

Velar and dental stop consonant softening in Romance*

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Experimental and descriptive evidence from the Romance languages suggests that velar and dental stop consonant softening, i.e., the process by which stops of these places of articulation turn mostly into palatoalveolar or alveolar affricates or fricatives, has proceeded gradually through intermediate (alveolo)palatal stop realizations. Several arguments are adduced in support of this interpretation: the presence of (alveolo)palatal stops and of (alveolo)palatal consonants of other manners of articulation in Romance languages and dialects, whether through gestural blending, gestural strengthening or other production strategies; alternations between (alveolo)palatal stops and affricates in several dialectal areas; variability in closure location for (alveolo)palatal stops in general, which accounts for their confusion with dental or velar stops; experimental evidence from speech production and perception studies. Moreover, there appears to be a plausible relationship between (alveolo)palatal stop realizations differing in closure fronting, and differences in fronting in the affricate and fricative outcomes of original Latin dental and velar stops. Historically, those differences depend mainly on place of articulation and voicing for the original stop as well as on the contextual and position conditions in which the stop occurred. The present investigation reveals that fine articulatory detail needs to be taken into consideration in the formulation of phonetic explanations of sound change.

Keywords: velar softening, dental softening, palatalization, alveolopalatal consonants, Romance languages, gestural blending, gestural strengthening, stop closure fronting

* This research was funded by projects MEC HUM2006-03743 and FFI2009-09339 from the Spanish Government, FEDER, and 2005SGR864 and 2009SGR3 from the Catalan Government. I would like to thank José Ignacio Hualde, Carmen Pensado, Joe Salmons, Fernando Sánchez Miret, Paul Videsott and three anonymous reviewers for comments on previous versions of the manuscript.

1. Introduction

Experimental evidence demonstrates the need to pay attention to phonetic detail in the study of the causes of sound change. It has been shown that phonetic attributes such as vowel nasalization and pharyngealization or velarization in /l/ do not proceed categorically but continuously. Indeed, languages and dialects differ in the degree to which these attributes are realized as opposed to vowels being produced as either fully oral or fully nasal (Solé 1992, 1995), or in /l/ being invariably strongly clear or strongly dark and thus exhibiting F2 frequencies about 2000 Hz or about 1000 or less (Carter & Local 2007). The non-categorical status of some phonetic features is relevant for phonology to the extent that it may affect the phonetic characteristics and the distribution of specific allophones as well as the implementation of segmental assimilations and other phonological processes. It is also relevant for sound change in so far as slight variations in the phonetic realization of given sound types may or may not trigger their perceptual replacement by other phonetic segments (Mowrey & Pagliuca 1995). For example, the vocalization of dark /l/ into /w/ is expected to take place just in the case of those variants of the alveolar lateral which are strongly dark and, therefore, exhibit highly similar formant frequencies to those for /w/.

This line of research will be pursued here by exploring the relevance of phonetic detail in the explanation of sound change in Romance through the analysis of the front affricate and fricative outcomes [(t)ʃ], [(d)ʒ], [(t)s] and [(d)z] of velar stops but also of dental stops, as for Romanian [tʃer] and French [ʃjel] derived from Latin CAELU, and for Romanian [puts] and Friulian [potʃ] derived from Latin PUTEU.¹ For the most part, we will be dealing with the affrication process of velar stops known as velar softening.

Based mostly on evidence from present-day dialects, Romance linguists in the past put forward an articulatory hypothesis according to which those affricate and fricative outcomes were formed from intermediate stop realizations exhibiting a palatal, alveopalatal or even alveolar closure location, i.e., [k] > [c] > [tʃ] and [t] > [c] > [ts] (Rousselot 1924–25, Scripture 1902). This articulation-based hypothesis was supported by extensive knowledge about the articulatory characteristics

