2. Phonological treatments of the Bulgarian data

2.1. Jer accounts for the Bulgarian ghost vowel alternations

2.1.1. Scatton's treatment of ghost vowel syncopation: DEL and LOW

Scatton (1975) argues for the existence of underlying jers (high lax vowels) in modern Bulgarian: /ŭ/, the back jer, and /ĭ/, the front jer. One rule (DEL) deletes some of the jers; the others are changed into mid vowels by another rule (LOW), namely:

ŭ —> ə   ĭ —> e

This is a case of absolute neutralization.
Scatton's proposals were entirely in keeping with the then totally accepted principles of SPE phonology.
The jer solution first appears in Lightner's analysis of Russian (Lightner 1965). Lightner introduces the distinctive feature of tenseness in underlying representations. Underlyingly, jers are lax vowels. However, they never surface as lax. All phonetically manifested jers are mid tense vowels. Tenseness is not distinctive in surface phonetic forms.
Here is the formulation of the two rules (DEL and LOW) from Scatton (1975):

DEL $$\begin{bmatrix} +\text{syll} \\ -\text{tense} \\ +\text{high} \end{bmatrix} \longrightarrow \text{Ø} \;/\; \#\ X \ \_\_\_ \left(C_0 \begin{bmatrix} [+\text{syll}] \\ \left\{ \begin{matrix} [+\text{tense}] \\ [-\text{high}] \end{matrix} \right\} \end{bmatrix} Y \right) \#$$

LOW $$\begin{bmatrix} +\text{syll} \\ -\text{tense} \end{bmatrix} \longrightarrow [-\text{high}]$$

"High lax vowels delete before a syllable containing any non-high or any tense vowel and in word-final position; they are lowered when they occur in a syllable followed by a syllable containing another high lax vowel." (Scatton 1975:17).

Below, we give the following simpler forms for DEL and LOW without feature matrices. We put Y instead of ŭ for the back jer and E instead of ĭ for the front jer. V stands for a non-jer vowel and # for the word-end.

$$\text{DEL} \qquad \begin{Bmatrix} \text{Y} \\ \text{E} \end{Bmatrix} \longrightarrow \text{Ø} \ \Big/ \ \_\_\_ \begin{Bmatrix} \text{C}_0\text{V} \\ \# \end{Bmatrix}$$

A jer is deleted before a non-jer vowel, with or without intervening consonant(s), and at the word-end.

LOW   Y —> ə
       E —> e

As LOW is ordered after DEL, this means that all jers that remain after DEL has applied must be lowered to mid vowels.

2.1.1.1. Abstract segments: inflectional jers

The above analysis works if a back jer (Y) is posited at the end of every consonant-final (Ø-inflected) word. The presence of a jer inflection at the end of masculine singular nouns is motivated by a tendency for the article to repeat the vowel of the number/gender marker. But this repetition is not systematic. The Ø-inflected feminine nouns, for instance, take an *a*-final article (*-ta*) like *a*-inflected feminine nouns, e.g. *pèsen* 'song' — *pesen+tà*, def.; cf. *žen+à* 'woman' — *žen+à+ta*, def.[1] All neuter singular nouns, regardless of whether their inflection is *-o* or *-e*, take the same article (*-to*), cf. *ok+ò* 'eye' — *ok+ò+to*, def., where the vowel of the article is identical to that of the inflection, and *det+è* 'child' — *det+è+to*, def., where these vowels differ. Plural *i*-inflected nouns take the article *-te*, which does not reproduce exactly the vowel of the plural inflection: *vòpl+i* 'wails' — *vòpl+i+te*, pl. def.; *žen+ì* 'women' — *žen+ì+te*, pl. def. However, the repetition tendency is corroborated by neuter nouns that admit of alternative plurals, e.g. *ràm+o* 'shoulder' — *ram+enè*, pl., *ram+enè+te*, pl. def., and *ram+enà*, alternative pl., *ram+enà+ta*, pl. def., as well as by *a*-inflected masculine singular nouns, e.g. *bašt+à* 'father' — *bašt+à+ta*, def.
Scatton motivates his positing a jer inflection in e.g. *nos* 'nose' (/nos+Y/) by admitting underlying -/tY/ for the masculine singular article with repetition of the inflectional vowel /Y/ of /nos+Y/, thus deriving the definite form *nos+ăt* [nosə̀t] 'the nose' from an

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[1] As for stress, the two *-ta* articles differ. The latter is inherently stressless, whereas the former is provided with a lexical accent. Some speakers tend to pronounce stressed *-ta* as [tə̀] in colloquial speech, but the unstressed *-ta* is also pronounced with a final schwa-like sound due to vowel reduction, e.g. /že'nata/ is realized as [že'natʌ].

underlying /nos+Y+tY/, where the *ă* [ə] results from the retention and lowering of the inflectional jer before the final jer of the article. It is clear that the jer inflection, necessary to correctly derive the forms of Ø-inflected feminine nouns like *pèsen* 'song' /pesEn+Y/, cannot be given such motivation, the definite form being *pesen+tà*, not **pèsen+ăt*.

In order to derive the correct surface forms with the rules DEL and LOW, similar inflectional jers should be posited at the end of all Ø-inflected forms in Bulgarian:

- the singular indefinite forms of Ø-inflected masculine nouns
- the singular indefinite masculine forms of adjectives, participles and ordinal numerals
- the singular indefinite forms of Ø-inflected feminine nouns
- the singular forms of the truncated imperatives of *dăržà* 'hold' and its prefixed derivatives (cf. 1.2.3.1.3)

Consider the derivations for *lovèc+ăt* 'hunter' def., and *lovc+ì*, pl., as required by Scatton's analysis:

lov+Ec+Y+tY	lov+Ec+i	
lovEcYt	lovci	DEL
lovecət		LOW

2.1.1.2. How to order DEL and LOW ?

As reported by Scatton himself, the same result is obtained if DEL and LOW are applied in inverted order.[2] In this case, first LOW´ applies to jers that find themselves before another jer with intervening consonant(s).

$$\text{LOW´} \qquad \begin{Bmatrix} \text{Y} \\ \text{E} \end{Bmatrix} \longrightarrow \begin{Bmatrix} \text{ə} \\ \text{e} \end{Bmatrix} \Big/ \; \_\_ \; \text{C}_1 \begin{Bmatrix} \text{Y} \\ \text{E} \end{Bmatrix}$$

Then DEL´ deletes all surviving jers.

$$\text{DEL´} \qquad \begin{Bmatrix} \text{Y} \\ \text{E} \end{Bmatrix} \longrightarrow \text{Ø}$$

[2] «In the discussion above I took for granted that DELETE precedes LOWER. However, it is possible to formulate these two rules in such a way that the opposite order holds, LOWER — DELETE, without affecting the outcome of derivations in any way.» (Scatton 1975:18)

Assuming the above formulations for LOW´ and DEL´ with inverted order of the rules, we obtain the following alternative derivations for *lovèc+ăt* 'hunter' def., and *lovc+ì*, pl.,

lovEc+Y+tY	lovEc+i	
lovecətY		LOW´
lovecət	lovci	DEL´

2.1.1.3. Deriving the object definite forms (*kratăk člen*)

In Scatton's analysis, whatever order of the rules is adopted, the object form of the masc.sg. definite form *lovèc*+[ə] cannot be derived without introducing an additional rule: the object form must be obtained from the non-object one by means of truncation of the final [t]. Moreover, T-Truncation must be ordered after LOW or after DEL´ according to which order DEL–LOW is adopted:

lovEc+Y+tY		lovEc+Y+tY	
lovEcYt	DEL	lovecətY	LOW´
lovecət	LOW	lovecət	DEL´
lovecə	T-Truncation	lovecə	T-Truncation

2.1.1.4. Is the schwa of the postpositive masc.sg. definite article a ghost vowel ?

The *ă* [ə] of the definite masc.sg. article does not alternate with zero. According to the definition of ghost vowels adopted here (vowels that alternate with zero in surface forms), it must be viewed as a stable vowel /ə/. Our principle is to posit underlying structures (either jers or the alternative structures — floating segments — that we introduce further on, cf. 2.2) only where an alternation with zero actually occurs. This is not the case with the vowel [ə] of the definite article. Therefore, the underlying forms of the masc.sg. definite article should be: +/ə/, not +/<ə>/, for the *kratăk člen*, and +/ət/, not +/<ə>t/, for the *pălen člen*.
It is preferable to attribute the retention of ghost vowels before the masc.sg. definite article to a morphophonological effect than to the presence of another underlying ghost vowel. Moreover, the definite article for the masc.sg. is not the only vocalic inflection to have such suspending effect on GV alternations, see 1.1.6.1.

2.1.1.5. Derivational jers

Another problem with the jer analyses of Slavic ghost vowels is that one has to assume not only that every zero-inflection is an underlying (and never surfacing) jer, but also that some of the suffixes that we interpret as consonant-initial are jer-initial.

Scatton (1975:32) posits two jer-initial suffixes: the adjectivizing *-sk+i* and the nominalizing *-stv+o* whose lexical representations are assumed to be -/Esk+i/ and -/Estv+o/, respectively.

Unlike inflectional jers, derivational jers do have phonetic realization, but their distribution is different from that of root-internal jers and jers in suffixes with ghost vowels (e.g. -en-/-n-, -ăk-/-k-). The surfacing of so-called derivational jers is conditioned not by the nature of the following vowel (jer or non-jer), but by the nature of the preceding consonant (a [–anter] coronal requires the manifestation of [e], cf. 1.1.4.4). We prefer interpreting *-estv+o* as a separate allomorph of the nominalizing suffix *-stv+o*, with stable underlying /e/, not with jer /E/. The *-estv+o* allomorph is selected at the level of lexical representations by roots that end in a [-anter] coronal (see 1.1.4.4). The same is valid for *-esk+i* vs. *-sk+i*, where a third allomorph *-k+i* can be observed (see chapter 1, ex. 62).

2.1.1.6. Distinguishing CS-roots from roots with an underlying <V>

Scatton does not distinguish underlyingly <V>-stems from CS-stems (see 1.5.3). In his analysis *misăl* 'thought' like *filtăr* 'filter', *rebro* 'rib' like *srebro* 'silver' must contain a stem-internal jer, i.e. their underlying representaion is /misYl+Y/, /filtYr+Y/, /rebYr+o/, /srebYr+o/ from more abstract /##misl#Y##/, /##filtr#Y##/, /##rebr#o##/, /##srebr#o##/. The stem jer is inserted at the level of lexical representations by means of the rules of SYL´ and ŭL (hence, YL), cf. Scatton (1975:33-34). Thus, the difference between GV roots that take the non-jer allomorph of the adjectivizing suffix -EN, e.g. *misl+en*, *misl+en+a*, *rebr+en*, *rebr+en+a*, and GV roots that select the jer allomorph of the same suffix, e.g. *filtăr+en*, *filtăr+n+a*, *srebăr+en*, *srebăr+n+a*, is not encoded in the respective underlying forms. The analysis cannot account for the existence of two alternative EN-adjectives from *vjatăr* 'wind' — *vjatăr+en*, *vjatăr+n+a*, with the jer allomorph, and *vetr+en*, *vetr+en+a* with the non-jer allomorph of the suffix (cf. 1/129), given that the sole possible representation of the root is /v^{j}atYr+Y/ from more abstract /##v^{j}atr#Y##/. In our opinion, it should be possible to posit two alternative underlying forms for a stem like *vjatăr* 'wind', each giving rise to a different -EN adjective.

2.1.2. Zec's Lexical Phonology analysis of GV alternations in Bulgarian

Zec (1988) assumes the existence of two levels in the lexical component of Bulgarian phonology: a cyclic and a postcyclic one. Her rule of Jer Vocalization that corresponds to Scatton's LOW is a cyclic rule, while Jer Deletion (equivalent to Sactton's DEL) is post-cyclic. In Zec's interperetation the latter cannot apply before the rule of Jer Vocalization (i.e. LOW) has lowered all the jers that could be lowered. Jer Deletion applies before Final Devoicing, a post-cyclic lexical rule that devoices obstruents in word-final position. That is why Jer Deletion itself must apply at the post-cyclic lexical level.

Let us consider the derivation of *lovèc+ăt* 'fool', def., and *lovc+ì*, pl. in Zec's interpretation:

Cycle 1	lovEc	lovEc	
	—	—	Jer Vocalization (LOW´)
Cycle 2	lovEc]Y	lovEc]i	
	lovec]Y	—	Jer Vocalization (LOW´)
Cycle 3	lovec]Y]tY	—	
	lovec]ə]tY	—	Jer Vocalization (LOW´)
Output of Cyclic Level	lovecətY	lovEci	
	lovecət	lovci	Jer Deletion (DEL´)

The rule describing jer surfacing (Scatton's LOW) does not need to apply cyclically. There is no reason for LOW to apply after each word formation rule or in derived environments. Actually, in Scatton's analysis the rule of LOW applies simultaneously on all jers that find themselves in its context of application, thus yielding the correct outcomes.

2.1.3. Doing without inflectional jers

If we want to capture the generalization stated in 1/136-v, we can re-formulate the rule of LOW as follows:

(i) LOW"

$$\begin{Bmatrix} Y \\ E \end{Bmatrix} \longrightarrow \begin{Bmatrix} \text{ə} \\ e \end{Bmatrix} \Big/ \_\_\_ C_0 \begin{Bmatrix} Y \\ E \\ C \\ \# \end{Bmatrix} \quad \begin{matrix} \text{(i)a} \\ \\ \text{(i)b} \\ \text{(i)c} \end{matrix}$$

Here (i)**b** and (i)**c** represent the two subcontexts of context 2 in Table 1 (1.6.3), whereas (i)**a** refers to context 3 in the same table.

