

THE GAMMA PATTERN IN PORTUGUESE VERBAL INFLECTION

O PADRÃO GAMA NA FLEXÃO VERBAL DO PORTUGUÊS

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RESUMO: Este artigo procura desenvolver uma análise unificada de dois tipos de alternância de raiz no paradigma do tempo presente dos verbos do português. Um tipo possivelmente envolve um traço flutuante de altura, que afeta a vogal da raiz; o outro é uma instância de supleção. No entanto, os dois tipos de alternância seguem exatamente o mesmo padrão por todo o paradigma do presente. Princípios básicos da Nanossintaxe são evocados para explicar esse quadro.

PALAVRAS-CHAVE: Padrões de alomorfia de raiz; Traços fonológicos flutuantes; Lexicalização sintagmática; Nanossintaxe.

ABSTRACT: This paper attempts to develop a unified analysis of two types of root alternation in the present tense of Portuguese verbs. One type arguably involves a floating height feature affecting the root vowel. The other one is an instance of suppletion. But the two types of alternation trace exactly the same pattern through the present tense paradigm. Basic principles of Nanosyntax are invoked to account for this.

KEYWORDS: Root allomorphy patterns; Floating phonological features; Phrasal lexicalization; Nanosyntax

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1. OVERVIEW

Portuguese verbs with the theme vowel *e* or *i* display a special pattern of syncretism in the present tense²:

(1)

Subjunctive	Indicative	Subjunctive	Indicative
<i>peç-a</i>	<i>peç-o</i>	<i>poss-a</i>	<i>poss-o</i>
<i>peç-a-s</i>	<i>ped-e-s</i>	<i>poss-a-s</i>	<i>pod-e-s</i>
<i>peç-a</i>	<i>ped-e</i>	<i>poss-a</i>	<i>pod-e</i>
<i>peç-a-mos</i>	<i>ped-i-mos</i>	<i>poss-a-mos</i>	<i>pod-e-mos</i>
<i>peç-a-is</i>	<i>ped-i-s</i>	<i>poss-a-is</i>	<i>pod-e-is</i>
<i>peç-a-m</i>	<i>ped-e-m</i>	<i>poss-a-m</i>	<i>pod-e-m</i>

The shape of the pattern followed by the roots in red is reminiscent of the Greek letter Γ . I will refer to it as the gamma pattern³. Below, I first lay out my theoretical commitments. Then, I present the data illustrating two different instantiations of the gamma pattern and proceed to developing an account of how the pattern arises.

2 BASIC PRINCIPLES OF NANOSYNTAX

The following are the ingredients of Nanosyntax that will be relevant to the account of the gamma pattern to be presented in section 5.⁴

2.1 PHRASAL LEXICALIZATION AND LEXICAL ENTRIES

Unlike other approaches to morpho-syntax, Nanosyntax holds that only phrasal constituents, i.e. XPs, can be targeted by lexical insertion. Each of the terminals is a single syntactic feature.

² The paradigms in this paper are given the way they appear in European Portuguese according to native speakers and textbooks. The corresponding paradigms of Brazilian Portuguese would lack the 2sg and the 2pl forms, and the 1pl form would apparently be more marginal in colloquial usage.

³ It has also been dubbed the L Pattern (Maiden 2005).

⁴ For a more comprehensive introduction to Nanosyntax, see Baunaz et al (2018).

Correspondingly, a lexical entry associates a phonological representation with a syntactic tree:

$$(2) A \leftrightarrow [_{XP} X [_{YP} Y [_{ZP} Z]]]$$

The Superset Principle allows A to lexicalize any phrasal constituent identical to a subtree of the syntactic structure the lexical entry associates it with:

$$(3) \quad \begin{array}{l} a [_{XP} X [_{YP} Y [_{ZP} Z]]] = A \\ b [_{YP} Y [_{ZP} Z]] = A \\ c [_{ZP} Z] = A \end{array}$$

Notice that every subtree will contain the lowest terminal in the larger structure, e.g. Z in (3a). We will call this element the foot of the lexical item. Two morphemes may compete. For example, both the A in (2) and the B in (4) can lexicalize the structures in (3)b-c as far as the Superset Principle is concerned:

$$(4) B \leftrightarrow [_{YP} Y [_{ZP} Z]]$$

The outcome of the competition is determined by the Elsewhere Principle: When two lexical items A and B compete, and the structure associated with B is a proper substructure of the structure associated with A, B wins:

$$(5) \quad \begin{array}{l} a [_{XP} X [_{YP} Y [_{ZP} Z]]] = A \\ b [_{YP} Y [_{ZP} Z]] = B \\ c [_{ZP} Z] = B \end{array}$$

Every constituent of a tree built by the syntax must be lexicalized. Notice, however, that this does not mean that a syntactic structure is obliterated by the morpheme lexicalizing it. Rather, the address of the morpheme in the lexicon is associated with the root node, i.e. the unique node dominating everything else in the structure, while the syntactic structure itself remains visible throughout the

derivation. Bearing this point is crucial to the understanding of the derivations of morphological forms.

2.2 DERIVATIONS

Lexicalization goes hand in hand with structure building by Merge. As soon as a new phrase is built, it must be lexicalized. This will sometimes require recourse to “rescue operations”. Suppose we have just built the structure in (6) by merging Y with ZP previously lexicalized by some C:⁵

$$(6) [_{YP} Y [_{ZP} Z]] = [_{YP} Y [_{ZP} C]]$$

The newly built YP will be lexicalized as a whole by C, if the lexicon contains the lexical entry in (7) so that C “extends to Y”:

$$(7) C \leftrightarrow [_{YP} Y [_{ZP} Z]]$$

In this case, no rescue operation is called for. If the lexicon does not contain any lexical entry linking a morpheme to a superstructure of $[_{YP} Y [_{ZP} Z]]$, but does contain the entry in (8),

$$(8) D \leftrightarrow [_{YP} Y]$$

the Y in (6) can only be lexicalized, if the ZP moves across it to become the specifier of YP:

$$(9) [_{YP} Y [_{ZP} C]] \rightarrow [_{YP} [_{ZP} C] [_{YP} Y]] = [_{YP} [_{ZP} C] [_{YP} D]]$$

$[_{YP} Y]$ is not a subtree of the structure in (6), but it is a subtree of the structure derived by movement assuming that “rescue movement” does not leave a trace behind.⁶

Suppose now that we merge X onto the structure derived in (9):

⁵ $[_{ZP} C]$ is shorthand for $[_{ZP} Z]$ with the address of C associated with ZP.

⁶ There can be no entry $D \leftrightarrow Y$, since lexicalization only target phrasal constituents.

$$(10) \text{ } [_{XP} X [_{YP} [_{ZP} C] [_{YP} D]]]$$

If there is no lexical item able to lexicalize the whole XP, there are two possible rescue operations. If D has the entry in (11) rather than the entry in (8),

$$(11) D \leftrightarrow [_{XP} X [_{YP} Y]]$$

we obtain a structure in which X can be lexicalized by moving ZP, the specifier of the complement of X, across X:

$$(12) [_{XP} X [_{YP} [_{ZP} C] [_{YP} D]]] \rightarrow [_{XP} [_{ZP} C] [_{XP} X [_{YP} D]]] = [_{XP} [_{ZP} C] [_{XP} D]]$$

In this case, D “extends to X”. If D has the entry in (8), but there is a lexical entry like (13),

$$(13) E \leftrightarrow [_{XP} X]$$

the whole complement of X must move:

$$(14) [_{XP} X [_{YP} [_{ZP} C] [_{YP} D]]] \rightarrow [_{XP} [_{YP} [_{ZP} C] [_{YP} D]] [_{XP} X]] = [_{XP} [_{YP} [_{ZP} C] [_{YP} D]] [_{XP} E]]$$

It is generally assumed that moving the specifier of the complement of the newly merged feature is less costly than moving the whole complement (“move as little as possible”). Thus, we have a ranking:

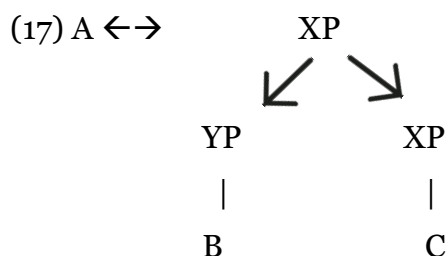
- (15) a When a new feature X has been merged, try to lexicalize the whole resulting structure as it is
- b If that fails, try moving the specifier of the complement of X
- c If that fails, try moving the whole complement of X

There will be cases in which none of the options in (15) is successful, then, the derivation backtracks to try an alternative to a choice made at an earlier stage. The full ranked list is as in (16):⁷

- (16) a When a new feature X has been merged, try to lexicalize the whole resulting structure as it is
 b If that fails, try moving the specifier of the complement of X
 c If that fails, try moving the whole complement of X
 d If that fails, backtrack

2.3 POINTERS

Since lexicalization applies cyclically, the ingredients of the complement of a newly merged X were already lexicalized when X was merged. This opens up for the possibility that a lexical entry makes reference to the specific lexical items that have lexicalized the complement of X. This reference is encoded as pointers from the root node of XP to the addresses of the lexical items chosen to lexicalize its daughters.