1. Throughout the text, phonetic variants are usually represented in phonetic transcription, and are accompanied by their Latin etymon, the orthographic form in the reference language and an English gloss. The orthographic form may be preceded by the abbreviations Cat. (Catalan), Fr. (French), It. (Italian), Port. (Portuguese) and Sp. (Spanish). The major phonetic equivalences for the Latin etymological forms used in this study are as follows: TY=[tj], CY=[kj], CI/E=[ki/e], DY=[dj], GY=[gj], GI/E=[gi/e], CA=[ka], GA=[ga], I=[j]. Most of these sequences may occur word initially or intervocalically, e.g., DY- and -DY-, respectively. Moreover, postconsonantal [j] is represented by the characters I and E, as in PALEA “straw”.

of palatal consonants in Romance, which has been complemented in recent times with new data obtained with modern techniques such as electropalatography and articulography. Before exploring those sound change mechanisms, information needs to be provided about the typological and production characteristics of [ç] and other palatal consonants.

In the Romance languages, the lateral [ʎ], the nasal stop [ɲ], the oral stops [ç, ʝ], the fricatives [ç, ʝ] and the approximant [j] may be truly palatal and thus articulated at the prepalate, mediopalate and/or postpalate exclusively (as indicated by the IPA chart), but they are far more frequently alveolopalatal and thus articulated simultaneously in the alveolar and palatal zones (see Recasens 1990). Moreover, articulatory data reveal that these consonants exhibit differences in closure or constriction location depending on manner of articulation: the stops [ç, ʝ, ɲ] are generally alveolopalatal, and less typically, exclusively palatal; the lateral [ʎ] involves more alveolar fronting and less back dorsal contact than the three stops because of requirements on laterality; constriction location for the approximant [j] and for the fricatives [ç, ʝ] appears to occur most often in the palatal zone. In view of the considerable variation in closure or constriction location involved, those seven consonants will be referred to as '(alveolo)palatal', not just as 'palatal', throughout this paper. On the other hand, the affricates and fricatives [tʃ, dʒ, ʃ, ʒ] will be identified as 'palatoalveolar' since they often exhibit a lamino-postalveolar place of articulation with concomitant tongue dorsum raising (Recasens & Espinosa 2007). The affricates and fricatives [ts, dz, s, z] are fully alveolar.

(Alveolo)palatal consonants differ from dentals, alveolars and velars coarticulated with palatalizing vocalic segments (e.g., in sequences such as [ti, tj, ki, kj]), as well as from palatalized dentals, alveolars and velars in languages where these consonants have phonological status (e.g., [tʲ, kʲ] in Slavic languages). The former sequences are produced with two consecutive lingual gestures, i.e., a front or back gesture followed by a dorsopalatal gesture, activated sequentially in time. As to the latter comparison, the difference is one of gestural simplicity vs. gestural complexity. Distinctively palatalized dental, alveolar and velar consonants are complex segments involving the simultaneous and independent activation of a primary lingual gesture and a secondary dorsal gesture, which accounts for why the latter gesture may be significantly delayed with respect to the former one in languages such as Russian. (Alveolo)palatals, on the other hand, are simple segments involving a single laminopredorsal or dorsal closure or constriction and a gradual release usually proceeding from front to back (French: Bothorel, Simon, Wioland & Zerling 1986, Catalan: Recasens, Fontdevila & Pallarès 1995).

In principle, the affrication of [t, d] in sequences such as [tj, dj] can be easily accounted for articulatorily since dental stops and front affricates exhibit close-by closure locations (Hall, Hamann & Zygis 2006). Velar softening is more problematic

since the resulting affricate is articulated at a much more anterior location than the original velar stop. In order to cope with this problem, Ohala and colleagues have challenged the articulation-based hypothesis for the most frequent velar softening scenario, i.e., that of velar stops before front vocalic segments such as [i, e, j]. Their proposal claims that the change [k] > [tʃ] is not associated with a shift in place of articulation towards the front palate but with the spectral similarity between the velar stop burst and the frication noise of the palatoalveolar affricate, which share a similar frequency peak about 2500–3500 Hz. Some support for this hypothesis derives from the finding that [ki] may be confused with [ti] at the perceptual level (Chang, Plauché & Ohala 2001, Guion 1998).

