

Proposing Morphonotactics

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In this contribution we propose the establishment of morphonotactics as a subpart of morphonology based on previous research in morphonology, Natural Morphology and Natural Phonology, notably the Beats-and-Binding model of phonotactics. Our area of investigation concerns consonant clusters. Focusing on morphonotactics in English (6), German (7), Italian (8) and Polish (9), we establish a gradient continuum between morphonotactics and phonotactics and investigate the impact of morphological and phonological typology on cross-linguistic differences in the number and nature of morphonotactic clusters*.

1. Introduction

Phonotactic aspects of morphonology have not been treated as systematically as morphonological alternations (since Baudouin de Courtenay 1894, 1895) or rules (cf. Dressler 1985). In this contribution we intend to propose a distinct area of morphonology, i.e. morphonotactics, and argue for it within the semiotically based model of morphonology (Dressler 1985, 1996) and the phonotactic model of Beats-and-Binding phonology (Dziubalska-Kořaczyk 2002). Morphonotactics refers to the first of Trubetzkoy's (1931:161ff) three parts or tasks of morphonology, i.e. "the study of the phonological structure of morphemes". Trubetzkoy understood this merely in terms of the structure of single morphemes. And here we typically find, at least in languages approaching the inflecting-fusional type (cf. below), 1) most variety in shapes of lexical roots, in terms of both phoneme inventory and phonotactics, 2) less variety in shapes of derivational affixes, and 3) least variety, i.e. most restrictions, in shapes of inflectional affixes. This scale is clearly related to type and token frequency differences: lexical roots have the highest type frequency, but most lexemes a rather low token frequency, inversely inflectional affixes have the smallest type frequency but generally a high token frequency. Derivational affixes are inbetween. A pioneer of these studies was Jakobson (1962:108-109, cf. Kilbury 1976, Dressler 1985:232ff) with his claim: "the different grammatical classes of formal units can be characterized by a different utilization of phonemes and even of distinctive features". This field of investigation is outside the

scope of our contribution (more in Beedham 1994, 2005). It must be noted that these claims have been made, originally and even generally later on, for inflecting-fusional languages only, which nullifies much of Bybee's (2005) criticisms.

What we will focus on here is rather shapes of morpheme combinations, particularly when they differ from the phonotactics of lexical roots and thus signal morpheme boundaries, as in E. *seem+ed* /si:m+d/ (i.e., there is no lexical final [-md] cluster). This is a prototypical case of morphonotactics. This will lead us to the definition of morphonotactics as the area of interaction between morphotactics and phonotactics and to an emphasis on the transitions between morphonotactics and ordinary phonotactics. Among phonemic sequences of morphonotactic relevance, we will limit our study here to consonant clusters.

2. *Morphonology*

Morphonology has been defined in Dressler (1985, 1996) as the area of interaction between morphology and phonology with gradual synchronic and diachronic transitions from phonological rules or processes (PRs) via morphonological rules (MPRs) to allomorphic rules (AMRs). Morphonology is based on an integration of the theories of Natural Morphology and Natural Phonology (cf. Kilani-Schoch & Dressler 2005, Dressler 1996, Dziubalska-Kořaczyk & Weckwerth 2002). Both theories consist of three subtheories:

1. a subtheory of universal preferences (or universal markedness), which deals with universal parameters, such as iconicity and transparency, on the one hand, and with universal natural phonological processes on the other. The main function of morphonology is to co-signal morphological patterns;
2. a subtheory of typological adequacy, where in morphology (following Skalička 1979) languages are characterized for the degrees to which they approach ideal constructs of language types. In this contribution we will limit ourselves to the ideal inflecting-fusional, agglutinating and isolating type and will show that morphonotactics, like overall morphonology, is important only in the inflecting-fusional type. In phonological typology, polar notions such as vocalic vs. consonantal languages (cf. Maddieson 2006) and stress-timed vs. syllable-timed languages (cf. Bertinetto 1988 for an elaborate discussion) are relevant;

3. a subtheory of language-specific system adequacy which studies what is normal and productive in a given language.

One main question is now whether morphonotactics can be accounted for in all three subtheories as a subpart of entire morphonology.

3. Beats-and-Binding theory of phonotactics

In Beats-and-Binding theory of phonology (cf. Dziubalska-Kořaczyk 2002) the unmarked sequence of sounds consists of CV's (i.e. CVCV(CV)). Markedness starts with the introduction of any new consonantal phoneme into the sequence, e.g. CVC or CCV. The clusters which arise can be ordered on the scale of preference from the least marked to gradually more marked. The measure of markedness is the overall sonority, understood as a perceptual effect brought about to the ear by manner of articulation of sounds (MOA) as well as place of articulation (POA) and distance in voicing (Lx). In fact, rather than the overall sonority, it is better to refer to a net auditory distance to which all the three factors contribute (sonority, place of articulation and voicing).

