ON THE EVOLUTION OF THE SHORT HIGH VOWELS OF LATIN INTO ROMANCE[*]

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0. *Introduction*

As is well known, one of the main characteristics of the development of the Latin vowel system is the merger between the short high vowels and the long mid vowels into mid [+ATR] vowels in the majority of the Romance languages. For example consider Italian. In (1) we see how the long and short vowels of the front series of Classical Latin evolved into this language (see Calabrese 2003 on the use of the feature [ATR] in Romance). In this paper I will propose an analysis of this merger.

(1)

Classical Latin		Italian
[+high, +ATR] i:	⟶	[+high, +ATR] i
[+high, +ATR] i		
		[-high, +ATR] e
[-high, -ATR] ɛ:		
[-high, -ATR] ɛ	⟶	[-high, -ATR] ɛ

The paper will proceed as follows. The main facts about the history of the Romance vowel system will be introduced in section 1. In section 2, I will discuss the process of merger we see in (1). The crucial event in the change in (1) is the assignment of different specification for the feature [ATR] to long and short vowels. Long vowels were associated with the feature [+ATR], short vowels with the feature [-ATR]. We will see that diachronic processes of fusion between high [-ATR] vowels and mid [+ATR] vowels are common across languages; thus, for example, they are found in the history of the Kwa languages of Niger-Congo (cf. Stewart 1972), in the Edoid languages of

Nigeria (cf. Archangeli & Pulleyblank 1994), in the Tungusic languages (cf. Vaux 1996), and so on. I will propose to analyze all these processes, as well as the merger we observe in Latin, as instances of the same formal operation. This operation is the repair operation called Negation by Calabrese (1985, 1995). In section 3, I will discuss some of its properties.

1. *The Latin vowel system and its development*

In this section I will review some of the historical facts from Latin and its evolution into Romance. Phonemically Classical Latin had a typical basic five vowel system: two high vowels: one front unrounded and the other back rounded, two mid vowels: one front unrounded and the other back rounded, and one central unrounded low vowel. Each vowel could be contrastively short or long. Everyone agrees on this. There is, however, disagreement when we consider their surface phonetic shape. The issue is whether or not length contrasts were phonetically associated with quality distinctions. Two different positions can be identified in this regard. The first position, explicitly taken by linguists such as Allen (1965) and Sturtevant (1940), assumes that the short non-low vowels of Classical Latin were lower and more open than the long ones.[1] Namely, the short non-low vowels were [-ATR] whereas the long ones [+ATR]. According to this hypothesis, the surface non-low vowels of Classical Latin were those in (2). It follows that according to this hypothesis the changes we observe in Vulgar Latin were essentially already present *in nuce* in Classical Latin.

(2)   [-ATR]   [+ATR]
      ɪ   ʊ   iː   uː
        ɛ   ɔ   eː   oː

The alternative position, which as far as I know is not explicitly taken by any linguist, but is implicitly present in many textbooks discussing the evolution of the Latin vowel system (see for example Herman 1997:32), holds that there were no distinctions in [ATR] values in long and short vowels in Classical Latin. According to this position, the system of Classical Latin was therefore that in (3) where the high vowels are [+ATR] and the mid vowels [-ATR] as expected in typical five vowel systems:

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[1] There is no evidence that the long and short variant of the low vowel differed in quality at any stage of Latin. The low vowel remained [-ATR] regardless of its length.

(3)   i   ʊ   iː   uː
         ɛ   ɔ   ɛː   ɔː

According to this position, a differentiation in [ATR] values as that in (2) developed only in later stages of Latin or was characteristic of a more popular variety of this language.[2]

The Latin alphabet in Classical Latin had five letters for the vowels: *i, e, o, a*, in addition to the digraph: *ae, au, oe* for the diphthongs. Given that we cannot listen to Classical Latin speakers, we have to use inferential evidence to establish how these letters were actually pronounced so that we can decide between the system in (2) and that in (3). In this section I will provide three pieces of evidence in support of the hypothesis that the system in (3) is the correct one. The first comes from the evolution of the Classical Latin vowel system into two conservative Romance varieties such as Sardinian and Southern Lucanian. The second is obtained by considering the spelling of Latin words into the Greek alphabet. In particular we will consider the spelling of Latin mid vowels in Greek. Given that the phonetic value of the vowel symbols of this alphabet is well known, we can then infer the phonetic value of the Latin mid vowels. Finally a study of the spelling mistakes in inscriptions and of the pronunciation mistakes reported by the ancient writers will give us more insights on the actual pronunciation of the Latin vowels and thus provide us with the third piece of evidence in support of the system in (3).

I. The strongest evidence for assuming that the Latin vowel system was that in (3) with no [ATR] distinctions in the mid vowels is provided by the more isolated or peripheral Romance varieties where the classical Latin system appears to have evolved by losing length distinctions. This occurred in Sardinian (cf. Rohlfs 1966) and in southern Lucanian (cf. Lausberg 1939, Rohlfs 1966) (see 4 and 5).[3]

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[2] In (3), the mid vowels are assumed to be [-ATR]. This follows from markedness considerations: it is known that the presence of mid [+ATR] vowels implies the presence of mid [-ATR] vowels. Therefore in a standard five vowel systems where only one set of vowels is present these mid vowels should be [-ATR]. Obviously, when there is no opposition in a phonetic area, the range of articulations of a segment in that area is much wider and this segment may be realized in an intermediate position with respect to the polar positions of that area. Thus the mid vowels in a five vowel system may be realized in an intermediate position with respect to the opposite poles ± ATR. This does not have any consequences on their phonological identity as [-ATR] segments.

[3] Parlangeli (1971) and Mancarella (1989) argue that the Southern Lucanian vowels system developed from the common Romance seven vowel system. Savoia (1997), Trumper (1979)

The same development appears to have also occurred in African Latin, if we believe Saint Augustin (En. in Psalm. 138, 20). In that passage, he says that *"Afrae aures de correptione vocalium vel productione non iudicant"*[4] and warns that the Africans easily confused *ōs* 'mouth' with *ŏs* 'bone'. Observe that if *ōs* and *ŏs* were confused, *ō* and *ŏ* must have had the same vowel quality. Latin borrowings to Berber also provide evidence that in African Latin like in Sardinian and southern Lucanian, both Latin short [ĭ] and [ŭ] were treated as high vowels: thus in Berber we find: *akiker, ikiker* < Lat. *cĭcer* 'chickpea', *afurk, tfurket* <Lat. *fŭrka, ulmu, tulmuts* < Lat. *ŭlmu* 'elm'.

It is reasonable to hypothesize that in the variety of Latin where the distinctions in length were simply lost, the resulting vowels show the quality of the Latin vowel. Now as we we can observe from the forms in (4), both Sardinian and southern Lucanian display the vocalic correspondences in (5) with Latin (cf. Rohlfs 1966, Lausberg 1939). Given that the phonetic value for the feature [ATR] in the Latin vowel is still not known at this point of the paper, the symbols in the top line must be considered as abbreviations for configurations including values for the features [high], [low], [back], [round], as well as distinctions in length, but crucially not including values for the feature [ATR]. Note that the correspondents of the Latin midvowels pairs are the [-ATR] [ɛ] and [ɔ].

(4) Sardinian: *nive* < Lat. *nĭves* 'snow', *filu* < Lat. *filu* 'thread', *kadɛna* < Lat. *catēna* 'chain', *fɛle* < Lat. *fĕle* 'gall', *sɔle* < Lat. *sōle* 'sun', *rɔda* < Lat. *rŏta* 'wheel', *ruke* < Lat. *crŭce* 'cross', *muru* < Lat. *mūru* 'wall'.

Southern Lucanian (San Chirico Raparo): *nivi* < Lat. *nĭves* 'snow', *filu* < Lat. *filu* 'thread', *krɛta* < Lat. *crēta* 'chain', *sɔli* < Lat *sōle* 'sun', *kruči* < Lat. *crŭce* 'cross', *luči* < Lat. *lūce* 'light'.

