are directionless; hence, according to my analysis, they can affect both the n→B and B←n bindings.

can be important as external evidence, let us take a closer look at the whole of the row in (7).

It can be noticed that the Spanish realizations retain the phonetic content of <c> in the form of a voiceless interdental fricative: /e(k)s ˈθeso/. This scenario is hence proposed to have arisen as follows. At some time in the past, when the voicing in question started operating as a stress-conditioned natural process (cf. previous subsection), this <c> in English still had its phonetic content, as a voiceless lenited variant of /k/ before front vowels. Accordingly, the cluster behaved like any in type (1): a voiceless consonant following /ks/ prevented voicing of the cluster. Since the English articulation was probably much closer to /s/, the two segments coalesced, leaving <x> in the intervocalic position. The irrefutable fact is that synchronic phonology still retains this earlier pattern. The question thus arises of why words such as *except* /ɪkˈsept/ still pattern like e.g. *expect* and have not come within algorithm (2). Several explanations are possible, the most plausible being that phonology somehow still sees this /s/ as being without melodic content and thus triggers the algorithm as if it was still there. The standard NP interpretation might imply that the phenomenon in question might not in fact be operating as an exceptionless phonological process but has passed to the level of a rule, and this passage happened after the elision of the /s/ in *except*, which complies with the ontology proposed in the previous subsection.[17]

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[17] For a canonical generative analysis of the issue see SPE p. 221, a derivation of e.g. *exceed*, *excite* from underlying stems as /kēd/, /kīt/, with /k/ turning to /s/ by Velar softening (this would actually be [kᵈ]). Then there will be an intermediate stage of the derivation, [eks=sīyd], [eks=sāyt], and finally a rule of cluster simplification would apply (a rule eliminating the first identical consonant in the geminate). There is thus no voicing in *excel* due to the fact that the rule voicing prestress consonants is blocked by the cluster of three consonants (Chomsky and Halle 1968: 221f). We can clearly see the epistemological gist of generative grammar: the assumption that the underlying representations do not basically change but have to become more and more dissociated from any reality to account for the changes. This results in disregarding language diachrony and not bothering with whether the process in question might still be active or not. In short, this means that morphologi-

Algorithm 4. The situation involving /h/ is somewhat more complex than the previous phonotactic concatenations. It is assumed that /h/ is the weakest consonant in English.[18] Dictionaries often give two alternative pronunciation options (e.g. the Collins Cobuild dictionary gives the pronunciation of *exhume* as /ɛkshoˈ**ju**ːm/. The Oxford Spanish-English Dictionary gives, in addition to this, the realization /ɪgˈzuːm/ as well. The latter, voiced version is given in the Forvo online spelling dictionary as the only realization (<http://photactic_concatenatio ns.l.forvo.com>). Both versions are in fact justified by the analytical frame adopted here: in the realization with /-ksh-/ algorithm 1 is operative: V/ks/ S⁻ᵛ**V**. In other words, if English phonology happens to "see" the *h*, it is 'recognized' as a voiceless consonant and the algorithm for the position preceding voiceless stops is triggered. If the phonology does not see the *h*, i.e. if the /h/ is too weak to matter for phonological processing (which is mostly the case with *h* being placed before the tonic beat), algorithm (2) applies (worst-case scenario – execution with a voiced cluster). Hence, this algorithm is practically tantamount to (3) (when *h* is realized) or to (2) (when it is not realized).

In functional terms another explanation of the /h/ conundrum is thus possible. In utterances where /h/ is able to resist the tonic beat pressure, the algorithm given in (1) is triggered. In cases where the tonic beat (level 0 preferences) with the stress concentrator are stronger than Level 1 preferences, the $n^\Sigma \rightarrow B$ 'overwhelms' the /h/ (induces the lenition of /h/ to ø.). In such cases nothing protects the /ks/ cluster and the situation is clear, as in algorithm (2). This analysis also confirms the key status of the binding as a carrier of certain mental information, in this case the active nature of a stress con-

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cal rules are thrown into the mind of a competent speaker who has, in real time, to do all the concatenations, as in *correlate,* which, according to SPE, has an underlying representation with /koN=/. In Chomsky and Halle's words, "[i]t is a widely confirmed empirical fact that underlying representations are fairly resistant to historical change, which tends, by and large, to involve late phonetic rules" (Chomsky and Halle 1968: 49).