More recent research has shown that, in principle, the acoustic equivalence hypothesis just referred to could account for velar softening for stops if aspirated but not if unaspirated. Unaspirated [k], which is the prevailing realization in Romance, cannot possibly be confused perceptually with [tʃ] (Recasens & Espinosa 2009, Zygis, Recasens & Espinosa 2008). Moreover, velar softening for unaspirated stops may not only apply before front vocalic segments but also before low [a] and central [ə] as well as word finally after any vowel (see §2.2). In line with descriptive and experimental evidence reported in early articulatory studies and in recent production and perception work, it can be concluded that the transformation of unaspirated velar stops into affricates and fricatives is not a discrete change involving two discontinuous places of articulation but a segmental substitution which has operated continuously through (alveolo)palatal stop realizations differing in degree of closure fronting. Within this framework, this paper will shed new light on the articulation-based hypothesis of velar softening by showing that phonetic differences in the affricate, fricative and other output realizations may be associated with the articulatory and aerodynamic characteristics of intermediate (alveolo)palatal stop productions.

The structure of the paper reflects the assumption that velar and dental stop softening is a two-step process involving first palatalization and then affrication. In §2, we will explore the mechanisms of (alveolo)palatal consonant formation, and will show that (alveolo)palatal consonants in general and (alveolo)palatal stops in particular are frequent sounds in the Romance languages. Sections 3 and 4 raise several articulatory, historical and dialectological arguments in support of the notion that dental and velar stops have given rise to affricate, fricative and other phonetic outcomes through (alveolo)palatal stop realizations.

2. Mechanisms of (alveolo)palatal consonant formation

The palatalization of a dental, alveolar or velar consonant may yield eventually the new (alveolo)palatal consonant articulations [ʎ, ɲ, ç, ʝ, ç, ʝ] whether through

an increase in dorsal contact towards the palate median line and some closure or constriction retraction for dentals and alveolars, or through an increase in tongue contact towards the front palate for velars. The formation of (alveolo)palatals through tongue contact expansion may be achieved by means of two basic mechanisms, i.e., gestural blending and gestural strengthening. Gestural blending operates on sequences composed of a dental, alveolar or velar consonant and a front glide or vowel, or else on consonant clusters composed of a dental or an alveolar and a velar, and yields an articulation produced at an intermediate location between the two original adjacent phonetic segments or else encompassing their closure or constriction areas (Browman & Goldstein 1989, 1992, Recasens 2006). Thus, for example, [ç] may result from increasing temporal overlap and spatial superposition between the consecutive consonant segments of the sequences [kj] and [kt]. Gestural strengthening involves an increase in tongue contact whenever the target consonant is sufficiently long, and may also operate on any consonant in prominent word and phrase positions and prosodic conditions. This is in line with consonants being articulated with a larger tongue contact area if geminate than if non-geminate, and in initial position than in other positions within the word and the phrase (Farnetani 1990, Fougeron & Keating 1997).

This section shows that the formation of (alveolo)palatal consonants has been very productive in the Romance languages from dentals and alveolars (2.1), velars (2.2) and consonant clusters (2.3), through gestural blending and strengthening and even other mechanisms (2.4). In particular, the possibility that the (alveolo)palatal stops [ç, ʝ], which do not occur very frequently in the world's languages, were once widespread in Romance renders highly plausible the hypothesis that affricates and fricatives developed from those realizations. Special attention will be given to velar palatalization since this has been a major source of (alveolo)palatal stops and, ultimately, of affricates and fricatives.

2.1 Dentals and alveolars

Gestural blending accounts for the regressive palatalization of dental [t, d] into [ç, ʝ] before [j] (see 1a below) or a front vowel (1b), and of alveolar [n, l, s, z] into [ɲ, ʎ, ʝ, ʒ] before [j] (2a), a front vowel (2b) or [u] (2c). It may also lead to the less frequent progressive palatalization of dentals and alveolars after [j] (3a) or a high vowel (3b) which is in accordance with the prominence of the mechanico-inertial carryover effects associated with the tongue dorsum fronting and raising gesture for (alveolo)palatal segments in general. In particular, the original sequences [kt, ks] (see FACTU and EXIRE in (3a) below) may have undergone velar vocalization into [j] followed by progressive palatalization, i.e., [kt] > [jt] > [ç] and [ks] > [js] >

[ʃ], while the outcome [c] of [kt] may also have been created through blending of the back and front lingual gestures for [k] and [t] (see §2.3).