Lexical entries of this kind will make their appearance in section 5.3.

2.4 THE RULES OF THE GAME

To play by the rules, we need to build analyses such that the correct paradigms fall out entirely from the general principles just sketched and the inventory of lexical entries. Nanosyntax has no room for context-sensitive lexical insertion, readjustment

⁷ Another option is to form a specifier/complex left branch in a separate workspace. This will not be made use of in this paper.

rule, impoverishment, fission, merger or any of the other mechanisms routinely employed in other frameworks.

3. TWO DIFFERENT INSTANTIATIONS OF THE SUBJUNCTIVE/INDICATIVE GAMMA PATTERN

3.1 THE THEME VOWELS

In the present tense, we see three distinct theme vowels in the indicative:⁸

(18)

<i>tom-a-r</i> ‘take’	<i>vend-e-r</i> ‘sell’	<i>part-i-r</i> ‘leave, break’
<i>tom-o</i>	<i>vend-o</i>	<i>part-o</i>
<i>tom-a-s</i>	<i>vend-e-s</i>	<i>part-e-s</i>
<i>tom-a</i>	<i>vend-e</i>	<i>part-e</i>
<i>tom-a-mos</i>	<i>vend-e-mos</i>	<i>part-i-mos</i>
<i>tom-a-is</i>	<i>vend-e-is</i>	<i>part-i-is</i>
<i>tom-a-m</i>	<i>vend-e-m</i>	<i>part-e-m</i>

I assume that the choice of theme vowel is determined by the size of the root. The theme vowels have different feet in the structural layer above the starting point of the root. So, verbs with the theme vowel X have roots that lexicalize everything up to the foot F_X of X:

- (19) a structure = [... [F_X [Y ... [V]]]]
 b $X \leftrightarrow$ [... [F_X]]
 c X-root \leftrightarrow [Y ... [V]]

Verbs with other theme vowels have bigger or smaller roots. Notice that *i*-verbs like *part-i-r* have the same theme vowel -e- as *e*-verbs in the 2sg and 3sg/pl. This implies that the foot of *e* is lower than the foot of *i*, since roots can shrink, but not grow. By the Superset Principle, the *i*-root in (20)b can lexicalize just the

⁸ The forms appear in the paradigm in the order 1sg-2sg-3sg-1pl-2pl-3pl.

complement of E, the foot of *e*, in (20)a, but the *e*-root in (20)c cannot lexicalize the complement of I, the foot of *i*:

- (20) a [... [I [E [V]]]]
 b *i*-root = [E [V]]
 c *e*-root = [V]

This correctly predicts that no verb with *e* in the infinitive replaces *e* with *i* in the present tense paradigm.

I'll take it that the shift from *i* to *e* in the 2sg and the 3sg/pl of *i*-verbs is driven by a feature W in the 2sg and the 3sg/pl which can be lexicalized by *e*, but not by *i*:

- (21) a the 2sg and the 3sg/pl = [... [W [X [I [E [V]]]]]]
 b $i \leftrightarrow [X [I]]$
 c $e \leftrightarrow [W [X [I [E]]]]$

The derivation of a form like *part-e-s* starts out with the *i*-root *part* lexicalizing as much as it can, i.e. everything up to I:

- (22) $[_{EP} E [_{VP} part]] = [_{EP} part] \rightarrow [_{IP} I [_{EP} part]] \rightarrow [_{IP} [_{EP} part]] [_{IP} I]] =$
 $[_{IP} [_{EP} part]] [_{IP} i]]$

Then, *i* lexicalizes X:

- (23) $[_{XP} X [_{IP} [_{EP} part]] [_{IP} i]]] \rightarrow [_{XP} [_{EP} part]] [_{XP} X [_{IP} i]]] = [_{XP} [_{EP} part]] [_{XP} i]]$

Since *i* does not extend to W, the derivation backtracks when W is merged:

- (24) $[_{WP} W [_{XP} [_{EP} part]] [_{XP} i]]] \rightarrow \text{backtracking} \rightarrow [_{EP} E [_{VP} part]] \rightarrow$
 $[_{EP} [_{VP} part]] [_{EP} E]] =$
 $[_{EP} [_{VP} part]] [_{EP} e]]$

Then, *e* will extend all the way up to W.

Like *e*, the theme vowel *a* must be able to lexicalize W, since *a* occurs in the 2sg and the 3sg/pl. I will assume that *a* has its foot above the foot of *i*, e.g. X = A, the foot of *a*:⁹

- (25) a the 2sg and the 3sg/pl = [... [W [A [I [E [V]]]]]]
 b $a \leftrightarrow [W [A]]$
 c $a\text{-root} \leftrightarrow [I [E [V]]]$

Notice also that there is no theme vowel in the forms with the 1sg ending -*o*. Likewise, the indicative theme vowels do not co-occur with the subjunctive theme vowels:

(26)

<i>tom-a-r</i>	<i>vend-e-r</i>	<i>part-i-r</i>
<i>tom-e</i>	<i>vend-a</i>	<i>part-a</i>
<i>tom-e-s</i>	<i>vend-a-s</i>	<i>part-a-s</i>
<i>tom-e</i>	<i>vend-a</i>	<i>part-a</i>
<i>tom-e-mos</i>	<i>vend-a-mos</i>	<i>part-a-mos</i>
<i>tom-e-is</i>	<i>vend-a-is</i>	<i>part-a-is</i>
<i>tom-e-m</i>	<i>vend-a-m</i>	<i>part-a-m</i>

Like the *a* occurring in the indicative, the *a* seen in the subjunctive forms of *e*-verbs and *i*-verbs must be capable of lexicalizing the W in the 2sg and the 3sg/pl, and a reasonable hypothesis is that it has exactly the same lexical entry as the indicative *a*:

- (27) the subjunctive $a \leftrightarrow [W [A]]$

Yet, *e*-roots and *i*-roots cannot turn into *a*-roots in the subjunctive. This fact will provide one of the basic elements in the line of analysis initiated in section 4.

⁹ This assumption raises a serious question that I will not attempt to answer here: Why does an *i*-root have to shrink all the way down to E as in (24), if *a* can lexicalize W and is footed above E?

Finally, only *i*-verbs and *e*-verbs give rise to instances of the gamma Pattern. This too plays an important role in the analysis developed in sections 4 and 5.

3.2 TWO DIFFERENT ROOTS

As we saw in section 1, some *i*-verbs and *e*-verbs exhibit a gamma pattern with two roots such that the difference between them cannot easily be attributed to any productive phonological process:

(28)

<i>pedir</i>		<i>poder</i>	
<i>peç-o</i>	<i>peç-a</i>	<i>poss-o</i>	<i>poss-a</i>
<i>ped-e-s</i>	<i>peç-a-s</i>	<i>pod-e-s</i>	<i>poss-a-s</i>
<i>ped-e</i>	<i>peç-a</i>	<i>pod-e</i>	<i>poss-a</i>
<i>ped-i-mos</i>	<i>peç-a-mos</i>	<i>pod-e-mos</i>	<i>poss-a-mos</i>
<i>ped-i-s</i>	<i>peç-a-is</i>	<i>pod-e-is</i>	<i>poss-a-is</i>
<i>ped-e-m</i>	<i>peç-a-m</i>	<i>pod-e-m</i>	<i>poss-a-m</i>

The roots *meç/med* and *oiç/ouv* alternate in the same fashion as *peç/ped* in the paradigms of *med-i-r* ‘measure’ and *ouv-i-r* ‘hear’. The roots *faç/faz,caib/cab, perc/perd* alternate like *poss/pod* in the paradigms of *faz-e-r* ‘do, make’, *cab-e-r* ‘fit into’ and *perd-e-r* ‘lose’.

I will take this type of gamma pattern to involve two roots each with its own lexical entry alternating in accordance with principles sketched in section 2.

3.3 THE HEIGHT ALTERNATION

The other type of gamma pattern involve an alternation between roots the relation between which can be characterized by a simple phonological statement.