The phonotactic preferences specify the universally required relationships between net auditory distances within clusters which guarantee, if respected, preservation of clusters. Clusters, in order to survive, must be sustained by some force counteracting the overwhelming tendency to reduce towards CV's. This force is a perceptual contrast as defined above. The *Net Auditory Distance Principle* (NAD) (cf. Dziubalska-Kořaczyk 2002, Dziubalska-Kořaczyk & Krynicki in press) defines the way in which segments should order themselves in a successful sequence. Optimal relations take the form of well-formedness conditions holding for double, triple and n-member clusters in all positions in a word, i.e., initial, medial and final.

The less respected the preferences are, the more marked clusters arise. In a typological perspective, consonantal languages are expected to have more dispreferred clusters than vocalic languages. The same applies to stress-timed vs. syllable-timed languages. In terms of system-adequacy, languages vary as to a language-specific tolerance to violating phonotactic preferences. What is allowed within a morpheme (a "phonological" or "lexical" cluster) in one language may be allowed exclusively across a morpheme boundary in another. The latter will be referred to as morphonotactic clusters.

4. Cooperative interactions between morphotactics and phonotactics

There is convergence between morphotactics and phonotactics, when morphotactic operations such as concatenation or apophony create normal phonotactic sequences which exist already in monomorphemic lexical words. For example, English preterit and past participle formation creates new sequences of /d/ preceded by homorganic sonorants /n, l, r/, as in *screen+ed* vs. *find*, *yell+ed* vs. *child*, *steer+ed* vs. *weird*. Such phoneme sequences are hardly apt to co-signal the application of morphological rules (MRs) and thus do not stimulate morphological decomposition and therefore, expanding on arguments used by Hay & Baayen (2002, 2005), may be liable to loose their internal morpheme boundaries in diachronic development. This type of interaction is expected to prevail in languages approaching the ideal agglutinating language type.

5. Conflictual interaction between morphotactics and phonotactics: concatenation

Within the area of the first subtheory of universal preferences, conflictual interaction between morphotactic concatenation and phonotactic preferences as formulated within Beats-and-Binding phonology (Dziubalska-Kołaczyk 2002, 2005) creates or motivates marked phonotactic structures (cf. Dressler et al. 2001), in our case, among consonant clusters. These marked consonant clusters may be of two types:

- a) clusters whose number of phonemes exceeds the number of consonants found in monomorphemic words. The excessive consonants are often classified as extrametrical consonants in other phonotactic theories (recently, e.g., Fery and van de Vijver 2003), which is unfortunate because, as we will see, there are gradual transitions between morphonotactic and phonotactic sequences;
- b) clusters which are marked in complexity, i.e. in violating universal phonotactic preferences as established by the theory.

One main question here is to what extent MRs may violate phonotactic constraints within a language and thereby violate universal phonotactic preferences (area of the first subtheory of universal markedness). In regard to the second subtheory of typological adequacy we expect, in agreement with overall morphonology, that languages approaching the ideal inflecting-fusional language type

more closely (e.g. strongly inflecting languages such as Polish) will have more marked clusters of both types than languages which approach the ideal isolating language type (i.e. weakly inflecting languages such as English and less so German and Italian).

A second main distinction in the degree of deviation of morphotactic (i.e. morphologically and phonologically motivated) consonant clusters from purely phonotactic (i.e. merely phonologically motivated) ones follows the gradual scale of (only or also) morphologically motivated clusters,

- 1) which are always morphologically motivated, i.e. never occur in monomorphemic words (cf. Dressler 1985:220f);
- 2) which are morphologically motivated as a strong default, i.e. which are paralleled by very few exceptions of a morphologically unmotivated nature;
- 3) which are morphologically motivated as a weak default, i.e. which are paralleled by more exceptions of a morphologically unmotivated nature;
- 4) whose majority is morphologically motivated;
- 5) whose minority is morphologically motivated, i.e. which are quite normal phonotactic clusters, which may also have some morphological motivation.

Since we expect, in languages approaching the ideal inflecting-fusional type, to have more radically marked morphotactic clusters in inflectional concatenations than in concatenations of word formation (derivation and compounding), we will concentrate on inflectional morphology. A further problem of interaction between morphotactics and phonotactics is, whether and to which degree PRs repair the output of morphotactic operations.

In the following we are going to look selectively at morphotactic consonant clusters motivated by morphological operations in English (6), German (7), Italian (8) and Polish (9).

