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# SEGMENTAL COMPLEXITY AND THE NOTION OF PHONOLOGICAL STRENGTH

The aim of the paper is to present and discuss some issues related to the notion of phonological strength and segmental complexity. It is demonstrated that both notions, i.e. complexity and strength are not interchangeable. The starting point for the investigation is the principle of Licensing Inheritance, which aims to explain the processes of lenition. The research proves, however, that the distributional behaviour of English plosives can be explained neither by the internal structure of plosives nor by the principle of Licensing Inheritance. Although accounting for the peculiar behaviour of plosives, the notion of strength, in its traditional sense, cannot be recognized within Government Phonology as it runs counter to the basic theory-internal principles.

## 1. Introduction

Although English seems to be one of the most widely studied languages in terms of phonology, there are still some gaps which remain mysterious and call for explanation. One of such holes to patch is the distribution of plosives clustering with the preceding sonorants in the right edge of the word in English. In this language it is quite a common situation that a rhymal complement position (coda for short)[1] is occupied by a sonorant, while a following onset dominates a plosive, e.g. ***finger, donkey, lumber, crumpet, shoulder, pink, lamp, field,*** etc. At first sight there is nothing special about such clusters. The fact that the words like *shoulder* and *field* are put in the same line should not surprise us as in more recent phonological theories, such as Government Phonology, henceforth GP, for instance, a word-final consonant is invariably syllabified in the onset position (Kaye (1990), Harris & Gussmann (1998)). Thus, the word-medial cluster *-ld-* in *shoulder* and the word-final *-ld* in *field* are syllabified in the same fashion, i.e. as the coda-onset sequence with the difference that the former one is followed by a realized nucleus, while the latter by the empty one. To my knowledge, Gussmann (1998) is the first scholar who has pointed out the peculiar behaviour of plosives in such clusters. The combinations in question are interesting in that after a sonorant and before the empty nucleus only some plosives are attested while some others are ruled out. Thus, for

[1] Although the coda as a constituent is absent from Government Phonology it can be identified with the rhymal complement. Thus, when we use either of these terms the same thing is meant. It must be remembered, however, that here the coda should not be understood in the traditional sense.

example, word-finally after the bilabial nasal [m] only the voiceless bilabial plosive is possible, similarly after the velar nasal [ŋ], the voiced velar plosive is inaudible. More strikingly, given the restriction imposed on the velar and bilabial plosives we should expect a similar distribution of the last pair of English plosives. However, the situation is entirely different as both voiceless and voiced alveolar plosives are perfectly possible after the homorganic nasal [n]. Moreover, the same distributional pattern of plosives is preferred when the rhymal complement position is occupied by the lateral. Although here most of the clusters do not share the place of articulation, the restrictions on the occurrence of plosives are nearly identical. Thus, after the coda lateral both velar and bilabial voiced plosives are unattested, while the alveolar pair can occur freely. Another interesting observation concerning sonorant-plosive sequences is the fact that only some of these clusters can be preceded by a reduced vowel (schwa). Strikingly, it is again the alveolar pair that indicates exceptionality when compared with other plosives. Thus, from the facts above it follows that the distribution of the English plosives is indeed constrained in some way and deserves a more thorough inspection. In the final position, after the sonorant, the plosives appear in a certain pattern and the alveolar plosives seem to be the least restricted pair in that they can appear freely in the position where other plosives are banned.

It will be demonstrated that the proposal put forward in Harris (1997) and concerning the theory of neutralisation is not able to account for the mysterious behaviour of plosives in English. Additionally, it will be pointed out that, although covering the problematic facts, Gussmann's (1998) solution cannot be incorporated, in its original form, into the GP theory. Thus, the peculiar distributional pattern of plosives seems to be a challenge for a theory which not only presents the existing facts but also aspires to a theory which can answer the most fundamental question, namely, why things are the way they are.

In this paper I will adopt the insights known from GP and widely described in Kaye, Lowenstamm and Vergnaud (1985, 1990), Charette (1991), Harris (1990, 1994), Harris and Lindsey (1995) and others.

The paper is organized as follows. In 2, we present some crucial facts concerning the sonorant-plosive sequences, their distributional and co-occurrence restrictions in English. Section 3, illustrates Harris' (1997) principle of Licensing Inheritance. Additionally, this section contains a discussion of the segmental and syllabic complexity and the licensing properties of nuclei. Section 3 ends with some general remarks, which settle the observation of the inability of the Licensing Inheritance principle to account for the problematic clusters. In 4 we discuss the notion of phonological strength and the solution it offers to the problematic clusters. Particular attention is paid to some additional facts which may confirm the strength hypothesis. This section also mentions some consequences of the attempt to introduce this concept into GP. Section 4 ends with the negative conclusion that the strength of a particular segment cannot be derived from its internal structure (segmental complexity) and that the strength, as a traditional notion, cannot find its way into the GP theory.

## 2. The distribution of plosives at the right edge of the word in English

In section 1 above it was mentioned that in English the coda position is frequently occupied by a sonorant, while the following onset dominates a plosive. In this section we discuss two characteristic instances of this configuration, one where the coda is filled by a nasal consonant and the other where the lateral appears in this position. The presentation

of the relevant data is based on Gussmann's (1998) analysis. In his article the author starts with the peculiar nature of the velar nasal in English to end up with a more general distributional pattern of the sonorant-plosive clusters.