Thus reformulating the rule of LOW, we can get rid of inflectional jers and posit jers only where ghost vowel alternations are actually observed.

LOW´´ is followed by the rule DEL´´: jers that are not lowered have to be deleted.

(ii) DEL"

$$\begin{Bmatrix} Y \\ E \end{Bmatrix} \longrightarrow \varnothing \qquad \text{(ii)}$$

The order LOW-DEL will be preferred to DEL-LOW.[3]

2.2. Accounts for Metathesis in Bulgarian

2.2.1. Scatton's treatment of metathesis

Scatton (1975:30) treats the metathetic alternation as "a special case of the vowel-zero alternation". He demonstrates that most of the forms of metathesizing roots, namely those where the sequence is *Lă*, are derivable by means of the same rules — DEL and LOW — that are needed to account for vowel/zero alternations.

To derive the *ăL* forms of metathesizing roots, Scatton introduces a rule of syllabification (SYL) which attributes a syllabic status to those liquids that, after the deletion of jers, find themselves in inter-consonantal position. But syllabicity of liquids is only an intermediate state: two rules of syllabic reinterpretation (L**ə** and **ə**L) are ordered immediately after SYL in the course of derivation, inserting a schwa in the neighbourhood of syllabic liquids.

[3] According to Velcheva (1993), historically the even-numbered jers in sequences of contiguous syllables containing jers dissimilated by vowel height. Only after the dissimilation process had taken place the remaining jers underwent a process of weakening which ended in their loss.

SYL	L —> L̩ / #(XC) ___ (CY)#	
Lə	L̩ —> Lə / #X ___C_2 Y#	
əL	L̩ —> əL	

Here are the derivations for examples (3a)–(3e), Table 3, as required by Scatton's analysis of metathesis:

krYv+av+Y	krYv+Y	krYv+Y+ta	krYv+En+Y	krYv+En+a	
krvav	krYv	krYvta	krYvEnY	krYvna	DEL
	krəv	krəvta	krəven	krəvna	LOW
kr̩vav					SYL
					Lə
kərvav					əL

It can be seen that rule «Lə» remains unexploited. The latter is necessary for morphemes that contain a non-alternating sequence *Lă* as in *krăst+ove*, pl. of *krăst* 'cross', *tlăst+a*, fem. of *tlăst* 'fat'. As Scatton (1975:34) posits an underlying jer (derived by means of the rules of SYL´ and LY, see 0, that apply at the level of lexical representation of morphemes) in such forms, he needs the rule «Lə» in order to reinterpret the syllabic liquids that are triggered before a vocalic suffix, e.g.:

krYst+Y	krYst+ove		tlYst+Y	tlYst+a	
krYst	krstove		tlYst	tlsta	DEL
krəst			tləst		LOW
	kr̩stove			tl̩sta	SYL
	krəstove			tləsta	Lə

Following the principle of positing underlying structures only where an actual alternation can be observed, we prefer to posit not a jer, but a schwa in the lexical representation of nonalternating roots like *krăst* 'cross', *tlăst* 'fat':

(1)	krəst+Y	krəst+ove	tləst+Y	tləst+a	
	krəst	krəst+ove	tləst	tləst+a	DEL

Thus, in our interpretation, no syllabic liquids can be obtained in the course of derivation when roots like those in (1) take a vocalic suffix. Therefore, the rule «Lə» proves unnecessary if such perspective is adopted.

2.2.1.1. Double application of Syllabification + Syllabic reinterpretation

The rules of SYL´, LY and YL in Scatton (1975:33), "apply at the level of lexical representation":

SYL´ L –> L̩ / C ___ C

LY L̩ –> LY / ___ C_2

YL L̩ –> YL

This subset of rules is necessary, as Scatton assumes a more abstract underlying form for non-metathetic roots containing a non-alternating *Lă* or a non-alternating *ăL* : a liquid between consonants, e.g. /##krst#Y##/, /##tlst#Y##/. The surface (and non-alternating) schwa in non-metathetic roots is then inserted by the above rules.
Following the principle of positing underlying structures only where surface alternations occur, we assume that only the metathetic roots with alternating sequences *Lă*/*ăL* (e.g. *krăv* 'blood', *kărv+i*, pl., *pălz*+[^{j}+ə] 'creep' ipfv., *plăz+n+a*, pfv.semelfactive) should contain a jer in their lexical representations. All forms with metathesis, unless they select the non-jer -/en/ suffix (cf. 1.2.7.2.2), can be viewed as coming from underlying /CLYC/. As for the non-alternating *Lă* sequences (e.g. *krăst* 'cross', *krăst+ove*, pl.), they are the manifestation of an underlying /CLəC/. Likewise, the nonalternating *ăL* sequences (e.g. *žălt* 'yellow', *žălt+a*, fem.) are the manifestation of an underlying /CəLC/. Assuming such lexical representations, we do not need the rules of SYL´, LY and YL, i.e. the double application of the rules of syllabification and syllabic reinterpretation before and after LOW-DEL is no more required.

2.2.1.2. Word-initial sequences "sonorant + schwa"

The final form of the rules of SYL´, LY, YL, SYL, Lə and əL (Scatton 1975:37-38) is a step towards a unified account of metathesis and ghost vowels in sonorant-final stems. It includes nasals, but not [v] in the focus of these rules.
Scatton also posits underlying pre-consonantal sonorants for word-initial sequences of "sonorant + schwa" (Scatton 1975:37). But the latter sequences are never alternating.

Hence, in our interpretation they will be represented as /#Sə/, i.e with stable schwa instead of jer. Thus, instead of /##rk#a##/ giving /rYk+a/ for *răka* 'hand' and /##mx#Y##/ giving /mYx+Y/ for *măx* 'moss', cf. *măx+ove*, pl., we posit underlying /rək+a/ and /məx/ with stable schwa.

2.2.1.3. About Scatton's treatment of suspended metathesis before -va-

Scatton (1972:42, 1974) treats the imperfectivizing suffix *-va-* that exerts a suspending effect on metathesis (cf. 1.2.7) as derived from an underlying /ava/. Actually, *-ava-* is another productive imperfectivizing suffix in Bulgarian, used with stressless verb roots. When a stressless root is combined with the suffix /ava/, stress is shifted to the suffix-initial vowel, e.g./s+pest+^{j}+ə̀/ 'save' pfv. 1p.sg.pres., /s+pest+^{j}+àva+m/ ipfv. 1p.sg. pres. In Scatton's analysis stress-assignment is followed by a rule of A-Deletion that deletes the initial /a/ of the suffix /ava/, when the latter remains unstressed. A-Deletion must be ordered after Metathesis, i.e. after the set of rules that regard jers, syllabification and syllabic reinterpretation, in order to achieve the imperfectives with suspended metathesis (cf. 1.2.7.2):

iz+skrYc+ava+m	
iz+skrỲc+ava+m	Stress-assignment
izskr̀cavam	DEL
izskr̩̀cavam	SYL
izskə̀rcavam	əL
izskə̀rcvam	A-Deletion

To derive secondary imperfectives from semelfactive perfectives by means of the *-va-* suffix, e.g. *skrăc+va+m* 'squeak' ipfv. 1p.sg.pres., coming from *skrăc+n+ə*, pfv. 1p.sg.pres., a rule of N-Deletion is needed. In Scatton's analysis, this rule of consonant deletion has to apply in pre-vocalic context, given that it must precede A-Deletion:

skrỲc+n+ava+m	
skr̀cnavam	DEL
skr̩̀cnavam	SYL
skrə̀cnavam	Lə
skrə̀cavam	N-Deletion
skrə̀cvam	A-Deletion

It is preferable to posit a consonant-initial lexical form /va/, instead of /ava/, for the suffix -*va*-, thus treating the deletion of the semelfactive -*n*- before [v] as a case of cluster simplification (skrə̀cnvam > skrə̀cvam; cnv > cv). The suspension of metathesis, restricted to prefixed derived imperfectives, will then be attributed to a morphophonological effect exerted by the imperfectivizing suffix -*va*- in combination with a prefix (cf. 1.2.7.).

2.2.2. Zec's treatment of metathesis

Zec (1988) posits a lexical representation for metathesizing roots with no underlying jer and with an interconsonantal liquid, i.e. the same representation that Scatton assigns to non-metathesizing roots containing a stable *Lă* or a stable *ăL* sequence. The problem with Zec's analysis is that it neglects part of the data on metathesis in Bulgarian, namely the forms where a metathetic root combines with a suffix which exhibits a ghost vowel alternation. These forms are impossible to derive with the representations and rules adopted by Zec.

Since liquids are never syllabic in surface Bulgarian forms, Zec assumes that they cannot be syllabic at the post-cyclic lexical level either. What provides them with prosodic licensing at this level is not their integration in syllables, but in moras – subsyllabic prosodic units. In Bulgarian, in addition to vowels, some liquids (those in metathetic roots) can be viewed as underlyingly moraic, i.e. sufficiently sonorous to form moraic peaks. Thus, in Zec's analysis, the underlying forms for *krăv* 'blood' and *grăb* 'back' contain a liquid with a prelinked mora:

```
        μ                          μ
        |                          |
  g     r     b              k     r     v
```

Moraic structure is built in a cyclic fashion: "moraification obeys the strict cycle and will operate throughout the cyclic component" (Zec 1988:562).

```
       μ      μ                  μ      μ
     / |    /  |               / |    /  |
  [ [ g  r  b ]  Y ]         [ [ k  r  v ]  Y ]

       μ      μ     μ                  μ      μ      μ
     / |    /  |  /  |               / |    /  |   /  |
  [ [ g  r  b ]  a  t ]  Y ]      [ [ k  r  v ]  a  v ]  Y ]
```

After Jer Deletion has removed jers (see 2.1.2) we obtain:

```
     μ                    μ
   / | \                / | \
  g  r  b              k  r  v

    μ     μ                     μ     μ
  / |   / | \                 / |   / | \
  g  r  b  a  t               k  r  v  a  v
```

At the post-cyclic lexical level syllables are created by mora-to-syllable mapping. Since all Bulgarian syllables are monomoraic, this is a one-to-one mapping. The internal constituency of each mora is preserved under this mapping.
The output of the mapping is:

```
     σ                     σ
     |                     |
     μ                     μ
   / | \                 / | \
  g  r  b               k  r  v

     σ    σ                    σ     σ
     |    |                    |     |
     μ    μ                    μ     μ
   / |  / | \                / |   / | \
  g  r  b  a  t              k  r  v  a  v
```

Further Zec assumes that moras and syllables posit different requirements: not every segment that can serve as a moraic peak can also serve as a syllabic peak. In particular, Bulgarian liquids are sufficiently sonorous to serve as proper moraic peaks, but not to serve as proper syllable nuclei. The single mora in the syllable will have to conform to the sonority requirements imposed by syllables. This is done by means of a rule of (Schwa) Epenthesis which acts as a kind of repair strategy. It is predictable where the epenthesized vowel will appear with regard to syllable structure. If two vowels were inserted, i.e. both to the left and to the right of the moraic liquid (e.g. *gərəb, *gərəbat, *kərəv, *kərəvav), the resulting form would require a disruption of moraic structure. This is not allowed under the mora-to-syllable mapping defined by Zec.

In addition to the general syllable structure constraint in Bulgarian, which allows at most one consonant in the coda, the Epenthesis rule poses a further constraint: it obligatorily creates closed syllables:

Epenthesis (Zec 1988:565):

```
      σ
      |
      μ
    / | \
   c  v  c
```

(where "c" and "v" stand for consonantal and vocalic segment, respectively)

However, in derivatives where metathetic roots like *krăv* 'blood' and *grăb* 'back' find themselves before a ghost vowel (jer) suffix, e.g. *krăv+en* 'bloody', *krăv+n+a*, fem., and *grăb+en* 'back' adj., *grăb+n+a*, fem., the rule of Epenthesis as formulated above gives wrong outputs. This subset of data seems to have been ignored in Zec's analysis.

```
     μ        μ        μ                   μ        μ        μ
   /  |   /    |  /     |                /  |   /    |   /    |
[ [ g   r   b ]  E  n ]  Y ]          [ [ k   r   v ]  E  n ]  Y ]
```

After Jer Vocalization and Jer Deletion:

```
     μ       μ                          μ       μ
   /  |   /  |  \                     /  |   /  |  \
  g   r   b   e   n                  k   r   v   e   n
```

After mora-to-syllable mapping:

```
      σ       σ                          σ       σ
      |       |                          |       |
     μ       μ                          μ       μ
   /  |   /  |  \                     /  |   /  |  \
  g   r   b   e   n                  k   r   v   e   n
```

The rule of Epenthesis then gives the following forms that are incorrect:

```
*    σ          σ                      *    σ        σ
     |          |                           |        |
     μ          μ                           μ        μ
   / | \      / | \                       / | \    / | \
  g  ə  r    b  e  n                     k  ə  r  v  e  n
```

2.3. An Only-Stem-Internal (OSI) Jer Analysis

In this section we discuss a unified treatment of metathesis and ghost vowels in CS-stems.

2.3.1. Enlarging the focus of SYL: Sonorant Syllabification

We would like to reconsider the following generalization stated in chapter 1, (132)-v, based on Table 1, and repeated in (2) below:

(2) All schwa insertions are pre-sonorant:

- in context 2 (stem types B, D)

and some of them are pre-liquid:

- in context 1 (stem types C, D)
- in context 3 (stem type D).