There are three degrees of height in Portuguese: high – mid – low:¹⁰

¹⁰ The correspondence with standard IPA terminology:
 high =close
 mid = close-mid
 low = open-mid

- (29) a *i – e – ε* (front)
 b *u – o – ɔ* (back)

In the present indicative forms, stressed *e* and *o* in the root are generally low, but not in the 1sg of *e*-verbs and *i*-verbs:¹¹

(30)

<i>dev-e-r</i>	<i>mov-e-r</i>	<i>serv-i-r</i>	<i>dorm-i-r</i>	
<i>dev-o</i>	<i>mov-o</i>	<i>serv-o</i>	<i>durm-o</i>	<i>e = /e/, o = /o/</i>
<i>dev-e-s</i>	<i>mov-e-s</i>	<i>serv-e-s</i>	<i>dorm-e-s</i>	<i>e = /ε/, o = /ɔ/</i>
<i>dev-e</i>	<i>mov-e</i>	<i>serv-e</i>	<i>dorm-e</i>	<i>e = /ε/, o = /ɔ/</i>
<i>dev-e-mos</i>	<i>mov-e-mos</i>	<i>serv-i-mos</i>	<i>dorm-i-mos</i>	
<i>dev-e-is</i>	<i>mov-e-is</i>	<i>serv-is</i>	<i>dorm-is</i>	
<i>dev-e-m</i>	<i>mov-e-m</i>	<i>serv-e-m</i>	<i>dorm-e-m</i>	<i>e = /ε/, o = /ɔ/</i>

With *a*-verbs, *e* and *o* are also low in the 1sg indicative:

(31)

<i>lev-o</i>	<i>cort-o</i>	<i>e = /ε/, o = /ɔ/</i>
<i>lev-a-s</i>	<i>cort-a-s</i>	<i>e = /ε/, o = /ɔ/</i>
<i>lev-a</i>	<i>cort-a</i>	<i>e = /ε/, o = /ɔ/</i>
<i>lev-a-mos</i>	<i>cort-a-mos</i>	
<i>lev-a-is</i>	<i>cort-a-is</i>	
<i>lev-a-m</i>	<i>cort-a-m</i>	<i>e = /ε/, o = /ɔ/</i>

So:

- (32) a In the 1sg of the indicative of *e*-verbs, stressed *e* and *o* in the root are mid.

¹¹ Notice that the theme vowel *e* is mid when stressed as in *dev-e-mos*. Unstressed *e* and *o* are generally schwa and [u] in European Portuguese.

b In the 1sg of the indicative of *i*-verbs, stressed *e* and *o* in the root are high, i.e. replaced by *i* and *u*.

Clearly, this is not a phonological effect caused by the -*o*:

- (33) a The root vowel is affected differently in *e*-verbs and *i*-verbs.
b The 1sg -*o* has no effect on the root vowel of *a*-verbs.

In all the subjunctive forms of *a*-verbs, stressed *e* and *o* are still low:

(34)

<i>lev-e</i>	<i>cort-e</i>	<i>e</i> = / ε /, <i>o</i> = / \mathfrak{c} /
<i>lev-e-s</i>	<i>cort-e-s</i>	<i>e</i> = / ε /, <i>o</i> = / \mathfrak{c} /
<i>lev-e</i>	<i>cort-e</i>	<i>e</i> = / ε /, <i>o</i> = / \mathfrak{c} /
<i>lev-e-mos</i>	<i>cort-e-mos</i>	
<i>lev-e-is</i>	<i>cort-e-is</i>	
<i>lev-e-m</i>	<i>cort-e-m</i>	<i>e</i> = / ε /, <i>o</i> = / \mathfrak{c} /

But:

- (35) a In the subjunctive forms of *e*-verbs, stressed *e* and *o* in the root are mid throughout:

<i>dev-a</i>	<i>mov-a</i>	<i>e</i> = / e /, <i>o</i> = / o /
<i>dev-a-s</i>	<i>mov-a-s</i>	<i>e</i> = / e /, <i>o</i> = / o /
<i>dev-a</i>	<i>mov-a</i>	<i>e</i> = / e /, <i>o</i> = / o /
<i>dev-a-mos</i>	<i>mov-a-mos</i>	
<i>dev-a-is</i>	<i>mov-a-is</i>	
<i>dev-a-m</i>	<i>mov-a-m</i>	<i>e</i> = / e /, <i>o</i> = / o /

b In the subjunctive forms of *i*-verbs, *e* and *o* are replaced by *i* and *u* throughout:

<i>sirv-a</i>	<i>durm-a</i>
<i>sirv-a-s</i>	<i>durm-a-s</i>
<i>sirv-a</i>	<i>durm-a</i>
<i>sirv-a-mos</i>	<i>durm-a-mos</i>
<i>sirv-a-is</i>	<i>durm-a-is</i>
<i>sirv-a-m</i>	<i>durm-a-m</i>

This cannot merely be a phonological effect caused by the following theme vowel *a*:

- (36) a The root vowel is affected differently in *e*-verbs and *i*-verbs although both have the subjunctive theme vowel *a*.
b The indicative theme vowel *a* of *a*-verbs has no such effect on the root vowel.

Notice that the height alternation applies to all *i*-verbs and *e*-verbs with *e* or *o* in the root except for those that have a special root like *peç* and *poss*. Stressed *peç* and *poss* have low *e* and *o* even though they occur in the 1sg indicative and in the subjunctive forms.¹²

3.4 THE *PEÇ/PED* ALTERNATION AND THE HEIGHT ALTERNATION IN THE ROOT VOWEL

The height alternation just described follows the same gamma pattern as the *peç/ped* alternation:

(37)

¹² Val Rammé and Thayse Letícia Ferreira tell me that the root *perc* in the 1sg *perco* and in the subjunctive forms *perca* etc. of the verb *perder* ‘lose’ have a close-mid *e* in their Brazilian Portuguese, unlike *peç* and *poss*. I don’t know how to account for this. In European Portuguese, stressed *perc* has a low *e*.

The height alternation:		The <i>peç/ped</i> alternation:	
indicative:	subjunctive:	indicative:	subjunctive:
1 [mid/high]-o	[mid/high]-a	<i>peç-o</i>	<i>peç-a</i>
2 [low] -e-s	[mid/high]-a-s	<i>ped-e-s</i>	<i>peç-a-s</i>
3 [low] -e	[mid/high]-a	<i>ped-e</i>	<i>peç-a</i>
1 [low]-e/i-mos	[mid/high]-a-mos	<i>ped-i-mos</i>	<i>peç-a-mos</i>
2 [low]-e/i-is	[mid/high]-a-is	<i>ped-i-is</i>	<i>peç-a-is</i>
3 [low]-e-m	[mid/high]-a-m	<i>ped-e-m</i>	<i>peç-a-m</i>

The fact that stressed *peç* and *poss* have low-mid *e* and *o* rather than *i* as in *sint-o* and *sint-a*, *sint-as* etc. and close-mid *o* as in *mov-o* and *mov-a*, *mov-a-s* etc. suggests that the raising of the root vowel reflects the presence of a special piece of structure, and that special roots like *peç*, *poss*, *oiç/ouç* lexicalize this piece of structure.¹³

4. THE BASIC INTUITION

As a prelude to a formal implementation, I begin by presenting the intuitions that will guide it.

4.1 THE *PEÇ/PED* ALTERNATION

Since I am taking alternating roots like *peç* and *ped* to correspond to different lexical entries, the principles adopted in section 2.1. lead to the assumption that the 1sg indicative and the subjunctive forms must be the only ones in the present tense paradigm with a piece of structure that only *peç* can lexicalize. This assumption will allow us to relate the *peç/ped* alternation to the height alternation.

4.2 THE HEIGHT ALTERNATION

¹³ The *e* is also low in *quer-o*, the 1sg form of *querer* ‘want’, although *quer*, unlike *peç* and *poss*, occurs in all the forms of the present indicative. The subjunctive forms have a different root, *queir*. It is as yet not clear how this can be fitted into the account proposed in this paper.

Here is the difference between *e*-verbs and *i*-verbs with respect to the vowel alternation in the root in the present tense:

- (38) a In *e*-verbs, stressed *e* and *o* in the root are mid in the 1sg indicative and in the subjunctive, but low elsewhere
 b In *i*-verbs, *e* and *o* in the root become *i* and *u* in the 1sg indicative and in the subjunctive, but are low *e* and *o* elsewhere

This seems to reflect a difference between the indicative theme vowels of the two verb classes:

- (39) a In *e*-verbs, the indicative theme vowel is a mid *e* (when stressed)
 b In *i*-verbs, the indicative theme vowel is *i* (a high vowel)

That is, the root vowel seems to inherit the height of the indicative theme vowel, but only in those forms where the indicative theme vowel doesn't actually appear, i.e. in the 1sg indicative and in the subjunctive forms.