The characteristic feature of English nasals is the fact that while followed by a plosive they cannot support a distinct place of articulation[2], in other words, they are invariably homorganic with the following plosive. Thus, after the rhymal [m] we can find only the bilabial plosive and after [n] the alveolar one, the same is true for the velar nasal as after this consonant only the velar plosive is accepted. The data below illustrate this observation.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (1) | fi**ng**er | [fiŋgə] | | lu**mb**er | [lʌmbə] | pa**nd**a | [pændə] |
| | a**ng**er | [æŋgə] | | sa**mb**a | [sæmbə] | ha**nd**le | [hænd$^{ə}$l] |
| | a**nch**or | [æŋkə] | | si**mp**le | [sɪmp$^{ə}$l] | pa**ntr**y | [pæntri] |
| | mo**nk**ey | [mʌŋki] | | tru**mp**et | [trʌmpɪt] | co**ntr**ast | [kɒntrɑ:st] |

There are two immediate observations. Firstly, the nasal in such clusters must share its place of articulation with the following plosive. Secondly, all the clusters in (1) appear word-medially. Note, however, that the second observation is not an essential condition for these clusters to occur as domain-finally we encounter a similar situation.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| (2) | wi**ng** | [wɪŋ] | | la**mb** | [læm] | me**nd** | [mend] |
| | si**ng** | [sɪŋ] | | bo**mb** | [bɒm] | sou**nd** | [saʊnd] |
| | wi**nk** | [wiŋk] | | la**mp** | [læmp] | te**nt** | [tent] |
| | si**nk** | [siŋk] | | plu**mp** | [plʌmp] | le**nt** | [lent] |

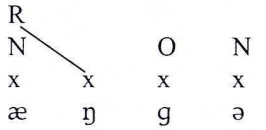
Similarly to the word-medial position, all the nasal-plosive clusters in (2) are homorganic. However, there is one main difference between the two contexts, namely, word-finally the distribution of plosives is limited. In other words, the two phonological contexts indicate different contrastive potentials, the latter being more restricted than the former. As has already been mentioned, the distributional restriction is imposed on the class of voiced plosives, while the voiceless plosives are not restricted in this respect.

It seems reasonable to stop, for a while, the discussion at this stage to explain some problematic points which may have occurred to the reader and which have not been mentioned so far. Firstly, one may ask why in (2) above the words *wing* and *bomb* appear together with *wink* and *lamp* in the first place. Should we bother and try to explain the whole situation when such sequences seem not to be clusters at all but rather single consonants? Note that although such words contain the plosives in the written form, they are never pronounced word-finally. However, such plosives are realized word-medially, which may indicate that these consonants are always present and the only situation when they are suppressed is in the word-final position. On the other hand, it must be remembered that we cannot rely on the orthographic conventions as more often than not they are misleading. The solution to this problem can be sought in Gussmann (1998; 2001). The author indicates that the velar nasal is invariably linked with the following velar plosive. In other words, the velar nasal exists only when it shares its velarity with the following

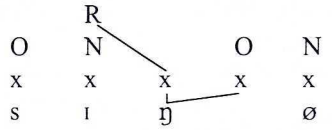
[2] This observation is not only true for English nasal plus plosive clusters, but also for other languages like Polish, German and others (see Gussmann, 2001).

plosive[3]. Thus, the velar nasal seems to be a complex segment in that it comprises its nasal properties and the place of articulation which is shared with the following plosive consonant. The only situation where the plosive is not manifested phonetically is in the word-final position. It is worth mentioning, however, that this position is not totally deleted. Although not audible phonetically, the final plosive is manifested indirectly through the velarity of the preceding nasal. To put it differently, the plosive is phonologically present even if phonetically we only have a trace of it in the form of the velarity of the nasal. The velar nasal in every case, then, is the first member of a specific consonantal cluster and never a single consonant. Note that in the case of the final *-mb* clusters the situation is slightly different, as here it seems that the bilabial plosive can be totally suppressed. The nasal does not have to acquire the place of articulation from the following plosive, as it is itself bilabial. Thus, the place of articulation of the bilabial plosive is not necessarily reflected in the preceding nasal. On the other hand, the existence of the direct alternations of the type *bomb – bombard* [bɒm] - [bɒmbɑ:d] may indicate that the final [m] in *bomb* is not accidental and only phonetically final as it is influenced, in a way, by the following plosive. From the discussion above it follows that in both contexts illustrated in (1) and (2) above the situation is, to a certain extent, the same with only that difference that in the second context the voiced velar and bilabial plosives are suppressed. The situation, however, is even more complex that it might seem at first sight. Consider first the graphical representation of the cluster *-ng-* in both contexts, in (3) below.

(3) a.




b.