[18] See Zabrocki (1960 [1980: 56]).

centrator on n→B in stress-timed languages. Additional evidence comes from the fact that /h/ is not normally mute in English in initial position (when supported by an n→B binding). For example, in *hilarious* the /h/ is regularly pronounced, yet it gets elided in *exhilarate.*[19] Moreover, the elision does not occur in any other Latinate compounds, as a check of the forms with {co-, mis-, dis-} confirmed. But if the words are used without the /h/ in their basic forms, as in *honour* and *honest,* no derivatives feature the sound, either, in these compounds; if the basic version does involve the form with the /h/, the compounded form does not eliminate it, e.g.

(2) a. *disharmonious* /ˌdɪshɑrˈmonɪəs/ (AE)
    b. *mishap* /ˈmɪshæp/
    c. *cohesion* /koˈhiʒən/
    d. *disheartening* /dɪsˈhɑːtn-ɪŋ/
    e. *mishandle* /mɪs ˈhændl̩/
    f. *cohortative* /koˈhɔrtətɪv/ (AE)
    g. *anhydrous* /ænˈhaɪdrəs/

The algorithms proposed above can also explain the issue of the pronunciation of /h/ in some derivatives. For example, in *exhortative* the /h/ is elided according to the procedures above, but in *cohortative*the /h/ remains. The basic form is of course that of the form without suffixation, where the velar fricative is pronounced; hence there is ground to posit elision in {ex-} derivatives (cf. *hilarious* versus *exhilarate*). Furthermore, there is no voice assimilation at all in the remaining suffixes ending in /s/, e.g. *misguide, misnomer, disburden, disgruntle.* Looking deeper into the data, it becomes evident that the last two types are in fact superfluous: the phonological behaviour of the concatenations does not show any new variables: it is either a lenitive process that is triggered or it is not.

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[19] From *ex* 'thoroughly' and Lat. *hilarare* 'to make cheerful', versus Lat. *hilarus* 'cheerful'. Source: <http://www.etymonline.com/index.php?term=ex hilarate>.

Then, what first emerged as descriptive in seven different types, collapses into four scenarios which are still reducible to two algorithms: trigger lenition or do not trigger it.

The study has shown that the initial seven observable contexts, reducible in the first step of the analysis to four algorythms, in fact boil down to one basic phonological lenition context for the Latinate {ex-}. In traditional notation the situation can be described as follows:

$$(/ks/ \text{ in } \{ex\text{-}\}) \;\rightarrow\; \begin{cases} [gz] \_ \begin{cases} \text{'V} \\ \text{,V} \end{cases} \\ [ks] \;/\; \_ \text{ all other environments} \end{cases}$$

Figure 1
A traditional description of the regularities encountered
on the basis of the juxtaposition in Table 1 for the English data

It reads thus: the /ks/ cluster in {ex-} becomes voiced when immediately followed by a vowel with primary or secondary stress (in *SPE* the secondary stress is not taken into account, hence this is another contradistinction of my analysis to *SPE*). Simply, lexemes, e.g. *exemplification,* are not considered in the sections on /s/ voicing. As can be seen from Figure 1, the pretonic position (with primary or secondary stress) is the only environment that is different from all the remaining ones, which is an exact parallel to the one shown in my previous work on *angma* assimilation with the {con-} prefix.

The discussion thus shows that, in English, in cases not previously decided by the morphology, the tonic beat can induce lenition of the /ks/ cluster. The process can clearly be seen in derivatives, as in the case of, e.g., *execute*, where the basic realization is /ks/ and word-initial stress, versus *execu-*

tive, where the shift in stress implies lenition into /gz/.[20] The lenitive process is also indicated by the fact that <h> in cases with the lenitive algorithm triggered is lost. In the algorithms without lenition it is seen as a standard voiceless vowel, but in the binding carrying the stress concentrator, any psychological reflection of <h> is lost: concatenations such as *exˈhilarate* are straightforward instances of pattern (3) [V/gz/ ˈVS(VS)]. In such cases the lenitive process has operated as far as possible: it voices the intervocalic cluster and has eliminated the weak /h/.[21]

As a final step in the discussion I would like to address the suggestion of reversing the scenario, and positing that all that happens here involves the protection of intervocalic /ks/ by word-initial stress. Basically, I see no reason to do this. The B&B discussion is coherent in its present form and, additionally, it explains other related phonological issues, such as the elision of /h/ in derivatives, the velar versus alveolar nasal opposition in {con-}, the issue of *except* where <x> is in an intervocalic position and always realized as voiceless, and the voicelessness of the cluster in *ex officio* or *exhume* (as /ɛkshˈjuːm/ or /ɛgzˈjuːm/). Adopting the suggestion of "in intervocalic position, *gz* everywhere except if preceded by a stressed vowel, in which case *ks* occurs" would mean that all these generalizations are lost and independent explanations would have to account for these issues. Furthermore, it would

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[20] This is also the case with another Latinate prefix, showing similar sensitivity to stress- {con-}, e.g. *congress* versus *congressional* and additionally, a possibility of dyadic stress patterns on *conglobate* which entailed concomitant changes in the nasal realization.

