A SYLLABIC ANALYSIS OF VOWEL EPENTHESIS
IN THE SUFFIX -ed IN ENGLISH

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1. Introduction

The purpose of this article is to demonstrate that certain cases of vowel epenthesis in English are sensitive to syllable structure. More specifically, we shall concentrate on the process of the insertion of an unstressed vowel that takes place in adverbial and nominal forms created by attaching the suffixes *-ness* and *-ly* to the past participle forms of verbs such as those in (1):

(1)   absor[bd] – absor[bɪd]ly
       consu[md] – consu[mɪd]ly

We shall argue that the phenomenon under analysis can only be accounted for if we take into consideration the constraints imposed on English syllable structure, namely the extrasyllabicity of certain consonants. In other words, vowel insertion in the suffix *-ed* will be shown to be closely related to the issue of syllabic well-formedness. Our findings will be given further support by the results of an experiment we have conducted for three dialects of English.

In section 2 we present the basic facts concerning the vowel-zero alternation in the *-ed* participles and their derivatives. We demonstrate that the data found in several major English dictionaries do not allow for drawing any generalisations concerning the alternations in question.

2. Data

In this section we shall present the relevant data to be examined in this paper. Prior to our discussion of the vowel insertion phenomenon, we would like to emphasise that the past participles under analysis do not include those in which the vowel is present underlyingly in the suffix -ed, namely all the verbs which retain their historical pronunciation with [ɪd], e.g., *aged* [eɪdʒɪd], *blessed* [blesɪd], *jagged* [dʒægɪd],

dogged [dogɪd], or *wicked* [wɪkɪd]. These items are clearly exceptional and cannot be handled by regular phonological rules.

Having excluded such idiosyncratic forms, we are left with a number of verbs where the vowel is absent before /d/. We provide some representative examples in (2), with their pronunciation taken from Wells' *Longman Pronunciation Dictionary* (1990), Jones's *Pronouncing Dictionary* (1991) and Webster's 3rd *International Dictionary* (1981):

(2) absorbed [əbˈsoːbd] detached [diˈtætʃt]
amazed [əˈmeɪzd] enlarged [ənˈlaːdʒd]
ashamed [əˈʃeɪmd] peeved [piːvd]
civilised [ˈsɪvəlaɪzd] marked [maːkt]
concealed [kənˈsiːld] perplexed [pəˈplekst]
concerned [kənˈsɜːnd], ([kənˈsɜːnɪd]) pleased [pliːzd]
confined [kənˈfaɪnd relaxed [rɪˈlækst]
confused [kənˈfjuːzd] resigned [rɪˈzaɪnd]
consumed [kənˈsjuːmd] shamefaced [ˌʃeɪmˈfeɪst]
deformed [diˈfoːmd] supposed [səˈpəuzd], ([səˈpəuzɪd])
depraved [dɪˈpreɪvd] veiled [veɪld]

However, the pronunciation of these items is no longer so uniform after the attachment of the suffixes *-ness* and *-ly* to them. In some words the presence of the suffix triggers the insertion of the vowel before /d/, while in others the vowel is absent despite suffix incorporation. We have checked the pronunciation of 45 such deverbal adverbs and nouns in several dictionaries (Wells' *Longman Pronunciation Dictionary* (1990), Jones's *Pronouncing Dictionary* (1999), Longman's *Dictionary of Contemporary English*, Webster's 3rd *New International Dictionary* (1981), *Random House Unabridged Dictionary* (1983) and *The Oxford English Dictionary* (1961)). Having analysed the pronunciations provided by these dictionaries we have managed to distinguish two groups into which we can divide the items under investigation. One group comprises those adverbs and nouns which consistently have a vowel in *-ed*. We present representative examples of such items in (3):

(3) ama[zɪd]ness consu[mɪd]ly
mar[kɪd]ness pee[vɪd]ly
repo[zɪd]ly
suppo[zɪd]ly

In the case of these words this is the only possible pronunciation the dictionaries provide.

The other group, by far a bigger one, comprises those items which display variation, that is which can be pronounced with either a vowel or without it. However, even within this group the dictionaries are not uniform in giving priority to one of the possible pronunciations. In other words, for some adverbs and nouns the form with a vowel is given as first, while other dictionaries provide exactly an opposite alternative for the same words, that is without a vowel, as the first possibility. From what we have observed, the pronunciation with an additional syllable seems to be favoured over the one without it, as the latter is more frequently quoted as the second option. In (4) we present a list of those adverbs and nouns in whose case the consulted dictionaries suggest the forms with a vowel in *-ed* as the first option and without it as the second:

(4) absor[bɪd]ly ~ absor[bd]ly
concea[lɪd]ness ~ concea[ld]ness
concear[nɪd]ly ~ concear[nd]ly
concer[nɪd]ness ~ concer[nd]ness
confi[nɪd]ness ~ confi[nd]ness
confi[nɪd]ly ~ confi[nd]ly
confir[mɪd]ness ~ confir[md]ness
confu[zɪd]ly ~ confu[zd]ly
defor[mɪd]ly ~ defor[md]ly
defor[mɪd]ness ~ defor[md]ness
determi[nɪd]ly ~ determi[nd]ly
distre[sɪd]ly ~ distre[st]ly
distre[sɪd]ness ~ distre[st]ness
enlar[dʒɪd]ness ~ enlar[dʒd]ness
perple[ksɪd]ly ~ perple[kst]ly
perple[ksɪd]ness ~ perple[kst]ness
rela[ksɪd]ly ~ rela[kst]ly
rela[ksɪd]ness ~ rela[kst]ness
resig[nɪd]ly ~ resig[nd]ly

There are also a few adverbial and nominal derivatives for which the vowel-less pronunciation is favoured over the one with a vowel. However, in this case the dictionaries are not unanimous and there are words whose pronunciation differs depending on the dictionary. This concerns such items as those in (5):

(5) 1st deta[tʃt]ly – Wells, Jones; 1st deta[tʃɪd]ly – Random H. and Webster
1st shamefa[st]ly – Jones; 1st shamefa[sɪd]ly – Random H., Webster

Moreover, some of the items we have analysed are transcribed without a vowel only, but there are only a few of them. They are listed in (6):

(6) determi[nd]ness
plea[zd]ness
shamefa[st]ness
unbia[st]ly

It needs mentioning, however, that the only dictionary to offer the pronunciation of the nouns in (6) is Webster's 3rd *New International Dictionary* (1981) and the corresponding adverbs are shown by all dictionaries to display variation.