It becomes clear that both contexts differ not only in that whether they allow the plosive to be realized or not but also, and more crucially, by the fact that in the first context the cluster is followed by the filled nucleus (3a), while in the second context by the empty one (3b). The representations in (3) illustrate the fact that every onset must be licensed by the following nucleus empty or filled, hence in, for example, *pink* the final *k* is not at all final but followed and licensed by the nucleus which happens to be empty. Thus, it follows that in (3b) the final, partly suppressed onset plosive is also licensed by the following empty nucleus. In short, word-final consonants are syllabified as onsets and are licensed by the following nuclei (see Kaye (1990), Harris (1994) and Gussmann and Kaye (1998) for a more thorough discussion). By combining the facts from both contexts we come to the conclusion that the realization or suppression of certain plosives is connected with the status of the following nucleus. To sum up, in the nasal-plosive clusters the voiced velar and bilabial plosives are suppressed when licensed by

[3] Many counterexamples may occur to the reader e.g. *wrongful*, *kingship* or *longed* [rɒŋful], [kɪŋʃɪp] and [lɒŋd]. These words, however, indicate morphological complexity and as such cannot constitute a proper domain for phonology to search for distributional patterns. Such clusters do not differ from those which arise at the word-level and hence must be treated as purely accidental.

the following empty nucleus. The audible nuclei, on the other hand, can license all plosives, no matter whether voiced or voiceless. These observations can be further confirmed by other combinations of sonorant plus plosive clusters in the same contexts. Consider some additional data in (4) below (Gussmann 1998:119)

| (4) | | domain-internal | domain-final |
|---|---|---|---|
| | a. | fal**c**on, cal**c**ulate | bu**lk**, si**lk** |
| | | vu**lg**ar, pi**lg**rim | ——— |
| | b. | cu**lp**rit, pa**lp**able | he**lp**, gu**lp** |
| | | e**lb**ow, a**lb**um | bu**lb**, ...? |
| | c. | we**lt**er, fi**lt**er | asphal**t**, difficul**t** |
| | | boul**d**er, shoul**d**er | bui**ld**, fie**ld** |

(4) illustrates another common instance of the sonorant-plosive clusters where the rhymal complement is occupied by the lateral. Unlike in (1) and (2) above, the sonorant in (4) does not have to share the place of articulation with the following plosive. Thus, we have homorganic clusters (4c) and non-homorganic ones (4a, b). What is crucial, however, is the fact that the plosives following the lateral behave identically to those following the nasals. If we compare both clusters, i.e. the nasal-plosive and the lateral-plosive, in both contexts it becomes immediately apparent that word-internally after a sonorant all plosives have the chance to appear, while word-finally some of the plosives are ruled out. The banned consonants are the voiced velar and bilabial plosive, the latter can occur after the lateral but its occurrence is restricted to only one form *bulb* [bʌlb][4].

The discussion above reveals the distributional pattern of English plosives preceded by sonorants, namely, the occurrence of plosives is not restricted only in a situation when the plosive is licensed by the audible nucleus. When, on the other hand, the nucleus is empty the contrastive potential of the immediately preceding onset is restricted to voiceless plosives and to the alveolar pair [t] and [d]. If, however, GP is to be a theory which not only enumerates the existing phenomena but also tries to find the answer to the question why certain phenomena occur in the first place, we should seek for a satisfactory solution to one main problem. What is so special about the alveolar plosives that makes them able to appear in both contexts without any restrictions? Before we present a discussion which may partly explain the peculiar behaviour of English plosives, it seems crucial to mention one more general observation. It was demonstrated (Gussmann (1998)) that the occurrence of the oral stops in the sonorant-plosive clusters is closely related not only to the following nucleus but also to the preceding one. When a reduced nucleus, the schwa, precedes the sonorant-plosive clusters word-finally, the plosive is restricted to only one type, i.e. it must be alveolar, voiced or voiceless, no other plosive is tolerated in this context. Thus, we can easily find clusters of the sonorant-alveolar plosive preceded by a schwa, e.g. *difficult, sergeant, herald, emerald,* while the remaining plosives in the same context are simply ruled out. This is illustrated in (5) below (Gussmann 1998:123) where the asterisk indicates impossible combinations:

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[4] In addition to *bulb* Gussmann (1998) gives four other words: *alb, galbe, ilb and stilb,* which are, however, of foreign origin or very rare.

| (5) | nasal | lateral |
|---|---|---|
| velar | əŋk* əŋ* | əlk* |
| labial | əmp* | əlp* əlb* |
| alveolar | ənt ənd | əlt əld |

Note that the reason why *-əlg** or *-əmb** are omitted in the table above is the fact that they are always impossible word-finally even if preceded by a full nucleus. All the facts presented in this section contribute to the observation that the alveolar stops have a special status among English plosives. They are able to appear in the contexts where other plosives are forbidden. To explain this privileged position of the alveolar plosives and the fact why other plosives are suppressed in identical positions (especially the voiced velar and bilabial ones), we have to look closer at the segmental and syllabic complexity and the principle of Licensing Inheritance.