(5) ī   ĭ   ē   ĕ   ā   ă   ō   ŏ   ū   ŭ
      \ /   \ /   \ /   \ /   \ /
       i   ɛ   a   ɔ   u

[4] "The African ears cannot judge about long and short vowels", i.e., African speakers cannot distinguish between long and short vowels.

As in all science, it has always been assumed in linguistics that in the absence of contrary evidence, a choice among alternative accounts is made on the basis of simplicity. Now the system that we observe in Sardinian and Southern Lucanian, i.e. the one we observe in the bottom line in (5), can be simply derived from that of Classical Latin by assuming that the Latin vowels in the top line of (5) had the phonetic values in (3) and there was simply a loss of length distinctions, a change that is independently needed for all Romance varieties.

If we assume that the Latin vowels had the phonetic values in (2), accounting for correspondences in (5) becomes much more complex. In fact in this case, not only do we need to assume loss of length contrasts, but also the two changes in (6a-b). Furthermore these three changes must have independently occurred in the three different and geographically distant varieties characterized by this development.

(6) a. [-ATR] ι, υ → [+ATR] i, u
     b. [+ATR] e:, o: → [-ATR] ɛ, ɔ

Given that the development of the other varieties of Romance is also simply accounted for by assuming that Latin had the system in (3) as will discussed later, the considerable complexities which the hypothesis that Latin had the system in (2) creates are a good reason for rejecting it. Therefore the simplest hypothesis to explain the characteristics of Sardinian and Lucanian vowels is that the Latin vowels were also [-ATR]. Thus, as hypothesized in (3), the classical Latin long and short mid vowels were [ɛ, ɔ, ɛ:, ɔ:]. We can now consider the other two pieces of evidence showing that Latin had the system in (3):

II. The Latin letter $\bar{e}$[5] is almost regularly transcribed into Greek by the letter η. For example, in Plutarchus (I c. A.D.), we find the following transcriptions of Latin words: ῥῆγι (Lat. *rēgi*), χαρῆρε (Lat. *carēre*), Ῥῆνος (Lat. *Rhēnus*). In other authors, we find θησαυρός for Lat. *thēsaurus*, Μαιχῆνας for Lat.

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[5] The Latin alphabet did not in general distinguish between long and short vowels. There are only five vocalic symbols i, u, e, o. a and each of them could represent a long or short vowel. We know the quantity of the letters in words from their metrical scansion in poetry, from the evolution of the vowels they represent in the Romance languages and from what the Latin grammarians tell us. So when one refers to a 'long' letter such as long $\bar{e}$ or $\bar{o}$ one is usually referring to an abstract entity composed of an attested symbol whose phonetic value for the feature [ATR] is to be determined and of a quantity diacritic we infer from different sources.

Maecēnas, 'Ρήγουλος for Lat. *Rēgulus* (data from Kuhner & Holzweissig 1966:15).

If we assume the principle that sound symbols are not interchangeable unless they have the same or closely approximating phonetic values (cf. Sturtevant (1940)), we must conclude that the Latin letter ē and the Greek letter η represented the same sound. We know that the Greek letter η represented a long mid front [-ATR] [ε]. Meillet & Vendryes (1966: 101) give the phonetic values in (7) to the Greek letters for mid vowels--here I assume that close (*'fermé'*) vowels are [+ATR] and open (*'ouvert'*) ones [-ATR] (see also Sturtevant 1940: 32-42):

(7) ε = 'e fermé bref' = [+ATR][e] o = 'o fermé bref' = [+ATR][o]
   $\varepsilon\iota$ = 'e fermé long' = [+ATR][e:] $o\upsilon$ = 'o fermé long' = [+ATR][o:]
   η = 'e ouvert long' = [-ATR][ε:] ω = 'o ouvert long' = [-ATR][ɔ:]

Why was Greek η used to transcribe the Latin letter ē when there was another grapheme εῑ that could represent a long [+ATR] [e:]? The only possible answer is that the Latin letter ē stood for a long [-ATR] [ε:]. The same reasoning holds for the Latin letter ō. It is in fact transcribed into the Greek letter ω. 'Ρώμυλος for Lat. *Rōmulus*, Κικέρω for Lat. *Cicerō*. If what we said before holds, ω and ō represented the same sound, i.e., a long [-ATR] [ɔ:]. Given that the Latin sound represented by short e and o evolved into [-ATR] [ε] and [ɔ] in all of the Romance languages, we have to assume that there was no difference in [ATR] values between short and long midvowels in Classical Latin as the system hypothesized in (3) predicts.

II. Latin inherited from Indo-European the dipthong [ai]. This diphthong which was pronounced as such in early Latin (e.g. *silvai frondosai* (Ennius III-II c. B.C.)), changed into [ae] in the urban area of Rome during classical times. The following quote from Terentius Scaurus describe this change:

> *A* igitur littera praeposita est *u* et *e* litteris...Et apud antiquos *i* littera pro *ea* (i.e. *e* littera) scribebatur, ut testantur μεταπλασμοί, in quibus eius syllabarum diductio, ut *pictai vestis* et *aulai medio* pro *pictae* et *aulae.* Sed magis in illis *e* novissima sonat

> 'Well then, the letter *a* is prefixed to *u* and *e*. . . And among the ancients *i* was written for *e*, as is shown by alterations of sound, among them the separation of syllables as *pictai vestis* and *aulai medio* for *pictae* and *aulae.* But in those words the final sound is more nearly that of *e*.' (quoted and translated in Sturtevant 1940:124)

At the same time, starting from the second half of the II c. B.C., a monophthongal pronunciation of this diphthong emerged in the Latin spoken in the extra-urban area, i.e., in what the ancient writers call 'rustic' Latin.

Now, as pointed out by Sturtevant (1940), this lead to a situation of conflict between the diphthong *ae* of urban Latin and the monophthongal counterpart that was a characteristic feature of 'rustic' Latin. Varron (Ling. 7,96) describes this situation of linguistic conflict with the following words:

> *obscaenum* dictum ab *scaena*; eam, ut Greci, Accius scribit *scena<m>*. In pluribus verbis *a* ante *e* alii ponunt, alii non, ut quod partim dicunt *scaeptrum*, partim *sceptrum*, alii Plauti *Faeneratricem*, alii *Feneratricem*; sic *faenisicia* ac *fenisicia*, ac rustici pappum *Mesium* non *Maesium*. A quo Lucilius scribit: *Cecilius pretor ne rusticus fiat*

> 'Obscaenum* is from *scaena*; this word, Accius writes *scena<m>* as the Greeks do. In many words, some set *a* before *e*, others do not, for example some pronounce *scaeptrum*, and others pronounce *sceptrum*, some the *Faeneratricem* of Plautus and others *Feneratricem*; just so they say *faenisicia* and *fenisicia*, and the rustics call the (stage) granddaddy *Mesium*, not *Maesium*. From which pronunciation Lucilius writes:[6] "Let us not make *Cecilius* of a rustic *pretor*"' (quoted and translated in Sturtevant (1940: 125)

This passage from Varro indicates not only the monophthongal pronunciation of urban *ae* (e.g. urban *praetor* pronounced *pretor*) but also the opposite reaction due to hypercorrection: urban *scēna* from Greek σκηνή is pronounced *scaena*. As Sturtevant puts it: "No doubt persons who took pains to say *praetor* instead of *prētor* overcorrected *scēna* to *scaena*. In the same way *scēptrum* from Greek σκῆπτρον was overcorrected to *scaeptrum*" (Sturtevant 1940:127)