To this purpose, we will enlarge the focus of the rule SYL by including, beyond liquids, all other sonorants, i.e. the nasals [m, n] (as Scatton does in the final form of his rule, 1975:37) and [v], which functions, at least in some aspects, as a sonorant in Bulgarian: like sonorants and unlike voiced obstruents, it does not spread [+voiced], cf. 1.1.3.2.
This will give the following rule of Sonorant Syllabification (SYL´´):

(iii) SYL´´ $S \longrightarrow \underset{\cdot}{S} \ / \ C \_\_ \begin{Bmatrix} C \\ \# \end{Bmatrix}$ (iii)a / (iii)b

It is easy to see that thus reformulated, the rule covers all the contexts listed in (2).

2.3.2. Pre-Sonorant Schwa Epenthesis

The syllabic sonorants generated in intermediate representations will trigger schwa epenthesis only when followed by a (non-syllabic) consonant or when found at the word-end. If the consonant that follows the focus sonorant is another sonorant that has been turned syllabic by means of rule (iii), rule (iv) is inapplicable. We thus exclude context 2 for stem type D (see Table 1), where no schwa surfaces before the liquid.

(iv) ə-Epenthesis

$$\underset{\cdot}{S} \longrightarrow \text{ə}S \;/\; \_\_\_ \begin{Bmatrix} C \\ \# \end{Bmatrix} \qquad \text{where } C \neq \underset{\cdot}{S} \qquad \begin{matrix} \text{(iv)a} \\ \text{(iv)b} \end{matrix}$$

2.3.3. Sonorant Desyllabification

Those syllabic Ṣ's that have not triggered schwa-epenthesis, i.e. remain unchanged after application of rule (iv), must undergo a rule of desyllabification, see (v). This is necessary because Bulgarian has no syllabic sonorants in its inventory of surface segment realizations.

(v) Son Desyll

$$\underset{\cdot}{S} \longrightarrow S \qquad \text{(v)}$$

The rules of SYL´´(iii), ə-Epenthesis (iv) and Son Desyll (v), in addition to LOW´´(i) and DEL´´(ii), will suffice to generate all forms from all stem types recapitulated in Table 3. Here we repeat the entire rule set for an only-stem-internal jer treatment of Bulgarian GV alternations:

(i) LOW"

$$\begin{Bmatrix} Y \\ E \end{Bmatrix} \longrightarrow \begin{Bmatrix} \text{ə} \\ e \end{Bmatrix} \Big/ \_\_\_ C_0 \begin{Bmatrix} Y \\ E \\ C \\ \# \end{Bmatrix} \qquad \begin{matrix} \text{(i)a} \\ \\ \text{(i)b} \\ \text{(i)c} \end{matrix}$$

(ii) DEL"

$$\begin{Bmatrix} Y \\ E \end{Bmatrix} \longrightarrow \varnothing \qquad \text{(ii)}$$

(iii) SYL"

$$S \longrightarrow \underset{\cdot}{S} \;/\; C \_\_\_ \begin{Bmatrix} C \\ \# \end{Bmatrix} \qquad \begin{matrix} \text{(iii)a} \\ \text{(iii)b} \end{matrix}$$

(iv) ə-Epenthesis

$$\underset{\cdot}{S} \longrightarrow \text{ə}S \;/\; \_\_\_ \begin{Bmatrix} C \\ \# \end{Bmatrix} \qquad \text{where } C \neq \underset{\cdot}{S} \qquad \begin{matrix} \text{(iv)a} \\ \text{(iv)b} \end{matrix}$$

(v) Son Desyll

$$\underset{\cdot}{S} \longrightarrow S \qquad \text{(v)}$$

2.3.4. Testing the rule set of the OSI Jer Analysis

We will now test this rule set with the examples of Table 3. In Table 4 below, we use capital Y for the back jer (corresponding to our ghost schwa <ə> and to Scatton's high lax ŭ) and capital E for the front jer (corresponding to our ghost <e> and to Scatton's high lax ĭ).

1	filtYr+i filtri	filtYr filtər (c)	filtYr+če filtərče (b)	filtYr+En filtəren (a),(c)	filtYr+En+a filtərEna (a) filtərna	 (i) (ii)
1´	pesEn+i pesni	pesEn pesen (c)	pesEn+ta pesenta (b)	pesEn+En pesenen (a),(c)	pesEn+En+a pesenEna (a) pesenna	 (i) (ii)
2	misl+ʲ+ə	misl misl̩ (b) misəl (b)	misl+ta misl̩ta (a) misəlta (a)	misl+en	misl+en+a	 (iii) (iv)
3	krYv+av krvav kr̩vav (a) kərvav (a)	krYv krəv (c)	krYv+ta krəvta (b)	krYv+EN krəven (a),(c)	krYv+En+a krəvna (a)	 (i) (ii) (iii) (iv)
4	vrv+olic+a vr̩volica (a) vərvolica (a)	vrv vr̩v̩ vr̩əv (b) vrəv (b)	vrv+čic+a vr̩v̩čica (a) vr̩əvčica (a) vrəvčica (a)	vrv+en vr̩ven (a) vərven (a)	vrv+en+a vr̩vena (a) vərvena (a)	 (iii) (iv) (v)
5	begl+i	begl begl̩ (b) begəl (b)	—	begl+Ec beglec (c)	begl+Ec+i beglci begl̩ci (a) begəlci (a)	 (i) (ii) (iii) (iv)
6				begl+ec	begl+ec+i	 (i-v)

7	drYž+ə držə dr̩žə (a) dəržə (a)	drYž drəž (c)	drYž+k+a drəžka (b)	-dr(Y)ž+Ec^{FGE} * -držec (c) -dr̩žec (a) -dəržec (a)	-drYž+Ec+i -drəžci (a)	* (i) (ii) (iii) (iv)
8	srn+a sr̩na (a) sərna (a)	—	srn+dak sr̩n̩dak (a) sr̩əndak (a) srəndak	srn+Ec srnec (c) sr̩nec (a) sərnec (a)	srn+Ec+i srnci sr̩n̩ci (a) sr̩ənci (a) srənci	 (i) (ii) (iii) (iv) (v)
				srn+en (like 4: vrv+en)	srn+en+a (cf.4: vrv+en+a)	
9	drYz+ost drzost dr̩zost (a) dərzost (a)	—	drYz+na drəzna (b)	dr(Y)z^{FGE}+Yk * drzək (c) dr̩zək (a) dərzək (a)	drYz+Yk+a drəzka (a)	* (i) (ii) (iii) (iv)

Table 4

* (Y) denotes the deletion of the root jer in the underlying form of derivatives (when Ø-inflected) from roots that are lexically marked to manifest the Fratricidal Ghost Effect (FGE); see 1.6.5.

- in the case of the lexically-marked FGE suffix -EC — ex. 7c; cf. ex.(140) in ch.1
- in the case of lexically-marked FGE metathetic roots — ex. 9c; cf. ex. (142) in ch.1

The morphological decomposition and translation for the examples in table 4 can be found in (143) of chapter 1. The first column gives the example number. The last column specifies the rule (i, ii, iii, iv or v) that is responsible for the forms at the respective line. The letters (a), (b) and (c) to the right of some examples specify which subpart of rules (i), (iii) and (iv) is involved.

2.3.5. Problems relating to the rules of the OSI Jer Analysis

Rules (i), (ii) and (iv) contain heterogeneous contexts inside the disjoint brackets. It is not obvious why a the word-end and a following consonant should trigger the same structural change. Neither is it understandable how a following jer is related to a consonant cluster/a consonant at the word-end to provoke the same effect: the lowering of a preceding jer.

Rule (iii) produces sounds that are not possible as surface phonetic realizations in Bulgarian, namely syllabic sonorants: [r̩], [l̩], [n̩], [m̩] and [v̩].

2.4. Harmonic Phonology account for the Bulgarian data

2.4.1. Some principles of Harmonic Phonology

2.4.1.1. Levels and representations in Harmonic Phonology

Goldsmith (1993:26) considers that traditional structuralist phonology, with its three levels of representation and two rule components relating the levels (fig.1), establishes an inherent ordering of the rules of these two components.

Morphophonemic representation MP		Phonemic representation PM		Phonetic representation PT
↓		↓		↓
•	↔	•	↔	•
	(MP, PM) rules of phonemic alternation		(PM, PT) allophony rules	

fig.1

Halle & Chomsky (1968) use only two levels of representation (MP, PT) and only one set of principles relating them. The rules do not directly relate the levels. Rules create entities which are not representations on any particular linguistic level — the intermediate stages of derivations. Ordering of rules is not the function of relations across levels.

A harmonic grammar consisits of 2 types of relations:

- rules that relate distinct levels
- rules that decrease the complexity of representation on a single linguistic level

A level is a way of describing an utterance. Analysis makes specific generalizations about each level: about its tactics and well-formedness conditions. Each level contains complexity measures, which evaluate the degree of complexity of representations.

A level (L) consists of:

- a vocabulary of items (a set of features, an inventory of permitted segments, associations, etc.)
- a set of relations expressing relative well-formedness (a measure of well-formedness)

- a set of intralevel (L, L) rules: possible paths for a representation to achieve maximal well-formedness

The representation of a given expression on level L is a pair of representations (L_i, L_f; where i = initial, f = final) and L_f is the best-formed representation accessible to L_i given the (L, L) rules.

Harmonic Phonology makes use of the M/W/P model.

There are three levels of phonological interest. Bleeding and counterfeeding relations, common in natural languages, establish the need for more than 2 levels. The three levels are:

- M-level: a morphophonemic level, the level at which morphemes are phonologically specified
- W-level: the level at which expressions are structured into well-formed syllables and well-formed words (with a minimum of redundant phonological information)
- P-level: a level of broad phonetic description; the interface with articulatory/acoustic devices

The M-level is essentially devoid of phonological motivation. Its representation may violate all conceivable phonotactics. Its sole function is as a repository of the minimal information necessary to capture the sound characteristics of the morpheme. It is a structure that incorporates the morphemes that provide the realization of the morphosyntactic information. Its inital state M_i is the representation that provides the interface with the morphosyntax.

It is on the W-level that the bulk of the significant well-formedness conditions (tactics) are stated. The W-level representation expresses the form the language squeezes its morphemes into in order to satisfy the alternation of consonants and vowels, licensed coda and syllable material, tonal association, etc. (W,W) rules are ways of manipulating the phonological substance present at the deeper M-level.

Language-particular W-level phonotactics consist entirely of syllable structure conditions and autosegmental phonotactics (autosegmental licensing specifications, autosegmental restrictions on the minimal/maximal number of associations). Other W-level phonotactics are universal.

P-level is the level of systematic phonetics. Its final state P_f serves as the interface with the phonetic component.

2.4.1.2. Two types of rules: intra-level and cross-level. No extrinsic ordering of rules.

The Harmonic Phonology model decomposes the phonological analysis into intralevel and cross-level components. It thus emphasizes the tactics specific to autonomous levels of the phonological component (Goldsmith 1993:46).

The following types of phonological rules exist:

- 3 intralevel rule types: (M,M), (W,W) & (P,P);
- 2 cross-level rule types: (M,W), (W,P), where the order of the symbols is irrelevant.

Neither intralevel nor cross-level rules are ordered. They operate simultaneously. Within a level, rules apply in the manner generally referred to as 'free reapplication', subject to the Elsewhere Condition, in the sense that, when a language has two competing repair strategies for a phonotactic violation within a given level, it chooses the one that is more specific for the task at hand.

Cross-level rules do not give rise to derivations with intermediate stages.

While intralevel rules must be harmonic, cross-level rules need not be harmonic, i.e. their application needs not increase the well-formedness of the representation.

2.4.1.3. Syllabification. Autosegmental licensing.

Early M-level syllabification serves the purpose of exposing problems for the phonology, generally in the guise of unsyllabified (i.e. unsyllabifiable) material.

A general well-formedness condition is imposed on W-level that syllabification must be total.

Syllables are constructed in such a way as to build the largest syllables (i.e. the smallest number of syllables) consistent with the language's restrictions on possible syllables. The maximal number of segments possible must be covered with the minimal number of syllables.

There are prosodic units that are licensers. The syllable node is the primary licenser. It acts as licenser for the onset and the nucleus. Secondary licensers can be the coda node, a word-final appendix and some word-final morphemes.

The licenser is endowed with the ability to license a set of features (autosegments) – point of articulation, continuancy, voiceness, etc. A given licenser can license no more than one occurrence of the autosegment in question.

When the syllables of a language have a coda position, the coda is a secondary licenser, a node that also serves as the point of origin of a licensing path down to the skeleton. The language will assign a subset (typically, a small subset) of the features of the language to the coda position.

The Ω-licenser (Ω = word-final appendix) is another kind of secondary licenser at word-boundary. It licenses word-final extrasyllabicity: the features that appear in word-final appendices. For instance, in English word-internal syllables any single consonant can appear in the coda, but word-finally obstruent clusters may appear. Goldsmith (1990:147) attributes the possibility of the second consonant to a word-final appendix (Ω) position. Moreover, only coronals may be extrasyllabic in English, i.e. only segments not specified for point of articulation. The English word-final appendix licenses only the features [voice] and [continuant].
All autosegmental material must be licensed at W-level. Elements not licensed at this level will not proceed to the P-level, i.e. are deleted.