In Latin, both the 1sg *-o* and the subjunctive *-a-* come on top of the indicative theme vowels *-e-* and *-i-*:¹⁴

(40)

a <i>tim-e-re</i> 'fear'		b <i>aud-i-re</i> 'hear'	
indicative:	subjunctive:	indicative:	subjunctive:
<i>tim-e-o</i>	<i>tim-e-a-m</i>	<i>aud-i-o</i>	<i>aud-i-a-m</i>
<i>tim-e-s</i>	<i>tim-e-a-s</i>	<i>aud-i-s</i>	<i>aud-i-a-s</i>
<i>tim-e-t</i>	<i>tim-e-a-t</i>	<i>aud-i-t</i>	<i>aud-i-a-t</i>
<i>tim-e-mus</i>	<i>tim-e-a-mus</i>	<i>aud-i-mus</i>	<i>aud-i-a-mus</i>
<i>tim-e-tis</i>	<i>tim-e-a-tis</i>	<i>aud-i-tis</i>	<i>aud-i-a-tis</i>
<i>tim-e-nt</i>	<i>tim-e-a-nt</i>	<i>aud-i-unt</i>	<i>aud-i-a-nt</i>

The pattern formed by the prevocalic theme vowels is the Gamma Pattern.

¹⁴ Unlike *i* and *e*, the theme vowel *a* never combines with 1sg *o* and the subjunctive *e* in Latin: **am-a-o*, **am-a-e-m* vs, *am-o*, *am-e-m*

We might assume that Portuguese is underlyingly similar, but doesn't allow the indicative theme vowel to surface in front of another vowel:¹⁵¹⁶

(41)

a <i>tem-e-r</i> 'fear'		b <i>sent-i-r</i> 'feel, hear'	
indicative:	subjunctive:	indicative:	subjunctive: ¹⁷
<i>tem-e-o</i>	<i>tem-e-a</i>	<i>sent-i-o</i>	<i>sent-i-a</i>
<i>tem-e-s</i>	<i>tem-e-a-s</i>	<i>sent-e-s</i>	<i>sent-i-a-s</i>
<i>tem-e</i>	<i>tem-e-a</i>	<i>sent-e</i>	<i>sent-i-a</i>
<i>tem-e-mos</i>	<i>tem-e-a-mos</i>	<i>sent-i-mos</i>	<i>sent-i-a-mos</i>
<i>tem-e-is</i>	<i>tem-e-a-is</i>	<i>sent-is</i>	<i>sent-i-a-is</i>
<i>tem-e-m</i>	<i>tem-e-a-m</i>	<i>sent-e-m</i>	<i>sent-i-a-m</i>

Then, the gamma-shaped pattern of the height alternation would follow:

- (42) a The -o and the subjunctive theme vowel "push the indicative theme vowel into the root"
- b The root vowel is affected by the height feature of the indicative theme vowel only when this happens.

We might, for example, think of this in terms of a phonological process erasing the first of two consecutive V-nodes. In the 1sg and in the subjunctive forms, the first V-node holds the theme vowel which floats onto the root vowel when its V-node is erased:

(43) [[[*sent*] [*i*]] [*o/a*]] [[[*tem*] [*e*]] [*o/a*]]

/ / / /

V V V V

→

¹⁵ But as witnessed by forms like *sério* and *séria*, the masculine and the feminine form of an adjective, there is no general ban on sequences of two unstressed vowels. I return to this issue in section 5.2.

¹⁶ As in Latin, I assume that the theme vowel *a* never co-occurs with the 1sg *o* and the subjunctive *e*. This will ultimately explain why no *a*-verb shows a root alternation similar to the *peç/ped* alternation.

¹⁷ If, as proposed in section 3.1., *a* lexicalizes the feature W that makes *i* shift to *e* in the 2sg and the 3sg/pl of the indicative, *i* does not shift to *e* in the subjunctive of *i*-verbs.

[[[<i>sent</i>] [<i>i</i>] [<i>o/a</i>]]	[[[<i>tem</i>] [<i>e</i>] [<i>o/a</i>]]
/	/
V	V

Of course, this leaves a number of questions open. In particular, why does only the height feature of the theme vowel end up on the root vowel? I will return to this issue in section 5.2.

Another issue is why an *a* in an *i*-root or an *e*-root does not seem to be affected, although [close] could conceivably take *a* to *i* and [close-mid] could take it to *e*. Likewise, [close-mid] could take *i* and *u* in an *e*-root to *e* and *o*. This issue will be put aside in the hope that the literature on neutral vowels under vowel harmony will eventually provide a clue.

The proposal just made is similar to the analysis proposed by Harris (1974) which is also based on the assumption that the theme vowels *e* and *i* occur between the root and the 1sg *o* and the subjunctive *a*.¹⁸ But Harris attributes the height alternation to vowel harmony induced by the theme vowel, which is subsequently truncated. Unlike my analysis, this raises the question why the theme vowel induces harmony only in the environments where it is going to be truncated.¹⁹ Also, Harris's analysis doesn't seem to explain why vowel harmony doesn't also affect special roots like *peç* and *poss*, while the analysis to be developed here will predict this.

4.3 THE LINK BETWEEN THE HEIGHT ALTERNATION AND THE *PEÇ/PED* ALTERNATION

We are led to the assumption that the 1sg indicative and the subjunctive forms must be the only ones in the present tense paradigm with a piece of structure that only *peç* can lexicalize. We have also noted that the vowel in special roots like *peç* is not affected by the height alternation, but remains open-mid like other stressed root vowels. We can now capture this fact by saying that special roots lexicalize the indicative theme vowel in the 1sg and in the subjunctive forms.

¹⁸ I am indebted to an anonymous reviewer for making me aware of Harris (1974) and Wetzels (1995).
¹⁹ Wetzels (1995:5.1) characterizes this as a serious problem with Harris's analysis and proposes a way of eliminating it which is quite similar to what is proposed in this paper.

For this reason, the *peç/ped* alternation and the height alternation follow the same gamma pattern. This is the most important result of the analysis we are pursuing in this article.

5 AN IMPLEMENTATION

We are now ready to present a more precise implementation of the analysis proposed in the preceding section .

5.1 THE GENERAL IDEA

In section 3.1., we suggested that the *a* appearing in the subjunctive forms of *e*-verbs and *i*-verbs has the same lexical entry as the *a* in the indicative forms of *a*-verbs:

(44)

<i>vend-e-r</i>	<i>part-i-r</i>
<i>vend-a</i>	<i>part-a</i>
<i>vend-a-s</i>	<i>part-a-s</i>
<i>vend-a</i>	<i>part-a</i>
<i>vend-a-mos</i>	<i>part-a-mos</i>
<i>vend-a-is</i>	<i>part-a-is</i>
<i>vend-a-m</i>	<i>part-a-m</i>

(45) the subjunctive *a* \leftrightarrow [W [A]]

Yet, *e*-roots and *i*-roots remain *e*-roots and *i*-roots in the subjunctive. Given the structure

(46) [... [A [I [E [V]]]]]

we have

- (47) a $i\text{-root} \leftrightarrow [E [V]]$
 b $e\text{-root} \leftrightarrow [V]$

but

- (48) $a\text{-root} \leftrightarrow [I [E [V]]]$

This provides an important cue for the formal account of the gamma pattern. When *a* appears on an *i*-root or an *e*-root in the subjunctive, *i* or *e* will be introduced before *A* is merged. The derivation in (49) of the 2sg subjunctive of an *i*-verb illustrates this:²⁰

- (49) $[IP\ I\ [EP\ part]] \rightarrow [IP[EP\ part][IP\ I]] = [IP[EP\ part][IP\ i]] \rightarrow$
 $[AP\ A\ [IP[EP\ part][IP\ i]]] \rightarrow$
 $[AP[IP[EP\ part][IP\ i]][AP\ A]] = [AP[IP[EP\ part][IP\ i]][AP\ a]] \rightarrow \dots$

With an *e*-root, we will have:

- (50) $[EP\ E\ [VP\ vend]] \rightarrow [EP[VP\ vend][EP\ E]] = [EP[VP\ vend][EP\ e]] \rightarrow$
 $[IP\ I\ [EP[VP\ vend][EP\ e]]] \rightarrow [IP[VP\ vend][IP\ I\ [EP\ e]]] =$
 $[IP[VP\ vend][IP\ e]] \rightarrow$
 $[AP\ A\ [IP[VP\ vend][IP\ e]]] \rightarrow [AP[IP[VP\ vend][IP\ e]][AP\ A]] =$
 $[AP[IP[VP\ vend][IP\ e]][AP\ a]] \rightarrow \dots$

Thus, the indicative theme vowels *e* and *i* will appear between the root and *a* in the subjunctive forms of *e*-verbs and *i*-verbs just as in Latin. As suggested in section 4.2., *e* and *i* are then “pushed into the root” in Portuguese.