Hypercorrection--Sturtevant's overcorrection--typically arises when a phonetic contrast is lost in a dialect in close contact with another more prestigious dialect in which the contrast is maintained. Once the speakers of the innovative dialect become aware of the fact that they are pronouncing certain words differently from many of the individuals with whom they are in contact, it is not uncommon for the former to take corrective steps to eliminate the differentiating trait (Halle & Idsardi 1997). The corrective step involved in 'hypercorrection' can be formally described as follows: Given a process P modifying an element *A* as *B* in an environment *X _ Q*, hypercorrection involves an attempt by speakers to mask this process by adding to their idiolect

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[6] The correct classical forms are *Caecilius* and *praetor*.

a further process which reverses the effect of P, i.e.: $B \to A/X \_ Q$, The problem is that this inversion applies blindly to all instances of B, not only to those that are the output of the process P, but also those that are underlying. Hypercorrection then follows. For example: a characteristics of my pronunciation of English is the deletion of word-initial [h] in English, i.e., [h]->Ø/ #_. When I want to be more careful I reinsert it not only in the right words, those in which I deleted the inital [h], but also in words that are vowel-initial in English, i.e., the inverted process Ø->[h]/ #__ over-applies, or better applies regularly in all the right contexts.[7]

To account for the rustic Latin pronunciation of the dipthong *ae* and for the hypercorrection situation Varro describes, we must assume the process in (8). The hypercorrected inversion of this process is given in (9).

(8)   [ae]   →   The sound represented by the letter *ē* in Latin

(9)   The sound represented by the letter *ē* in Latin   →   [ae]

Observe that by definition the sound that is input of the inverted process must be identical to that which is the output of non-inverted process. Therefore, the output of monophthongization process in (12) must have been identical to the sound that was target of hypercorrection. It follows that the sound represented by urban Latin [ē] must have been identical to the sound that was the output of monophthongization of [ae] in 'rustic' Latin. Now as pointed out by Sturtevant (1940:125), the outcome of the monophthongization of [ae] in 'rustic' Latin was a long open (=[-ATR]) [ɛː]. This is shown by the following facts:

a) We know that in all Italic languages of central Italy with the exception of Latin of urban Rome, the diphthong [ai] inherited from Indo-European was monopthongized (Sturtevant 1940:125; Pisani 1964:9). Since we know for certain that in Umbrian--one of these Italic languages--this monophtong was [ɛː] (Buck 1904:44), we can assume the same pronunciation for all other Italic languages. We know that 'rustic' Latin was strongly influenced by these languages, and is characterized by many of their features. It follows that it is highly plausible that that the rustic monophthong for urban *ae* was pronounced in the same way, therefore as [ɛː].

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[7] The obvious further step in hypercorrection is the simplification of underlying representations with the replacement of all A in the environment X_ Q with B. The presence of this step is irrelevant in my analysis here.

b) Sturtevant (1940:126) points out that a number of 'rustic' words displaying monophthongs for urban *ae* got into standard Latin. These forms were later assimilated into the system of urban Latin and therefore underwent the process that assigned the feature [+ATR] to long vowels, as in (13). These forms show up in most of the Romance languages with the outcome that we expect for long Latin *ē*. Interestingly in Italian where the rustic dialects may be expected to exert some influence, these forms show a different outcome. Sturtevant provides the following table (Sturtevant 1940, table 9):

(10)   *ĕ*   Rustic *ē* for *ae*   *ē*

	ĕ	Rustic *ē* for *ae*		*ē*
Latin	*mel*	*sēpes*	*fēnum*	*vērum*
Italian	*miele*	*siepe*	*fieno*	*vero*
French	*miel*	*soif*	*foin*	*voire (<vērē)*
Spanish	*miel*		*heno*	*vero*

Talking about forms like *sēpes* and *fēnum*, Sturtevant says: "we must assume that they [...] spread over the Roman world in a form that urban Latin had adopted from rural speech but had assimilated to its own speech material. The peculiar Italian development indicates that *ē* from *ae* remained [ε] in the rural districts where it originated until it was amalgamated with general Vulgar Latin [ε] from *ĕ* and *ae*" (Sturtevant (1940:126). Again we can conclude that the monophthongization of *ae* in rustic Latin produced a mid [-ATR] [ε]. Since this sound was long, it was [εː].

Given that the sound represented by urban Latin [ē] was identical to the sound which was the output of monophthongization of [ae] in 'rustic' Latin, as argued above, it follows that the urban Latin long mid front vowel was a long [-ATR] [εː]. This what is predicted by the hypothesis that the Latin vowel system was that in (3).

Observe that we have the same situation in the case of the monophthongization of the diphthong *au*. The diphthong *au* was monophthongized as *o* in "rustic" Latin. Festus (II c. A.D.) says "*Orata* appellatur a colore *auri*, quod rustici *orum* dicebant, ut *auricolas oricola*" (quoted in Kuhner & Holzweissig 1966). The same type of hypercorrection seen for *ae* is found in this case. For example, Suetonius talking about the emperor Vespasian tells us the following:

Et tamen nonnulla eius facetissima extant, in quibus et haec. Mestrium Florum consularem, admonitus ab eo *plaustra* potius quam *plostra* dicenda, postero die *Flaurum* salutavit.

'And yet some excellent jests of his are still told, among them these. When he had been admonished by the consular Mestrius *Flōrus* that he should say *plaustra* rather than *plōstra*, the next day he greeted *Flōrus* as *Flaurus*.' (quoted and translated in Sturtevant (1940:132).

We therefore have to assume that the outcome of the diphthongization of *au* in rustic Latin and long *ō* of the classical language were the same sound. Given that the monopthongization of Latin *au* in Italian[8], as in other languages, produces a [-ATR] [ɔ], as shown in (11), we can conclude also the outcome of the monophthongization of *au* was a [-ATR] [ɔ]. It follows that the long *ō* of classical Latin was [ɔː].

(11) Lat. *tauru* > It. *tɔro*, Lat. *auru* > it. *ɔro*, Lat. *causa* > it. *kɔsa*
     Lat. *pauper* > It. *pɔvero*

We can conclude that there is clear evidence that in Classical Latin long and short mid vowels did not have different [ATR] values, i.e., the Latin letters *ē/ĕ*, *ō/ŏ* actually represented [ɛː/ɛ , ɔː/ɔ], i.e. [-high, -low, -ATR] vowels. The same must be said for the short and long high vowels. The fact that there is no difference in the outcomes of the high vowels in Southern Lucanian and Sardinian shows that short and long high vowels had the same quality, and therefore did not have different [ATR] values. The same evidence is provided by the grammarian Consentius, when he reports that some people, and speakers from Africa in particular, pronounce the word *piper* 'pepper' with a long vowel in the first syllable, when it ought have been a short vowel ("*quidam dicunt piper producta priore syllaba, cum sit brevis, quod vitium Afrorum familiare est*"). This indicates that they had the same quality and differed only in length. Further support for this is offered by the treatment of the short high vowels in the Latin borrowings to Berber mentioned above (i<*ĭ*, u<*ŭ*).

Latin authors clearly state that the short high vowels were pronounced differently than the long ones only in the 'rustic' variety of Latin. In particular, they were 'lowered'. Thus Cicero (De orat. 3, 46) says:

Quare Cotta noster, cuius tu illa lata, Sulpici, non numquam imitaris ut *Iota* litteram tollas et *E* plenissimum dicas, non mihi oratores antiquos, sed messores videtur imitari.

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[8] Differently than what happened for ae, the monophthongization of au was not a characteristic feature of vulgar Latin and was introduced independently in the different Romance varieties (see Tecavcic 1972 for discussion).