As can be seen from our presentation of dictionary data, there are three sets of words ending in *-ness* and *-ly*. One group comprises the items pronounced with a vowel exclusively (3), the next one those with vowelless pronunciation (6) and in the third one we find words that display variation, i.e., which can be pronounced both with a vowel and without it (4). The last group is by far the biggest, which means that the dictionaries provide double pronunciation for the majority of the words in question. If we analyse these three types in terms of the clusters that emerge after suffix attachment, we can easily observe that the same sequences can often be found in different groups. Let us take the /md/ cluster. It is present both in (3) and (4) (*consu[mɪd]ly* vs *defor[mɪd]ly* or *defor[md]ly*), which means that for certain adverbs and nouns with this cluster the consulted dictionaries provide exclusively vowel-less pronunciation while for others variation is acceptable. A similar inconsistency can be noticed in the case of the /nd/ and /st/ sequences. The items with these clusters belong to types (4) and (6). Thus, the words such as, for example, *shamefacedness* and *determinedness* are claimed to be pronounced without a vowel only while *concernedly* or *distressedly* admit two options. The /zd/ cluster can also serve as an interesting example as it is present in all three groups since the dictionaries provide syllabic pronunciation for *reposedly* and non-syllabic one for *pleasedly* as the only possibilities, while *confusedly* is shown to display variation.

In view of such examples a conclusion can be drawn that it is hardly possible to formulate any rule which could account for the pronunciation of the items under investigation. It appears from the dictionary data that the presence or the absence of the vowel is not determined by the nature of the consonantal cluster but it is rather a feature of individual words in which epenthesis takes place in a completely different context. It is doubtful whether one rule of vowel insertion can be formulated to cover such very distinct cases. In what follows we intend to challenge this conclusion and demonstrate that the pronunciation of deverbal nouns and adjectives is, in fact, rule-governed. Before doing that, however, we shall address briefly the issues of the nature of the process observed in the analysed items as well as its former interpretations.

3. The nature of the process

There does not seem to be an agreement among the linguists as to the nature of the process triggered in the suffix *-ed*. What needs to be considered is whether the presence of [ɪ] in past participles of the *wanted* type and its presence in adverbs and nouns created after the attachment of *-ly* and *-ness* (e.g. in *suppo[zɪd]ly* and *mar[kɪd]ness)* are instances of the same phenomenon. There seem to be five options worth analysing.

One option (A) is that the suffix *-ed* in both verbs and adjectival and nominal derivatives is represented as underlying /d/ and there is one rule of insertion which covers both cases. This would mean that a vowel is inserted whenever the phonological context is met, that is every time a verb ends with /t/ or /d/. This approach accounts for *wan[tɪd]* and *exacerba[tɪd]ly*. We formulate a simplified insertion rule in (7).

(7) $\varnothing \rightarrow$ i/t,d # _ d #

However, (7) does not explain the presence of the vowel in the items such as *absor[bɪd]ly* or *mar[kɪd]ness*.

Another possibility (B) is that in all instances the suffix in question is underlyingly /d/, but there are two insertion rules. One rule (7) concerns past participles only and is phonologically motivated by the presence of /td/ and /dd/ clusters. Another rule would apply only to polymorphemic adverbs and nouns. It is clear that the latter would have to operate in a broader context than the former, i.e., not only in the /td/ and /dd/ clusters, but in other cases as well (e.g. *mar[kɪd]ness*).

A third option (C) to consider is that the underlying representation of the *-ed* suffix is /id/ and that a rule of deletion is at work. It would remove /i/ in all past participles apart from those whose stems end in /t/ or /d/. The problem is, however, that such a rule would only account for the shape of past participles (e.g. *marked – mar[kt]*, *kissed – ki[st]*) but would not work for adverbs and nouns since the vowel fails to delete in some items with consonantal clusters identical to those in past participles, e.g., in *mar[kɪd]ness*. Again, formulating one deletion rule to cover both cases appears impossible.

A fourth possibility (D) is, thus, positing two separate vowel deletion rules: one for the past participles and another for deverbal adverbs and nouns. The removal of the vowel takes place in two different contexts.

There seems to be yet another option (E) worth taking into account. According to it, the underlying representation of *-ed* is syllabic but there are two rules at work. One is the deletion rule that is triggered everywhere except in the cases leading to the emergence of clusters (the *wanted* type). It would account both for *mar[kt]* and *ki[st]*, and for *determi[nd]ly* and *concea[ld]ness*. Another rule is the one of insertion which epenthesises the vowel in such items as *markedly, consumedly, depravedness* and many others.

It can be concluded that two options, i.e. (A) and (C) must be rejected and three analyses, i.e., (B), (D) and (E) can be considered acceptable. One regards /d/ as the underlying representation of the *-ed* suffix and requires two insertion rules (B). The next one assumes the syllabic representation of *-ed* and two deletion rules (D). In the third possible option (E) both deletion and insertion rules apply and the suffix is underlyingly /id/.

Since all these analyses allow us to obtain the desired results, it is impossible to determine which of them should be adopted. As two of the three acceptable options require vowel epenthesis in deverbal nouns and adjectives, we shall assume that, indeed, a process of /i/ insertion is at work here. This assumption is in agreement with the generative tradition which appears to favour a non-syllabic interpretation of *-ed* and vowel epenthesis over a syllabic analysis of the suffix with a deletion rule.

4. A stress-based account of vowel epenthesis

Miner (1975) and Anderson (1973) claim that the presence or absence of the vowel in the *-ed* suffix in adverbs and nouns is conditioned by a stress factor. These linguists agree that if in the past participle forms of verbs stress falls on the stem-final syllable, the vowel /i/ is bound to appear before /d/ on the attachment of the suffixes *-ly* and *-ness* irrespectively of the nature of the stem-final segment. In accordance with this proposal, all the vocabulary items listed in (3) should be pronounced with a vowel in the suffix, which, indeed, is the case. On the other hand, according to Miner and Anderson, the placement of stress is not taken into account if the stem-final consonant of a verb is /d/ or /t/: in such instances the vowel is obligatory. Thus, the forms such as *exacerbatedly* or *exacerbatedness* will be pronounced with the vowel before /d/, even though the stress here falls on the antepenultimate syllable of the verbal stem.