In Latin, the 1sg *o* of the indicative co-occurs with *i* and *e*, but not with *a*:

- (51) *tim-e-o* *aud-i-o* *am-o*/**am-a-o*

²⁰ You may wonder why *A* is lexicalized by *a* rather than *i/e* in the subjunctive forms. An answer will be suggested in section 7.1.

This follows if *o* has the same foot as *a* so that *o* completely overwrites *a* in structures that include the 1sg features, e.g. [1]:

$$(52) o \leftrightarrow [1 \dots [A]]$$

Taking Portuguese to be similar, the derivation of the 1sg of an *a*-verb will run as follows:

$$(53) \quad [AP A [IP cant]] \rightarrow [AP [IP cant] [AP A]] = [AP [IP cant] [AP a]] \rightarrow \\ [1P 1 [AP [IP cant] [AP a]]] \rightarrow [1P [IP cant] [1P 1 [AP a]]] = [1P [IP cant] [1P o]]$$

Then, the theme vowels *i* and *e* will be introduced before *o* is introduced for exactly the same reason that *i* and *e* are introduced before *a* in the derivation of the subjunctive forms of *i*-verbs and *e*-verbs:²¹

$$(54) \quad [IP I [EP part]] \rightarrow [IP [EP part] [IP I]] = [IP [EP part] [IP i]] \rightarrow \\ [AP A [IP [EP part] [IP i]]] \rightarrow \\ [AP [EP part] [AP A [IP i]]] = [AP [EP part] [AP i]] \rightarrow [1P 1 [AP [EP part] [AP i]]] \rightarrow \\ \text{backtracking} \rightarrow [AP A [IP [EP part] [IP i]]] \rightarrow [AP [IP [EP part] [IP i]] [AP A]] = \\ [AP [IP [EP part] [IP i]] [AP a]] \rightarrow [1P 1 [AP [IP [EP part] [IP i]] [AP a]]] \rightarrow \\ [1P [IP [EP part] [IP i]] [1P 1 [AP a]]] = [1P [IP [EP part] [IP i]] [1P o]]$$

$$(55) \quad [EP E [VP vend]] \rightarrow [EP [VP vend] [EP E]] = [EP [VP vend] [EP e]] \rightarrow \\ [IP I [EP [VP vend] [EP e]]] \rightarrow [IP [VP vend] [IP I [EP e]]] = \\ [IP [VP vend] [IP e]] \rightarrow [AP A [IP [VP vend] [IP e]]] \rightarrow \\ [AP [VP vend] [AP A [IP e]]] = [AP [VP vend] [AP e]] \rightarrow \\ [1P 1 [AP [VP vend] [AP e]]] \rightarrow \\ \text{backtracking} \rightarrow [AP A [IP [VP vend] [IP e]]] \rightarrow \\ [AP [IP [VP vend] [IP e]] [AP A]] = \\ [AP [IP [VP vend] [IP e]] [AP a]] \rightarrow [1P 1 [AP [IP [VP vend] [IP e]] [AP a]]] \rightarrow \\ [1P [IP [VP vend] [IP e]] [1P 1 [AP a]]] = [1P [IP [VP vend] [IP e]] [1P o]]$$

²¹ The derivation backtracks when 1 is merged because only *o* can lexicalize 1 and the foot of *o* is A.

Therefore, *e* and *i* will appear between the root and *o* in the 1sg indicative form of *e*-verbs and *i*-verbs as in Latin, and again, I will assume that *e* and *i* are “pushed into the root” in Portuguese.

The gamma pattern of height alternation falls out from these proposals about *o* and *a*.

5.2 “PUSHED INTO THE ROOT”

In section 4.2., I proposed that the indicative theme vowel between the root and the 1sg *o* or the subjunctive *a* is “pushed into the root” because of a ban on two consecutive unstressed V-nodes. In terms of the analysis suggested in section 4.2, this means that the first of the two V-nodes in

$$(56) \begin{array}{ccccc} [[[_w \text{ sent }][_z i]][_Q o/a]] & & [[[_v \text{ tem }][_z e]][_Q o/a]] \\ / & / & / & / \\ V & V & V & V \end{array}$$

is erased and features previously associated with it float onto the root vowel.

In footnote 11, however, we pointed at the ban on consecutive V-nodes cannot be completely general, since forms like *sério*, *séria* (the m.sg and f.sg forms of an adjective) are perfectly fine. We might get around this problem by taking advantage of the fact that the *i* in *sério*, *séria*, unlike the theme vowels, is part of the root. However, the analysis in section 5.1. suggests an alternative which completely dispenses with the need to posit a phonotactic restriction to drive the height alternation in the root.

Suppose that in addition to having

$$(57) \begin{array}{l} a \ i \leftrightarrow [A [I]] \\ b \ e \leftrightarrow [W [A [I [E]]]] \end{array}$$

as the lexical entries for the theme vowels *i* and *e*, we have

$$(58) \quad a \text{ floating [high]} \leftrightarrow [I]$$

b floating [mid] \leftrightarrow [I [E]]

Then, the derivation of the 1sg and subjunctive forms in section 5.1. directly produces

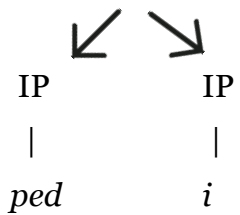
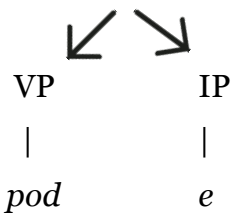
- (59) a [_{1P} [_{IP} [_{EP} *sent*] [_{IP} high]] [_{1P} o]] [_{AP} [_{IP} [_{EP} *sent*] [_{IP} high]] [_{AP} a]]
 b [_{1P} [_{IP} [_{VP} *tem*] [_{IP} mid]] [_{1P} o]] [_{AP} [_{IP} [_{VP} *tem*] [_{IP} mid]] [_{AP} a]]

with floating [high] and [mid] not attached to a V-node unless they float onto the root.

This line of analysis also overcomes the second problem mentioned in section 4.2. The only feature that floats onto the root vowel is now [high] or [mid], because these are the only features that lexicalize [I] and [I [E]]. The other features characterizing the theme vowels *i* and *e* are only introduced when they lexicalize [A [I]] and [A [I [E]]].

5.3 THE *PEÇ*/*PED* ALTERNATION

I assume that the *peç*/*ped* alternation, unlike the height alternation, involve two roots each with a separate lexical entry. Specifically:

- (60) a *peç* \leftrightarrow IP

ped \leftrightarrow [_{EP} E [_{VP} V]]
 b *poss* \leftrightarrow IP

pod \leftrightarrow [_{VP} V]

The entries for *peç* and *poss* contain two pointers down from the root node of IP – the leftmost pointing to the lexical item that has lexicalized the specifier of IP,

and the other one pointing to the theme vowel that has lexicalized the IP's right branch.²²

The short story is now this: *peç* and *poss* will only appear in the same derivations that elsewhere lead to the theme vowel floating onto the root.

Thus, *peç* and *poss* occur only in the 1sg indicative and in the subjunctive forms. To illustrate why they will not appear in the other forms, we look at the derivation of 1pl indicative forms like *podemos*.

The root *poss* will override *pod* as soon as $[_{VP} pod]$ has become the specifier of IP lexicalized by *e*:

$$(61) \quad [_{EP} E [_{VP} pod]] \rightarrow [_{EP} [_{VP} pod] [_{EP} E]] = [_{EP} [_{VP} pod] [_{EP} e]] \rightarrow \\ [_{IP} I [_{EP} [_{VP} pod] [_{EP} e]]] \rightarrow [_{IP} [_{VP} pod] [_{IP} I [_{EP} e]]] = [_{IP} [_{VP} pod] [_{IP} e]] = \\ [_{IP} poss]$$

At this point, the address of *poss* is associated with the root IP node, but the internal structure of IP is still visible to the derivation as are the addresses previously associated with its constituents.