## 3. Syllabic complexity and the properties of empty nuclei

The discussion in this section draws on Harris' (1997) proposal of a coherent theory of neutralisation (Licensing Inheritance), which unifies the relationship between the distribution of prosodic licensing within a word and the allocation of melodic contrasts. In general, the idea of Licensing Inheritance is that the amount of phonological material (the number of elements in a given segment) which a skeletal slot is able to license is determined by its location within the prosodic structure at various levels, i.e. in the syllable, the foot, and the phonological word. The weaker the prosodic position of a slot, the less segmental complexity it can support. Given the existence of licensing relations among segments, we can consider the distribution of plosives in both contexts from the perspective of licensing path which binds segments together. This, however, involves making reference to the complexity of segments and syllables, as well as to the licensing properties of nuclei (Harris (1994, 1997), Cyran (2001)), hence we should start by explaining these notions. The main purpose of this section, however, is to demonstrate that the principle of Licensing Inheritance cannot explain the problematic distribution of English plosives.

### 3.1. Segmental complexity

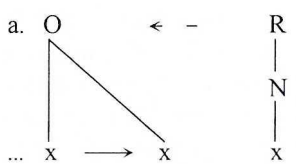
Phonological segments in this model are formed out of privative elements. Each element is fully specified, which means that elements are pronounceable at all levels of derivation, by themselves or in combinations with others. Thus, vocalic systems are defined in terms of three main resonance elements I, A,U corresponding to the corner vowels [i, a, u]. The mid vowels [e] and [o] are combinations of (A, I) and (A,U) respectively. The latter are complex segments where the complexity is calculated straightforwardly from the number of elements involved, while the former are non-complex as they consist of only one element. The general idea behind the Licensing Inheritance is that in prosodically weak contexts, the less complex segments should have better chances of survival than the compounds. In a situation when a relatively complex segment appears in a weak context it is expected to undergo a reduction. However, the reduction in complexity does not hinder interpretability of the remaining material, since each element is autonomously pronounceable. Similarly to vowels, consonants in GP are composed of one or more elements (Harris & Lindsey (1995)), and again more complex segments should be more difficult to license than the less complex

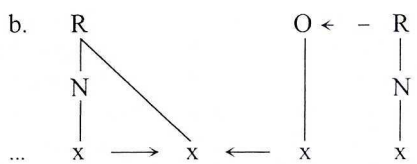
ones. Generally speaking, in a prosodically weak position the mono-elemental or bi-elemental segments should in principle have better chances to appear than those containing three or four elements. Below we illustrate the internal structure of some segment types (Cyran (2001:17)).

(6) sonorants (I) = j, (A) = r, (U) = w, (A, ʔ) = l, (U, N) = m, (A, N) = n
fricatives (A, h, H) = s, (U, h, H) = f
stops (U, h, ʔ, H) = p, (A, h, ʔ, H) = t
A – coronality, I – palatality, U – labiality, ʔ- occlusion, h – noise, N – nasality, H – aspiration, L – voicing.

### 3.2. Licensing properties of nuclei

Syllabification in GP results from governing relations contracted by two segments (Kaye, Lowenstamm & Vergnaud (1990)). Adjacent positions enter into asymmetrical relations where one of the participants acts as the governor and the other as the governee. The assignment of these functions in a given string is determined by the elemental complexity of the two adjacent segments (Harris (1990)). The direction of governing relations is resolved on the basis of complexity slope. Additional formal conditions on government, such as adjacency and directionality, ensure that all possible syllabic constituents recognized in GP are maximally binary. Thus, if a complex segment is followed by a less complex one we are dealing with left-headed governing domains which are characteristic for branching onsets. If, however, the order of segments happens to be that of a less complex consonant followed by a more complex one, then the direction of government must be from right to left, this is characteristic of an interconstituent relation between an onset and the preceding rhymal complement. Both types of relations are illustrated below:

(7) a. 


b. 


government ⟶
licensing - →

The branching onset as in the English word *paltry* [pɔ:ltri] is represented in (7a), while (7b) illustrates the coda position governed by the following onset as in *finger* [fiŋgə]. In both examples (7a,b) the governing relations must be licensed by the following nucleus, this form of licensing first introduced by Charette (1990, 1992) was called Government Licensing. She proposes that a governing onset head requires a licence to govern its complement, from the nucleus governing it. Similarly, an onset segment must be government-licensed in order to be able to govern the preceding coda segment. Charette distinguishes between direct (7b) and indirect (7a) Government Licensing as separate parameters defining licensing properties of nuclei. In this way, she points to an interesting fact concerning the nuclei, namely, that languages differ in respect to what extent they allow their

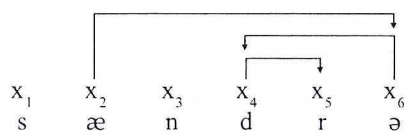
nuclei to license. Thus, English allows for both structures in the word-internal position, i.e. when followed by the filled nucleus, while word-finally, only direct licensing is attested. This simply means that branching onsets cannot appear word-finally in English, the only structure which is possible in this position is of the coda-onset type. From Charette's analysis it follows that in English empty nuclei are weaker than the filled ones as the former cannot license branching onsets, while the latter can license both structures. This conclusion is confirmed by Cyran's (2001) cross-linguistic analysis of the licensing properties of nuclei. He indicates that various syllabic and segmental complexities require different licensing strength. Simplifying, the occurrence of different constituents (branching or simplex) and their ability to support different melodic patterns depends on the fact whether the following nuclear position is occupied, reduced or empty. Thus, languages may choose one of the three options: the filled, reduced or empty nucleus. Moreover, languages make arbitrary choices as to how much they allow their nuclei to license. What is important, however, is the fact that in a given language a reduced nucleus cannot license more structures than the filled one, similarly the empty nucleus can license at most the same amount of complexity as the reduced one but never more.