[21] Some dictionaries, e.g. the *Pronunciation dictionary of American English* or *Merriam-Webster*, give two possible realizations for<exh>**V**S types with /gz/ and /ks/. However, most online sources, e.g. *Forvo*, give the version confirming the pattern proposed here. It might be concluded that the above analysis is stated in terms of preferences and tendencies rather than general laws, which is also congruent with B&B tenets. The tendency is thus that phonology tends to classify cases with <h> to follow an algorithm ruled by stress preferences.

have to be explained why, if a post-tonic position protects against lenition in <ex>, it induces lenition in {con-}.[22]

Let us now address some issues implied in other possible proposals. Assume that the scenario "in intervocalic position, *gz* everywhere except if preceded by a stressed vowel, in which case *ks* occurs" would run into several problems. First of all, the isolated form, as corroborated by current English dictionaries, is voiceless (e.g. *ex officio*). Secondly, contemporary morphological activity with {ex-} in English, as shown in the preceding subsection, clearly involves the voiceless form, even in concatenations such as *ex-immigrant, ex-girlfriend*. Finally, French vocabulary of type (F.) *luxe* 'luxury', *luxueux* 'luxurious', *luxurieux* 'lascivious', *axiome* 'axiom', *axiété* 'anxiety' involves only voiceless realization.[23] In English voiced realization is allowed or preferred, as in e.g. *luxurious* or *anxiety.* This voicing would thus be unaccounted for, and it would seem that the parallel with French is not that fortunate. In voiceless contexts, as in *expect,* the cluster is always voiceless. If the basic form were voiced, the cluster should behave as concatenations with {ab-} do, e.g. *abscond*, where the resulting morpheme contact is preserved without voice assimilation: /-bsk-/.

As Zabrocki points out, in the Germanic languages, groups of obstruents did not undergo crucial changes during the lenitive process, the obstacle being an augmented consonantal mass of a group of consonants.[24] This last fact also influenced another process, namely, voicing assimilation. These groups in their totality resisted this process. Increased lenition and what follows, assimilation, was also resisted in the case of a single

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[22] Most crucially, it is not usually the case that a tonic position protects from lenition. A random example is an analysis Mascaró proposes for Servigliano (2011), where "in Tonic Metaphony a final vowel causes raising of the stressed vowel (ε→e, ɔ→o, e→i, o→u)"(Mascaró (2011: 22). See also examples from English, where both flapping and the creation of syllabic consonants occurs exclusively after the tonic beat.

[23] *Multimedialny słownik francusko-polski PWN* (2006).

[24] Groups of obstruents of type *pst, sks* changed according to the rules of articulatory mechanics, as established by Zabrocki, and the only change was the spirantization of the first element (Zabrocki 1980 [1951]: 31 [135]).

consonant, namely long *s*. This clearly shows not only that the consonantal group as such resisted assimilation, but the augmented consonantal mass was supplied by the cluster (Zabrocki 1980 [1951]: 57 [171]. Examples given by Zabrocki include *giwahsan*, *gifohtan* (OE *gefohten*), *Gun-wiss*.[25] Since the analysis reported in this section deals with obstruent clusters and such clusters are not at all affected by Verner's Law, I conclude that this option is not relevant to the discussion.

It should also be pointed out that two factors are usually cited as hindrances to lenitive voicing under Verner's Law: one is stress and the other word-initial position. The data shown in Table 1 actually shows that the word-initial position is affected just as much as the word-medial one (cf. *xylophone*), and unlike all other Greek loans (e.g. *pterodactyl*) it has voicing after the elision[26], so neither preservation of the cluster nor the influence of preceding stress can be posited. Hence, if we adopt the scenario of "in intervocalic position, *gz* everywhere except if preceded by a stressed vowel, in which case *ks* occurs" or the underlying version as coming directly from French, we would have in addition to explain the voicing of /s/ from <x> in word-

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[25] As evident from an example from Reszkiewicz (1973: 42), clusters involving a preceding liquid could also be affected: "[w]hen the original /-rs-/ was voiced to /-rz-/ through Verner's Law, Gmc. */-rz-/ resulted in /-rr-/ in Old English, cf. OE *i(e)rre* 'angry' and Goth. *aírzeis*". See the detailed discussion of the lenitive development of clusters involving liquids and nasals in Zabrocki (1980[1951]:58ff [172ff]). Reszkiewicz also mentions the devoicing of voiced consonants that took place before /s/. "In this way, IE*/aks/ (L. *axis* (...) > PG */aks-/ (cf. OS *aksa*), which in Old English, after the regular shift back from /xs/ to /ks/ appears as *œx, eax*. Likewise (...) IE */uks-/ (Skt. *ukṣa*) PG * /uxsōn-/ (OS *ohso*) > OE *oxa*'ox'" (Reszkiewicz 1973: 44).