When A is merged, the derivation chooses the optimal rescue operation to allow lexicalization of A, which is specifier movement applying to $[_{VP} pod]$, the specifier of IP:

$$(62) \quad [_{AP} A [_{IP} poss]] = [_{AP} A [_{IP} [_{VP} pod] [_{IP} e]]] \rightarrow [_{AP} [_{VP} pod] [_{AP} A [_{IP} e]]] = \\ [_{AP} [_{VP} pod] [_{AP} e]]$$

As a result, $[_{VP} pod]$ is outside IP, and the lexical entry for *poss* no longer allows *poss* to override the address previously associated with $[_{VP} pod]$. The address of *poss* associated with IP, on the other hand, is overridden when *e* lexicalizes $[_{AP} A [_{IP} e]]$. The rest of the derivation is straightforward. The *e* will eventually reach *mos*.

Likewise for *pedimos*:

$$(63) \quad [_{IP} I [_{EP} ped]] \rightarrow [_{IP} [_{EP} ped] [_{IP} I]] = [_{IP} [_{EP} ped] [_{IP} i]] = [_{IP} peç] \rightarrow \\ [_{AP} A [_{IP} peç]] = [_{AP} A [_{IP} [_{EP} ped] [_{IP} i]]] \rightarrow [_{AP} [_{EP} ped] [_{AP} A [_{IP} i]]] = \\ [_{AP} [_{EP} ped] [_{AP} i]]$$

²² If we had *poss* \leftrightarrow $[I [E [V]]]$ without pointers, we would get *poss* followed by *a* in all the indicative forms: $[_{AP} A [_{IP} poss]] \rightarrow [_{AP} [_{IP} poss] [_{AP} A]] = [_{AP} [_{IP} poss] [_{AP} a]] \rightarrow \dots$

The crucial property of the derivations leading to *poss-o* and *poss-a* and *peç-o* and *peç-a* is that the specifier of IP is never affected by specifier movement after A has merged. Instead, complement movement must be used when A has been merged, since *o* and *a* are both footed at A. Here's the derivation of *posso* and *possa*:²³

$$\begin{aligned}
 (64) \quad & [\text{EP } E [\text{VP } \textit{pod}]] \rightarrow [\text{EP} [\text{VP } \textit{pod}] [\text{EP } E]] = [\text{EP} [\text{VP } \textit{pod}] [\text{EP } e]] \rightarrow \\
 & [\text{IP } I [\text{EP} [\text{VP } \textit{pod}] [\text{EP } e]]] \rightarrow [\text{IP} [\text{VP } \textit{pod}] [\text{IP } I [\text{EP } e]]] = [\text{IP} [\text{VP } \textit{pod}] [\text{IP } e]] = \\
 & [\text{IP } \textit{poss}] \rightarrow \\
 & [\text{AP } A [\text{IP } \textit{poss}]] \rightarrow [\text{AP} [\text{IP } \textit{poss}] [\text{AP } A]] = [\text{AP} [\text{IP } \textit{poss}] [\text{AP } a/o]]
 \end{aligned}$$

The derivation of *peço* and *peça* is similar.

The fact that the constituent containing the root does not end up separated from the theme vowel by specifier movement is also a property of the derivations where the height feature of the theme vowel floats onto the root. Taking special roots like *peç* and *poss* to lexicalize the whole constituent containing the floating height feature explains why such roots have open vowels.

Since we are assuming (see footnote 14) that the theme vowel *a* does not co-occur with the 1sg *o* and the subjunctive *a*, it also follows that no *a*-verbs has a root alternation of the *peç/ped* type.

6 AN EXTENSION TO TWO DIFFERENT ALTERNATION PATTERNS

There are two instances of height alternation in the root vowel that don't conform to the Gamma pattern. I will now argue that these actually involve an alternation between two roots with distinct lexical entries.

6.1 AN ALTERNATION WITH A HIGH VOWEL IN THE 1/2PL

A small group of verbs display the following alternation pattern:²⁴

²³ The derivation of *posso* involves backtracking from 1for the reason mentioned in footnote 14.

²⁴ The voiced postalveolar fricative is represented by the letter *g* before *i* and *e* and by *j* elsewhere. The paradigm given for *frigir* is the one found in textbooks for European Portuguese, but an anonymous referee (native speaker of Brazilian Portuguese) tells me that only the forms of *frigir* with stress on the theme vowel are grammatical.

(65)

<i>sub-i-r</i> ‘go up’		<i>frig-i-r</i> ‘fry’	
<i>sub-o</i>	<i>sub-a</i>	<i>frig-o</i>	<i>frig-a</i>
<i>sob-e-s</i>	<i>sub-a-s</i>	<i>freg-e-s</i>	<i>frig-a-s</i>
<i>sob-e</i>	<i>sub-a</i>	<i>freg-e</i>	<i>frig-a-s</i>
<i>sub-i-mos</i>	<i>sub-a-mos</i>	<i>frig-i-mos</i>	<i>frig-a-mos</i>
<i>sub-i-s</i>	<i>sub-a-is</i>	<i>frig-i-s</i>	<i>frig-a-is</i>
<i>sob-e-m</i>	<i>sub-a-m</i>	<i>freg-e-m</i>	<i>frig-a-m</i>

In this pattern, the root has *u* or *i* not only in the 1sg and in the subjunctive forms, but also in the 1/2pl.²⁵ The root of the infinitive has a high vowel as well unlike the infinitive of verbs following the Gamma Pattern such as *dormir* and *sentir*.

The high vowel of the root in the 1/2pl and the infinitive cannot be attributed to a height feature floating off the theme vowel, since the 1/2pl ending and the infinitival ending *r* do not cut the expansion of the theme vowel. Instead, the pattern must be handled by positing a separate lexical entry for each of the two alternating roots.

It is striking that the root vowel is low in exactly the three forms of the present indicative paradigm where the theme vowel *i* shifts to *e*, i.e. the 2sg and the 3sg/pl. In section 3.1., we noted that this shift shows that an *i*-root shrinks in these forms in the sense that it lexicalizes only [V] rather than [E [V]], since E is the foot of *e*. We can take advantage of this by postulating the following lexical entries:

- (66) a *sub* \leftrightarrow [EP E [VP V]] b *frig* \leftrightarrow [EP E [VP V]]
 sob \leftrightarrow [VP V] *freg* \leftrightarrow [VP V]

This correctly predicts that *sub* and *frig* will appear in all forms with the theme vowel *i* given the structure in (67) and the lexical entry in (68):

²⁵ In European Portuguese, it is hard to distinguish unstressed *sob* from *sub*, since unstressed *o* = [u] in EP. In Brazilian Portuguese, however, unstressed *o* = [o], but the unstressed root of *subir* has [u] in the infinitive and the 1/2pl.

$$(67) [\dots [A [I [E [V]]]]]$$

$$(68) i = [_{AP} A [_{IP} I]]$$

Since the 1sg indicative and the subjunctive forms also have the theme vowel *i*, but with *o* or *a* on top, *sub* and *frij* also occur in these forms, but are not affected by the height feature floating off the *i*, since the root vowel is high to begin with.

In the 2sg and the 3sg/pl indicative, the theme vowel is *e*, forcing the root to shrink down to $[_{VP} V]$:

$$(69) e \leftrightarrow [W [A [I [E]]]]$$

By the Elsewhere Principle, *sob* and *frij* block *sub* and *frij* in the derivation of the forms with the theme vowel *e*. To illustrate, I give the derivation of *sob-e-s*, *sob-e*, *sob-e-m* up to the point where the agreement suffixes are added:

$$\begin{aligned} (70) \quad & [_{EP} E [_{VP} \text{sob}]] = [_{EP} \text{sub}] \rightarrow [_{IP} I [_{EP} \text{sub}]] \rightarrow [_{IP} [_{EP} \text{sub}] [_{IP} I]] = \\ & [_{IP} [_{EP} \text{sub}] [_{IP} i]] \rightarrow \\ & [_{AP} A [_{IP} [_{EP} \text{sub}] [_{IP} i]]] \rightarrow [_{AP} [_{EP} \text{sub}] [_{AP} A [_{IP} i]]] = [_{AP} [_{EP} \text{sub}] [_{AP} i]] \rightarrow \\ & [_{WP} W [_{AP} [_{EP} \text{sub}] [_{AP} i]]] \rightarrow \text{backtracking} \rightarrow [_{EP} E [_{VP} \text{sob}]] \rightarrow \\ & [_{EP} [_{VP} \text{sob}] [_{EP} E]] = \\ & [_{EP} [_{VP} \text{sob}] [_{EP} e]] \rightarrow [_{IP} I [_{EP} [_{VP} \text{sob}] [_{EP} e]]] \rightarrow [_{IP} [_{VP} \text{sob}] [_{IP} I [_{EP} e]]] = \\ & [_{IP} [_{VP} \text{sob}] [_{IP} e]] \rightarrow [_{AP} A [_{IP} [_{VP} \text{sob}] [_{IP} e]]] \rightarrow [_{AP} [_{VP} \text{sob}] [_{AP} A [_{IP} e]]] = \\ & [_{AP} [_{VP} \text{sob}] [_{AP} e]] \rightarrow [_{WP} W [_{AP} [_{VP} \text{sob}] [_{AP} e]]] \rightarrow \\ & [_{WP} [_{VP} \text{sob}] [_{WP} W [_{AP} e]]] = [_{WP} [_{VP} \text{sob}] [_{WP} e]] \end{aligned}$$

Notice that the alternation between a mid and a high root vowel in the paradigms of *subir* and *frigir* is unlikely to be due to phonology. While the verb *sumir* behaves like *subir*, *resumir* has *u* in the root throughout.