> 'For this reason, it seems to me, Sulpicius, that this friend of ours, Cotta, whose broad sounds you sometimes imitate when you drop the letter *I* and pronounce a very full *E* instead, imitating farmhands rather than the orators of the past' (translated by May & Wisse 2001:237)

In the same way, Varron (Rust. 1, 2, 14) observes that the word *villa* was pronounced *vella* in the Roman countryside. Observe that Cicero and Varron could characterize the 'lowered' pronunciation of short high vowels as rustic only if they were not lowered in the urban pronunciation. We can then plausibly assume that the short high vowels in Classical Latin, the urban variety of Latin, must not have differed from the long ones, and that they were both [+ATR].

In conclusion there is robust evidence that the classical Latin vowel system was that in (3): there was no difference in [ATR] values between short and long vowels. However at a certain point of the history of Classical Latin, probably around the first century A.D., as argued later, long and short vowels became differentiated by [ATR] distinctions: long vowels became [+ATR] and the short ones [-ATR]. This was reported by the ancient grammarians, as shown by the following quote by Servius (V c. AD):

> Vocales sunt quinque, *a e i o u*. Ex his duae, *e* et *o*, alter sonat productae, aliter correptae... *E* quando producitur, vicinum est ad sonum *i* litterae, ut *meta*; quando autem correptum, vicinum est ad sonum diphthongi, ut *equus*.

> 'There are five vowels *a e i o u*. Two of these, *e* and *o*, sound in one way when long, in another when short. [...] Similarly when *e* is long it is near to the sound of the letter *i*, as *meta*; but when short it is near to the sound of the diphthong (i.e. *ae*), as *equus*.' (Sturtevant 1940:111)

In the same way, Pompeius (V c. AD) says:[9]

> *e* aliter longa aliter brevis sonat. ... Ergo quomodo exprimenda sunt istae litterae? Dicit ita Terentianus, "Quotienscumque *e* longam volumus proferri, vicina sit ad *i* litteram." Ipse sonus sic debet sonare quomodo sonat *i* littera. Quando dicis evitat, vicina debet esse--sic pressa, sic angusta ut vicina sit ad *i* litteram. Quando vis dicere brevem *e*, simpliciter sonat.

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[9] The same can be said for the back vowels. Terentianus states: [..] *"Igitur sonitum reddere cum voles minori, retrorsus adactam modice teneto linguam, rictu neque magno sat erit patere labra. At longior alto tragicum sub oris antro molita rotundis acuit sonum labellis."* 'Therefore when you want to give sound to short o, hold the tongue drawn back moderately, and it will be enough for the lips to be parted a little. But long o, formed in the deep cavern of the mouth, sharpens its tragic sound with rounded lips.' (Sturtevant 1940:118)

'Long *e* has one sound, short *e* another... How then are those letters to be pronounced? Terentianus says: Whenever we want to produce long *e* let it be near letter i" The sound itself should sound as the letter *i* sounds. When you say *evitat*, it should be near--so compressed, so narrow as to be near the letter *i*. When you want to pronounce short *e*, it has an unmixed sound. (Sturtevant (1940:111)

A difference in [ATR] values is also reported for the high vowel. For example the late grammarian Consentius in *De Barbarismis et Metaplasmis* 16.1-4 reports the following:

<*i* littera> medium quidam inter *e* et *i* habet, ubi in medio sermone est, ut *hominem*. Mihi tamen videtur, quando producta est, vel acutior vel plenior esse, quando brevis est, medium sonum exhibere...

'<The letter *i*> has a sound intermediate between *e* and *i* when it is in the middle of a word, as *hominem*. To me, nevertheless, it seems to be sharper or (perhaps) fuller when it is long, and when it is short (it seems) to show the intermediate sound' (Sturtevant 1940:112).

An obvious issue here is the nature of this intermediate sound: was it a [-ATR] [ɪ] or had it already been lowered to [e]? Inscriptional evidence seems to indicate that it had already been lowered. Thus, we find mistakes such as the following in inscriptions: *admenistrator*, CIL12.674, instead of *admĭnĭstrator*, *anema*, CIL 10.3305, instead of *anĭma, carmena*, CIL 3.12854, instead of *carmĭna, fede*, CIL 12.2089, instead of *fĭde, menus*, CIL 8.9984, instead of *mĭnus, corenthus*, CIL 9.4569, instead of *corĭnthus*. The same type of errors are found in the case of short ŭ: *colomnas*, CIL 9.4875, *moritor*, 3.14190, *oxor*, 3.9585 instead of *colŭmnas, moritŭr, ŭxor*. In the same way, Spence (1965) found that the Latin short ĭ , ŭ were often transcribed as e , o in the Latin inscriptions of Pompei (79 A.D.), for example *veces*, instead of *vĭces, pravessimus*, instead of *pravĭssimus, mulierebus*, instead of *mulierĭbus*,

Errors such as *posuiru* instead of *posuērunt, minsibus* instead of *mēnsibus, filix* instead of *fēlix, crudilitas* instead of *crudēlitas, octubris , nepus* instead of *octōbris , nepōs* (quoted by Palmer 1954)--where *ē, ō* are replaced by *i , u* --can be considered as further evidence that the sounds represented by *ē/i , ō/u* had become identical. According to Palmer (1954), these errors are due to confusions of spelling which must be interpreted on the principle that sound symbols are not interchangeable unless they have similar values. Now, the Latin alphabet did not in general distinguish between long and short vowels. "Consequently, in Vulgar Latin the single letter *E* had two values, *[e]* (< *ē*) and

[ε] (< ĕ). Similarly the letter I could represent *[i] (< ī)* and *[e] (<ĭ)*. This meant that when the partially educated writer was faced with the task of rendering his own pronunciation *[e]* he could use either *E* or *I*"(Palmer 1954:154). The same could be said of ŭ.

Looking back to the different historical treatments of the diphtong *ae* will now allow us to pinpoint when these changes occurred. Earlier we saw that 'rustic' Latin was characterized by a monophtongal outcome for urban Latin *ae*. We find effect of this 'rustic' pronunciation in written documents where the diphthong *ae* was often replaced by vowel letter *e* (Kuhner & Holzweissig 1966: 26). So in the inscriptions, we find the letter *e* instead of the correct digraph *ae*, e.g. *pretor, preda, sepe* instead of the correct *praetor, praeda, saepe* (cf. Grandgent 1962, Leumann-Hofmann-Szantyr 1977). Interestingly, as we expect from the discussion of hypercorrection in the preceding pages, we can have the opposite situation: the digraph *ae* is used in place of the letter *e*. Here we find an interesting temporal split. Before the I c. AD, the digraph *ae* is used where we expect a long *ē*; after that date *ae* is instead often used where we expect a short *ĕ* (cf. Sturtevant 1940:127), Kuhner & Holzweissig (1966:26). Thus, before the I c. AD, we can find *haeres, caeteri* instead of the correct *hēres, cēteri* (Kuhner & Holzweissig 1966). In contrast, after this time we find *saenatus* (CIL 6.5180) instead of *sĕnatus*, in the inscriptions from Pompei (quoted by Väänänen 1981:31): *haberae* instead of *haberĕ, maeae* instead of *mĕae, advaentu* instead of *adventu, saecunda* instead of *secundae*, In the same way, the grammarian Pompeius (V c. A.D.) blames the confusion of *aequus* and *equus* (quoted by Grandgent 1962).[10]

How can we explain the diffent types of spelling mistakes involving *ae*? Although the monophthongization of *ae* emerged first in rustic Latin, it eventually spread to urban Latin. We have established that its outcome was a long mid [-ATR] [ɛː] in rustic Latin. Remember that rustic *ae* could be confused with urban *ē* only so long as there was no distinction in quality between them. Thus before the first century A.D., *ae* and *ē* were both the long [-ATR] vowel [ɛː]. At this very time, Greek words with *η* were transcribed in Latin by both *e* and *ae*: for Greek σχηνή, σχῆπτρον, we thus have the Latin spelling *scaena/scena, scaeptrum/sceptrum*, as mentioned above.