6. Morphotactics in English

Candidates for exclusively morphotactically motivated consonant sequences are the word-final clusters /-fs, -vz/ as in *laughs, loves, wife's, wives*, which occur only in plurals (including the plurale tantum *greaves*), third singular present forms and in Saxon genitives. These are marked phonotactic sequences, since they occupy the same rank on the sonority/manner of articulation scale and differ minimally

in place of articulation. Additional exclusively morphologically motivated clusters are /-bz, -gz, -ðz, -Θs, -mz, -md, -nz/ (except in names), as in *bobs, Bob's, eggs, deaths, wreathes, clothes, times, seems, seemed, tons* (a possible exception is colloquial *muggins*).

A very strong default case of morphonotactics is represented by the word-final clusters /-ts, -dz/, as in *cats, kids*, whose monomorphemic opponents are extremely rare: *waltz, grits, adz(e)*, and little integrated loan words *quartz, kibbutz*. A still strong default is represented by /-p+s/, as in *caps, keeps*; Latinate exceptions are few, such as *apse, lapse*, plus *glimpse*.

A rather weak default is constituted by the clusters /-ks/, as in *docks, lacks*, note the many Latinate words, such as *tax, sex, box, flux, fix*, plus *six*.

In contrast to the exclusively morphonotactic word-final clusters in *eight+th, six+th, ten+th, nin(e)+th, seven+th, hundred+th* (plus *bread+th, wid+th*), only unproductive derivational MRs create the exclusively morphonotactic word-final consonant clusters in *dep+th, warm+th, leng+th, streng+th* (plus monophthongisation in *five* → *fif+th*). This goes against Kaye's (1995:310, cf. 302, 304, 308, 311) claim that words produced by irregular, non-analytic morphology deliver normal phonotactic structures to the phonological component. A further counter-example is morphological voicing in *wreathes, clothes*. What fits Kaye's claim better are the unproductive morphological rules which motivate *kept, slept* etc. and which produce the same phonotactics as *apt*. Whereas *keep+s, sleep+s*, created by a productive morphological rule, show morphonotactic sequence of a long vowel followed by a stop + sibilant, a sequence which only marginally occurs in monomorphemic words such as *hoax* and *coax*.

Note that the psycholinguistic reality of morpheme domains in phonotactics, as in *scream+ed*, has been confirmed by psycholinguistic experiments (see Wright 1975).

7. *Morphonotactics in German*

Our main illustration for problems of German morphonotactics comes from word-final *-Cst* clusters. They are morphologically motivated, whenever there is a suffix /st/ (2nd.Sg., superlative, unproductive nominalisation) or a suffix /t/ (3rd.Sg., past participle, nominalisation) after a root-final /s/ ².

Exclusive morphological motivation exists for the clusters /-mst/, as in *kämm+st* 'you comb', *schlimm+st* 'worst', *ge+sims+t* 'with

a moulding or mantlepiece', /-xst, -fst/, as in *lach+st* 'you laugh', *tun+lich+st* 'if possible', *schlaf+st* 'you sleep', *zu+tief+st* 'deepest', with the affricate /-pfst/, as in *tropf+st* 'you drip', *stampf+st* 'you stamp' and in the longer consonant clusters /-rkst/, as in *werk+st* 'you work', *ver+korks+t* 'kink', /-lkst/, as in *welk+st* 'you fade', /-ŋkst/, as in *stink+st* 'you stink', /-lpst, -mpst/, as in *stülp+st* 'you turn up', *selb+st* 'self', *tramp+st* 'you tramp', *plumps+(s)t* 'you plop'.

A strong default is represented by /-lst/, as in *sattel+st* 'you saddle', *ver+mittel+st* 'by means of', *Ge+schwul+st* 'tumor' vs. monomorphemic *Wulst* 'bulge', *Hulst* (and possibly *Schwulst* 'bombast' from earlier *Schwul+st*), in regional variation /-ŋst/ or /-ŋkst/, as in *hang+st* 'you hang', *gering+st* 'least', *jüng-st* 'most recently' vs. monomorphemic *Angst* 'anxiousness', *Hengst* 'stallion' /-rpst/, as in *darb+st* 'you suffer want', *zirp+st* 'you chirp' vs. *Herbst* 'autumn' (with diachronic loss of unstressed schwa before /st/, cf. cognate E. *harvest*), /-rnst/, as in *lern+st* 'you learn', *warn+st* 'you warn' vs. *E/ernst* 'E/earnest' (with similar schwa loss).

The default is slightly weaker in postvocalic /-pst/, as in *lieb+st* 'you love', *tapp+st* 'you plod', *neb+st* 'together with' vs. *Obst* 'fruits', *Papst* 'pope', *Propst* 'provost' (with loss of the second vowel), and /-kst/, as in *wag+st* 'you dare', *weck+st* 'you wake', (*h*)*eilig+st* 'holiest; fastest', *mix+(s)t* 'you/he mix(es)', *klecks+(s)t* 'you/he blot(s)', *wächs+(s)t* 'you/he grow(s)', *ge+wachs+t* 'waxed' vs. *Axt* 'axe', *Text* 'text', *verflixt* 'darned', and in the affricate /ts/ plus /-(s)t/, as in *reiz+(s)t* 'you/he irritate(s)', *salz+(s)t* 'you/he salt(s)', *schmerz+(s)t* 'pain(s)', *pflanz+(s)t* 'plant(s)', *schluchz+(s)t* vs. *jetzt* 'now', *Arzt* 'physician' and (with earlier morpheme boundary) suppletive superlative *zu+letzt* 'last'.