So far we have not said anything about the prosodically weak positions. This will be explained in the immediately following sub-section.

### 3.3 Licensing Inheritance

Harris' (1994, 1997) theory of Licensing Inheritance unifies the intimate relationship between the distribution of prosodic licensing within a word and the allocation of melodic contrasts. Within a given domain all positions must be licensed except one, the head of this domain. Thus, licensing is a function which enables the integration of a word by binding each unit in one way or another to some other unit. The head distributes the licence to all the segments in a given domain, which can be done directly or indirectly. Given that every position requires the licence to support a particular set of melodic contrasts, it follows that the further the position on the licensing path appears the less licensing ability it acquires. To put it differently, in a given domain the weakest position is the one which is licensed indirectly through many mediators. These mediators absorb some of this licensing potential, hence the licensing which goes to the last position is highly depleted. This is illustrated on the example of the English word *Sandra* in (8) below.

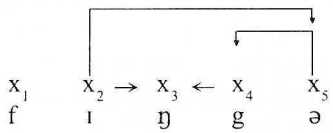
(8)




(8) represents the distribution of the licensing potential in the right edge of the word *Sandra*. We can see that before the licensing receives $x_5$, it goes through many mediators. Therefore, the licensing must be divided among the three segments (the mediators). The least goes to the $x_5$ position, as it is at the end of the licensing path. It follows that in (8) $x_5$ position is prosodically the weakest. Note that this position, i.e. $x_5$, is occupied by a simple segment [r] composed of only one element (A). After this very general introduction to the theory of Licensing Inheritance we can consider the problematic sonorant-plosive se-

quences, this time from the point of view of the licensing path. In (1) above we saw that all the nasal-plosive clusters are possible when followed by a realized nucleus, even if the nuclear position is occupied by the reduced vowel. First consider the word *finger* represented in (9) below.

(9)




In (9) $x_4$ appears in a relatively weak position as it is indirectly licensed, through $x_5$, by the head of this domain ($x_2$). Yet $x_4$ receives enough licensing potential to support the relatively complex segment, the voiced velar plosive. It was demonstrated that in this particular context every combination of sonorant plus plosive is possible (see (1) and (4) above). The situation, however, changes dramatically when the same clusters are followed by the nucleus which is not realized. Consider again the examples in (2) which are repeated below for the reader's convenience

(10)

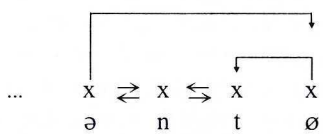
| | | | | | |
|---|---|---|---|---|---|
| wi**ng** | [wɪŋ] | la**mb** | [læm] | me**nd** | [mend] |
| si**ng** | [sɪŋ] | bo**mb** | [bɒm] | sou**nd** | [saʊnd] |
| wi**nk** | [wiŋk] | la**mp** | [læmp] | te**nt** | [tent] |
| si**nk** | [siŋk] | plu**mp** | [plʌmp] | le**nt** | [lent] |

As has already been mentioned in the course of our previous discussion, in the context like (10) above both voiced velar and bilabial plosives cannot be realized phonetically when licensed by the empty nucleus. To stay mute the nucleus needs a small amount of the licensing potential, as it does not have to support any melodic material. Therefore, receiving less from the head of the domain this nuclear position, in turn, passes on less licensing potential to the preceding position and this may be the reason why the onset position indicates a reduced contrastive potential. The main question, however, stands on, namely why is the voiced alveolar plosive [d] allowed to appear in the position where other voiced plosives are banned. We may try to find the solution by inspecting the internal structure of plosives. Note that the plosives can be divided into two groups. Voiceless or more precisely fortis plosives[5] are more complex as they contain one more element - the laryngeal (H), while the lenis (voiced) counterparts do not possess the laryngeal element (L). Given the fact that fortis plosives are more likely to appear before the empty nucleus, we arrive at the paradoxical situation where the more complex segments, those which are more costly in terms of licensing, appear in the relatively weak position. Moreover, less complex plosives (lenis) are forbidden in this position. Additionally, the situation is complicated by the fact that, although all fortis plosives behave identically in this context, we cannot say the same about the lenis ones. Note that in (10) the lenis alveolar plosive is accepted in the position

[5] It is a widely accepted fact that voicing is not an adequate term for the characterisation of the two kinds of consonants. This is related to the fact that in English there are truly voiceless consonants, while fully voiced ones hardly exist at all.

where other lenis plosives are ruled out. All these facts contribute to the negative conclusion that the distribution of English oral stops in sonorant-plosive clusters can be accounted for neither by the licensing nor the segmental complexity. It goes without saying, however, that the mysterious distribution of plosives is connected with the licensing properties of nuclei. Remind the fact that most of the clusters in question never appear after a reduced vowel, e.g. [-ənk]*, [-əlp]* etc. Thus, it follows that in a situation when a nuclear position (the head of the domain) occupied by a reduced vowel licenses a word-final empty nuclear position, the latter is able to support only the alveolar plosives in the preceding onset. Note that in such a context the head is not only indirectly licensing the onset position, through the final empty nuclear position, but it also has to license an immediately following rhymal position. This is illustrated in (11) below.