In view of the approach to vowel epenthesis under examination, /i/ should appear in adverbs and nouns every time the stress condition is met. Nevertheless, the theory does not seem to hold true for all the items under analysis, even though some of them comply with the stress placement requirement. There are, however, many words where the vowel is not inserted despite the stress falling on the stem-final syllable. We present the relevant examples in (8):

(8)   conceal   —   concealedness   [kən'siːldnəs]
                        concealedly   [kən'siːldlɪ]
      concern   —   concernedness   [kən'sɜːndnəs]
                        concernedly   [kən'sɜːndlɪ]
      confine   —   confinedness   [kən'faɪndnəs]
                        confinedly   [kə'faɪndlɪ]
      resign   —   resignedness   [rɪ'zaɪndnəs]
                        resignedly   [rɪ'zaɪndlɪ]

Clearly the stress-based theory of vowel insertion cannot be viewed as adequate and alternative explanations must be sought. In what follows we shall provide a description of the experiment from which such counterexamples emerged and then attempt to explain the phenomenon under discussion with reference to syllable structure.

5. The experiment description

In view of the fact that the pronouncing dictionaries do not seem to be uniform in their treatment of adverbs and nouns formed from past participles, we have decided to conduct an informal experiment. The purpose of it was to examine native speakers' judgements concerning the presence and absence of the vowel in this group of items. Secondly, our aim was to determine the exact environment in which the process of vowel insertion takes place. In order to check whether there are any dialectal differences in the treatment of the items under analysis, we have carried out the experiment for three different dialects of English; the London dialect, that is near RP, the West Yorkshire dialect spoken in Bradford and one of the Irish dialects spoken in County Kerry. The choice of the first two dialects has been conditioned by their availability to the experimenter, while the third one has been selected for the analysis due to its distinctive features, namely its proneness to vowel epenthesis processes.

5.1. Subjects

The subjects of our experiment conducted for the London dialect were thirty people (18 women and 12 men) at the age ranging from 30 to 50, educated, that is at least with A-levels. All of them were born and educated in London and spent most, if not all their lives there.

Thirty speakers of the West Yorkshire dialect (that is 21 women and 9 men) tested in our experiment were between 20 and 30 years of age. 19 of them were students of Bradford University, the remaining ones finished their education at 16, with O-levels only. All of them were native Bradford inhabitants living in the districts famous for their broad Yorkshire accent.

The last thirty informants we have tested were native Irish people from County Kerry, strictly speaking from the area around the town called Killarney. They were mostly adults, ranging in age from 18 to 50. 14 of them were women and 16 were men. We have no record of their educational level.

There were altogether 90 respondents who took part in our experiment.

5.2. Stimuli and procedure

The procedure we followed when conducting the experiment was similar for all the three groups of informants. They were individually presented with a list of 45 adverbs and nouns formed from past participles and asked to read them aloud. In all the cases the list consisted of separate words arranged in columns, but the speakers from Bradford were additionally requested to read the same items in contexts, that is used with other words in sentences. By doing so we wished to pinpoint any potential variation that might have appeared in the pronunciation of the items in question when read individually and in connected speech. However, as the results obtained in the additional experiment did not exhibit any differences when compared with the ones based on the word list, we decided not to employ this method when testing the remaining two groups.

As for the vocabulary items chosen for the test, these were words with the environments potentially triggering various vowel insertion processes, not only epenthesis in the suffix *-ed,* but also other insertion phenomena which are not the subject of this article. They were mostly taken from the *Random House Dictionary* (1983), *Reverse Dictionary of Present-day English* (1971) and Webster's 3rd *New International Dictionary* (1981). We were careful in arranging the data in such a way as to avoid putting items of the same type or form in an adjacent position as it could influence the speakers' judgements. In other words, those examples which were similar, were separated by distracters in the form of the items exhibiting other phenomena we wished to analyse. All the responses were recorded.

The subjects were not aware of the purpose of the test, which means that they were not told that the experiment was carried out in order to determine the environments triggering the process of vowel insertion. Only after they read the lists were they provided with the explanation, if it was requested.

We do realise that our experiment was not a formal one, but believe that the obtained results are reliable enough to serve as a back-up for our analysis. In what follows, we are going to use them in order to argue against the previous account of vowel epenthesis in the suffix *-ed* and to propose an alternative one with syllable structure as the conditioning factor of the process.

6. An alternative approach

6.1. The experiment results

Although we have conducted the experiment for three various dialects of English, in what follows we present the joint results as the dialectal differences were negligible.

The vast majority of our informants, that is eighty-four out of ninety, chose to insert a vowel in the items listed in (9):

(9a)	(9b)	(9c)	(9d)
absor[bɪd]ly	asha[mɪd]ly	perple[ksɪd]ly	confu[zɪd]ly
absor[bɪd]ness	asha[mɪd]ness	perple[ksɪd]ness	repo[zɪd]ly
deta[tʃɪd]ly	confir[mɪd]ly	rela[ksɪd]ly	repo[zɪd]ness
deta[tʃɪd]ness	confir[mɪd]ness	rela[ksɪd]ness	suppo[zɪd]ly
enlar[dʒɪd]ly	defor[mɪd]ly		
enlar[dʒɪd]ness	defor[mɪd]ness		
mar[kɪd]ly	depra[vɪd]ness		
mar[kɪd]ness	pee[vɪd]ly		

These results conform with the previous analyses as in all the items stress is placed on the syllable immediately preceding the suffix *-ed* and, indeed, /i/ is present here.

However, more than 80% of our informants, that is 74, did not insert a vowel in any of the words presented in (10), irrespectively of their stress placement:

(10)　concea[ld]ly　　confi[nd]ly　　distre[st]ly　　shamefa[st]ly
　　　concea[ld]ness　confi[nd]ness　distre[st]ness　shamefa[st]ness
　　　concer[nd]ly　　determi[nd]ly　resig[nd]ly　　unbia[st]ly
　　　concer[nd]nes　determi[nd]ness　resig[nd]ness　vei[ld]ly

As can easily be seen, with the exception of *determinedly* and *determinedness*, in all the items listed in (10) it is the stem-final syllable of the past participle that receives stress and yet the process of vowel epenthesis is not triggered. Therefore, it seems obvious that some other factors than stress must be at work here.