Notice also that our analysis correctly predicts that no *e*-verb will follow a pattern of root alternation similar to *subir* and *frigir*, since the root of an *e*-verb is never forced to shrink.

6.2 VOWEL-FINAL ROOTS WITH A HIGH VOWEL IN THE 1/2PL

Some verbs with vowel-final roots follow the same pattern as *subir*:

(71)

<i>destru-i-r</i> ‘destroy’
<i>destru-o</i>
<i>destróis</i>
<i>destrói</i>
<i>destru-í-mos</i>
<i>destru-í-s</i>
<i>destro-e-m</i>

The final vowel of the root is *u* in the 1sg and the 1/2pl, but *o* elsewhere, and the *o* forms a diphthong with the glide *j* in the 2sg and the 3sg. I propose that *destruir* has the following two roots:

- (72) a *destru* \leftrightarrow [_{EP} E [_{VP} V]]
 b *destro* \leftrightarrow [_{VP} V]

But these roots generate the right pattern only if the glide in the diphthong /oj/ in the 2sg and the 3sg corresponds to the theme vowel *e* rather than an unexpected occurrence of the theme vowel *i*. That is:

- (73) *destróis* = *destro-e-s*
destrói = *destro-e*

This assumption seems plausible in light of the fact that a diphthong also comes out in the 2sg and the 3sg also in *e*-verbs like *mo-e-r* ‘grind’:

(74)

<i>mo-o</i>
<i>móis</i> = <i>mo-e-s</i>

<i>mói</i> = <i>mo-e</i>
<i>mo-e-mos</i>
<i>mo-e-is</i>
<i>mo-e-m</i>

Notice that it is unlikely that the *o* in *destróis*, *destrói* and *destroem* is due to a phonological process lowering the root-final *u*, since *destruir* contrasts with *instruir*:

(75)

<i>instru-i-r</i> ‘instruct’
<i>instru-o</i>
<i>Instruis</i>
<i>Instrui</i>
<i>instru-í-mos</i>
<i>instru-í-s</i>
<i>instru-e-m</i>

But this contrast can be accounted for by assuming that *instruir*, unlike *destruir*, has a single root:²⁶

(76) *instru* = [_{EP} E [_{VP} V]]

6.3 AN ALTERNATION WITH A HIGH VOWEL IN THE 2SG AND THE 3SG/PL

Another group of verbs follow the pattern exemplified by *polir* and *agredir*:²⁷

(77)

²⁶ Apparently, some speakers have *destruis*, *destrui*, *destruem* rather than *destróis*, *destrói*, *destroem* with a single root, i.e. *destruir* behaves like *instruir*. For these speakers, *destruir* too has only one root.

²⁷ An anonymous reviewer claims that *polir* has no present tense forms in Brazilian Portuguese. Standard grammars and textbooks for European Portuguese, however, give the full paradigm as in (77).

<i>pol-i-r</i> ‘polish’		<i>agred-i-r</i> ‘agress’	
<i>pul-o</i>	<i>pul-a</i>	<i>agrid-o</i>	<i>agrid-a</i>
<i>pul-e-s</i>	<i>pul-a-s</i>	<i>agrid-e-s</i>	<i>agrid-a-s</i>
<i>pul-e</i>	<i>pul-a</i>	<i>agrid-e</i>	<i>agrid-a</i>
<i>pol-i-mos</i>	<i>pul-a-mos</i>	<i>agred-i-mos</i>	<i>agrid-a-mos</i>
<i>pol-i-s</i>	<i>pul-a-is</i>	<i>agred-i-s</i>	<i>agrid-a-is</i>
<i>pul-e-m</i>	<i>pul-a-m</i>	<i>agrid-e-m</i>	<i>agrid-a-m</i>

In this pattern, the root has *u* and *i* in all the forms except the 1/2pl and the infinitive where the root vowel is *o* and *e*.²⁸

The height of the root vowel in the 2sg and the 3sg/pl of the indicative cannot be ascribed to [high] floating off the theme vowel *i*, since this only happens when *i* would be followed by the 1sg *o* or the subjunctive *a*. Hence, *pulir* and *agredir* must each have a root coming with a high vowel to begin with, i.e. *pul* and *agrid*, in addition to the root with a non-high vowel occurring in the 1/2pl, i.e. *pol* and *agred*:

$$(78) \quad a \text{ } pol \leftrightarrow [{}_{EP} E [{}_{VP} V]] \quad b \text{ } agred \leftrightarrow [{}_{EP} E [{}_{VP} V]] \\ pul \leftrightarrow [{}_{VP} V] \quad \quad \quad agrid \leftrightarrow [{}_{VP} V]$$

These entries generate a pattern where the roots with the mid root vowels appear in all and only the forms with the theme vowel *i*. These include the 1sg indicative and the subjunctive form, but in precisely these two cases the *i* gives rise to a floating [high] which associates with the root vowel as shown in the derivation of the 1sg *pulo* and the subjunctive *pula*:²⁹

$$(79) \quad [{}_{EP} E [{}_{VP} pul]] = [{}_{EP} pol] \rightarrow [{}_{IP} I [{}_{EP} pol]] \rightarrow [{}_{IP} [{}_{EP} pol] [{}_{IP} I]] = \\ [{}_{IP} [{}_{EP} pol] [{}_{IP} i]] \rightarrow \\ [{}_{AP} A [{}_{IP} [{}_{EP} pol] [{}_{IP} i]]] \rightarrow [{}_{AP} [{}_{IP} [{}_{EP} pol] [{}_{IP} i]] [{}_{AP} A]] = \\ [{}_{AP} [{}_{IP} [{}_{EP} pol] [{}_{IP} i]] [{}_{AP} a/o]] = \\ /pula/, /pulo/$$

²⁸ Unstressed *e* = schwa, unstressed *o* = [u] in European Portuguese, but [o] in Brazilian Portuguese.

²⁹ The backtracking step in the derivation of *pulo* is omitted.

Notice that this analysis correctly predicts that no *e*-verb will follow a pattern of root alternation similar to *polir* and *agredir*, since the root of an *e*-verb shrinks.

7. PUZZLES

In this final section, I look at three puzzles that remain unsolved. The solutions suggested here will be incomplete.