2.4.2. Underlying structures for ghost vowels

2.4.2.1. Ghost vowels in autosegmental (multilinear) frameworks

As reported by Szpyra (1992:278), the multilinear jer approaches distinguish jers from the other vowels by representing them underlyingly only on the skeletal tier (Spencer 1986) or only on the segmental tier (Rubach 1986, 1993). As for non-jer vowels, they are represented on both tiers.
In Rubach (1986:259), Rubach (1993:141) and Kenstowicz & Rubach (1987) the surfacing (vocalization) of jers is described as a skeletal point (X slot) assignment: →

Yer Vocalization

$$\textcircled{V} \rightarrow \begin{array}{c} X \\ | \\ V \end{array} \; / \; \_\_\_ \; C \textcircled{V}$$

The circled V stands for a floating vowel, that is, a segment without an associated X slot.
Jers that remain without an X slot cannot be licensed prosodically and hence are never realized phonetically. At the end of phonology they are deleted by the Stray Erasure convention: "Erase segments and skeleton slots unless attached to higher levels of structure. […] By 'higher levels of structure' I mean either a position in the syllable or one in a morphological template. […] in surface structure all strings are exhaustively syllabified." (Steriade 1982:89)

Following Paradis & El Fenne (1995)[4] we assume that floating segments are visible to syllabification rules. In Bulgarian the presence of an underlying floater blocks the process of syllabification. The syllable cannot span an unsyllabified element. The unsyllabified segmental material (cf. Goldsmith's contingent extrasyllabicity) can be only peripheral. Contrary to what is alleged by Szpyra (1992:297), it seems that Polish jers do not always block syllabification, at least in some imperatives (cf. Rubach 1993:641, note 11). However, in Bulgarian the blocking effect of floaters is sytematic.

For Szpyra (1992) the surfacing of jers serves as repair strategy to satisfy the requirement of full syllabification (prosodification). When the next consonant is already prosodified, the preceding jer does not vocalize. The vocalization of jers creates new syllable nuclei to which hitherto unsyllabified consonants can attach and become prosodically licensed. Thus, the function of jer vocalization is to ensure the syllabic well-formedness of lexical items.

Itô (1989) describes two strategies for dealing with unsyllabified consonants:

- vowel epenthesis (the epenthesis site being determined by the direction of syllabification)
- erasure of unsyllabified consonants

Szpyra (1992) adds a third strategy: the vocalization of adjacent unsyllabified jers.

In Szpyra's analysis a jer, underlyingly, is an “empty root node devoid of any melodic features”. The empty node acquires the feature [-cons] when preceding an unsyllabified (stray) consonant. Thus, Szpyra posits an underlying segment that is fully underspecified: it is neither a vowel nor a consonant. However, an empty root node always surfaces as a vowel in Polish.

2.4.2.2. Floating vowels and epenthetic schwas instead of jers

Some schwas in Bulgarian are stable vowels, i.e. they are not involved in GV (or metathetic) alternations. We assume that a stable schwa comes from an underlyingly anchored schwa, i.e. a schwa which is provided with a skeletal point:

```
              •
/ə/  =        |
              ə
```

[4] «We maintain that segments are visible to syllabification rules, whether they are, with respect to these rules, well-formed (anchored) or not» (Paradis & El Fenne 1995:188)

As for surface schwas that are GV-alternating (or metathetic) vowels, we distinguish between two possible origins. They may come from an underlying floating schwa, i.e. a floating segment [ə] that is not linked to the skeleton:

<ə> =

ə

But they can also be not represented by any underlying structure at all. In the latter case, they result from a default epenthesis.

As demonstrated by Anderson (1996), based on data from vowel reduction in informal modern Bulgarian (cf. Pettersson & Wood 1987), *ă* (/ə/) is the minimally specified (unspecified) vowel in Bulgarian. Three distinct notational systems (a Dependency Phonology notation and two under-specified binary-feature systems – a radical and a non-radical one) provide characterizations which display detailed equivalences.

The Dependency Phonology notation proposed by Anderson represents /ə/ as the only vowel not reducible to combinations of *i*, *u* and *a*:

{i}	/i/			{u}	/u/
{a, i}	/e/			{a, u}	/o/
		{ }	/ə/		
		{a}	/a/		

There are difficulties in providing a generalization appropriate to the reduction phenomena in Bulgarian in terms of the standard binary features (cf. Pettersson & Wood 1987:§3). By contrast, a unitary characterization based on underspecified traditional binary features is available. Actually, Anderson translates the 'Jakobsonian' features of the Aronson's classification of the Bulgarian vowels (acute/grave, plain/flat and diffuse/compact; cf. Aronson 1968:32) into the following radical underspecified account invoking the traditional binary features [back], [round] and [low]:

[–bck]	/i/			[+rnd]	/u/
		[ ]	/ə/		
[–bck,+lw]	/e/			[+rnd,+lw]	/o/
		[+lw]	/a/		

An alternative solution, which is "less radically relativistic", assumes an underspecified interpretation using the traditional markedness values (cf. Chomsky & Halle 1968:405), except that /a/ is specified as [–high] to differentiate it from /ə/:

[–bck] /i/ [+bck] /u/

[–bck,–hg] /e/ [+bck,–hg] /o/

[ ] /ə/

[–hg] /a/

All three notations represent /ə/ as the unspecified member of the Bulgarian vowel system. Therefore, it is not surprising that /ə/ functions as the default vowel in the cases of epenthesis.

As for surface [e]'s that are involved in GV alternations, they are of only one possible origin: they must come from an underlying floater <e>, i.e. a segment [e] that lacks a skeletal slot underlyingly:

<ə> =

ə

2.4.3. Rules regarding ghost vowels

The complicated pattern of GV and metathetic alternations/ suspensions of alternations in Bulgarian can be given a unified account with only two rules in the Harmonic Phonology framework. The first rule anchors floaters, i.e. provides some /<ə>/ and /<e>/ with a skeletal slot. The second one inserts the default vowel [ə]. Both rules are syllabically-conditioned: the anchoring/insertion is triggered by an unsyllabified consonant.

A third rule is necessary to cover the special behaviour of lexically-marked FGE metathetic roots and of metathetic roots before the lexically-marked FGE suffix -ec/-c-, see 1.5.5. The latter rule adjusts certain sequences of floaters in M-level representations.

2.4.3.1. The cross-level (M,W) rule of Floater Anchoring

M/W level: <V>-before-*C Anchoring (*C=unsyllabified consonant), see (i) below.

(i)

•
|
M: <V> *C
↓
• •
| |
W: V C

If more than one consonants remain unsyllabified and if they are all preceded by a floater, each of these floaters undergoes the rule of Anchoring.

No doubt <V>-Anchoring contributes to syllabification of otherwise unsyllabifiable material, but it sometimes overgenerates vocalic nuclei and hence produces some extra syllables. It is not entirely harmonic, i.e. not completely or, perhaps, not only conditioned by syllable structure. That is why we consider it to be a cross-level rule. A cross-level rule need not be harmonic.

2.4.3.2. The intra-level (W,W) rule of Schwa Epenthesis

W/W level: **ə**-before-*S Epenthesis (*S=unsyllabified sonorant), see (ii) below.

(ii)

•
|
W: *S
↓
• •
| |
W: ə S

If more than one adjacent sonorants remain unsyllabified (and cannot trigger the rule of Anchoring), only the last one triggers Epenthesis. This yields one of the preferred syllable types in Bulgarian: CVC in the case of two sonorants and CCVC from a sequence of three unsyllabified consonants.

ə-Epenthesis seems to be a harmonic rule. It contributes to syllabification of otherwise unsyllabifiable material, and it never overgenerates vocalic nuclei. Hence, no extra syllables are produced by means of **ə**-Epenthesis. **ə**-Epenthesis yields only the preferred syllable types CVC and CCVC. Thus, we consider it to be an intra-level rule. It applies at W-level, where total syllabification is a well-formedness condition. Schwa epenthesis in Bulgarian is just a repair strategy to rescue sonorants that would otherwise be subjected to Stray Erasure. As an intra-level W/W rule it takes place after <V>-Anchoring, a M/W cross-level rule.

2.4.3.3. A rule adjusting M-level representations to describe the FGE

What we called the Fratricidal Ghost Effect (see 1.5.5) must apply on M-level, i.e. at the level of morpheme concatenation, and before the application of early M-level syllabification.

M/M level: <V>-before-<V> Deletion, see (iii) below.

(iii)

```
                          •   +            •   ]word
                          |                |
M:        <V>1            C     <V>2       C
           ↓
                          •   +            •   ]word
                          |                |
M:                        C     <V>2       C
```

where

(iii a) <V>$_1$ is in a metathetic root that is lexically-marked to undergo the FGE and <V>$_2$ is in a GV suffix (-/<e>n/, -/<ə>k/, -/<e>c/); see ex. (142) in ch.1

or

(iii b) <V>$_2$ is in the suffix -/<e>c/ that is lexically-marked to provoke the FGE and <V>$_1$ is in a metathetic root; see ex. (140) in ch.1.

In both cases the suffix must be uninflected; i.e. it must find itself at the word-end.

2.4.4. Harmonic Phonology account for examples 1-9, Table 3

Now rules (i), (ii) and (iii) will be tested with the example sample of Table 3, chapter 1.

2.4.4.1. <V>-roots, examples 1a-e

In the plural (example 1a) the stem-final consonant syllabifies at M-level with the vowel of the inflection. There are no unsyllabified consonants.

```
ex.1a   M:      •    •    •    •         •  +  •
                |    |    |    |         |     |
              ( f    i    l    t )  ə  ( r     i )
```

Thus the floater remains unanchored and is eliminated by Stray Erasure. The final result is:

```
ex.1a   P:      •    •    •    •    •    •
                |    |    |    |    |    |
              ( f    i    l    t ) ( r    i )
```

With resyllabification:

```
ex.1a   P:      •    •    •    •    •    •
                |    |    |    |    |    |
              ( f    i    l ) ( t    r    i )
```

In the singular (example 1b), the stem-final consonant remains unsyllabified. As it is preceded by a floater, it triggers the latter's anchoring by means of rule (i).

```
ex.1b   M:      •    •    •    •         •
                |    |    |    |         |
              ( f    i    l    t )  ə   *r
                                    ↓                       (i)
        W:      •    •    •    •    •    •
                |    |    |    |    |    |
              ( f    i    l ) ( t    ə    r )
```

The word *malăk* 'little' masc.sg. is an example demonstrating that M-level syllabification does not apply across floaters. Otherwise (*malk*), which is a possible syllable in Bulgarian, cf. *polk* 'regiment', *vălk* 'wolf', would be created.

```
ex.1b   M:      •     •     •           •
                |     |     |           |
              ( m     a     l )   ə   * k
                                  ↓                              (i)
        W:      •     •     •     •     •
                |     |     |     |     |
              ( m     a ) ( l     ə     k )
```

The intervening floater <ə> prevents [k] from adjoining the syllable created around the preceding nucleus [a].

Consider next the derivation of *orel* 'eagle' masc.sg.:

```
ex.1b   M:      •     •           •
                |     |           |
              ( o     r )   e   * l
                            ↓                                    (i)
        W:      •     •     •     •
                |     |     |     |
              ( o ) ( r     e     l )
```

(*orl*) is a possible syllable in Bulgarian, cf. *vărl* 'cruel', *Karl* 'Charles', but the intervening floater <e> prevents the word-final [l] from adjoining the syllable created around the nucleus [o]. Thus *l triggers the anchoring of <e> and [r] is resyllabified at W-level as onset of the syllable created around the now anchored [e].

The schwa in the diminutive (example 1c) results from the application of rule (i). The stem-final [r] cannot be syllabified in one onset with the following affricate [č] because of the sonority sequencing hierarchy. Thus *r triggers the anchoring of the preceding floater.

```
ex.1c   M:      •     •     •     •           •  +   •     •
                |     |     |     |           |      |     |
              ( f     i     l     t )   ə   * r     (č     e )
                                        ↓                        (i)
        W:      •     •     •     •     •     •      •     •
                |     |     |     |     |     |      |     |
              ( f     i     l ) ( t     ə     r )   (č     e )
```

The masc.sg. of the adjective (example 1d) is the result of double simultaneous application of rule (i). Both [n] and [r] remain unsyllabified, and both are preceded by a floater. An extra syllable is created, given that (*fil*)(*tren*) would be a completely syllabifiable form.

```
ex.1d   M:     •     •     •     •           •   +         •
               |     |     |     |           |             |
             ( f     i     l     t )   ə    * r       e    * n
                                       ↓              ↓              (i)
        W:     •     •     •     •     •     •        •    •
               |     |     |     |     |     |        |    |
             ( f     i     l ) ( t     ə ) ( r        e    n )
```

The feminine of the adjective (example 1e) has only one unsyllabified consonant. The second floater <e> remains unanchored, as the following consonant [n] is syllabified at M-level.

```
(3)  ex.1e  M:  •     •     •     •           •   +         •   +   •
                |     |     |     |           |             |       |
              ( f     i     l     t )   ə    * r       e  ( n       a )
                                        ↓                                (i)
            W:  •     •     •     •     •     •             •       •
                |     |     |     |     |     |             |       |
              ( f     i     l ) ( t     ə     r )      e  ( n       a )
```

Another solution which yields a well-formed syllable structure, including all anchored elements of the lexical form in (3), would be to rescue the unsyllabified *r by anchoring the second floater, <e>, instead of the first, <ə>. This would generate the following well-formed structure: (*fil*)(*tre*)(*na*). However, the rule of <V>-Anchoring – a cross-level rule, that need not be harmonic – requires that the floater precede, not follow the unsyllabified consonant.
The floater <e> in (3), still unsyllabified at W-level, undergoes Stray Erasure. This gives the following surface form:

```
ex.1e   P:     •     •     •     •     •     •     •     •
               |     |     |     |     |     |     |     |
             ( f     i     l ) ( t     ə     r ) ( n     a )
```

2.4.4.2. CS-roots, examples 2a-e

```
(4)   ex.2a   M:    •     •     •     •   +          •
                    |     |     |     |              |
                  ( m     i     s ) ( l              ə )

                                              [cor]

              W:    •     •     •     •              •
                    |     |     |     |              |
                  ( m     i     s ) ( l^j            ə )
                                      |
                                    [cor]
```

In (4) above (example 2a), the verbalizing suffix consists of an anchored schwa preceded by a floating feature that causes palatalization as secondary articulation when it associates to a consonant. If we adopt Clements' model of feature geometry (Clements & Hume 1995, Clements 1993), the floating feature is [coronal] and it links at W-level to the V-place node under the vocalic node of the preceding [l], thus giving rise to a palatalized [l^j].