There is also a group of words in the pronunciation of which the subjects were not unanimous. We present these items in (11):

(11)　amazedness
　　　civilizedness
　　　pleasedly
　　　pleasedness

50 out of 90 respondents pronounced *civilizedness* and *amazedness* without an intervening vowel and 47 out of 90 did the same with *pleasedly* and *pleasedness*. All these items contain verbal stems which end with /z/.

As can be seen from the experiment results, three groups of words can be distinguished, as was the case with the dictionary data. One group comprises the items pronounced with a vowel in the suffix (9). In the second one there are items in which insertion is not triggered (10). The last group (11) comprises the words which exhibit variation, that is by some pronounced with a vowel while by others without it. However, on comparing the experimental data with the dictionary ones, we can observe that the former are much more clearly defined. According to the consulted dictionaries, in only a few items vowel epenthesis is triggered. Quite different results have been obtained in the experiment, as the respondents decided to insert the vowel in far more words than is claimed by the dictionaries. As for the non-syllabic pronunciation, it is offered for four dictionary items only while our informants chose this pronunciation much more frequently. A striking difference can also be observed in the case of examples with fluctuating pronunciation as this group is the biggest in the dictionary data and the smallest in the experimental ones. We shall try to account for these inconsistencies in the following sections.

Coming back to our analysis of the items obtained in the experiment and listed in (9) and (10), we can formulate a generalisation as to the environments in which the

insertion is triggered as well as the ones where the process does not operate. It follows from our experiment that the vowel is unquestionably present in the suffix *-ed* to divide the clusters such as /bd/, /kt/, /gd/, /dʒd/, /tʃt/, /md/, /vd/ and /kst/. On the other hand, there is no insertion when the stem-final consonant is /n/, /l/ and /s/ that is in the clusters such as /nd/, /ld/ and /st/. The cluster /zd/ receives no uniform treatment with half of the speakers opting for vowel insertion and the other half against it. As the speakers did not seem to take the location of stress into consideration while pronouncing the analysed words with or without a vowel in the suffix, we suggest that stress placement is not a factor which conditions the operation of the insertion process.

In what follows we are going to argue that the occurrence of the epenthetic vowel is related to syllabic well-formedness, that is to the constraints imposed on codas in English. First, however, let us present the approach to English syllable structure we have adopted for the purpose of our analysis.

6.2. English syllable structure

Despite several differences in the approaches to English syllable structure adopted by various linguists, the majority of them seem to agree as to the fact that the Sonority Sequencing Principle (SSP) (Selkirk 1984) generally holds for English. According to it, for the syllable to be well-formed the sonority must rise towards the peak and fall away from it. The sonority scale for different groups of segments may also differ depending on a particular approach, but for the purpose of this article we shall adopt the one proposed by Selkirk (1984: 116), where stops, as the least sonorous segments, are followed on the scale by fricatives, nasals, liquids, glides and vowels, the latter being the most sonorous ones.

As there are certain violations of the SSP found on the surface, the principle is often claimed to work at a deeper level of representation, which means that both phonetic and phonological syllables need to be recognised. However, not all linguists isolate both types of syllables. They also differ in their views on the template structure of the phonological syllable.

Having analysed several views on English onsets and codas, we have decided to adopt the one proposed by Durand (1990: 209) and Szpyra (1995: 68) as it matches the structure of the universally preferred syllable type. We present the model of this template in (12).

In this template the nucleus is the only obligatory element of the syllable. The onset and the coda can comprise maximally two consonants, with the sonority distance between them larger in the onset. This means that the onset of the English syllable is governed not only by the SSP but also by the minimal distance constraints, which state that segments too close on the sonority scale cannot be found in the onset. Thus, the template in (12) allows only obstruents followed by approximants in this constituent.

(12)

where C_1 is more sonorous than C_2
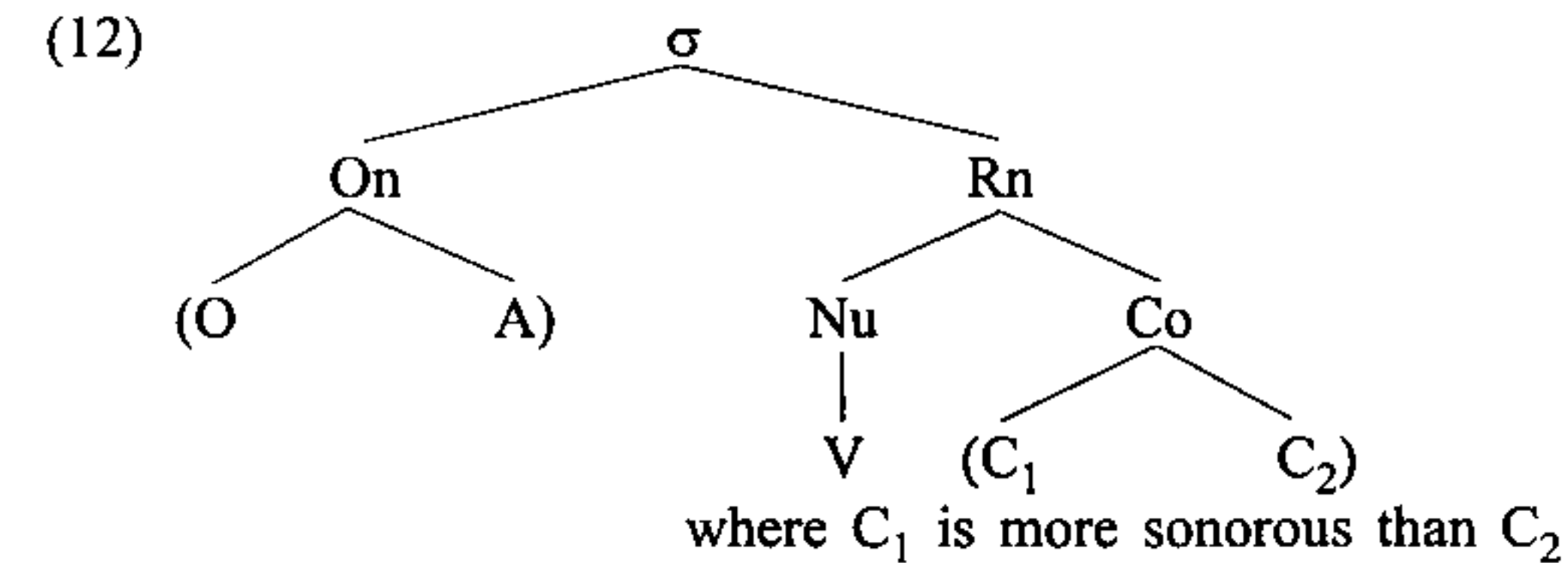
There is, however, a group of clusters which are systematically excluded from occurring in the syllable-initial position despite the fact that they conform to both the SSP and the minimal distance constraints. These are clusters such as /dl/, /tl/, /bw/ and /pw/, which are disallowed word-initially in English by language specific constraints.