7.1 THE SUBJUNCTIVE *A* = THE INDICATIVE *A*

I have suggested that the subjunctive *a* of *i*-verbs and *e*-verbs is identical to the indicative *a* of *a*-verbs. If so, they have the same foot *A*. But in footnote 18, I pointed out that it is surprising that *A* is lexicalized by *a* rather than *i* and *e* in the subjunctive, if the subjunctive *a* is footed at *A*, since *i* and *e* extend to *A* in the indicative. When *A* has been merged, the optimal way of lexicalizing it would be to move the root around it to allow *i* and *e* to extend:

- (80) a $[_{AP} A [_{IP} [_{EP} \text{root}] [_{IP} i]]] \rightarrow [_{AP} [_{EP} \text{root}] [_{AP} A [_{IP} i]]] =$
 $[_{AP} [_{EP} \text{root}] [_{AP} a]]$
 b $[_{AP} A [_{IP} [_{VP} \text{root}] [_{IP} e]]] \rightarrow [_{AP} [_{VP} \text{root}] [_{AP} A [_{IP} e]]] =$
 $[_{AP} [_{VP} \text{root}] [_{AP} e]]$

To eliminate this problem, we might place a feature *P* between *A* and *I* in the indicative, but not in the subjunctive:

- (81) a indicative = $[\dots [A [\textcolor{red}{P} [I [E [V]]]]]]$
 b subjunctive = $[\dots [A [I [E [V]]]]]$

Then, *i* and *e* won't extend to *A* in the subjunctive, if they have the entries in (82):

- (82) a $i \leftrightarrow [\dots [A [\textcolor{red}{P} [I]]]]$
 b $e \leftrightarrow [\dots [A [\textcolor{red}{P} [I [E]]]]]$

Therefore, *i*-roots and *e*-roots will have *a* lexicalizing A on top of *i* and *e* in the subjunctive, but not in the indicative:

(83) the subjunctive of *i*-verbs and *e*-verbs:

- a $[_{AP} A [_{IP} [_{EP} \text{root}] [_{IP} i]]] \rightarrow [_{AP} [_{IP} [_{EP} \text{root}] [_{IP} i]] [_{AP} A]] =$
 $[_{AP} [_{IP} [_{EP} \text{root}] [_{IP} i]] [_{AP} a]]$
- b $[_{AP} A [_{IP} [_{VP} \text{root}] [_{IP} e]]] \rightarrow [_{AP} [_{IP} [_{VP} \text{root}] [_{IP} e]] [_{AP} A]] =$
 $[_{AP} [_{IP} [_{VP} \text{root}] [_{IP} e]] [_{AP} a]]$

If *a*-roots have lexical entries like (84), *a*-verbs will have the theme vowel *a* in the indicative without *i* or *e* between the root and *a*:

(84) $a\text{-root} \leftrightarrow [P [I [E [V]]]]$

However, this does not prevent *a* from also occurring in the subjunctive forms of *a*-verbs. The derivation of the subjunctive forms would run as in (85):

(85) $[_{IP} I [_{EP} a\text{-root}]] = [_{IP} a\text{-root}] \rightarrow [_{AP} A [_{IP} a\text{-root}]] \rightarrow$
 $[_{AP} [_{IP} a\text{-root}] [_{AP} A]] = [_{AP} [_{IP} a\text{-root}] [_{AP} a]]$

Therefore, something more will have to be said to account for the fact that *a*-roots shift from *a* to *e* in the subjunctive. A way must be found of preventing *a*-roots from extending beyond VP in the subjunctive. Then, the shift to *e* (rather than *i*) would follow from *e* being the theme vowel with the lowest foot. But at the same time, *i*-roots and *e*-roots must be allowed to extend up to I and E both in the indicative and the subjunctive. It still appears difficult to satisfy both exigencies.

On the other hand, the rudimentary analysis suggested here doesn't allow us to identify the indicative *e* with the subjunctive *e* anyway, since the subjunctive *e* doesn't have *a* on top and therefore must have a different entry than the indicative *e*:

(86) the subjunctive *e* $\leftrightarrow [\dots [A [I \dots]]$

Moreover, if the subjunctive *e* also is footed at E, this is not just ugly, but falsely predicts that *e*-verbs should have *e* without *a* on top in the subjunctive.

7.2 THE SUBJUNCTIVE *A* = THE INDICATIVE *A*, THE SUBJUNCTIVE *E* = THE INDICATIVE *E*

The fact *i*-verbs and *e*-verbs have *a* (on top of *i* and *e*) in the subjunctive, while *a*-verbs have *e* in the subjunctive, represents a challenge, if we are unwilling to consider it as an instance of accidental homonymy. We have just seen that we may have the subjunctive *a* = the indicative *a* in a way consistent with our account of the Gamma Pattern, but cannot, as things now stand, also derive the subjunctive *e* = the indicative *e*. All potential accounts of the double syncretism so far seem to be incompatible with saying that the subjunctive *a* stacks on top of *i* and *e* in Portuguese. This might be seen as an indication that my analysis of the Gamma Pattern cannot be correct. In particular, we should abandon the key assumption that the subjunctive *a* co-occurs with (a fragment of) the indicative theme vowels *i* and *e* in Portuguese.

However, the same cross-mood syncretism between theme vowels is found also in languages where the subjunctive *a* quite visibly stacks on top of the indicative *i* and *a*. In Latin, as already mentioned, we have (87):

(87)

indicative:			subjunctive:		
<i>tim-e-o</i>	<i>aud-i-o</i>	<i>am-o</i>	<i>tim-e-a-m</i>	<i>aud-i-a-m</i>	<i>am-e-m</i>
<i>tim-e-s</i>	<i>aud-i-s</i>	<i>am-a-s</i>	<i>tim-e-a-s</i>	<i>aud-i-a-s</i>	<i>am-e-s</i>
<i>tim-e-t</i>	<i>aud-i-t</i>	<i>am-a-t</i>	<i>tim-e-a-t</i>	<i>aud-i-a-t</i>	<i>am-e-t</i>
<i>tim-e-mus</i>	<i>aud-i-mus</i>	<i>am-a-mus</i>	<i>tim-e-a-mus</i>	<i>aud-i-a-mus</i>	<i>am-e-mus</i>
<i>tim-e-tis</i>	<i>aud-i-tis</i>	<i>am-a-tis</i>	<i>tim-e-a-tis</i>	<i>aud-i-a-tis</i>	<i>am-e-tis</i>
<i>tim-e-nt</i>	<i>aud-i-u-nt</i>	<i>am-a-nt</i>	<i>tim-e-a-nt</i>	<i>aud-i-a-nt</i>	<i>am-e-nt</i>

The subjunctive *a* of conjugation 2 verbs = the indicative *a* of conjugation 1 verbs, and the subjunctive *e* of conjugation 1 verbs = the indicative *e* of conjugation 2

verbs. But the indicative *e* of *e*-roots co-occurs with the subjunctive *a*. Any account of the double subjunctive *a* = indicative *a* and subjunctive *e* = indicative *e* will carry over to Portuguese and be consistent with my account of the gamma pattern.

7.3 VERBS THAT DO NOT FOLLOW THE GAMMA PATTERN

My account of the gamma pattern predicts that the present subjunctive forms will always have the same root as the 1sg of the present indicative. Half a dozen verbs do not conform to this prediction.

One of these is the *a*-verb *estar* ‘stand, be’:

(88)

subjunctive:	indicative: ³⁰
<i>estej-a</i>	<i>est-ou</i>
<i>estej-a-s</i>	<i>est-á-s</i>
<i>estej-a</i>	<i>est-á</i>
<i>estej-a-mos</i>	<i>est-a-mos</i>
<i>estej-a-is</i>	<i>est-a-is</i>
<i>estej-a-m</i>	<i>est-ão</i>

This verb is aberrant in that the infinitive and the present indicative forms clearly suggest that the root *est* is an *a*-root, while *estej* is either an *i*-root or an *e*-root, since it has *a* in the subjunctive. This type of root alternation is not predicted by anything in the analysis of the Gamma Pattern, but is also not inconsistent with it.

The verb *e*-verb *saber*, on the other hand, is problematic, and so is *querer* ‘like’:

(89)

³⁰ The list of exceptional verbs given in grammars often includes *dar* ‘give’, which, however, lends itself to being treated as a regular *a*-verb with the root *d*.

subjunctive:	indicative:	subjunctive:	indicative:
<i>saib-a</i>	<i>sei</i>	<i>queir-a</i>	<i>quer-o</i>
<i>saib-a-s</i>	<i>sab-e-s</i>	<i>queir-a-s</i>	<i>quer-e-s</i>
<i>saib-a</i>	<i>sab-e</i>	<i>queir-a</i>	<i>quer</i>
<i>saib-a-mos</i>	<i>sab-e-mos</i>	<i>queir-a-mos</i>	<i>quer-e-mos</i>
<i>saib-a-is</i>	<i>sab-e-is</i>	<i>queir-a-is</i>	<i>quer-e-is</i>
<i>saib-a-m</i>	<i>sab-e-m</i>	<i>queir-a-m</i>	<i>quer-e-m</i>

I have as yet nothing to say about these. They are *e*-verbs and the 1sg indicative and the subjunctive forms should have the same root.³¹

The other exceptional verbs are *ser* ‘be’, *ir* ‘go’ and the semi-obsolete *haver* ‘have’, which have a number of other exceptional properties in the present tense. Once these other properties are understood, one may also hope to understand why the 1sg indicative and the subjunctive forms have different roots.

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³¹ The 1sg indicative *quero* is exceptional both in that it has a low root vowel *e* as in the other indicative forms with stress on the root, and is not identical to the root of the subjunctive forms.