The default is definitely weaker in /-rst/, as in *kehr+st* 'you sweep', *äußer+st* 'extremely' vs. *Kars* 'karst', *Werst* 'Russian measure', *Horst* 'nest', *Durst* 'thirst', *Wurst* 'sausage' and (with earlier morpheme boundary or schwa loss) *erst* 'only', *Oberst* 'colonel', *Forst* 'forest', *Fürst* 'prince' and /-nst/, as in *dien+st* 'you serve', *ergeben+st* 'respectfully', *Ge+spin+st* 'yarn', *frans+(s)t* 'you/he frazzle(s)' vs. *Wanst* 'paunch', *sonst* 'otherwise', *Dunst* 'exhalation' and (with earlier morpheme boundary or schwa loss) *Gunst* 'favour', *Kunst* 'art', *Brunst* 'rut', *Dienst* 'service', *Gespenst* 'spectre', *einst* 'formerly'.

There is phonological repair via automatic degemination in the morphonotactic clusters /s+st/ (cf. above) and similar subphonemic degemination between the sibilant last phase of the affricate /ts/ and /st/ in *reiz+st* (see above). Or this latter simplification is simply a contact dissimilatory loss as in loss or assimilation of /s/ after the sibilant /ʃ/, as in *plausch+(s)t* 'you chat', *wäsch+(s)t* 'you/he wash(es)',

zisch+(s)t ‘hiss(es)’ and after the affricate /tʃ/, as in *quietsch*+(s)t ‘you squeak’, *watsch*+(s)t ‘you slap’, *plantsch*+(s)t ‘you splash’.

Morphological repair prevents opacifying fusion of root-final /t, d/ and the immediately following suffix /st/ into an affricate via morphological insertion of /e/ in the second singular, as in, *leid-e+st* ‘you suffer’, *rat-e+st* ‘guess’, *find-e+st* ‘find’ and in the superlatives *rund-e+st+e* ‘roundest’, *bunt-e+st+e* ‘most multicoloured’, but not in the more recent superlatives derived from present participles, as in *weit+geh+end+st* = *weit-e+st+gehend* ‘most far-reaching’.

Also word-internally morphological concatenation creates new consonant clusters. For example, the separable prefix/particle *ab-* motivates the exclusively morphotactic clusters /p+d, p+t, p+g, p+k, p+h, p+m, p+j, p+ts, p+v/, as in *ab+drehen*, *ab+tretten*, *ab+geben*, *ab+kommen*, *ab+hängen*, *ab+melden*, *ab+schaffen* (plus longer clusters, as in *ab+streiten*, *ab+ziehen*, *ab+zwicken*). Also some of the few non-separable prefixes create new clusters, as with *ent-*, fossil *ant-*, *ver-*, *zer-*. In addition, prefixes (and compounding) create geminate consonants which are disallowed morpheme-internally, and, phonotactically even worse, pseudogeminates are created by syllable- and morpheme-final obstruent devoicing, as in *ab-bauen* with /p+\$b/.

9. Morphotactics in Italian

For Italian morphotactics we concentrate on the, mainly verbal, prefix *s-*, derived from the Latin prefix *ex-* before word-initial consonant (cf. Iacobini 2004:112ff, 137). It becomes voiced before word-initial voiced consonants.

The only exclusively morphotactic clusters are /zr-/ , as in *s+radicare* ‘eradicate’, *s+ragionare* ‘talk nonsense’, *s+regolatezza* ‘immoderateness’, and the longer groups /zgr-, zgw-, sfr-/ , as in *s+gridare* ‘scold’, *s+guardo* ‘look’, *s+frenare* ‘unbridle’.

Default cases are the clusters /zb-, zd-, zg-, sf-/ , as in *s+balzare* ‘hurl’ vs. *sbaglio* ‘error’, *sbadigliare* ‘yawn’ (from obsolete *badigliare*), *s+dentare* ‘break the teeth’ vs. *sdraiare* ‘to stretch out’ (< Lat. *ex-*), *s+gommare* ‘ungum’ vs. *sgabello* ‘stool’, *s+favore* ‘disfavour’ vs. *sfinge* ‘sphinx’, *sfarzo* ‘pomp’. A weak default is represented by /zv-, zl-/ , as in *s+valigiare* ‘ransack’, *s+valutare* ‘devalue’, *s+vantaggio* ‘disadvantage’ vs. *svegliare* ‘wake up’ (< *ex-v-*), *svelto* ‘quick’, *svergolare* ‘twist’, etc.