In ex.2b and further on we use the symbol ˚C to denote a consonant (C) that remains unsyllabified not only after M-level syllabification has applied (i.e. at M-level it is represented as *C), but also after cross-level M/W rules have applied, i.e. it arrives unsyllabified at W-level. A ˚C triggers the intra-level W/W rule of **ə**-before-*S Epenthesis. Thus *C and ˚C denote the same thing: an unsyllabified consonant. The distinction is purely notational: *C denotes a consonant found at M-level, while ˚C refers to a consonant at W-level. This makes it easier to recognize unsyllabified consonants that will trigger rule (ii), namely ˚C, and to distinguish them from unsyllabified consonants that will trigger rule (i), namely *C.

Both in ex.2b and ex.2c, a sonorant, [l], remains unsyllabified at W-level and is represented as ˚*l*. At W-level this ˚*l* triggers the application of rule (ii).

```
        ex.2b   M:    •     •     •     •
                      |     |     |     |
                     (m     i     s)   *l

                W:    •     •     •     •
                      |     |     |     |
                     (m     i     s)   °l


(5)     ex.2b   W:    •     •     •           •
                      |     |     |           |
                     (m     i     s)         °l
                                        ↓                           (ii)
                W:    •     •     •     •     •
                      |     |     |     |     |
                     (m     i ) ( s     ə     l )


        ex.2c   M:    •     •     •     •  +   •     •
                      |     |     |     |      |     |
                     (m     i     s)   *l     ( t    a )

                W:    •     •     •     •      •     •
                      |     |     |     |      |     |
                     (m     i     s)   °l     ( t    a )


        ex.2c   W:    •     •     •           •     •     •
                      |     |     |           |     |     |
                     (m     i     s)         °l   ( t     a )
                                        ↓                           (ii)
                W:    •     •     •     •     •     •     •
                      |     |     |     |     |     |     |
                     (m     i ) ( s     ə     l ) ( t     a )
```

```
                                                    •   •                       •
Being a CS-stem, /misl/ selects the non-GV suffix   |   |     instead of        | .
                                                    e   n                   e   n
```

Both the masculine (ex.2d) and the feminine (ex.2e) of the adjective are completely syllabified since M-level:

```
ex.2d   M:     •     •     •     •  +  •     •
               |     |     |     |     |     |
             ( m     i     s ) ( l     e     n )


ex.2e   M:     •     •     •     •  +  •     •  +  •
               |     |     |     |     |     |     |
             ( m     i     s ) ( l     e ) ( n     a )
```

2.4.4.3. Metathetic <V>-roots, examples 3a-e

```
(6)   ex.3a   M:   •     •           •  +  •     •
                   |     |           |     |     |
                   k     r     ə   ( v     a     v )
```

In (6) two unsyllabified consonants arrive at W-level. The second one is a sonorant. It triggers ə-Epenthesis inside the W-level in order to satisfy the well-formedness condition on total syllabification:

```
ex.3a   W:     •           •           •  +  •     •
               |           |           |     |     |
               k          °r     ə   ( v     a     v )
                     ↓                                        (ii)
        W:     •     •     •           •  +  •     •
               |     |     |           |     |     |
             ( k     ə     r )   ə   ( v     a     v )
```

By Stray Erasure the floater that remains unanchored is eliminated. At P-level we obtain:

```
ex.3a   P:     •     •     •     •     •     •
               |     |     |     |     |     |
             ( k     ə     r ) ( v     a     v )
```

```
(7)   ex.3b   M:     •     •           •
                     |     |           |
                     k     r     ə    * v
                                 ↓                                  (i)
              W:     •     •     •     •
                     |     |     |     |
                   ( k     r     ə     v )
```

In (7) three consonants remain unsyllabified at M-level, but only one of them is preceded by a floater. The floater gets anchored and the structure becomes completely syllabifiable at W-level.

```
      ex.3c   M:     •     •           •   +   •     •
                     |     |           |       |     |
                     k     r     ə    * v    ( t     a )
                                 ↓                                  (i)
              W:     •     •     •     •       •     •
                     |     |     |     |       |     |
                   ( k     r     ə     v )   ( t     a )
```

In the above representation, corresponding to ex.3c, three consonants remain unsyllabified at M-level. The last one is preceded by a floater. It triggers the anchoring of the floater. The anchored floater is sufficient to impose well-formed syllable structure on W-level.

```
(8)   ex.3d   M:     •     •           •   +         •
                     |     |           |             |
                     k     r     ə    * v      e    * n
                                 ↓             ↓                    (i)
              W:     •     •     •     •       •     •
                     |     |     |     |       |     |
                   ( k     r     ə ) ( v       e     n )
```

The M-level structure in (8) is completely unsyllabifiable. Two of the unsyllabified consonants are preceded by an adjacent floater. Both trigger <V>-Anchoring. Thus, syllabification applies at W-level around the two vocalic nuclei resulting from the application of the M/W level rule (i).

```
(9)   ex.3e  M:     •     •           •   +         •   +   •
                    |     |           |             |       |
                    k     r     ə    * v       e   ( n       a )
                                ↓                                         (i)
             W:     •     •     •     •             •       •
                    |     |     |     |             |       |
                  ( k     r     ə     v )      e   ( n       a )
```

Another solution which yields a well-formed syllable structure including all anchored elements of the lexical form in (9) would be to rescue the unsyllabified *v by anchoring the second floater, <e>, instead of the first, <**ə**>, which would trigger **ə**-Epenthesis before *r. This would yield the following structure: (*kər*)(*ve*)(*na*). However, the rule of <V>-Anchoring requires that the floater precede, not follow the unsyllabified consonant.

The floater <e> in (9), unsyllabified at W-level, undergoes Stray Erasure. This gives the following surface form:

```
      ex.3e  P:     •     •     •     •     •     •
                    |     |     |     |     |     |
                  ( k     r     ə     v ) ( n     a )
```

2.4.4.4. Metathetic CS-roots, examples 4a-e

```
(10)   ex.4a  M:    •     •     •   +   •     •     •     •   +   •
                    |     |     |       |     |     |     |       |
                    v     r   ( v       o ) ( l     i ) ( c       a )

              W:    •     •     •
                    |     |     |
                   °v    °r   ( v       o ) ( l     i ) ( c       a )
```

In (10) two sonorants remain unsyllabified at M-level; **ə**-Epenthesis is triggered by the second one in order to give the preferred syllable type CVC:

ex.4a W: • • • • • • • • •
| | | | | | | | |
(v ə r) (v o) (l i) (c a)

(11) ex.4b M: • • •
| | |
v r v

In (11) three adjacent sonorants remain unsyllabified. There is no floater, so no cross-level rule applies. At W-level only one of the unsyllabified sonorants may trigger schwa epenthesis. The last one is selected, because inserting a syllabic nucleus before it gives one of the preferred syllable types in Bulgarian: CCVC (see chapter 1, 1.2.6).

ex.4b W: • • •
| | |
°v °r °v
↓ (ii)
W: • • • •
| | | |
(v r ə v)

ex.4c W: • • • • • • •
| | | | | | |
°v °r °v (č i) (c a)
↓ (ii)
W: • • • • • • • •
| | | | | | | |
(v r ə v) (č i) (c a)

Being a CS-stem, /vrv/ selects the non-GV suffix • • / | | / e n instead of • / | / e n.

The M-level representation of the adjective in the masculine sg. is:

ex.4d M: • • • + • •
| | | | |
v r (v e n)

and in the feminine:

```
ex.4e   M:     •     •     •   +   •     •   +   •
               |     |     |       |     |       |
               v     r   ( v       e )  ( n      a )
```

At W-level a schwa is inserted between the two unsyllabified sonorants to yield a CVC syllable both in the masculine and in the feminine:

```
ex.4d   W:     •           •     •     •     •
               |           |     |     |     |
              °v          °r   ( v     e     n )
                     ↓                                          (ii)
        W:     •     •     •     •     •     •
               |     |     |     |     |     |
             ( v     ə     r ) ( v     e     n )


ex.4e   W:     •     •     •     •     •     •   +   •
               |     |     |     |     |     |       |
             ( v     ə     r ) ( v     e ) ( n       a )
```

2.4.4.5. CS-roots + -EC, examples 5 & 6

In the fem. *begl+a* (example 5a) neither rule applies:

```
ex.5a   P:     •     •     •     •   +   •
               |     |     |     |       |
             ( b     e     g ) ( l       a )
```

The derivation of the masc. *begăl* (ex.5b) is like that of ex. 2b, *misăl*, see (5).

Being a CS-stem, /begl/ may select either the GV allomorph (e, •|c) or the non-GV allomorph (•|e •|c) of the suffix -EC. When it selects the GV allomorph, the derivation is:

```
(12)   ex.5d   M:    •     •     •     •   +         •
                     |     |     |     |             |
                    (b     e     g)    l         e  *c
                                                 ↓                  (i)
               W:    •     •     •     •         •     •
                     |     |     |     |         |     |
                    (b     e     g)   (l         e     c)
```

The floater is anchored because it finds itself before the unsyllabied *c. Clearly, ə-Epenthesis must not apply at this level. Otherwise it would yield the erroneous form **begəlec* with a schwa inserted before the unsyllabified *˚l.* As ə-Epenthesis applies at W-level, it follows syllabification triggered by the cross-level M/W rule of Floater Anchoring. The anchored floater [e] provides a nucleus for syllabification not only for the word-final [c], but also for the preceding as yet unsyllabified [l]. Thus the context for application of Schwa-before-*S Epenthesis is no longer present at W-level, for the sonorant has already been syllabified.

The form obtained in (12) above coincides with the -EC derivative of the same word when the non-GV allomorph is selected:

```
ex.6d   M:    •     •     •     •   +   •     •
              |     |     |     |       |     |
             (b     e     g)   (l       e     c)
```

The two allomorphs of -EC give different derivations only in the plural. When the non-GV allomorph is selected, the M-level representation of the plural (example 6e) is entirely syllabifiable, and neither rule applies:

```
ex.6e   M:    •     •     •     •   +   •     •   +   •
              |     |     |     |       |     |       |
             (b     e     g)   (l       e)   (c       i)
```

This is not the case of the M-level form with the GV suffix, where the unsyllabified [l] cannot trigger the anchoring of the floater, because the latter follows the former:

```
ex.5e   M:     •     •     •     •   +           •   +   •
               |     |     |     |               |       |
             ( b     e     g )   l         e   ( c       i )
```

Because [l] arrives unsyllabified at W-level, it triggers ə-Epenthesis:

```
ex.5e   W:     •     •     •           •            •     •
               |     |     |           |            |     |
             ( b     e     g )        °l      e   ( c     i )
                                 ↓                                    (ii)
        W:     •     •     •     •     •            •     •
               |     |     |     |     |            |     |
             ( b     e ) ( g     ə     l )    e   ( c     i )
```

The floater remains unanchored and undergoes Stray Erasure:

```
ex.5e   P:     •     •     •     •     •     •     •
               |     |     |     |     |     |     |
             ( b     e ) ( g     ə     l ) ( c     i )
```

2.4.4.6. Metathetic <V>-roots + -EC, examples 7a-e

Metathetic stems always select the GV suffix /-<e>c/.
Ex.7b *drăž* is derived like ex.3b *krăv* (7), while ex.7c *drăž+ka* copies the derivation of ex.3c *krăv+ta*.
Consider the derivation of ex.7a in (13), where we find the same verbalizing suffix as in ex.2a, misl[^{j}+ə] (both verbs belonging to the same conjugation type). The suffix consists of a schwa preceded by the floating node [coronal]. In (4), ex.2a, the floating node associates to the preceding stem-final consonant, causing its palatalization. But in Bulgarian the [coronal] node under V-place is incompatible with the [coronal] node under C-place when the latter is linked to the feature [–anterior]. This is the case for [ž]. [ž], like the other [–anter] coronal continuants (š, č), has no palatalized counterpart. So the floating [coronal] node from the suffix remains unlinked and finally undergoes Stray Erasure.

```
(13)   ex.7a   M:     •     •          •   +        •
                      |     |          |            |
                      d     r     ə    ž            ə

                                             [cor]



       ex.7a   W:   •          •          •          •
                    |          |          |          |
                    d         °r     ə  ( ž          ə )

                                               [cor]
                          ↓                                    (ii)
               W:   •     •    •          •          •
                    |     |    |          |          |
                  ( d     ə    r )   ə  ( ž          ə )

                                               [cor]
```

After the deletion of stray segments and nodes:

```
       ex.7a   P:   •     •    •    •    •
                    |     |    |    |    |
                  ( d     ə    r ) ( ž    ə )
```

At M-level in the sg. of the -EC derivative from the stem /dr<ə>ž/, *samodăržec*, we find the configuration that triggers <V>-before-<V> Deletion:

```
       ex.7d   M:  •    •    •    •  +  •   •        •  +      •
                   |    |    |    |     |   |        |         |
                   s    a    m    o     d   r    ə   ž     e   c
                                                 ↓                  (iii)
               M:  •    •    •    •  +  •   •        •  +      •
                   |    |    |    |     |   |        |         |
                   s    a    m    o     d   r        ž     e   c
```