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[10] Obviously we have also case going the other way around. Thus *queritur* is used instead of the correct *quaeritur*; Ausonius (IV c. A.D.) uses *Citheron* instead of *Cithaeron*, Prudentius (IV c. A.D.) *enigmata, heresis, sphera* instead of *aenigmata, haeresis, sphaera* (Kuhner & Holzweissig 1966).

Let us assume that when the monophthongization of *ae* spread to urban Latin, its outcome remained the same, i.e., a long [-ATR] [ɛ:]. This is a natural hypothesis. Furthermore, let us suppose that the monophthongization process was introduced in urban Latin only after the differentiation in [ATR] values between long and short vowels became a characteristic feature of this variety. At this point, urban [ɛ:] had already become [+ATR] e: and therefore it was no longer possible to confuse the digraph *ae* with the letter *ē*, because they had come to represent sounds that differed in quality. In contrast this digraph was used in place of short *ĕ*, since at this point these were the only letters that represented sounds which had the same quality ɛ. The difference in length was put aside in favor of the similarity in quality (Sturtevant 1940:111). We thus have an explanation of the temporal difference in the spelling mistakes involving *ae*. An important consequence follows from this: Given that the inscriptional records shows that the replacement of *ĕ* with *ae* begins to occur around the first century AD, we must conclude that the process differentiating the [ATR] values of short and long vowels must have already occurred around this time.

Thus after the I c. AD, the Latin vowel system had changed as follows:

(12) i: i   ɛ: ɛ   a: a   ɔ   ɔ: u   u:
     ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓
     i: e   e: ɛ   a: a   ɔ   ɔ: o   u

The best and most widely accepted traditional account for the changes that were described above is that proposed by Weinrich (1958) in a structuralist model.[11] It can be restated as follows in more current theoretical terms: the first step in the development involves the association of ATR values with length opposition by means of the process in (13). For now, I simply assume that [ATR] is the feature assigned by this process.

(13) a.
$$X \quad X$$
$$\backslash \ /$$
$$[\text{-cons}]$$
$$|$$

[ ] > [+ATR] / ___

---

[11] Spence (1965), Lüdtke (1965) Franceschi (1974) proposed alternative analyses of the development in (16) which cannot be discussed here.

b.   X
                                |
                             [-cons]
                                |
          [   ] > [-ATR] /   ___

After the application of the process in (13) the superficial voçalic system of Latin differed from that of classical Latin as in (14). The feature [+ATR] was not assigned to long [aː]. I assume that this is a case of blocking by an independently needed constraint against [+low, +ATR] vowels. This aspect of the change will not be discussed here.

(14) Cl. Latin: iː   i   εː   ε   aː   a   ɔ   ɔː   u   uː
                   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓
     Late Latin I: iː   ι   eː   ε   aː   a   ɔ   oː   ʋ   uː

The other crucial step in the traditional reconstruction is a reinterpretation of [+high, -ATR] vowels ('open' high vowels in the traditional terminology) as [-high, +ATR] vowels ('close' mid vowels in the traditional terminology). This is shown in (15). The process describing this change is given in (16). After the application of (16) we obtain the changes in (17).

(15) [ι] → [e]
      [ʋ] → [o]

(16) [+high, -ATR]   →   [-high, +ATR]

(17) Late Latin I: iː   ι   εː   ε   aː   a   ɔ   ɔː   ʋ   uː
                      ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓
     Late Latin II: iː   e   eː   ε   aː   a   ɔ   oː   o   uː

The final change to discuss was the loss of length oppositions. I will not discuss this change in detail here. It is enough to say--simplifying a little bit--[12]

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[12] This çhange occured only in stressed syllables in penultimate position (cf. Lat. 'teːla> It. 'teːla, Lat. 'pεdε(m)->It. 'pyεde (In Italian long [εː, ɔː] are diphthongized into [yε, wɔ]), Lat. 'stεːlla> It. 'stella, 'rεːgnu(m)>It. 'regno. That stressed syllables in antepenultimate position were not affected is shown by forms such as 'mεdicu(m)>It. 'mεdico, Lat. 'pεcora> It. 'pεcora (but there are exceptions, e.g., Lat. 'tεpidu(m)>It. tyεpido). This seems to indicate that foot structure plays a role in this changes. See D'Imperio and Rosenthal (1999) on the synchronic distribution of vowel length in Italian. Length distinctions were lost in unstressed

that short vowels lengthened in open syllables and long vowels shortened in closed syllables so that we get (18) (cf. Ten Brink 1879, Weinrich 1958 for more discussion).

(18)   Classical Latin: iː   i   ɛː   ɛ   aː   a   ɔ   ɔː   u   uː
       (13):   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓

                          iː   ɪ   eː   ɛ   aː   a   ɔ   oː   ʊ   uː
       (16):   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓   ↓

                          iː   e   eː   ɛ   aː   a   ɔ   oː   o   uː
       L-Loss: | ∨ | ∨ | ∨ |
       Romance: i   e   ɛ   a   ɔ   o   u

As discussed above, the evolution of the Latin vocalic system into the vocalic system of southern Lucanian and Sardinian involves simply loss of length oppositions and preservation of the quality of the Classical Latin vowels. It is given in (19).

(19) Classical Latin: iː   i   ɛː   ɛ   aː   a   ɔ   ɔː   u   uː
     L-Loss: ∨   ∨   ∨   ∨   ∨
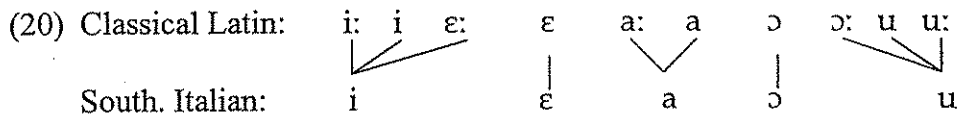   S.Lucan./Sard.:   i   ɛ   a   ɔ   u

Now, notice that (13) had to be active processes at a stage where Latin still had length oppositions. The presence of varieties characterized only by loss of quantity but not by (13) (and (16)) indicates that we need to reconstruct at least two Latin dialects. Only one dialect had (13) and (16), and it developed as in (18). The more conservative variety preserved the classical Latin vowel system. Crucially the loss of length oppositions spread throughout both dialects. This accounts for what happens in the more conservative variety (19). The evolution in (20), characteristic of many southern Italian varieties, can be explained by the addition of (21) to the system in (18) (see 22):[13]

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syllable at a much earlier stage of Latin. All types of processes of reduction and syncope affected vowels in these positions. The development of unstressed vowels will not be discussed here.

[13] An interesting development characteristic of Romanian and Eastern Lucanian is in (i), where a distinct [+ATR] midvowel appeared only in the front vowel and not in the back one. It will not be discussed here. See Calabrese (2003) for an account:

     (i)   Classical Latin: iː i eː ɛ aː a ɔ oː u uː
                               | ∨ | ∨   ∨   ∨
            Rom./E.Lucan.:   i   e   ɛ   a   ɔ   u

(20) Classical Latin: iː i εː   ε   aː a   ɔ   ɔː u uː

South. Italian: i   ε   a   ɔ   u

(21) [+ATR] → [+high]

(22) Classical Latin: iː i εː   ε   aː a   ɔ   ɔː   u uː

Romance in (18):   i   e   ε   a   ɔ   o   u

(21):

South. Italian   i   ε   a   ɔ   u
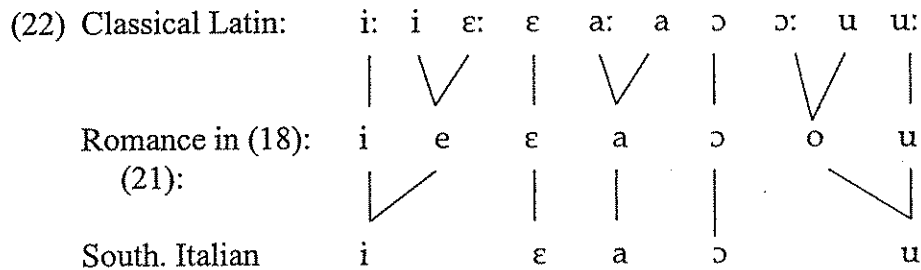
## 2. The change [+high, -ATR]-->[-high, +ATR].