In this model of the syllable all consonants not complying with the SSP are extrasyllabic and are incorporated into the coda later in the derivation. Some linguists (e.g. Goldsmith 1990) have also formulated a peripherality condition on extrasyllabicity, according to which segments can only be extrasyllabic in peripheral positions in the word, that is word-initially and word-finally. There are no extrasyllabic segments in the middle of the word.

Unsyllabified word-final consonants in English are said to form an appendix. It has been observed that the consonants in the appendix are uniformly coronal.

The model of the syllable presented in this section will serve us as a theoretical basis for the proposal we offer in what follows. Out of all the syllabic templates suggested for English, this one seems to account for the phenomenon of vowel insertion most adequately.

6.3. A proposal

After the presentation of the theoretical background for our analysis, we shall now proceed to the explanation of the results of our experiment in reference to syllable structure. To start with, let us examine the past participle forms of verbs. We can observe that the process of vowel insertion is not triggered here in any of the clusters created after incorporating the suffix *-ed*. It has to be born in mind that /d/, being a word-final coronal consonant, can be claimed to form an appendix in all the emerging clusters, namely in /md/, /vd/, /nd/, /st/, /ld/, /zd/, /bd/, /kt/, /gd/, /dʒd/ and /tʃt/. Therefore, at the phonological level it is not syllabified and remains outside the final syllable. Vowel epenthesis is not necessary even if some of these clusters violate the SSP, as shown in the examples in (13):

(13)   absor[bd]
        deta[tʃt]
        enlar[dʒd]
        mar[kt]
        perple[kst]

The situation becomes more complicated after the second suffix has been attached. The coronal consonant which constitutes an appendix in past participles can no longer be treated as such because it ceases to occupy the final position in the word. After the attachment of the suffixes -ly and -ness, /d/ is trapped between two consonants in a triconsonantal cluster which emerges as a result of double suffixation. Due to the constraints imposed on English onsets, /d/ is banned from being incorporated into the onset of the following syllable as this procedure would create an impermissible /dn/ cluster, in which there is no sufficient sonority distance between the stop and the nasal (there are no words in English that start with /dn/). As for /dl/, the cluster is ruled out from the onset position by language-specific constraints of English mentioned in 6.2. (there are no words with the initial /dl/). Thus, the only option is to adjoin /d/ to the preceding syllable.

As it happens, there are two possible cases here. In some items (10), the cluster emerging after the attachment of /d/ into the preceding syllable is a well-formed coda as it does not violate the Sonority Sequencing Principle. This is the case with the clusters such as /nd/ /ld/, and /st/, which are present in *concealedness, confinedly, concernedly, resignedly, shamefacedness* and *distressedly*.These sequences represent a sonority fall and do not trigger vowel epenthesis. Additionally, all these clusters can appear in single morphemes, which means that we have words like *wild, mild, land, band, must* and *feast.*

We can conclude that /nd/, /ld/ and /st/ are all well-formed codas which do not have to be broken by an epenthetic vowel. In other words, /d/ is not extrasyllabic in *concealedness. Concealdly, confinedness, confinedly, concernedness, concernedly, shamefacedness* or *shamefacedly,* and such forms are syllabified exhaustively, as illustrated in (14):

(14)
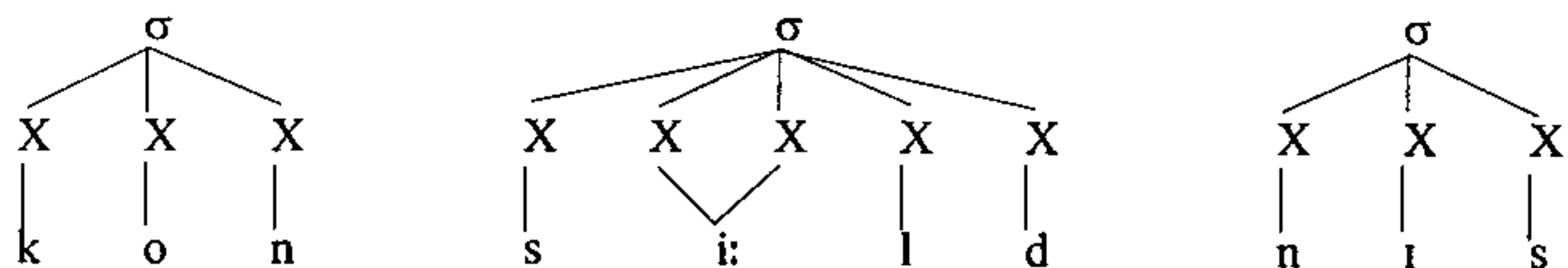
In *concealedness,* /d/ cannot be syllabified into the onset together with /n/, but can be attached to the coda with /l/. This results in a fully syllabified word, which requires no epenthesis.

However, not in all cases is the attachment of /d/ to the preceding syllable possible. In many items in (9a) /d/ cannot be incorporated into the coda as it would violate the SSP, which is the case with words such as *absorbedness, markedness, detachedly* or *enlargedness* since the clusters such as /bd/, /kt/, /dʒd/ and /tʃt/ do not display a fall in sonority required in the English coda. Hence, /d/ here can be syllabified neither into the onset nor into the coda of the adjacent syllables. In view of these considerations, we can conclude that /d/ is extrasyllabic in this environment. As extrasyllabicity is not allowed word-internally according to the peripherality condition proposed by Goldsmith (1990), the consonant must either be deleted or trigger vowel insertion to restore syllabic well-formedness, as claimed by Ito (1986). English speakers choose the latter solution and break the impermissible clusters with a vowel. The rule of insertion is formulated in (15):

(15) $\varnothing \rightarrow V / \_ *C$

and illustrated in (16):