M-level syllabification applies only after the elimination of the stem floater. The subsequent derivation is as follows (we represent only the final part of the word which contains the contexts of rules (i) and (ii)):

```
ex.7d   M:      •    •    •   +        •
                |    |    |            |
                d    r    ž       e   * c
                                  ↓                              (i)
        W:      •    •    •       •    •
                |    |    |       |    |
                d    r   ( ž      e    c )


ex.7d   W:      •         •    •    •    •
                |         |    |    |    |
                d        ˚r   ( ž   e    c )
                     ↓                                           (ii)
        W:      •    •    •    •    •    •
                |    |    |    |    |    |
              ( d    ə    r ) ( ž   e    c )
```

Since the plural (example 7e) is an inflected form, rule (iii) cannot apply: the suffix is not word-final.

```
ex.7e   M:    +   •    •         •   +       •   +   •
                  |    |         |           |       |
                  d    r    ə   * ž      e  ( c      i )
                            ↓                                    (i)
        W:    +   •    •    •    •           •       •
                  |    |    |    |           |       |
                ( d    r    ə    ž )     e  ( c      i )
```

After the anchoring of the stem floater by means of rule (i), the W-level representation becomes perfectly syllabifiable. The unanchored suffixal floater is subject to Stray Erasure.

```
ex.7e   P:      +  •    •    •    •    •       •
                   |    |    |    |    |       |
                  (d    r    ə    ž)  (c       i )
```

2.4.4.7. Metathetic CS-roots + -EC, examples 8

Being metathetic, the stems illustrated by examples 8 select the GV suffix -<e>c. Consider the following derivations:

```
(14)   ex.8a   M:     •    •    •  +  •
                      |    |    |     |
                      s    r   (n     a )
```

The unsyllabified sonorant in (14) triggers ə-Epenthesis at W-level:

```
       ex.8a   W:      •         •     •     •
                       |         |     |     |
                       s        °r    (n     a )
                            ↓                                 (i)
               W:      •    •    •     •     •
                       |    |    |     |     |
                      (s    ə    r )  (n     a )
```

```
(15)   ex.8c   M:     •    •    •  +  •    •    •
                      |    |    |     |    |    |
                      s    r    n    (d    a    k )
```

In (15) we have two consecutive unsyllabified sonorants. At W-level only one schwa may be inserted, and the ə-before-*S Epenthesis takes place before the last sonorant, yielding the preferred syllable type CCVC: (srən); see (16). If epenthesis took place before the first unsyllabified sonorant, a CVCC syllable with a complex coda would result: *(sərn). This goes against the well-formedness conditions of the W-level. As a harmonic rule, ə-Epenthesis is entirely conditioned by well-formedness constraints on syllabification. It yields the best possible syllables.

```
(16)  ex.8c  W:    •    •         •    •    •    •
                   |    |         |    |    |    |
                   s   °r        °n   (d    a    k)
                           ↓                              (ii)
             W:            •           •    •    •
                           |           |    |    |
                  ( s   r  ə      n) (d    a    k)


(17)  ex.8d  M:    •    •    •  +        •
                   |    |    |           |
                   s    r    n       e  *c
                                     ↓                    (i)
             W:    •    •    •       •   •
                   |    |    |       |   |
                   s    r   (n       e   c )
```

In (17), after the anchoring of the floater, only one sonorant remains unsyllabified. ə-Epenthesis applies, and the W-level representation becomes:

```
      ex.8d  W:    •    •    •    •         •
                   |    |    |    |         |
                  (s    ə    r ) (n    e    c )
```

In the plural (example 8e), the floater cannot be anchored, and thus two adjacent sonorants, [r] and [n], remain unsyllabified:

```
      ex.8e  M:    •    •    •  +         •  +  •
                   |    |    |            |     |
                   s    r    n       e   (c     i)
```

ə-Epenthesis, as in (16), applies only before the second sonorant:

ex.8e W: • • • • •
| | | | |
s ˚r ˚n e (c i)
↓ (ii)
W: • • • • • •
| | | | | |
(s r ə n) e (c i)

Finally, the floater undergoes Stray Erasure, giving the following P-level representation:

ex.8e P: • • • • • •
| | | | | |
(s r ə n) (c i)

2.4.4.8. Lexically-marked FGE metathetic roots, examples 9

Examples 9 illustrate a case of a metathetic root that is lexically marked to undergo the Fratricidal Ghost Effect.

Ex.9a *dărz+ost* is derived like ex.3a *kărv+av*, see (6), while ex.9c *drăz+na* copies the derivation of ex.3c *krăv+ta* .

Consider the derivation of the -<**ə**>k derivative (example 9d), where a GV suffix to the FGE root. is added The root floater undergoes <V>-before-<V> Deletion. The derivation is similar to that of ex.6d:

ex.9d M: • • • + •
| | | |
d r ə z ə k
↓ (iii)
M: • • • + •
| | | |
d r z ə k

M-level syllabification applies only after rule (iii) has adjusted the word-final sequence of two underlying floaters in successive syllables. However, the structure that results from the application of (iii) cannot be syllabified. Therefore, the remaining floater is anchored. Further, at W-level, ˚r triggers schwa epenthesis.

```
ex.9d   M:     •    •    •  +      •
               |    |    |         |
               d    r    z      ə  * k
                                ↓                      (i)
        W:     •    •    •      •  •
               |    |    |      |  |
               d    r   ( z     ə   k )
```

```
ex.9d   W:     •         •    •    •    •
               |         |    |    |    |
               d        °r   ( z   ə    k )
                    ↓                                  (ii)
        W:     •    •    •    •    •    •
               |    |    |    |    |    |
              ( d   ə    r )  ( z  ə    k )
```

In the feminine (example 9e), before a vocalic inflection, the metathetic root loses its FGE lexical mark; thus rule (iii) is inapplicable. After the anchoring of the root floater by means of rule (i), the W-level representation becomes perfectly syllabifiable.

```
ex.9e   M:     •    •         •  +        •   +   •
               |    |         |           |       |
               d    r    ə   * z      ə  ( k      a )
                         ↓                             (i)
        W:     •    •    •    •           •       •
               |    |    |    |           |       |
              ( d   r    ə    z )     ə  ( k      a )
```

Finally, the unanchored suffixal floater undergoes Stray Erasure:

```
ex.9e   P:     •    •    •    •    •       •
               |    |    |    |    |       |
              ( d   r    ə    z ) ( k      a )
```

2.4.5. Generalizations. Comparison with the linear analysis.

With only two rules (an M/W cross-level rule and a W/W intra-level rule) that need not be extrinsically ordered, the proposed Harmonic Phonology analysis accounts for both GV alternations and metathetic alternations in Bulgarian. The rules (<V>-Anchoring and Schwa Epenthesis) derive all the forms from both types of GV-alternating roots: roots containing a floater and roots ending in a CS-cluster (with no floater). For derivatives from metathetic roots with the -<e>c suffix and for a limited number of roots that are lexically marked we need a third rule (<V>-before-<V> Deletion) that serves to adjust the M-level representations of uninflected suffixed forms.

2.4.5.1. The Harmonic Phonology treatment of GV syncopation and Metathesis

GV syncopation in <V>-roots is the result of the non-application of <V>-Anchoring (example 1a). The forms that retain the ghost vowel are those in which the same rule has applied in order to rescue otherwise unsyllabifiable consonants (examples 1b, 1c).
Likewise, Metathesis (the realization of ăL instead of Lă) in <V>-roots is observed where <V>-anchoring (example 3a) fails to apply. By contrast, where the application of this rule is necessary to rescue otherwise unsyllabifiable consonants, there is no metathesis, i.e. the sequence remains Lă (examples 3b, 3c)
GV alternations in CS-roots are due to the application/non-application of **ə**-before-*S Epenthesis: the latter applies only where an otherwise unsyllabifiable consonant must be rescued (cf. examples 2b-c as opposed to ex.2a, 2d-e).
Metathesis in CS-roots is due to the variable site of application of the rule of **ə**-before-*S Epenthesis. Metathetic CS-roots contain a sequence of two sonorants (CS here is LS, a sequence of a liquid and another sonorant), and Schwa Epenthesis applies either before the first or the second sonorant according to the subsequent context (examples 4a-c).

2.4.5.2. The Harmonic Phonology treatment of the phonologically-conditioned suspension of GV syncopation and metathesis

The suspending effect of GV suffixes (when uninflected) on both syncopation (example 1d) and metathesis (example 3d) is due to the double and simultaneous application of <V>-anchoring: on the floater of the root and on the floater of the suffix.
There is no suspension of syncopation or metathesis in CS-roots in combination with a GV suffix. Tis is explained by the fact that the CS-root, whether non-metathetic

(examples 2d and 5d) or metathetic (examples 4d and 8d), contains no floater. With only one floater available — in the suffix — there is no room for double application of Floater Anchoring between levels M and W. Thus, neither GV syncopation nor metathesis can be suspended in a CS-root.

As for examples 7d and 9d, the non-suspension of the metathetic alternation is due to the deletion of the root floater in the M-level representation — a manifestation of the Fratricidal Ghost Effect that characterizes the suffix -/<e>c/ (example 7d) and the lexically-marked root /dr<ə>z/ (example 9d).

In sum, suspension of both alternations (syncopation and metathesis) can be observed only where two floating vowels find themselves separated by no other vowel in M-level representations.

2.4.5.3. Advantages of the Harmonic Phonology analysis

1) The Harmonic Phonology analysis, compared to the OSI Jer analysis, has the advantage of reducing the inventory of underlying segments. It posits no underlying jers /Y/ or /E/. Instead, it uses two of the six vowels found in surface representations of Bulgarian words — /ə/ and /e/ — as floating segments.

2) The surfacing of ghost vowels (all ghost [e]'s and part of the ghost [ə]'s) is viewed as the result of providing a floating vowel with a skeletal slot. Floaters anchor only when immediately followed by an unsyllabified consonant.

3) The surfacing of remaining ghost [ə]'s is interpreted as epenthesis of the default vowel [ə]: epenthetic schwa is inserted when immediately followed by a sonorant that remains unsyllabified after the anchoring of floaters.

4) Thus, the surfacing of all ghost vowels, be they underlying floaters or epenthetic schwas, is treated as the direct consequence of the process of syllabification. Both Floater Anchoring and Schwa Epenthesis are repair strategies aiming to provide full syllabification of the segmental string.

5) The Harmonic Phonology analysis does not introduce syllabic sonorants in the course of derivation. This is an advantage with respect to the OSI Jer analysis, because in modern standard Bulgarian syllabic sonorants are not part of the surface segmental inventory. In the Harmonic Phonology treatment, sonorants trigger epenthesis of schwa not because they become syllabic, but because they remain

unsyllabified up to W-level representations.

6) As in other multilinear analyses of vowel-zero alternations in Slavic (cf. Kenstowicz & Rubach 1987, Farina 1991) a rule deleting floaters is not needed. The floaters that remain unanchored are eliminated by Stray Erasure.

2.5. Optimality Theory account for the Bulgarian data

2.5.1. Some principles of Optimality Theory

Optimality Theory (OT) uses output-based well-formedness constraints instead of input-based rewrite rules. In OT it is necessary to allow for the specification of a large set of candidate outputs. The candidate set is evaluated by the system of constraints. The latter selects the actual output (the optimal candidate) from the available candidates.

Constraints are ranked in a hierarchy. Lower-ranked constraints can be violated in an optimal output form when such violation guarantees success on higher-ranked constraints. Individual grammars impose a ranking on the universal constraint set, possibly with some setting of parameters and fixing of arguments within the constraints.

If just one candidate passes the highest-ranked constraint, it best satisfies the system of constraints and is the optimal candidate. Constraint violation is not necessarily the end of a candidate's chances. In case of ties, e.g. when all candidates fail the highest-ranked constraint, the failure on this constraint is not fatal for the candidates. Once a victor emerges, the remaining, lower-ranked constraints are irrelevant. Whether the optimal candidate obeys them or not is irrelevant. Likewise, the evaluation of failed candidates by lower-ranked constraints is also irrelevant.

2.5.2. A two-level OT account for Bulgarian ghost vowels

We adopt here a two-level version of OT known as Correspondence Theory (McCarthy & Prince 1994). The constraints serve to match different surface forms (outputs) with a given underlying form; i.e. each output is evaluated for every constraint with respect to the corresponding underlying form.

In our OT analysis of Bulgarian ghost vowels, we use the traditional OT formalism: the constraint tableau. Constraints are arrayed across the top of the tableau in domination order. Constraints that are not crucially ranked with respect to each other are separated in the tableau by dashed, rather than solid, lines and by the comma'd grouping when giving the constraint ranking, e.g. PARSE**,** FILL >> *COMPLEX\Coda. The latter indicates that there is no implication about the relative ranking of PARSE and FILL. Each of them dominates *COMPLEX\Coda.

A blank cell in the constraint tableau corresponds to success of the respective constraint, an asterisk * in a cell – to violation of the constraint. ! marks the exact

point where a candidate loses out to other candidates. Cells that do not participate in the decision are shaded. ☞indicates the optimal candidate.
For each candidate set we first give the underlying representaion to be matched. The underlying representations we use are those we arrived at after the analysis of the data in chapter 1.
The meaning of angled brackets is different at the level of underlying represention and in the representations of output candidates. In the latter case, they indicate unparsed segments, as is usual in OT formalism. For instance, <n> in an output candidate — e.g., .pes.<n> — represents a segment [n] that is provided with a skeletal slot, but remains outside syllable structure because of the sonority sequencing hierarchy, for [n] is peripheral and more sonorous than [s]. In underlying representations, e.g. in the underlying form /pes<e>n/ of *pesen* 'song', a segment between angled brackets represents a floater, i.e. <e> is a floating vowel, a segment [e] with no skeletal slot.