The crucial sound change modifying vowel quality in the Latin system is that in (16). It is a fact that a merger between [+high -ATR] vowels and [-high, +ATR] vowels is quite common across the languages of the world. Here I provide a few examples.

1. The proto-language for the Niger Congo Kwa (Stewart 1972) is reconstructed as having the ten-vowel system in (23), with [±ATR] opposition for each vowel where capital /A/ is a [+ATR] low vowel:

(23)   -ATR   +ATR

ɪ   ʊ   i   u

ε   ɔ   e   o

a   A
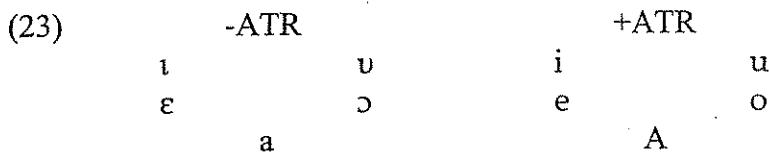
However, only a few of the modern Kwa languages have a vocalic system like that in (23). Stewart shows that the [+ATR] low vowel and the [-ATR] high vowels are most commonly eliminated by the context-free changes in (24)-(25). The change that is of particular importance here is the one in (25iii):

(24) i. A > a (i.e., [+low, +ATR]-->[+low, -ATR])
     ii. A > e (i.e., [+low, +ATR]-->[-low, +ATR])
     iii.A > ε (i.e., [+low, +ATR]-->[-low, -ATR])

(25) i. ɪ, ʊ > i, u (i.e., [+high, -ATR]-->[+high, +ATR])
     ii. ɪ, ʊ > ε, ɔ (i.e., [+high, -ATR]-->[-high, -ATR])
     iii. ɪ, ʊ > e, o (i.e., [+high, -ATR]-->[-high, +ATR])

2. Elugbe (1982) observes the same type of reductions that we see in the Kwa languages in another group of African language, the Edoid languages. The vowels that were eliminated from the proto-language of these languages were the [+high, -ATR] /ı, ʊ/ and the [+low, +ATR] A and the different reflexes of these vowels are similar to those found in the development of the Kwa languages: namely in the development from the proto-language to the daughter languages, /ı/ became [i], [e] or [ɛ], /ʊ/ became [u], [o] or [ɔ], and /A/ became [a], [e] or [ɛ].

3. The same changes are found in the Sudanic and Tungusic languages (Vaux 1996).

4. The change [ı, ʊ] → [e, o] is found in vowel harmony systems (cf. the so called 'Umbrian' metaphony) after the raising to high of mid [-ATR] vowels (Calabrese 1998, Zetterstrand 1998).

5. The change [ı, ʊ] → [e, o] accounts for the lowering of short lax vowels in Chinautla (a dialect of Pokoman, a Quichean language) (cf. Campbell 1977, Donegan 1978):

(26)   ʊkʻ > okʻ   'louse'
        pıš > peš   'tomato'

6. In southern and Western Swedish, beginning in the 15th century, short lax [ı] and [ü] were lowered to [e] and [ø,] thus *fesk* 'fish', *møkke* 'much' versus Central Swedish *fısk, mükke* (Haugen 1976, Donegan 1978).

In all of these cases we observe the context-free process in (27) merging [-ATR] high vowels with [+ATR] mid vowels. It is formalized in (28), equal to (28), above.

(27)   [ı, ʊ] → e, o

(28)   [+high, -ATR] → [-high, +ATR]

Weinrich (1958) explains the merger in (27) by assuming that the [+high, -ATR] vowels (his 'open' high vowels) and the [-high, +ATR] vowels (his 'close' mid vowels) are acoustically very similar. Given this similarity, it is assumed that these two classes of vowels cannot be used for an efficient phonological contrast, and therefore they are merged. Let us explore this idea, although it is unclear if such functional acoustic explanations ever work in phonology. Weinrich's analysis is stated in terms of the structuralist model that was fashionable at the time he wrote his essay. His account, however, could be

restated in terms of the P-map theory of Steriade (1999), a much more contemporary model. Steriade argues that the knowledge of the relative acoustic similarity between segments is a fundamental part of the linguistic knowledge of a language. The P-map includes statements such as that in (29):

(29) The pair of segments x-y is more similar than the pair of segments w-z.

Assuming that segments that are acoustically more similar are easier to be confused in perception, it follows that some featural contrasts are more confusable than others.

According to Steriade, the primary function of a P-map is to guide the speaker in search of the minimal input deformation that can solve the problems posed by a linguistic constraint. She assumes that speakers actively try to avoid perceptible deviations from established lexical norms. The P-map serves as an instrument differentiating more from less perceptible innovations. In our case we would have a statement such as that in (30):

(30) A vowel involving the features [+high,-ATR] is more similar to a
       vowel involving the features [-high,+ATR] than to any other vowel.

To account for the change we observe in (28), we assume, as stated in (30), that the [+high, -ATR] vowels [ɪ, ʊ] are acoustically similar to the [-high, +ATR] vowels [e, o]. On the other hand, we need a trigger for the change, the problem that speakers solve by resorting to the minimal deformation suggested by (30). This problem must be posed by a linguistic constraint against [+high, -ATR] vowels. As a matter of fact, the configuration [+high, -ATR] is argued to be phonologically complex in Calabrese (1988, 1995) and excluded by the marking statement in (31).

(31) * [+high, -ATR]

If this constraint is active, these vowels must be repaired. If we assume that speakers follow the P-map in this repair and replace a disallowed segment with a segment that is minimally different from the target segment, we have an explanation for the change in (28).

Statements such as those in (30), which must obviously be universal to have any explanatory power, predict the existence of only one possible repair, that in (28). Observe now that as we can see in (25) and in many other cases, the elimination of the [+high, -ATR] vowels does not lead only to [e] and [o], but

also to the [+high, +ATR] vowels [i] and [u] and the [-high, -ATR] vowels [ɛ] and [ɔ]. This is totally unexpected in Steriade's theory where such dialectal variation should not be allowed.

We could modify Steriade's theory and propose that the P-map in some cases actually includes ranges of possible similarities of identical ranking. This would fundamentally weaken the idea that certain acoustic configurations are more similar than others: if [+high, -ATR] [ʊ] is not only similar to [-high, +ATR] [o] or to [+high, +ATR] [u]--a plausible statement from the acoustic point of view-- but also to [-high,-ATR] [ɔ] --a less plausible statement--, why isn't it similar to [ə], [ʌ], [ɨ], etc.? How do we restrict the range of possible similarities? But let us assume that this idea of a range of similarities is fine. If we do this, dialectal variation would be allowed. In the cases under discussion, this range would overlap with the possible changes we see in (25). Thus, we would have the range of similarities in (32), given in featural terms:

(32) a. [+high, -ATR]   =   [+high, +ATR]/ [-cons. .., ___]
     b. [+high, -ATR]   =   [-high, -ATR]/ [-cons. .., ___]
     c. [+high, -ATR]   =   [-high, +ATR]/ [-cons. .., ___]

But once we assume such a range of possibilities, we are in a situation in which we can no longer say anything about the actual changes we observe in the individual languages. To account for them we still have to say that in the language in (25i), we preserve the feature [+high], while we change the feature [-ATR]; in (25ii), we preserve the feature [-ATR] while changing [+high]. Crucially in the case in (25iii), we have to say that we do not preserve any features, but that we change both of them. Once we allow for a range of similarities, we are forced to account for the occurrence of each of the changes in independently motivated formal terms, and thus the P-map becomes totally redundant.