[26] The French realizations (e.g. *xénophobie* or *xérographie*) are pronounced with a full /ks-/ cluster – according to *Multimedialnysłownikfrancusko-polski PWN* (2006) and *Dictionnaire General de la Langue Française*(1964) (e.g. (*xiphoïde, xérasie*). Although it must be admitted that the contemporary *Dictionnaire Culturelen Langue Francaise* (2005) gives both forms (/gz/ / /ks/) as licit in this phonotactic environment. Definitely the inspection of French data merits further research, which is left for further, diachronic study. For the present mainly synchronic analysis, of importance is the fact that in French all intervocalic occurrences of /ks / custer from {ex-} (e.g. *exo- exi- exa -*) are voiced, and so is the realization involving orthographically (<h>). All realizations involving *exc-* are, just as in English, voiceless. The phrase *ex libris*is also voiceless in French, just as in English.

initial positions. It must also be recalled at this point that the previously mentioned SPE rule explicitly assumes an /s/ voicing rule and nota/z/ devoicing one.

Recapitulating the discussion so far, the prefix {ex-} (just like {con-} and {in}) is unusual in English, in the sense that it shows a sensitivity to stress, in which it patterns with the cluster denoted by <x> and not with any other prefixes, even these ending in <x>.[27] However, the nature of this lenitive process seems to be elusive. It seems to entail only those lexemes where the original prefix is still detectable in orthography as a sort of phonological *corpus delicti*,[28] even if the lexemes involved have now acquired an entirely new meaning with only loose semantic ties to their original components and do not entail 'living' concatenations with {ex-}, nor with any other /s/-final prefix.

6. Conclusions

The study in question conducted a Beats-and-Binding exploration into some areas of the influence of stress within the general architecture of phonology, as exemplified in a case study of the {ex} prefix in English. Spanish lexemes were assumed to be the reference level for homophonous English ones, i.e. not influenced phonologically by the stress placement. A notion of stress concentrator was proposed as a critical variable to ac-

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[27] It might be recalled that for SPE the difference between the voicing in *exam* and the lack of such voicing in *toxemia* is that in *tox* the <x> is final in the formative. Chomsky and Halle disregard here the fact that *ex*, just as *pre-, tele-, -tion, mini-* (as in *mini + ster*) etc. is also formative. The fact that *ex* in SPE goes with a [–FB] boundary is unfortunately not a teleology of the lack of the formative status of *ex*. Cf. also this passage: "There are many verbs in English that are morphologically analyzable into one of the prefixes (trans, per, connect, followed by a stem such as –fer, -mit, -cede, -cur or –pel (...) The stress placement rules must assign primary stress to the final **formative** [emphasis mine, MHG] in these words, regardless of whether it contains a weak or a strong cluster" (Chomsky and Halle 1968: 94).

[28] As pointed out in e.g. Denning et al. (2007), concatenations with {ex-}, just as {in-} and {con-}, diachronically involved considerable assimilatory elisions, e.g. *ex + vade = evade, ex + mitt + ing = emitting* (Denning et al. 2007: 121).

count for the empirical findings, this was conceptualized as a possible property of the binding in PST languages, to which phonology reacts. The phenomenon in question was identified as lenition in the tonic-beat environment in English: the voicing of /s/ to [z], which in turn falls within the broader intricate topic of /s/ voicing in English. In Spanish, this type of lenition never occurs, as long as the first consonant is pronounced as a voiceless stop. We can see this as a clear advantage of B&B analysis: the four-layered architecture helped to account for the different status of word-medial cluster voice assimilations in Spanish and English: in Spanish they are effectuated only by Level 2 preferences: in *isla*, /s/ is voiced to [z] and in English they can be triggered on Level 1 (due to underlying Level 0 preferences).

The difference of the present analysis with the traditional SPE-based notation (cf. Fig. 1) is clear. Theoretically, nothing prevents the 'rule' to be written the other way round (see Scheer 2011 on that point): , that is e.g., with devoicing in the post-tonic position. The 'rule' is still a description, and does not make any predictions; nor does it influence the rest of the phonological architecture. The present analysis was a bottom-up procedure, where only the pre-assumed phonological units were able to make predictions, where explanations for the described situation were sought.