2.5.2.1. Constraints

Three of the seven constraints that we use to account for Bulgarian ghost vowel alternations and metathesis in a two-level OT framework are among the basic syllable structure constraints: PARSE, FILL and *COMPLEX (cf. Prince & Smolensky 1993). The first two are known as the Faithfullness family of constraints: "They declare that perfectly well-formed syllable structures are those in which input segments are in one-to-one correspondence with syllable positions" (Prince & Smolensky 1993:88). In our analysis of Bulgarian ghost vowels, all three universal constraints are to be augmented with language-particular parameters.
With two levels of representation and with underlying structures that contain floating segments, a language-specific parameter is necessary to restrict PARSE to non-floating segments, i.e. to segments that are provided with a skeletal slot underlyingly. The non-parsing of a floater, i.e. the fact that a floating segment remains unsyllabified and, therefore, not included in higher-level structures, is not a violation of PARSE in Bulgarian.

C1: PARSE\non-Floaters

PARSE NON-FLOATERS:
All non-floating segments of the underlying representation must be parsed.

The universal constraint FILL must also be parameterized. Apparently, FILL is not violated in Bulgarian, if a syllable position is filled with a segment (schwa) that is not underlyingly present, but represents the nucleus of a syllable whose coda is occupied by a sonorant. An additional condition is that there must be no floater available to fill the nucleus position in question.

C2: FILL\sonorant; closed σ

FILL with the default vowel (schwa) only if:

a. before a SONORANT [r, l, m, n, v]

AND

b. the sonorant is in coda position, i.e. the schwa is in a CLOSED SYLLABLE

AND

c. there is NO FLOATER AVAILABLE to be anchored before the sonorant

The universal constraint *COMPLEX (cf. Prince & Smolensky 1993:87 and 109) is restricted to codas in Bulgarian. This means that it bans branching codas, but allows branching onsets as well-formed syllable structures. This constraint should be parameterized as * COMPLEX\Coda:

C3: * COMPLEX\Coda

AVOID COMPLEX CODAS:
A complex coda must be avoided.

Another constraint, which is lower-ranked, proscribes open syllables whenever the nucleus is a floater that has been parsed.

C4: AVOID OPEN σ̣\Floater

AVOID OPEN SYLLABLES WITH A PARSED FLOATER AS NUCLEUS:
If there are two candidates with parsed floaters, the one whose floaters are all in closed syllables is the better candidate.

The first four constraints all refer to syllable structure. They interact with certain other constraints that relate more specifically to floaters: all floaters (C5), floaters of the root morpheme (C6), and floaters of the root in interaction with suffixal floaters in derivatives — lexically-marked cases (C7).

Generally, parsing of floaters is to be avoided. In French, what is traditionally called "mute E", or schwa, can be treated as a floater. In an OT framework, Tranel (1995:3) introduces the constraint AIF: "I regulate the appearance of floaters by introducing the univeral constraint AIF (Avoid Integrating Floaters). The force of AIF is to prohibit the 'insertion' of whatever higher structural node would turn a floater into a regular segment. AIF thus belongs to the group of faithfullness constraints." PARSE bans underparsing: leaving underlyingly anchored segments unparsed. FILL bans overparsing: parsing of a segment which is not underlyingly present or 'total epenthesis'. According to Tranel, "AIF can be seen as banning a type of 'partial epenthesis' whereby a higher structural node would be 'inserted'". In my treatment, the latter constraint bans parsing of segments that are underlyingly present on the segmental ("melodic") tier, but lack a skeletal slot. Therefore, it bans parsing of floating segments or floaters, and is, in a sense, the opposite of PARSE\non-Floaters, which requires parsing of anchored (non-floating) segments. F this reason I prefer to call this constraint differently:

C5: AVOID PARSE\Floaters

AVOID PARSING FLOATERS:
A candidate with no parsed floaters is better than a candidate that contains at least one parsed floater.

Formulated in this way, AVOID PARSE\Floaters is a binary constraint, unlike PARSE\Non-floaters, which is non-binary. AVOID PARSE imposes a single violation mark on every candidate that contains one or more parsed floaters. The number of unparsed floaters is irrelevant. Conversely, when evaluated for PARSE, a candidate receives as many violation marks as the number ofnon-floaters that remain unparsed; i.e. different degrees of violation of PARSE are possible.

But floaters that are part of the root morpheme, unlike suffixal floaters, tend to be parsed. This constraint is lower-ranked, and it requires that the parsing of the root segments be exhaustive.

C6: EXHAUSTPROOT

EXHAUSTIVE PARSING OF THE ROOT :

All underlying segments of the root morpheme, including floating segments, must be parsed.

The last constraint is needed to account for words that contain an FGE-marked morpheme: ex.7d and ex.9d. It bans the parsing of a floater in the root when the suffixal floater is parsed. A form must contain the nominalizing suffix -/<e>c/ (ex.7d) or be lexically-marked for this constraint (ex.9d).

C7: *ROOT FLOATER\Suffixal Floater

Do not allow a ROOT FLOATER to be parsed before a PARSED SUFFIXAL FLOATER if:

a. the suffix is -/<e>c/

OR

b. the root is lexically-marked for this constraint (it carries the FGE lexical mark)

2.5.2.2. Constraint ranking

{PARSE\non-Floaters, FILL\sonorant;closed σ} >> *COMPLEX\Coda >>
>> {AVOID PARSE\Floaters, *ROOT FLOATER\Suffixal Floater} >>
EXHAUSTPROOT >> >> AVOID OPEN σ\Floater

		PARSE \non-Floaters	FILL \sonorant; closed σ	*COMPLEX \Coda	AVOID PARSE \Floaters	*ROOT FLOATER \SuffFloater	EXHAUSTPROOT	AVOID OPENσ̣\ Floater
(18)	/kost/							
	.kos.<t>	*					*	
☞	.kost.			*				
	.ko.sət.		$*_{a}$					
	.kos.tə.		$*_{a,b}$					
(19)	/or<e>l/							
	.or.<l>	*					*	
	.orl.			*			*	
☞	.o.rel.				*			
	.o.rəl.		$*_{c}$				*	
	.or.lə.		$*_{a,b}$				*	
(20)	/mal+<ə>k/							
	.mal.<k>	*						
	.malk.			*				
☞	.ma.lək.				*			
	.mal.kə.		$*_{a,b}$					

(18) above demonstrates that in Bulgarian FILL dominates *COMPLEX\Coda:

(21) FILL >> *COMPLEX\Coda

When there is no floater in the underlying representation of a given word, e.g. /kost/ for *kost* 'bone' fem.sg., a consonant cluster that is an admissible complex coda (cf. candidate .kost.) is preferred to a violation of FILL (cf. candidates .ko.s**ə**t. or .kos.t**ə**.). From (19) and (20) we can see that *COMPLEX\Coda is higher-ranked than AVOID PARSE \Floaters:

(22) *COMPLEX\Coda >> AVOID PARSE \Floaters

With words containing an underlying floater, as part of the root (19) or of a suffix (20), to parse the floater (as in the optimal candidates .o.rel. and .ma.l**ə**k.) is a smaller violation than to create a syllable with complex coda (cf. the suboptimal candidates .orl. and .malk.).

2.5.3. OT accounts for the patterns of examples 1-9, Table 3

2.5.3.1. <V>-roots, examples 1

Examples 1a, 1´a reveal the domination of AVOID PARSE on EXHAUSTPROOT. The optimal candidates (ii) satisfy the former and violate the latter, which must therefore be lower-ranked:

(23) AVOID PARSE >> EXHAUSTPROOT

Candidates (iii) in examples 1b, 1´b involve a violation of AVOID PARSE. Nevertheless, they are optimal, because the other candidates violate higher-ranked constraints: PARSE or FILL. Candidates (ii) in examples 1´b, 1´c receive violation marks for FILL, because they contain a schwa insertion in a site where a floater, <e>, is available at the level of underlying representations. Candidates (ii) in 1b, 1c are attempts to avoid violation of *COMPLEX, but this leads to a more serious violation: a second unparsed underlying segment, which involves a second violation mark for PARSE.

Ex. nº	C. nº		PARSE \non-Floaters	FILL \sonorant; closed σ	*COMPLEX \Coda	AVOID PARSE \Floaters	*ROOT FLOATER \SuffFloater	EXHAUSTP ROOT	AVOID OPENσ̣\ Floater
1a		/filt<ə>r+i/							
	i.	.fil.tə.ri.				* !			*
☞	ii.	.fil.tri.						*	
1´a		/pes<e>n+i/							
	i.	.pe.se.ni.				* !			*
☞	ii.	.pes.ni.						*	
1b		/filt<ə>r/							
	i.	.filt.<r>	*		*			*	
	ii.	.fil.<tr>	* *					*	
☞	iii.	.fil.tər.				*			
1´b		/pes<e>n/							
	i.	.pes.<n>	*					*	
	ii.	.pe.sən.		$*_{c}$				*	
☞	iii.	.pe.sen.				*			
1c		/filt<ə>r+če/							
	i.	.filt.<r>.če.	*		*			*	
	ii.	.fil.<tr>.če.	* *					*	
☞	iii.	.fil.tər.če.				*			
1´c		/pes<e>n+ta/							
	i.	.pes.<n>.ta.	*					*	
	ii.	.pe.sən.ta.		$*_{c}$				*	
☞	iii.	.pe.sen.ta.				*			

Ex. nº	C. nº		PARSE \non-Floaters	FILL \sonorant; closed σ	*COMPLEX \Coda	AVOID PARSE \Floaters	*ROOT FLOATER \SuffFloater	EXHAUSTPROOT	AVOID OPENσ \Floater
1d		/filt<ə>r+<e>n/							
	i.	.filt.<rn>	* *					*	
	ii.	.fil.tərn.			*	*			
	iii.	.fil.tren.				*		* !	
☞	iv.	.fil.tə.ren.				*			*
1´d		/pes<e>n+<e>n/							
	i.	.pes.<nn>	*					*	
	ii.	.pe.sen.<n>	*			*			
	iii.	.pes.nen.				*		* !	
☞	iv.	.pe.se.nen.				*			*
1e		/filt<ə>r+<e>n+a/							
	i.	.filt.<r>.na.	*					*	
	ii.	.fil.tre.na.				*		* !	*
☞	iii.	.fil.tər.na.				*			
	iv.	.fil.tə.re.na.				*			* !
1´e		/pes<e>n+<e>n+a/							
	i.	.pes.<n>.na.	*					*	
	ii.	.pes.ne.na.				*		* !	*
☞	iii.	.pe.sen.na.				*			
	iv.	.pe.se.ne.na.				*			* !

In examples 1d, 1´d EXHAUSTPROOT violations play a decisive role. Candidate (iii) and candidate (iv) tie on AVOID PARSE\Floaters. Otherwise, both candidates receive another violation mark: candidate (iii) for EXHAUSTPROOT and candidate (iv) for AVOID OPEN σ\Floater. The correct outputs are obtained by ranking EXHAUSTPROOT higher than AVOID OPEN σ\Floater:

(24) EXHAUSTPROOT >> AVOID OPEN σ\Floater

2.5.3.2. Metathetic <V>-roots, examples 3

In 3a the decisive role is played by the relative ranking of AVOIDPARSE and EXHAUSTPROOT.

(25) AvoidParse >> ExhaustPRoot

In 3b, 3c candidates (ii) are the winners, because they incur the least serious violation – that of AvoidParse which is lower-ranked with respect to Parse, Fill and *Complex.

Ex. nº	C. nº		Parse \non-Floaters	Fill \sonorant; closed σ	*Complex \Coda	Avoid Parse \Floaters	*Root Floater \SuffFloater	ExhaustP Root	Avoid Openσ\ Floater
3a		/kr<ə>v+av/							
	i.	<kr>.vav.	* *					*	
	ii.	.krə.vav.				* !			
☞	iii.	.kər.vav.						*	
	iv.	.kə.rə.vav.		*$_{b}$		*			*
3b		/kr<ə>v/							
	i.	<krv>	*					*	
☞	ii.	.krəf.				*			
	iii.	.kərf.			*			*	
	iv.	.kə.rəf.		*$_{b}$		*			
3c		/kr<ə>v+ta/							
	i.	<krv>.ta.	* * *						
☞	ii.	.krəf.ta.				*			
	iii.	.kərf.ta.			*			*	
	iv.	.kə.rəf.ta.		*$_{b}$		*			

Ex. nº	C. nº		PARSE \non-Floaters	FILL \sonorant; closed σ	*COMPLEX \Coda	AVOID PARSE \Floaters	*ROOT FLOATER \SuffFloater	EXHAUSTP ROOT	AVOID OPENσ̣\ Floater
3d		/kr<ə>v+<e>n/							
	i.	<krvn>	*					*	
	ii.	<kr>.ven.	*			*		*	
	iii.	.krəv.<n>	*			*			
☞	iv.	.krə.ven.				*			*
	v.	.kər.ven.				*		* !	
	vi.	.kə.rə.ven.		*$_b$		*			
3e		/kr<ə>v+<e>n+a/							
	i.	<krv>.na.	*					*	
	ii.	<kr>.ve.na.	*			*		*	*
	iii.	.krə.ve.na.				*			* !
	iv.	.kər.ve.na.				*		* !	*
	v.	.kə.rə.ve.na.		*$_b$		*			*
	vi.	.kə.rəv.na.		*$_b$		*			
	vii.	.kərv.na.			*			*	
☞	viii.	.krəv.na.				*			

In 3d, candidates (iv) and (v) are tied until the evaluation for AVOID PARSE. They both receive a single violation mark for AVOID PARSE, a binary constraint, even though candidate (iv) contains two parsed floaters, while candidate (v) presents a single parsed floater. We see that, as in 1d, the decisive role for selecting (iv) as optimal candidate is played by the higher ranking of EXHAUSTPROOT over AVOID OPEN σ\Floater, cf. (24).