We could try to fix the problem noted above by proposing a mixed analysis, and say that whereas (25i) and (25ii) are repairs involving featural changes outside the control of the P-map, only the change (25iii) ([+high, -ATR] → [-high, +ATR]/ [-cons. .., ___]) is accounted for by the P-map. But also in this case, we would have problems, besides the further weakening of the P-map theory, insofar as we have to explain why it is just in the repair in (25iii)-- where the P-map should play a explanatory role -- that both feature values of the target configuration are changed.

We can conclude that the account of (28) in terms of a functional theory of acoustic similarities is simply not explanatory and cannot be maintained.

3. *The repair strategy of negation*

A more formal approach is proposed in Calabrese (1985). In that paper, I hypothesized that the sound change in (28) is not arbitrary, but that as in the account proposed above, it involves a repair triggered by the active marking statement in (31). Specifically in that paper I proposed that (28) is an instance of the simplification rule of negation applied to repair the configuration [+high, -ATR] yielding the derivation in (33). Calabrese (1995) proposes that negation as a repair has the format in (34):

(33) [+high, -ATR] → - ([+high, -ATR]) → [-high, +ATR]

(34) [αF, βG]   →   -([αF, βG])   →   -αF, -βG
    where [αF, βG] is a disallowed configuration.

In Calabrese (1995) I also propose that (34) in conjunction with the repair strategy of Delinking (which fixes a disallowed configuration by changing only one of its features) accounts for the range of repairs we observe in (24) and (25):

(35) a. A > a (delinking of [+ATR]) (*[+low, +ATR]->[+low, -ATR])
        ɪ, ʊ > i, u (delinking of [-ATR]) (*[+high, -ATR]->[+high,+ATR])
     b. A > e (delinking of [+low]) (*[+low, +ATR]->[-low, +ATR])
        ɪ, ʊ > ɛ, ɔ (delinking of [+high]) (*[+high, -ATR]->[-high, -ATR])
     c. A > ɛ/ɔ (negation) (*[+low, +ATR]->[-low, -ATR])
        ɪ, ʊ > e, o (negation) (*[+high, -ATR]->[-high, +ATR]

In addition to the processes we observe in (35c), there are many other phenomena that seem to indicate the existence of something like negation. They are listed below. All of these processes involve a context-free reversal of the feature specifications of the input configuration.

1. The contraction of a low and a high vowel creates a mid-vowel in many languages (i.e., a+y, a+w → ɛ, ɔ). In Calabrese (1988) I hypothesized that the coalescence of the two vowels creates a bundle containing the disallowed configuration [+high, +low]. This configuration is repaired by negation into the configuration [-high, -low], thus creating a mid-vowel.

2. The front round vowels [ö, ü] became the back unround vowels [ɨ, ə], i.e. [-back,+round] → [+back,-round] in the history of Mongolian and Celtic (see Dressler 1974 and below) (cf. also the pronunciation of /ö/ as [ɝ] by English speakers (*Gödel* pronounced like *girdle*) (see Kiparsky 1973).

3. The back unround vowel [ə] becomes [ö], i.e., [+back, -round] → [-back, +round] in the pronunciation of English /ə/ by foreign speakers (see Jones 1918).

4. Zetterstrand (1998) argues for a rule in Nzebi spreading the feature [+ATR]. The illicit output of this rule in (ii) and (iii) are repaired by negation in Zetterstrand's analysis:

    i.   ɪ, ʊ   →   i, u
        [+high, -ATR] → [+high, +ATR] (by [+ATR] spreading)

    ii.   ɛ, ɔ   →   ɪ, ʊ
        [-high, -ATR] → *[-high, +ATR] → [+high, -ATR]
        (by [+ATR] spreading followed by negation)

    iii. a   →   ɛ
        [+low, -ATR] → *[+low, +ATR] → [-low, -ATR]
        (by [+ATR] spreading followed by negation)

5. Zetterstrand (1998) argues for a rule in Swedish inserting the feature [+low]. The illicit output of this rule are repaired by negation in Zetterstrand's analysis:

    i.   ɛ, œ, ɔ   →   Œ, a
        [-high, -low, -ATR] → [-high, +low, -ATR]
        (by [+low] insertion)

    ii. e, ö, o   →   ɛ, ɵ, ɔ
        [-high, -low, +ATR] → *[+low, +ATR] → [-low, -ATR]
        (by [+low] insertion followed by negation)

    iii. i, ü, u   →   e, ö, o
        [+high, -low] → *[+high, +low] → [-high, -low]
        (by [+low] insertion followed by negation)

6. Voiced aspirated stops are changed into voiceless unaspirated ones in Armenian dialects (Vaux 1998), i.e., b^h, d^h, g^h → p, t, k ([-stiff v.f., +spread gl.] → [+stiff v.f., -spread gl.]).

A schematic list of the changes mentioned above is provided in (36):

(36) a. [+low, +ATR]   → [-low, -ATR] (= (35), 4.iii and 5.ii above)
     b. [+high, +low]   → [-high, -low]   (=1. and 5.iii above)
     c. [-back, +round] → [+back, -round   (= 2. above)
     d. [+back, -round] → [-back, +round]   (= 3. above)
     e. [-high, +ATR]   → [+high, -ATR]   (= 4.ii above)
     f. [-stiff v.f., +spread gl.] → [+stiff v.f., -spread gl.] (= 6. above)

All of the input configurations of negation in (33) and in (36) are phonologically complex and governed by independently motivated marking statements or prohibitions such as those listed in (37):

(37) a. *[+high, -ATR]   (input of (33))
     b. *[+low, +ATR]   (input of (36a))
     c. *[+high, +low]   (input of (36b))
     d. *[-back, +round]   (input of (36c))
     e. *[+back, -round]   (input of (36d))
     f. *[-high, +ATR]   (input of (36e))
     g. *[-stiff v.f., +spread gl]   (input of (36f))

The obvious objection against assuming that the same repair is operating in (33) and (36) is that the generalization it expresses is spurious: we could say that in these cases, we are not dealing with a single phenomenon but with different ones. For example we could assume that in the case of (33), (36a) and (36e) we are dealing with a process based on acoustic similarity, a hypothesis which however I have already shown to be untenable. But this surely cannot be said for the changes in (36c, d) and (36f) where the input and the output of the change are not acoustically similar, and especially for (36b) where the input [+high, +low] is articulatorily impossible. Therefore, an operation like negation must be assumed to exist in phonology at least to account for cases such as (43b, c, d, f). But if it must be used to account for these cases, it can also account for (33), (36a and 36e).

Negation, however, remains problematic for two reasons. First, it crucially relies on the binarity of features. There is quite strong evidence for their binarity: there are no languages that exhibit a phonological contrast between full realization/half-realization/no realization for some feature. Still, negation is an operation that crucially requires solely the switching/reversing of one value into its opposite. At first sight, this type of reversing/switching may be

regarded as unappealing. As we will see, however, there are sound changes that crucially require this feature value reversal.

Second, it crucially requires the simultaneous application of two operations. In phonology, and in particular in non-linear phonology, application of multiple operations has been allowed only when the targets form a constituent in the representation, for example, spreading or delinking of multiple features is supposed to occur only when each of these features is dominated by the same node, as in (3). As a matter of fact, one of the major successes of non-linear phonology, and in particular of feature geometry, was its account for the clustering of features in assimilation or dissimilation processes (cf., McCarthy 1989, Halle 1995). Negation seems to violate the requirement that the targeted features have something in common. We will see that this is not true.