A morpheme boundary exists in the majority of instances of /zl-, zm-, zn-, skw-/ , as in *s+leale* ‘disloyal’, *s+legare* ‘untie’ vs. the old and recent loan words *slitta* ‘sledge’, *slalom*, *slogan*, *slang*, *slam*,

etc., similarly *s+membrare* ‘dismember’ vs. *smalto* ‘enamel’, *smog*, *smoking*, etc., *s+naturare* ‘denaturate’ vs. *snello* ‘slender’, *snob*, *snack-bar*, *snort*, etc., *s+qualificare* ‘disqualify’ vs. *squadra* ‘team’, *squallido* ‘dismal’, *squalo* ‘shark’, etc.

Quite normal initial clusters are /sk-, skr-, skj-, skl-, sp-, spr-, spl-, spj-, st-, str-/. New word-internal consonant clusters may be created by prefixation (cf. Iacobini 2004). Word-final consonant clusters are disallowed, unless in recent loan words.

9. Morphonotactics in Polish

Polish is the most strongly inflecting language of the four languages studied in the present contribution: it has the richest morphology. Therefore we expect a greater number of morphonotactic consonant clusters in Polish than in the other three languages.

The same expectation stems from its typological status of a consonantal language. According to WALS (*World Atlas of Language Structures*) Polish has a moderately large (moderate meaning 22.4 consonants according to Maddieson 2006) system of consonants (31) and rich consonantal phonotactics. Complex clusters are tolerated in all positions, up to 4 consonants word-initially ([vzgl-] *względný* ‘relative’, [zdźbw-] *źdźbło* ‘blade of grass’) and 5 consonants word-finally ([-mpstf] *przestępstw* ‘crime Gen.Pl.’). In phonological words even 5 consonants initially may arise ([vzdźbl-] *w źdźble* ‘in a blade of grass’). Geminate consonants are also possible word-initially ([ss-] *ssak* ‘mammal’, [dźdź-] *dźdźu* ‘drizzle Gen.’). Rhythmically Polish exhibits both the properties of syllable-timing and stress-timing (compare also a scalar approach, e.g., Bertinetto 1988).

Combining the phonological and morphological perspective we may predict that the percentage of morphonotactic clusters among consonant clusters will rise with the number of consonants in a cluster. This has been confirmed by Zydorowicz (2006) who analyzed the data compiled by Bargiełówna (1950).

9.1. Concatenative sources of morphonotactic clusters

There are many more cases of morphonotactic clusters in Polish than in the other languages. Here we focus on just three similar initial clusters, i.e. *ws-* [fs-], *wsz-* [fš-], and *wsi-* [fç-]. According to the *Net Auditory Distance (NAD) Principle*, all three are dispreferred clusters (i.e. in all three the NAD between the two consonants is

smaller than the second consonant to vowel NAD). Still, among the three, the most likely cluster in a monomorphemic non-derived context would be [fç-] (2 to 3 ratio in NAD, while the other two both have 1 to 3 ratio, they are further away from the preference). However, [fʂ-] involves an additional feature of retroflexion of the sibilant, which contributes to the net auditory distance and which [fs-] does not have. Thus, the order of dispreference appears to be: [fs-] < [fʂ-] < [fç-]. Scrutinizing the Polish lexicon one finds that there is no monomorphemic *ws-* [fs-] cluster. *wsz-* [fʂ-] occurs in the fossilized but frequent prefixoids *wsze*, *wszech*, *wszem* ‘all, everybody’, in archaic *wszędy* ‘everywhere’, in frequent *wszystko* ‘everything’ (all of which are semantically related in an irregular way), and in archaic *wszak* ‘after all’. *wsi-* [fç-] appears in the Russian loan *wsio* ‘everything’ and in the colloquial pronunciation of the abbreviation *WSJO* [fço] from the recent term *Wyższa Szkoła Języków Obcych* ‘college of modern languages’. Thus, the prediction about the dispreferred cluster *ws-* [fs-] has been supported. As far as the other two clusters are concerned, the deductive problem of predicting which cluster should be the preferred one is mirrored in the inductive problem of what is more relevant: phonological productivity in the case of *wsi-* [fç-] or greater type frequency of *wsz-* [fʂ-]. This cannot be decided without comparing monomorphemic and bimorphemic clusters.

All the other instances of the three initial clusters are of a morphonotactic nature. The first group consists of the words with the prefix *w-* ‘in’, as in the verbs *w+sypać* [fs-] ‘pour’, *w+szyć* [fʂ-] ‘sew in’ (plus 3 other items), *w+siać* [fç-] ‘sow in’ (plus 11 other items), including the adverb *w-szerz* [fʂ-] ‘broadwise’. For examples with vowel deletion see section 9.2.