(16)
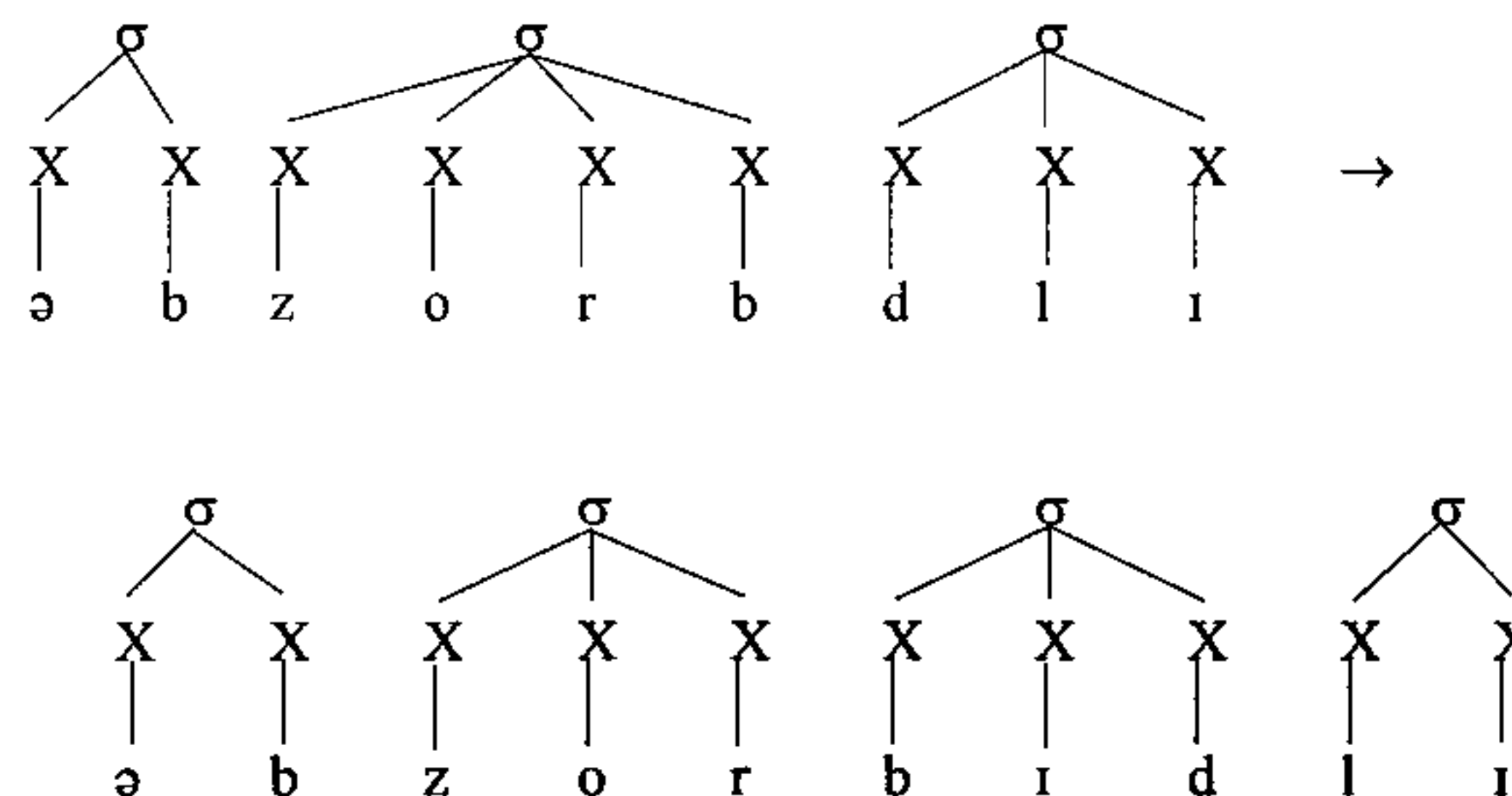
In this example, the attachment of -ed and -ly to the verb *absorb* creates a word-internal cluster of /bdl/. In this context /d/ cannot be syllabified into the preceding coda (/bd/ is not a well-formed coda) or the following onset (/dl/ is not a licit onset). Thus, it is extrasyllabic and therefore unpronounceable. Vowel epenthesis is triggered in order to create a new nucleus to which extrasyllabic /d/ can be attached and, as a result, syllabic well-formedness can be restored.

Continuing our analysis of the vocabulary items listed in (9b) we can notice that epenthesis often takes place despite the fact that in triconsonantal clusters the first

two consonants do not violate the coda condition. Such a situation occurs in the sequences such as /mdn/, /vdl/ and /zdl/ in *ashamedness, depravedly* or *supposedly.* However, despite the compliance of these clusters with the sonority hierarchy, the vowel is inserted here. The question nevertheless arises whether they are, in fact, permissible coda clusters in English. A striking feature of /md/, /vd/ and /zd/ is the fact that none of them can be found finally in monomorphemic words. To put it differently, there are no English words such as [*limd], [*sævd], etc. In order for a cluster of a nasal and an obstruent to be admitted in the coda of an English monomorphemic word, it must be homorganic (e.g. *find, lamp, sink*), which is not the case with /md/. Thus, /md/ is not a well-formed coda in English. As for the clusters of a fricative and an obstruent, they must be voiceless if they appear in single morphemes word-finally (e.g. *beast, loft, mask, lisp*). For that reason we do not find /vd/ or /zd/ in word-final position in English words. We can conclude that these sequences are excluded as licit English codas due to language-specific constraints which rule them out on a par with /dl/ and /tl/ in the onset and /md/ in the coda. Since in all these sequences, i.e. /mdn/, /vdl/ and /zdl/, /d/ cannot be assigned to the preceding coda or to the following onset, it remains extrasyllabic and triggers vowel epenthesis in (15). We illustrate this process in (17):