(11)




Given what we have said about the licensing properties of nuclei, the whole structure in (11) is weak as it is licensed, directly and indirectly, by a reduced vowel. In such a context (11) only the alveolar plosives are accepted, no other plosive can appear in this position.

From the discussion in this section it follows that either the proposal, that a prosodically weak position is reserved for non-complex segments is false, or there is something in the nature of plosives that has passed unnoticed. In the following section we focus on the other solution, which makes reference to the notion of phonological strength.

## 4. Phonological Strength

In his analysis of the sonorant-plosive clusters, Gussmann (1998) points to the fact that when a complex segment appears in a weak position it must be strong in order to survive, and vice versa, if a less complex segment occurs in a weak position and in spite of this fact it is suppressed, it must be weak. Thus, English plosives can be divided into those which are strong and those which are weak. In this particular case the complex simply means strong and the non-complex weak. It is worth noting that, although, these two concepts: complexity and strength, are equal as far as the pairs of fortis – lenis plosives are concerned, it runs counter to Harris' (1997) proposal, as it means that the stronger and hence more complex segments can appear in the prosodically weak position. What is more, the division into complex (strong) and non-complex (weak) is not satisfactory. Remind that while the fortis (more complex and hence stronger) class of plosives behaves identically, the same cannot be said about the lenis (less complex and hence weak). To put it differently, although consisting of the same number of elements, the lenis plosives indicate different values of strength. The problem why in the same context some lenis plosives are suppressed, while others are perfectly possible is resolved by means of the strength hierarchy. Thus, the plosives are divided into fortis - strong and lenis - weak on the grounds that the fortis, and not the lenis, can appear in both contexts, i.e. word-medially and finally, without any restrictions. Additionally, the alveolar stops are on the top of the strength hierarchy, as this pair is not constrained at all, the medial position on the scale is occupied by the bilabial

stops. This is dictated by the exceptional forms which end in [b] (see (4) in section 2). The weakest plosives seem to be the velar stops, note that [g] never appears before an empty nucleus. The strength hierarchy is represented below[6].

(12) Strength hierarchy for English plosives

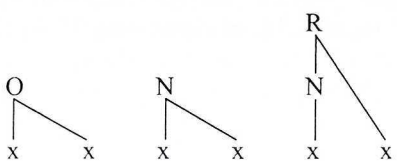
| strong | | | | weak |
|---|---|---|---|---|
| t, d | >> | p, b | >> | k, g |

From the strength hierarchy in (12) it follows that fortis plosives can be realized phonetically even if licensed by the weak licenser, empty nuclei, due to the fact that they are strong consonants, although, [d] does not belong to the fortis class, it is the strongest among the lenis plosives and hence can appear in the position reserved for the fortis consonants. The remaining two lenis plosives [g] and [b] are not strong enough to occur in the same position. These to segments can appear freely only before the filled nucleus – the strong licenser. In this way Gussmann's strength hierarchy puts into question Harris' principle of Licensing Inheritance.

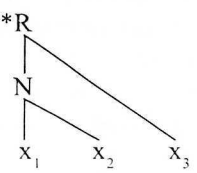
Before we discuss the consequences of introducing the notion of strength into GP theory, we will present some more examples which may confirm the special status of the alveolar stops among English plosives.

In section 1 it was mentioned that GP allows constituents to be at most binary branching. Such branching structures form governing domains where the governing relations are strictly local and strictly directional. The possible branching constituents are represented in (13)

(13) a.




b.




All structures in (13a) are head-initial governing domains. The logical possibility in (13b), i.e. a branching rhyme which contains a branching nucleus, should be excluded on the grounds that such a structure violates the condition on strict locality. In other words, in (13b) $x_1$ (the head of the domain) is not adjacent to $x_3$, and hence cannot govern it. From the above it follows that super-heavy rhymes (structures like those in (13b)) should be excluded from GP due to the fact that they violate universal principles. However, in English there exist some surface facts which suggest that such structures should be accepted as a case of the relaxation of the severe conditions on phonological structure advocated in GP. It is worth mentioning, however, that the occurrence of the rhymal complement in super-heavy rhyme structures is severely constrained. First note that such structures can appear both in the word-internal and word-final position. In what follows, however, we will concentrate on the word-final position because, as it was pointed out above, in this context the distribution of plosives indicates some peculiarities. In the vast majority of cases a final

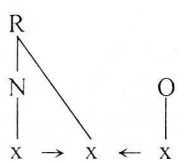
[6] It must be remembered that the strength hierarchies are not equal for all languages, they are often not even equal for the dialects of the same language (see Gussmann (1998)). This particular strength hierarchy is characteristic of plosives in the RP accent.