Comparing monomorphemic and bimorphemic clusters shows that *wsi-* [fç-] is a morphonotactic cluster by default whereas *wsz-* [fʂ-] is not.

The three double clusters discussed above are also part of triple clusters. The marked clusters *wsp-*, *wst-*, *wści-* [fsp-, fst-, fçtç-] (all reducible in casual speech, see 9.3) appear in the following monomorphemic words: *wspaniale* ‘splendid’, *wspak* ‘backward’, *wstążka* ‘ribbon’, *wstęga* ‘wide ribbon’, *wstecz* ‘back’, *wstyd* ‘shame’, *wściekać* ‘to get furious’ (with 22 derivatives³; all the words formerly with morpheme boundaries).

Comparable morphonotactic clusters have either one or two morpheme boundaries, e.g. two in *w+s+kazać* [fks-] ‘to point’ (plus 13 other items), one in *w+skoczyć* ‘to jump in’ (plus 29 other items) and *ws+pomagać* [fsp-] ‘to help’ (plus 5 other items). Another two-

morpheme-boundary cluster [fsx-] occurs in *w+s+chodzić* ‘to rise’ and *w+s+chód* ‘east, sunrise’, and another one-morpheme-boundary cluster [fštš-] in *w+szczeplić* ‘to implant’ (plus 7 other items). Thus the morphonotactic character of those triple clusters is only a weak default.

All comparable word-initial quadruple clusters are morphonotactic, with one morpheme boundary in *ws+tręć* [fstr-] ‘disgust’ (plus 2 derivatives, cf. *na+tręć* ‘pushy person’) and *w+strzelać* [fstš-] ‘shoot in’ (plus 5 other items), and two morpheme boundaries in *w+s+trzęsać* ‘to shake’ (plus 8 other items).

When passing from German and Italian doubles to triples and from Polish triples to quadruples, we observe an increase in phonotactic markedness and, as predicted, both a decrease in the number of lexical items and a bigger role of morphonotactics. However, if we move from Polish doubles to triples, then we find a reverse, i.e. an increase in the number of lexical items, and a smaller role of morphonotactics. The reason for this paradoxical phenomenon, i.e. that three-consonant clusters appear to be more system-adequate than two-consonant ones, may lie in the *Net Auditory Distance Principle*. The principle defines the preferences for sequences with reference to the vowel. Preferably, the distance between the vowel and the preceding consonant should be smaller than between this and the preceding consonant. This is not the case with the word-initial sequences [fsV-, fšV-, fǣV-]. Therefore, they are dispreferred sequences because the distance between [f] and the sibilant should consequently be greater than the distance in the neighbouring sequence (cf. also the discussion above in the section). In contrast, in the triple clusters [fskV-, fspV-] the distance in [-sk-] and [-sp-] is greater than in [fs-]. Thus, the preference is satisfied on the left side, whereas on the right side there is no difference to doubles (cf. the B&B preference for initial triples: $NAD(C_1, C_2) < NAD(C_2, C_3) \geq NAD(C_3, V)$). But worst of all is the cluster [fsxV-] where neither side of the preference is satisfied: this is precisely the cluster which is always morphonotactic.

9.2. Non-concatenative sources of morphonotactic clusters

In contrast to the other three languages, morphonotactic clusters in Polish arise also due to non-concatenative morphological operations. One such operation is a non-productive deletion of a root vowel: in the first syllable of a word it leads to the creation of new marked clusters, e.g. in adjective formation, as in *wieś* ‘village’ ~ *wsiowy* [fɕ-], *len* ‘linen’ ~ *lniany* [ɲ-], *lew* ‘lion’ ~ *lwi* [lv-], *mech* ‘moss’ ~ *mchowy* [mx-], *wesz* ‘louse’ ~ *wszawy* [fš-] or comparative

of adverb *lekko* 'light' ~ *lżej* [lʒ-]. The same operation also applies in inflection: masculine *len*, Gen.Sg. *ln-u*, *mech* ~ *mch-u*, feminine *wieś* ~ *ws-i*, *wesz* ~ *wsz-y*. Nominative *wesz* has been replaced in colloquial speech by the morphotactically transparent back-formation *wsza* with the prototypical nominative singular ending of feminine nouns and adjectives. Thus, a new citation form with initial *wsz-* [fʂ-] (cf. 5.4.1.) came into being.