Let us consider the first issue. Negation in its reliance on feature value switching relates to another set of processes that also crucially involve feature binarity, the processes that in classical generative phonology were described by the so-called 'exchange' rules: these processes are characterized by a switch in segments characterized by an exchange in feature specifications formally expressed as in (38):

(38) $[\alpha F]$ ---> $[-\alpha F]$

Some sample cases of processes involving exchange rules are listed below:

1. The vowels shift in English in the analysis of Chomsky & Halle (1968). The vowels shift of the Armenian dialect of Zok (Vaux 1998), in particular, the exchange between /u/ and /o/:

(39)   Classical Armenian   Zok
        o → u:
        gorc   gᵞurc   '(handi) work'
        Markos   Markus   'Mark'
        u → o:
        šun   šon   'dog'
   ptuʁ   pətoʁ   'fruit'

2. The exchange of [ATR] values in the mid vowels of Corsican (cf., Rohlfs 1966) and in many Apulian dialects (cf., Loporcaro 1989) so that etymological [+ATR] [e] and [o] became [-ATR] [ɛ] and [ɔ] and etymological [-ATR] [ɛ] and [ɔ] became [+ATR] [e] and [o] as in (40):

(40) [αATR] → [-αATR]/ [_____ , -high, -low]

3. The dissimilation in backness in the nuclear element of diphthongs (cf. 41b) which accounts for the dialectal variation between the Received Pronunciation (RP) and the Popular London (PL) dialect of British English in (41a) (Wells 1982:310, Kenstowicz 1994):

(41) a.   'price'   'mouth'
           RP: [aɪ]   [ɒʊ]
           PL: [ɒɪ]   [æʊ]
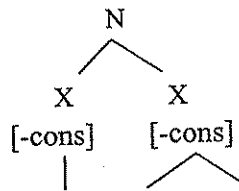
b. [αback] → [-αback]/ [_____] [αback +high]

4. The process of Tone polarity in Margi where an affix has the opposite tone of the adjacent stem tone Kenstowicz 1994):

(42) a. à sá gù   'you go astray'
         à tsú gù   'you beat'
     b. á wǐ gú   'you run'
         á dlà gú   'you fall'
     c. á vǎl gù   'you fly'

(43) Tonal Polarity rule:
     [αStiff v.f] → [-αStiff v.f]
     (where High Tone = +stiff vocal folds, Low tone = -stiff vocal folds)

5. In Common Czech /i/ → [e] and /e/ → [i]. Surface [e] later dipthongizes into [ej]. (Wolfe 1970, Anderson and Wayles 1973).

6. In some varieties of Arabic, there is an imperfect form whose form depends of the stem vowel the verb has in the perfect. If it is /a/, it is replaced with /o/, if it is /o/ it is replaced with /a/ (Chomsky & Halle 1968).

7. Luo has a process which exchanges voiced and voiceless stops in two morphological categories before the plural marker /-e/ and in the singular

appertentive: *got* 'mountain' > *gode* 'mountains' (ct. *god* 'mountain-of'), *lwedo* 'hand'> *lwete* 'hands'(ct. *lwet* 'hand-of') (Gregersen 1972).

8. In Shilluk we have a similar process: *lep* 'tongue' plural *leb, tuyc* 'rifle' plural *twaj, bak* 'fence' plural *bag, jago* 'chief' plural *jak* (Anderson & Wayles 1973).

There is no way of characterizing the processes listed in (49) other than by positing an operation switching the values of a given feature such as that in (48) as proposed by Chomsky & Halle (1968) in introducing exchange rules.[14] The existence of exchange rules demonstrate that at least a subset of features must be binary, and that processes where a value of a feature switches to its opposite specification must be possible.

Now consider the second issue. The existence of processes characterized by the simultaneous application of two different operations had already been noticed by Donegan & Stampe (1978) and Donegan (1978). In particular, at this regard, Donegan (1978) mentions the case of the merger of middle Welsh /ü/ with /ɨ/. The issue in this case is that when /ü/ changed into /ɨ/, both /i/ and /u/ also existed in Welsh. Since no merger with either /i/ or /u/ occurred, there is no doubt that both the process of de-rounding of /ü/ as in (44a) and the process of tongue body backing of the same vowel as in (44b) must have occurred simultaneously as in (45), i.e., by the negation process formulated in (36c).

(44) a. [+high, +round, -back]   →   [-round]
      b. [+high, +round, -back]   →   [+back]

(45)   [-back, +round]   →   [+back, -round]

As mentioned above, the multiple application of operations is disliked on the assumption that the simultaneous clustering of phonological operations must be motivated. Now at first nothing seems to put together the two features

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[14] Notice that in the exchange of [ATR] values in the mid vowels of many Apulian dialects where we have the change in (i), there is no plausible diachronic way of accounting for this change by means of intermediate steps. Both changes must have occurred simultaneously. The same is true for the dissimilation in backness affecting diphthongs in British English in (41b).

  (i) [+ATR] [e, o] → [-ATR] [ɛ, ɔ]
      [-ATR] [ɛ, ɔ] → [+ATR] [e, o]

undergoing negation. However, if we consider this issue in terms of the theory of markedness as before, the solution becomes clear. The fact is that all the feature combinations undergoing feature value reversal are independently disallowed by active marking statements (see 37). The fact that negation targets the entire disallowed configuration accounts for this clustering of features in a natural way.

Negation as stated above in (34) is a repair of an ill-formed configuration that is implemented by a special procedure involving a special set of instructions, those stated in the rule in (34).

In Calabrese (2002) I propose that repairs are better accounted for if they are seen as involving totally free manipulations of the ill-formed configuration which produce several, but not infinite as in OT, possible outputs. An evaluation procedure then picks out the most appropriate repair among these possible outputs on economy grounds.

.I will not be able to discuss a different way to see negation under this new approach here. I refer the reader to Calabrese (2002) for discussion and a different formulation of negation. What is important to stress here is that regardless of how this repair operation is interpreted (i.e, as the result of a special procedure or as the outcome of a free repair process), we have to assume the possibility of repair processes targeting a given ill-formed feature configuration and radically changing it in such a way that all aspects of the input ill-formed configuration are changed. In negation all aspects of the input ill-formed configuration are changed. Nothing is preserved. The peculiarity of Negation is therefore that it is radical, it is the most drastic measure to undertake against a disallowed configuration: total removal. It is as if both features of a marked configuration are marked as 'bad' and need to be removed. In OT terms we would be forced to say that negation is governed by something like an "anti-faithfulness" constraint.

Consider the Welsh case. Front rounded vowels became disallowed because the marking statement in (46) became active. Application of negation to the now disallowed front rounded vowels produced (47):

(46) *[-back, +round]

(47) [-back, +round]   →   [+back, -round] ([ü]->[ɨ])

From the point of view of this paper, the importance of negation is in accounting for the merger between the [+high, -ATR] and the [-high, +ATR] vowels of Proto-Romance, a merger that would otherwise remain mysterious.

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The negation operation in this case is represented in (33) repeated here as (47). The effect of (47) is to change the [+high, -ATR] vowels [ɪ, ʊ] into [e, o], thus accounting for the merger we observe in from classical Latin to Romance.

(48) [+high, -ATR]   →   [-high, +ATR]

4. *Conclusion*

Summarizing, I proposed that the process merging the high [-ATR] vowels and the mid [+ATR] vowels is due to a repair operation simplifying the marked configuration [+high, -ATR]. This operation changes the feature specification of a marked configuration into their opposite ([-aF, -bG]), therefore [+high, -ATR] →[-high, +ATR].

I have proposed a theoretical explanation for some aspect of the historical evolution of the Latin vowel system. In concluding it, I would like to stress the importance of re-examining linguistic history in the light of the ever evolving linguistic theory, and to propose explanations of historical facts using current frameworks. The validity of such explanations, as in all sciences, is in their ability to reduce the phenomena under analysis to other known phenomena and to extend the proposed explanations to other independent facts. I hope to have done this in this article by showing that the merger process we observe in (1) is nothing else than an instance of a more general process that removes marked segments and which is found in many other languages.

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