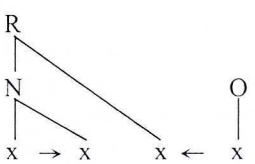
super-heavy rhyme consists of a long nucleus followed either by a coronal partial geminate, i.e. homorganic sonorant-plosive cluster, e.g. *paint* or a fricative plus plosive cluster, e.g. *paste*. Consider some more examples in (14):

(14) a. saint, pint
rind, sound
revolt, colt
child, field

b. paste, boast
cast, clasp
draft, craft

Some other possibilities, as not important to the discussion, are omitted, e.g. *pounce*, *range*. What is striking is the fact that there seems to be a bar on super-heavy rhymes containing a plosive coda consonant. What is even more striking, is that the onset following the super-heavy rhyme is almost invariably occupied by the alveolar stop. The only exceptions to this generalisation are some examples in (14b). Note, however, that most of the forms in (14b) are encountered only in dialects which show lengthened forms of historically short vowels. A further restriction is that the following onset in such cases is occupied by [t] in a great majority of cases. Since, however, our discussion concerns word-final sonorant-plosive clusters we should focus on the forms in (14a). Here we can see that the best candidate for the plosive in this position is the alveolar one. We should also note that word-medially we encounter an identical pattern, namely, only the alveolar plosives are possible in such structures. The only exception to this observation are words like *chamber* and *cambric*. The word-internal clusters, however, are followed by the strong licensor, the filled nucleus which means that the weaker plosives, although rare are also possible. Remind also the exceptional occurrence of [b] after the lateral word-finally. Harris (1994) claims that the well-formedness of a three-position rhyme depends on the additional support of the inter-constituent government. To clarify this point, consider the representation of both heavy and super-heavy rhymes in (15).

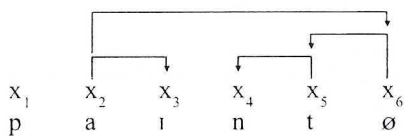
(15) a. 


b. 


We can see that the rhymal complement in (15a) is doubly licensed: once by the preceding nuclear position and again by the following onset position. The rhymal complement of a super-heavy rhyme (15b) is, however, only singly licensed, by the following onset. Simplifying, Harris (1994) suggests that inter-constituent government alone is sufficient to support a rhymal complement in super-heavy rhyme structures. If his prediction is correct, we should find only non-complex segments in this position. This is precisely the case, as shown in (14a) above. The absence of plosives in this position becomes obvious, as they are relatively complex segments. Additionally, the onset position in (14a) is exclusively occupied by the alveolar plosives. Given that this position is weak and that such plosives have to license the preceding sonorant on their own, this is the perfect place for the strongest plosives. On the other hand, the rhymal complements in (14b) are occupied by more complex segments: [s] and [f] which are composed of three elements. In these

cases the onset is primarily restricted to the strongest plosive [t]. The reason why we do not find clusters like *-mp-* or *-nk-* in super-heavy rhyme structures can be explained by the fact that the onset plosive has to license the preceding coda sonorant on its own, without any support from the preceding nucleus. We can illustrate the licensing path in such structures on the example of the word *pint*.

(16)




In (16) $x_2$, the head of the domain has to license both $x_3$, through the constituent government, and $x_6$, $x_6$ in turn licenses $x_5$ which is the weak position and hence occupied by the strong plosive. $x_5$ is the only licenser of the preceding $x_4$ position. This is the reason why $x_4$ is frequently occupied by a non-complex segment. [t] as a strong plosive can appear in a weak position and can also govern the preceding coda on its own. Summing up, the super-heavy rhyme structures further confirm the observation that the alveolar plosives deserve a special position among English plosives.

Additional confirmation of the above observation comes from the distribution of obstruent-plosive clusters in the word-final position. Consider first some examples of the obstruent plus stop sequences:

| | | | | | |
|---|---|---|---|---|---|
| (17) | a. | abreact | opt | b. craft | gift |
| | | abstract | abrupt | haft | raft |
| | | act | accept | soft | lift |

(17) illustrates the word-final clusters composed of two obstruents, in (17a) we have two plosives and in (17b) a fricative followed by a plosive. The immediate observation is that the last position of such combinations is invariably occupied by the fortis alveolar stop. Note also that all the clusters in (17) agree in voicing, this fact indicates the diminished licensing potency of codas and is reflected in an inability of this position to license independent laryngeal elements. Moreover, the first of the two oral stops in (17a) preferably remains unrealised, i.e. the licensed rhymal position lacks a counterpart to the licensing onset's (h) element. In other words, the complexity of segments appearing in the rhymal position of such structures is often reduced. Note also, that the lenis counterparts of obstruents in (17) are ruled out from this position. Some counterarguments like *lived* or *received*, for example, must be dismissed immediately on the grounds that such words indicate morphological complexity (see also the footnote on page 4). Thus, again the conclusion why we do not find words like **atp* or **etk* is that in this context the last position of such clusters is reserved to [t] - the strongest plosive.

The last set of data which may prove the above observations right comes from Polish. Polish, unlike English, allows empty nuclei to license both branching onsets and coda-onset interludes (see the representations in (7) above). Thus, in this language we find both *-rt* and *-tr* clusters word-finally, e.g. *kart*, *teatr* respectively. In his analysis of Polish branching onsets, Cyran (in press) arrives at an interesting observation, namely, he points

to the fact that real final branching onsets indicate character of exceptionality and scarcity. In other words, final branching onsets are severely restricted. Consider some examples which are quoted from Cyran (in press).