In the case of *ex*, as e.g. in (E.) *exam,* I propose the following binding scenario: $/\text{ı} \leftarrow \text{g z}^{\Sigma} \rightarrow \text{æ} \leftarrow {}^{(\Sigma)} \text{m}/$, /æ/ being the tonic vowel, stress concentrators develop in its bindings.

The n→B binding is directed at the fricative involved in a cluster, hence it can be affected by a stress concentrator. Following the work of Zabrocki on Verner's law, we can posit that both consonants bound by the sigma beat are indeed lenited (/k/ with the leftward binding and /s/ with the rightward one), but only in spirants is lenition visible in the form of voicing. To compare, lenitive processes in the case of the Spanish cognate (identical tonic beat) are as follows: Sp. *exámen* [e ←ɣˈ s → a m →e ← n]. The lenition in that language is pure-

ly phonotactic and it can be interpreted as ensuing from the fact that the B←n binding in this language is very weak *per se* and can only support less salient (weaker) consonants, hence there is a preference for word-final lenition and elision.

The phenomenon of stress-conditioned voicing certainly applies to monomorphemic /ks/ clusters (cf. *luxury – luxurious*, see also the SPE rule in [1]), just as in all morpheme internal concatenations with <ing> (e.g. *Ingham*) the /n/ obligatorily undergoes velar assimilation. Hence, the patterning of {ex-} with these lexemes points to the obliteration of the morpheme boundary. The process is not activated in the contemporary lexicon with hyphenated {ex-} where the boundary is still present (morphology, as BB assumes, has priority over phonology, hence the stress pattern does not matter in these cases).

Yet there is a lot of evidence to suggest that the phenomenon only seems to affect /ks/ clusters and that no other fricative-obstruent clusters or fricatives seem to follow this rule. On the other hand, there is practically no material in contemporary English to compare with (there is the aforementioned *eczema* which, as shown in the preceding section, seems to confirm the analysis; but in isolated /ps/ clusters with stress following, as in *psychic, capsize,* the process does not occur). This issue cannot be resolved at this stage of the research, I will simply point out that in Hall's study on Italian data, cited above, the process also applied only to this type of cluster and Hall (1942) implies that these clusters show a pattern rather similar to /kt/ clusters. On the other hand, Zabrocki's structural phonetics (Zabrocki 1980[1960]) accounts for the diverging scope of an operation of a given phonological process.[29]

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[29] For Zabrocki, a structure represents an ordering based on inherent features, such as the degree of aperture. A system, as opposed to a structure, is an ordering based on functional features. Zabrocki further defines structural mass as a potential element of force in a given consonantal group. Its value is determined by the structure of a given process. Differences in the values of the structural mass depend on the character of the structural binding with respect to the structure of the process. Hence it can be concluded that language-specific parameters determine the minimal requirements for the structural mass involved in specific clusters, both in terms of

The issue which this discussion attempts to disentangle thus seems to lie at the intersection of several topics replete with caveats: i) the morphonology of English prefixes, ii) /s/ voicing in English and iii) stress-related processes. Another problematic matter is the status of word initial <x> (a context not covered in SPE at all). On the one hand, it shows voicing, which is in accordance with my theory, but on the other, this voicing seems to be independent of stress placement (e.g. the word *Xantippa* is also voiced while the initial beat is under neither primary nor secondary stress). It could be explained as a tendency for assimilation in monomorphemic clusters (i.e. the 'natural' situation with assimilation), and in an intramorphemic context there is no need for the support of stress to trigger the process; but on the other hand, the difference from the /s/ in *psychic* would not be accounted for unless the scope is precisely narrowed to <x> clusters, as was the case in Hall's (1942) analysis which patterned *ks* explicitly only with *kt* clusters. One way or another, one statement from SPE still seems to carry weight: "clearly there is a great deal more to the matter of voicing of [s] (and probably [f] and [θ] as well [...] that deserves more careful investigation" (Chomsky and Halle 1968: 228f.). This discussion can thus be treated as a form of heuristic exploration of a fragment of the maze of phenomena at the intersection of English prefixation, /s/ voicing and stress-induced lenitions. Within this exploratory scope and in light of the evidence I have managed to gather so far, the B&B scenario seems to congruently explain the phonological behaviour of the {ex-} prefix and also to relate this behaviour to other aspects of the phonology of English, disclosing new purlieus for further investigation.

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the ability to develop a particular binding and the resistance of these clusters to a given process (cf. Zabrocki 1980 [1960]: 57).

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