(17)
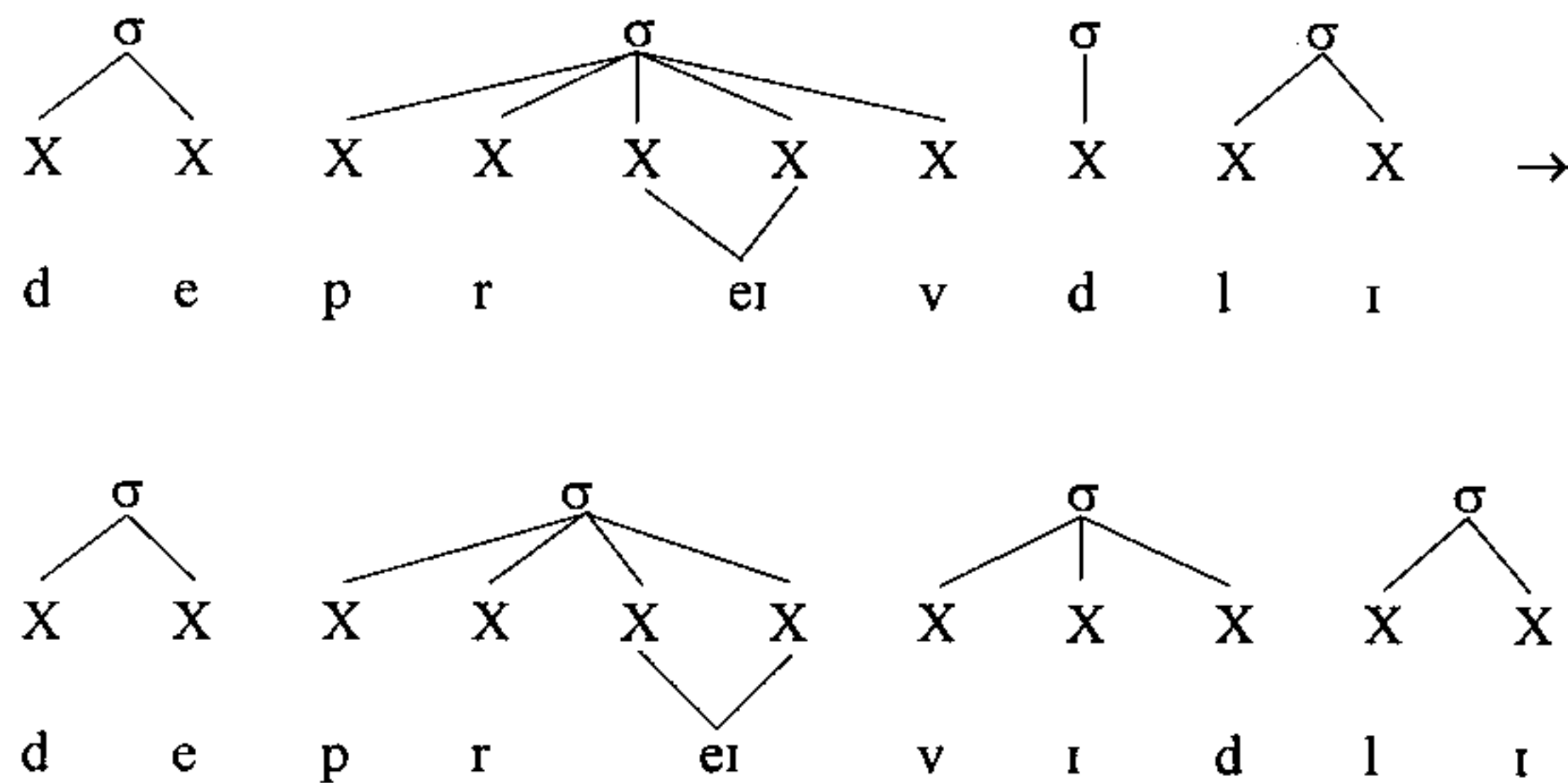
In this example the attachment of *-ed* and *-ly* to the verb *deprave* results in a word-medial cluster of /vdl/. We cannot assign /d/ to the preceding syllable as it would create an impermissible coda of /vd/, nor can we syllabify it into the following onset as /dl/ is not a licit constituent. Therefore, /d/ is extrasyllabic and triggers the insertion of the vowel in order to restore syllabic well-formedness.

As can be seen in four examples, namely *relaxedly, relaxedness, perplexedly* and *perplexedness,* the vowel also breaks the medial clusters of four consonants resulting from the attachment of *-ness* and *-ly* to three-consonantal /ksd/. Occupying the inter-

nal position, the coronals /sd/ can no longer be treated here as an appendix, as in the past participles *relaxed* and *perplexed.* In such circumstances /s/ and /d/ are extrasyllabic and cannot be incorporated into either the coda of the preceding syllable or the onset of the following one. Were it to be done, both /ks/ and /ksd/ clusters would violate the coda condition in English, and /sdn/, /sdl/, /dl/ and /dn/ would form impermissible onsets. In order to avoid such violations, the vowel is inserted creating the nucleus for the syllable with /s/ in the onset and /d/ in the coda. We show this process in (18):