2.5.3.3. CS-roots, examples 2 and 4

The optimal candidates in CS-roots are those with no violation marks. They all fill a nucleus with schwa in a closed syllable before a sonorant, which does not involve a FILL violation.

Ex. nº	C. nº		PARSE \non-Floaters	FILL \sonorant; closed σ	*COMPLEX \Coda	AVOID PARSE \Floaters	*ROOT FLOATER \SuffFloater	EXHAUSTPROOT	AVOID OPENσ\ Floater
2a		/misl+ʲ+ə/							
☞	i.	.mis.lʲə.							
	ii.	.mi.sə.lʲə.		*b					
2b		/misl/							
	i.	.mis.<l>	*					*	
☞	ii.	.mi.səl.							
2c		/misl+ta/							
	i.	.mis.<l>.ta.	*					*	
☞	ii.	.mi.səl.ta.							
2d		/misl+en/							
☞	i.	.mis.len.							
	ii.	.mi.sə.len.		*b					
2e		/misl+en+a/							
☞	i.	.mis.le.na.							
	ii.	.mi.sə.le.na.		*b !					
	iii.	.mi.səl.<e>.na.	* !						

Ex. nº	C. nº		Parse \non-Floaters	Fill \sonorant; closed σ	*Complex \Coda	Avoid Parse \Floaters	*Root Floater \SuffFloater	ExhaustP Root	Avoid Openσ\ Floater
4a		/vrv+olic+a/							
	i.	<vr>.vo.li.ca.	* *						
	ii.	.vrə.vo.li.ca.		*$_{b}$					
☞	iii.	.vər.vo.li.ca.							
	iv.	.və.rə.vo.li.ca.		* * $_{b}$					
4b		/vrv/							
	i.	<vrv>	* * *						
☞	ii.	.vrəf.							
	iii.	.vərf.			*				
	iv.	.və.rəf.		* $_{b}$					
4c		/vrv+čic+a/							
	i.	<vrv>.či.ca.	* * *						
☞	ii.	.vrəf.či.ca.							
	iii.	.vərf.či.ca.			*				
	iv.	.və.rəf.či.ca.		* $_{b}$					
4d		/vrv+en/							
	i.	<vr>.ven.	* *						
	ii.	.vrə.ven.		* $_{b}$					
☞	iii.	.vər.ven.							
	iv.	.və.rə.ven.		* * $_{b}$					
4e		/vrv+en+a/							
	i.	<vr>.ve.na.	* *						
	ii.	.vrə.ve.na.		* $_{b}$					
☞	iii.	.vər.ve.na.							
	iv.	.və.rə.ve.na.		* * $_{b}$					

2.5.3.4. CS-root + -/<e>c/, examples 5

Ex. nº	C. nº		PARSE \non-Floaters	FILL \sonorant; closed σ	*COMPLEX \Coda	AVOID PARSE \Floaters	*ROOT FLOATER \SuffFloater	EXHAUSTPROOT	AVOID OPENσ\ Floater
5a		/begl+a/							
☞	i.	.be.gla.							
	ii.	.be.gə.la.		* !					
5b		/begl/							
	i.	.beg.<l>	* !					*	
☞	ii.	.be.gəl.							
5d		/begl+<e>c/							
	i.	.beg.<lc>	* *					*	
	ii.	.be.gəlc.			*				
	iii.	.be.gə.lec.		* b		*			
	iv.	.be.gləc.		* c					
☞	v.	.be.glec.				*			
5e		/begl+<e>c+i/							
	i.	.beg.<l>.ci.	*					*	
	ii.	.be.gle.ci.				*			*
	iii.	.be.gə.le.ci.		* b		*			*
☞	iv.	.be.gəl.ci.							

2.5.3.5. Metathetic <V>-root + -/<e>c/, examples 7

Ex. nº	C. nº		PARSE \non-Floaters	FILL \sonorant; closed σ	*COMPLEX \Coda	AVOID PARSE \Floaters	*ROOT FLOATER \SuffFloater	EXHAUSTP ROOT	AVOID OPENσ\ Floater
7a		/dr<ə>ž+^{j}+ə/							
	i.	<dr>.žə.	* *						
	ii.	.drə.žə.				* !			*
	iii.	.də.rə.žə.		* b		*			*
☞	iv.	.dər.žə.						*	
7b		/dr<ə>ž/							
	i.	<drž>	* * *					*	
	ii.	.dərž.			* !			*	
☞	iii.	.drəž.				*			
	iv.	.də.rəž.		* b		*			
7c		/dr<ə>ž+k+a/							
	i.	<drž>.ka.	* * *					*	
	ii.	.dərž.ka.			* !			*	
☞	iii.	.drəž.ka.				*			
	iv.	.də.rəž.ka.		* b		*			
7d		/+dr<ə>ž+<e>c/							
	i.	<držc>	* * * *					*	
	ii.	<dr>. žec.	* *			*		*	
	iii.	.dərž.<c>	*		*				
	iv.	.drəžc.			*	*			
	v.	.drə.žec.				*	* !		*
☞	vi.	.dər.žec.				*		*	
7e		/+dr<ə>ž+<e>c+i/							
	i.	<drž>.ci.	* * *					*	
	ii.	<dr>.že.ci.	* *			*		*	*
☞	iii.	.drəž.ci.				*			
	iv.	.drə.že.ci.				*	*		*
	v.	.dər.že.ci.				*		* !	*
	vi.	.dərž.ci.			*				
	vii.	.də.rə.že.ci.		* b		*		*	
	viii.	.də.rəž.ci.		* b		*			

Candidate (v) and (vi) demonstrate that *ROOT FLOATER\Suffixal Floater must be higher-ranked than EXHAUSTPROOT, because (vi), with a violation mark for EXHAUSTPROOT, is the optimal candidate:

(26) *ROOT FLOATER\Suffixal Floater >> EXHASTPROOT

2.5.3.6. Metathetic CS-root + -/<e>c/, examples 8

Ex. nº	C. nº		PARSE \non-Floaters	FILL \sonorant ;closed σ	*COMPLEX \Coda	AVOID PARSE \Floaters	*ROOT FLOATER \SuffFloater	EXHAUSTP ROOT	AVOID OPENσ\ Floater
8a		/srn+a/							
	i.	<sr>.na.	* *					*	
	ii.	.srə.na.		* $_{b}$					
☞	iii.	.sər.na.							
	iv.	.sə.rə.na.		* $_{b}$					
8c		/srn+dak/							
	i.	<srn>.dak.	* * *					*	
	ii.	.sərn.dak.			* !				
	iii.	.sər.nə.dak.		* $_{a, b}$					
☞	iv.	.srən.dak.							
	v.	.sə.rən.dak.		* $_{b}$					

Ex. nº	C. nº		PARSE \non-Floaters	FILL \sonorant;closed σ	*COMPLEX \Coda	AVOID PARSE \Floaters	*ROOT FLOATER \SuffFloater	EXHAUSTP ROOT	AVOID OPENσ\ Floater
8d		/srn+<e>c/							
	i.	<srnc>	* * * *					*	
	ii.	<sr>.nec.	* *			*		*	
	iii.	.sərn.<c>	*					*	
	iv.	.srənc.			* !				
	v.	.srə.nec.		* b		*			
☞	vi.	.sər.nec.				*			
	vii.	.sə.rə.nec.		* b		*			
8e		/srn+<e>c+i/							
	i.	<srn>.ci.	* * *					*	
	ii.	.sərn.ci.			*				
☞	iii.	.srən.ci.							
	iv.	.sər.ne.ci.				* !			*
	v.	.sə.rən.ci.		* b					
	vi.	.sər.nə.ci.		* a, b, c					

2.5.3.7. FGE-marked roots, examples 9

Ex. nº	C. nº		PARSE \non-Floaters	FILL \sonorant; closed σ	*COMPLEX \Coda	AVOID PARSE \Floaters	*ROOT FLOATER \SuffFloater	EXHAUSTP ROOT	AVOID OPENσ\ Floater
9a		/dr<ə>z^{FGE}+ost/							
	i.	<dr>.zost.	* *						
	ii.	.drə.zost.				* !			*
☞	iii.	.dər.zost.						*	
	iv.	.də.rə.zost.		* b					*
9c		/dr<ə>z^{FGE}+n+ə/							
	i.	<drz>.nə.	* *					*	
☞	ii.	.drəz.nə.				*			
	iii.	.dərz.nə.			* !			*	
	iv.	.də.rəz.nə.		* b		*			

Ex. nº	C. nº		PARSE \non-Floaters	FILL \sonorant; closed σ	*COMPLEX \Coda	AVOID PARSE \Floaters	*ROOT FLOATER \SuffFloater	EXHAUSTP ROOT	AVOID OPENσ\ Floater
9d		/dr<ə>z^{FGE}+<ə>k/							
	i.	<drzk>	* * * *					*	
	ii.	<dr>.zək.	* *					*	
	iii.	.dərz.<k>	*		*			*	
☞	iv.	.dər.zək.				*		*	
	v.	.drə.zək.				*	* !		*
	vi.	.drəzk.			*	*			
9e		/dr<ə>z^{FGE}+<ə>k+a/							
	i.	<drz>.ka.	* * *					*	
	ii.	<dr>.zə.ka.	* *			*		*	*
	iii.	.drə.zə.ka.				*			* !
☞	iv.	.drəz.ka.				*			
	v.	.dərz.ka.			*				
	vi.	.dər.zə.ka.				*			* !
3d		/gr<ə>m+<ə>k/							
	i.	<grmk>	* * * *					*	
	ii.	<gr>.mək.	* *			*		*	
	iii.	.gərm.<k>	*						
	iv.	.gər.mək.				*		* !	
☞	v.	.grə.mək.				*			*
	vi.	.grəmk.			*	*			

If we compare the OT analysis for ex. 9d — /dr<ə>z+<ə>k/ — with that for /gr<ə>m+<ə>k/ 'loud', which parallels /kr<ə>v+<e>n/, ex. 3d, we can see that the different outputs from structurally identical underlying forms are due to the fact that *ROOT FLOATER is ranked higher than AVOID OPEN σ.

(27) *ROOT FLOATER >> AVOID OPEN σ

The root /gr<ə>m/ does not obey *ROOT FLOATER, because it lacks the lexical mark FGE. Thus, candidate (v) .grə.mək., with a parsed root floater in the presence of a suffixal floater that is also parsed, does not receive a violation mark for *ROOT

FLOATER. The decisive role for selecting the optimal candidate here is played by the domination order of EXHAUSTPROOT and AVOID OPEN σ, cf. (24).
Candidate (v) for ex. 9d receives the same marks as candidate (v) for /gr<**ə**>m+<**ə**>k/; however /dr<**ə**>z/ is a lexically-marked FGE root. Therefore, the simultaneous parsing of the root and the suffixal floater in the suboptimal candidate .dr**ə**.z**ə**k. is a violation of *ROOT FLOATER. The latter violation is fatal, because *ROOT FLOATER dominates AVOID OPEN σ.

2.5.4. Conclusion

An OT analysis accounts for the Bulgarian data presented in chapter 1 by means of seven constraints and their relative ranking.
The constraints can be distributed in two groups:

Constraints that refer to syllable structure:

- PARSE, FILL, AVOID PARSE (constraints that belong to the Faithfullness family of basic syllable structure constraints)
- *COMPLEX\Cod
- AVOID OPEN σ\Floater

Constraints that regard floating vowels:

- AVOID PARSE
- EXHAUSTPROOT (with additional reference to morpheme structure)
- *ROOT FLOATER (with additional reference to both morpheme structure and lexical marks)
- AVOID OPEN σ \Floater.

Some of the constraints, namely AVOID PARSE and AVOID OPEN σ \Floater, are found in both groups.

The underlying representaions of the OT analysis are built on the same assumptions as those of the Harmonic Phonology (HP) account for ghost vowels in Bulgarian. The FGE lexical mark on a subset of metathetic roots and on the suffix -EC as needed in both treatments.
The ordering of rules in the HP analysis follows from the relation between rules and constraints on syllabification that characterize specific levels. Thus, the Rule of Floater Anchoring affects floaters that are followed by consonants remaining unsyllabified after M-level syllabification has applied, while the rule of Schwa

Epenthesis is triggered by consonants that are still left unsyllabified after W-level syllabification has applied. Consequently, the rule conditioned by M-level syllabification (Floater Anchoring) takes precedence over the rule associated with W-level syllabification (ə-Epenthesis).

By contrast, the ranking of constraints, established by eliminating all rankings that do not select the right output as optimal candidate, is rather arbitrary. Moreover, the two conflicting constraints AVOID PARSE and EXHAUSTPROOT, see (23), require exactly the opposite as far as floaters of the root are concerned: AVOID PARSE requires them to remain unparsed, whereas EXHAUSTPROOT necessitates their parsing. The definition of the former as a binary constraint (the number of parsed floaters being irrelevant) is also motivated solely by the necessity to achieve the correct outputs.