(18) a. musztr
jesiotr
sióstr
hałastr
bóbr

b. teatr
parametr
litr
filtr
akr
makabr

It can be easily noticed that the forms in (18b) are of foreign origin. If we ignore possible multiplications produced by compounding, e.g. *milimetr*, and so on, the forms in (18) seem to exhaust the number of the word-final obstruent plus [r] sequences which may be regarded as branching onsets. What is striking is the fact that the clusters in (18) are almost exclusively restricted to [tr][7]. Thus, from his analysis it follows that the real branching onsets in Polish are limited in number and type, and additionally, they are mostly of foreign origin. What is crucial to our discussion, however, is the fact that the onset-head position is almost exclusively restricted to the fortis alveolar plosive [t]. Such onset-head position is licensed by the final empty nucleus, that is why the best candidate for the onset position is again the strong plosive [t].

The data presented in this section confirm Gussmann's (1998) observation that the peculiar behaviour of some plosives in English can be explained by means of the notion of strength. We saw that his proposal can be further confirmed by other distributional facts coming not only from English but also from Polish. However, the following question immediately appears, what are the consequences of the recognition of phonological strength in GP? It was demonstrated that in order to account for the distribution of plosives we have to make reference not only to the relative strength of stops but also to the licensing network connecting all positions in a given domain and the licensing properties of nuclei. Thus, we have demonstrated that if a weak plosive appears in a weak position it cannot be licensed by the weak licensor (empty nucleus), while a strong plosive, in spite of the fact that it is licensed by the empty nucleus, can appear in the same position. It seems that strong simply means the ability to appear in a weak position. One could also look at the strength from a different perspective and say that the weak consonants like the lenis plosives [g, b] are weak in the sense that they can easily loose its internal material (elemental composition), while strong consonants do not easily undergo such a reduction. Note that this observation does not imply that empty nuclei can license only some plosives. We could say that empty nuclei can license both fortis and lenis plosives but since the position (word-final onset) is prosodically weak the preference is that the plosive should be reduced in this position. If, therefore, in such a position a weak plosive (in this sense) appears it is automatically reduced. The strong plosive, on the other hand, is not easily reduced even in weak positions. This can be confirmed by the forms in (17a) above where in clusters of two stops it is the first one that is

[7] Some other combinations of obstruent plus sonorant [l], [w] and some of the obstruent plus [r] clusters were ruled out on different grounds (see Cyran (in press) for more information on the final branching onsets in Polish).

reduced and not the final one. However, the idea that strong consonants are not easily reduced encounters many problems, as [t] the strongest plosive is easily reduced in other contexts (see Harris (1997)). One thing seems to be certain, there is a need to introduce the notion of strength into the GP theory. As Gussmann (1998) observes it might be claimed that not all elements contribute in equal measure to the complexity of an expression. He adds, however, that such reasoning would require a departure from the strictly realistic stance. One could try to postulate an additional element which would represent the strength, this move, however, would necessitate the recognition of differentiation in the number of elements. In other words, the lenis plosives [d, b, g] would differ in respect to the number of elements they include. The same would have to be true for fortis plosives. Even worse, if we agreed that strength is represented by a separate element, how would this element be pronounced in isolation? Remind that in this theory every single element is independently pronounceable. Thus, the only conclusion that can be drawn from the discussion above is that there is a need for further study of English plosives (also in the word-internal position). Such a profound analysis of the distribution of plosives and other segments could reveal some more facts concerning the co-occurrence restriction and the relative strength of English consonants.

## 5. Final Remarks

In this paper we have presented and discussed the distribution of plosives in the sonorant-plosive clusters at the right edge of the word in English. The main aim was to demonstrate the peculiar behaviour of some plosives clustering with the preceding sonorants and other consonants. Thus, the discussion revealed some facts concerning the special status of the alveolar stops when compared with other English plosives. It was pointed out that the distribution of the sonorant-plosive clusters is closely related to the licensing properties of nuclei, not only the ones immediately licensing the plosives but also the heads of the whole domains. This observation is in line with the idea of Licensing Inheritance. However, this principle alone is insufficient to account for the problematic distribution of plosives. Therefore, we have also considered the idea of strength and its influence on the distribution of plosives. It was demonstrated that English stops indicate different strengths values and that the alveolar plosives are the strongest pair. This observation was confirmed by some other characteristic distributional patterns of the alveolar plosives in English and also in Polish. All these extra facts contribute to the conclusion that [t], indeed, enjoys a privileged status among plosives. The introduction of the notion of strength, however, complicates the situation, as this notion not only cannot be equalled with the complexity but more importantly, cannot be represented by the available machinery within GP. Thus, for the time being the notion of strength is just a label which covers some internal characteristic of consonants. It seems that the best way of explaining this internal characteristic is to study the distributional patterns and co-occurring restrictions with other segments. We believe that the future effort to introduce the notion of strength into GP should proceed in this very direction.

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