Another such operation is productive zero-Genitive-Plural formation. Polish declension always adds an inflectional vowel to root-final consonants with two exceptions of zero suffixes: first, in the nominative singular of some masculine microclasses, e.g. *podarek* 'present', *wegetarianin* 'vegetarian', second in the genitive plural of many neuter and feminine microclasses and in the microclass of masc. *wegetarianin*, Gen. Pl. *wegetarian* (with truncation of the pseudosuffix *-in* in the plural). Nominative singular feminine forms, such as *palma* 'palm' or neuter forms, such as *ranczo* 'ranch', are the citation forms that are stored in the mental lexicon. Their root-final consonant clusters appear word-finally only in zero genitive plurals: *palm* and *rancz*. In this way clusters may arise which do not appear elsewhere in word-final position in the language, e.g. in neuter nominative *przestępstwo* 'crime' ~ genitive plural *przestępstw* [-mpstf], or in feminine nominative *tratwa* 'raft' ~ genitive plural *tratw* [-tf] (with the obligatory phonological word-final devoicing of obstruents). An example from language for special purposes (e.g. mathematics) is *lambda* ~ *lambd* [-mbd] (without final devoicing because of the higher level of language awareness).

9.3. Avoidance and repair

Actual or potential marked clusters which are due either to concatenative or non-concatenative morphological operations may be avoided in various ways. Rarely there are simply empty slots in the paradigm or simply non-use of certain forms. The most radical instance is the paradigm of 'drizzle': the genitive singular *dżdżu* is in use, the instrumental *dżdżem* is potential but avoided, in contrast to the derivations adj. *dżdżysty*, verb *dżdżyż*, cf. *dżdżownica* 'caterpillar' (all with word-initial geminate affricates). However, there is no nominative singular **dżdż* [dʒdʒ], because vowel-less words are not allowed in Polish, except in extragrammatical interjections such as *pst* [pst].

Certain marked clusters are phonostylistically repaired, i.e. reduced in fast or sloppy speech. This happens with many masculine singular preterits in *-ł* [w] preceded by a root-final obstruent, as in

szed+ł ‘he walked’, *rós+ł* ‘he grew’ with the word-final morphonotactic clusters [dw, sw]. Similar reductions occur in root-final clusters in zero-genitive plural forms, e.g. as in the already mentioned *przestępstw* [-mpstf → -mstf, -ms] or in *mężczyzna* ‘man’ ~ gen. pl. *mężczyzn* [-zn → s]. Examples of word-initial reduction are *wszystko* ‘everything’ [fʂ → ʂ], *wschód* ‘east’ [fsx → sx], etc.

An obligatory phonological repair breaks up those morphologically potential word-final stop clusters which are phonotactically banned from the final position. The repair consists in the insertion of a vowel [e], as in feminine nominative singular *kotka* ‘cat’ ~ genitive plural *kotek*, *babka* ‘granny, cake’ ~ *babek*.

There is a related morphonological e-insertion as in nom.sg. *barka* ‘boat’ ~ gen.pl. *barek*, *bitwa* ‘battle’ ~ *bitew*, *torba* ‘bag’ ~ *toreb*, but here erroneous forms are produced: *bark*, *bitw*, *torb*, whereas **kotk* or **babk* are never produced. This is explained by the fact that word-final [-rk, -rp] exist in the citation forms *park*, *Serb*, and word-final [-tf] occurs in zero-genitive plurals (cf. *tratw* above).

Word-initially, there is a corresponding but rather obsolete morphonological e-insertion in *w+spinać się* [fsp-] ‘climb’ (imperfective) ~ perfective 3.Sg. *wespnie się* and in *w+ścielać* [fɛtɛ] (impfv.) ‘to do the bed’ ~ pfv. *wesłać*. The second pair is rather obsolete, whereas *wespnie się* is avoided by using the periphrasis *będzie się wspinąć* ‘will be climbing’ or by even using *wspnie się* [fspɲ-] without insertion. There is, however, also an example in current use, i.e. impfv. *w+spierać* [fspj-] ‘support’ ~ pfv. *wesprzeć* [vespʃ-].

Morphological repair of morphologically derived marked phonotactic clusters occurs via partial inflectional class change, as in *mizdrzyć się* ‘to wheedle’ with the expected imperative *mizdrz się* [-stʂɛ] replaced by *mizdrz+yj się* and in *spotkać* ‘meet’, expected 3.Sg. masc. preterit *spotkł* [-tkw], replaced by *spotkał*.

In word-final position, geminate consonants are disallowed. Thus the expected zero genitive plural of *willa* ‘villa’, namely *will* is phonotactically disallowed and replaced by the morphologically unpredicted form *will-i* (in analogy to other inflectional microclasses). An alternative is phonological degemination in [vil]. The same morphological replacement occurs in the genitive plural of *sybilla*, when speaking of the Sybills of the Cappella Sistina in Rome. The genitive plural of *mokka* ‘mocca’ is simply avoided. The zero plurals of *canzonetta*, *arietta*, *vendetta*, *grappa*, *mirra* are avoided or may have a degeminated final consonant. Or one tries to pronounce consciously a final geminate, as in the zero genitive plurals of *fontanna*, *sutanna*, *manna*, *henna*, *madonna*.