(18)
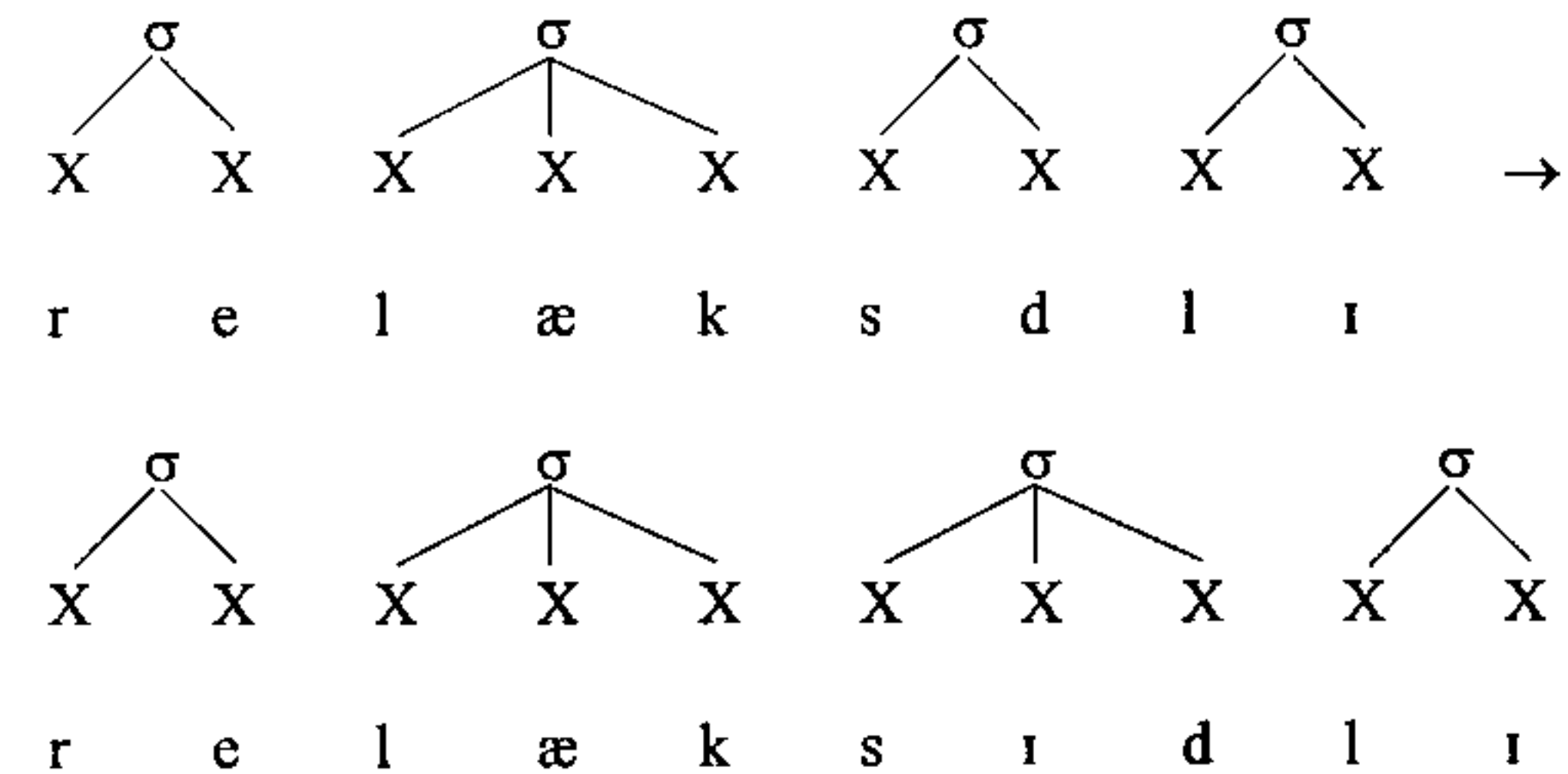
As can be noticed, after the attachment of the suffixes *-ed* and *-ly* to the verb *relaxed* we obtain the cluster of /ksdl/. In this context both /s/ and /d/ are extrasyllabic as their incorporation to either the coda of the preceding syllable or to the onset of the following one is impossible. Thus, a vowel is inserted to form an additional nucleus and restore violated syllable structure.

The question may arise why the vowel is epenthesised before /d/ and not /s/ although the latter is also extrasyllabic. This can be accounted for with reference to morphological structure. In *relaxedly* the vowel is inserted before a separate morpheme /d/. As /s/ is not a separate morpheme, there is no insertion before it. It might, therefore, be the case that the rule in (15) is morphologically conditioned.

Additionally, Szpyra's (1995) analysis of clippings has shown that /ks/ clusters enjoy a special status in English since they behave as a single unit which, in spite of its sonority profile, is syllabified into the coda. This means that both consonants are incorporated into the clipped forms, as shown in (19).

(19)	saxophone	→	sax
	Mexican	→	Mex
	tuxedo	→	tux

It may be the case, therefore, that /ks/ is a well-formed coda after all, and that in the word *relaxedly* only /d/ is extrasyllabic and vowel epenthesis is triggered before it to create a nucleus for a new syllable.

To account for the process of vowel insertion in the clusters discussed here we will adopt Borowsky's (1992: 147) proposal. As the incorporation of the suffixes *-ed* and *-ness* (*-ly*) into the stem takes place at level 2 (internal word-boundary affixation), representations arising from level 2 rules contain allophones as well as clusters not found morpheme internally. According to Kaye and Vergnaud's (1990) hypothesis, words constructed at level 2 are processed differently in speech recognition from level 1 items, which are listed in the lexicon. Words containing level 2 morphology are not stored and the speaker must recover the stem and the affixes in order to recognise them. A heavy cluster emerging after suffix incorporation marks the position where the speaker must make a cut in order to recognise the string. It might be the case, therefore, that the cluster of consonants created as a result of in-corporating both suffixes *-ed* and *-ness* (*-ly*) into the stem is too heavy for the speaker to be left undivided, especially since no similarity to single morpheme words can be established, as with /mdl/, /vdl/, /stn/, etc.

We would like to discuss now the /zd/ cluster from (9d), which is somewhat problematic as our informants were not unanimous in deciding whether or not it should be separated with a vowel. As has already been mentioned, this cluster is not found in monomorphemic words and is disallowed in the coda due to language spe-cific constraints. Consequently, /d/ is extrasyllabic here and should trigger vowei epenthesis. However, about 50% of our subjects did not divide the cluster with a vowel in *amazedness*, *pleasedly* and *civilizedness*. The only explanation for this in-consistency that we can offer is the phonetic similarity of /zd/ to /st/ and its homorganicity. As the latter sequence is permissible in the coda, some speakers re-gard the former as such as well. It has to be mentioned here that although half of the speakers tested in our experiment decided not to insert the vowel in *amazedness*, *pleasedly* and *civilizedness*, all of them did break the /zd/ cluster in *supposedly*, *con-fusedly*, *reposedness*, *reposedly* and *confusedness*. This would support our claim that /zd/ is not a well-formed coda and the insertion of the vowel is to be expected, which means that pronunciations without a vowel is exceptional.

There is one more point we would like to make. As can be observed, our analysis does not seem to apply to the dictionary data presented in section 2. The conclusion can be drawn therefore, that the rule of epenthesis triggered to eliminate the extrasyllabicity of consonants is not employed by all native speakers of English. Some of them appear to apply a much broader rule, which we formulate in (20):

(20) $\emptyset \rightarrow i$ / C # _ d # CV

according to which the vowel is inserted whenever.

It may also be the case that some speakers have a lexically rather than phonolog-ically motivated rule which means that vowel epenthesis depends on a particular word and not on a consonantal cluster.

7. Conclusion

The experiment we have conducted in order to determine the exact environment for vowel epenthesis in the suffix *-ed* in adverbial and nominal forms created from past participles shows that the previous stress-based theory does not hold true. An alter-native approach to this phenomenon has been proposed based on the syllabic struc-ture of the analysed items. It has been demonstrated that the process of vowel inser-tion before /d/ in polymorphemic adverbs and nouns takes place when the medial /d/ is extrasyllabic in the word, that is every time it cannot be assigned either to the coda of the preceding syllable or the onset of the following one. The vowel is in-serted by rule (15). When the coda condition for English is not violated after the suf-fix attachment, the insertion is not triggered as in these cases /d/ is not extrasyllabic.

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