10. Conclusion

The aim of the present contribution was to propose morphonotactics as a proper subfield of (mostly conflicting) interaction between phonology and morphology. As elsewhere in Natural Phonology and Morphology, we have found that also this subfield has fuzzy boundaries. Thus, one needs to approach it with the concept of gradualness.

The consonant clusters we have investigated in the four languages can be graded according to the role of morphology and phonotactics. As a result, we can distinguish at least (a) prototypical morphonotactic clusters, i.e. clusters which are exclusively due to morphological derivation, (b) clusters which are morphonotactic as a strong default or (c) as a weak default, i.e. with very few exceptions in (b) and more exceptions in (c), (d) clusters which exist both due to morphology and without interaction with morphology, and (e) clusters which never come into being due to morphology, e.g. initial clusters in a language which has neither monoconsonantal prefixes nor morphological deletion of the first vowel of a word.

Prototypical morphonotactic clusters (a) have the function of co-signaling the existence of a morphological rule, morphonotactic default clusters (b) and (c) fulfill this function less adequately, while phonotactic clusters of the type (d) and (e) cannot fulfill this function and therefore they may be called prototypical phonotactic clusters. Since fulfilling this co-signaling function should have some repercussion in processing, psycholinguistic experiments (which we have started to devise) may provide a tool for establishing a boundary between clusters of the type (c) and (d).

Since there is, within morphology, a universal preference for concatenation, also within morphonotactics we found a preference for the concatenative origin of consonant clusters. This is the only possible origin of morphonotactic consonant clusters in English, German and Italian, and this is the default in Polish. Looking beyond the four languages investigated, so far we have found cases of non-concatenative origin of clusters only in strongly inflecting-fusional languages (such as Polish). Note, for example, zero ablaut in Ancient Greek *tí+kt+ō* 'I'm giving birth to' (with reduplication and metathesis *tk* → *kt*) from the root /tek/ as in the 1.Sg. Aorist *é+tek+on*. Another example is Latin perfect *sprē+vi*, PPP *sprē+tus* from *spern+ere* 'reject', which are the only examples of initial [spr-] in Latin.

Turning to the phonological side of the interaction between phonotactics and morphology, one can say that prototypical

morphotactic clusters are always phonotactically marked, i.e. they are dispreferred with respect to comparable prototypical phonotactic preferences. By the same token, we have found that phonotactically most marked consonant clusters are of a morphotactic nature, and that their morphotactic character increases with the increase of the phonotactic markedness.

A consequence of increased phonotactic markedness is the avoidance of certain morphotactic clusters in performance. A more systematic means is a remedial repair, either only phonostylistic, or in terms of an obligatory phonological rule of vowel insertion. As may happen diachronically with any phonological rule, such vowel insertions may morphologize, i.e. turn into morphological rules. Finally, there is a preventive repair by morphological rules which block the creation of morphotactic clusters.

In terms of morphological typology, we have investigated strongly and weakly inflecting fusional languages. Here we can predict that the more strongly inflecting a language is the more morphotactic clusters it should have (cf. also above for non-concatenative morphology). In support of this prediction, Polish has most morphotactic clusters, German less, and Italian the least of the three languages. English should have even fewer clusters, which however is not true at least for inflectional origin of morphotactic clusters. This paradox can be explained by phonological typology: consonantal languages can be expected to have more morphotactic clusters than vocalic languages. Since Italian is clearly a less consonantal language than English, the mutual proportion of morphotactic clusters in the two languages is explained.

The most fundamental theoretical question is whether morphotactics is a proper subpart of morphonology. The latter follows deductively from the definition of morphonology as the effect of the interaction of phonology and morphology, and the definition of phonotactics as a proper part of phonology and of morphotactics as a proper part of morphology. Both segmental morphonology and morphotactics have the function of co-signaling morphological rules. Inductively, we have found that both segmental morphonology and morphotactics show the gradient continuum to segmental phonology and phonotactics respectively. The typological distribution of morphotactics and segmental morphonology so far has been found to be the same.

What our studies of the acquisition of morphotactics have demonstrated so far (see the interim report in WLG online 73, 2006) is that there is a following, explainable difference between segmental

morphonology and morphonotactics: segmental morphonology is being acquired AFTER all, or nearly all, of phonology is acquired, whereas at least some morphonotactic clusters are acquired before comparable phonotactic clusters. Clearly, more research is needed and has already been started by the authors and some of their research associates.

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Note

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¹ On which also online experiments have been performed together with Gary Libben (University of Alberta) and Eva Reinisch (Max Planck Institute for Psycholinguistics, Nijmegen).

² All the counts of lexical items have been done according to Dubisz (2006).

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