- (1) a. dialectal Tuscan [ˈtʃepido] It. *tiepido* “warm”, [ˈtʃetʃi] It. *dieci* “ten” (Rohlf 1966:206).
- b. Haute Loire [ciˈra] TIRARE “to throw”, Forez [ʃy] DURU “tough” (Nauton 1974:166, Gardette 1941:57).
- (2) a. Catalan [ˈpaʎə] PALEA “straw”, Ligurian [ˈbaʒu] BASIU “low” (Badia 1951:205–206, Rohlf 1966:407).
- b. Lazio [kaˈdʒuɲi] It. *calzoni* “trousers”, Surmeiran [ˈʃegvʎa] SIBILAT “he/she whistles” (Rohlf 1966:312, Lutta 1923:161).
- c. Campanian [ˈʎuna] LUNA “moon”, Marche [ʃuro] It. *sughero* “sugar” (Rohlf 1966:216, 225).
- (3) a. Catalan [ˈkujə] for [ˈkujnə] COQUINA “kitchen”, Romansh [fac] FACTU “done”, Tuscan [uʃˈʃire] EXIRE “to go out” (Recasens 1996:258, Haiman & Benincà 1992:70, Rohlf 1966:314).
- b. N.W. Tuscan [ˈfiʎo] FILU “son”, [ˈmuʎo] MULU “mule” (Rohlf 1966:306).

Strengthening alone accounts for instances of consonant palatalization across vowel contexts, i.e., for the transformation of clear [l] and [s] into [ʎ] and [ʃ] in word initial position (4), and of the alveolar geminates [ll, nn] into [ʎ, ɲ] and the affricates [ts, dz] into [tʃ, dʒ] (5).

- (4) Asturian [ˈʎargo] LARGU “long”, Romagnol [ʃak] SACCU “sack”, [ʃɔn] SOMNU “sleep” (Zamora Vicente 1989:122, Rohlf 1966:225).
- (5) Catalan [baʎ] VALLE “valley”, [ˈkaɲə] CANNA “cane”, Valencian Catalan [totʃ] Cat. *tots* “everybody”, Judeo-Spanish [ˈpɔdʒo] for [ˈpɔdzo] PUTEU “well” (Badia 1951:188, Recasens 1996:213, Lapesa 1980:528).

Strengthening through a gain in sublingual contact could explain the replacement of retroflex [ʎ] (-LL-) by [dʒ], and presumably by [tʃ] at a later stage, in S. Italian, Sicilian and Corsican. This sound replacement appears to be supported by the co-occurrence of both the retroflex and (alveolo)palatal outcomes in S. Italian (Calabrian [kaváˈdʒu, kaváˈʃu] CABALLU “horse”, Rohlf 1966:329–330), and by the existence of variants of [ʎ] such as [dʒ, dʎ] in Corsican (Dalbera-Stefanaggi 1991:113, 461, Rohlf 1966:328–333). The outcome [tʃ] of -LL- in Gascon and Asturian Spanish could also have resulted from the voiced (alveolo)palatal stop (Gascon [batʃ] VALLE “valley”, Rohlf 1970:152).

2.2 Velars

Parallel to the scenario for dentals and alveolars just described, (alveolo)palatal stop realizations in present-day Romance may derive from velars in specific phonetic contexts and word positions and, most significantly, not only before front vocalic segments but also before low and central vowels and word finally. The contextual and positional conditions triggering palatalization may be classified as follows, from less to more complex: before [j] in Romanian and S. Italy (6a); before [j] and a front vowel in Occitan and Francoprovençal zones (6b); before [j], a front vowel and [a] in Gallurese Sardinian and Norman zones (6c); before [a] in Friulian and Ladin, and before [a] and word finally after any vowel in Nonsberg Ladin (6d); before a front vocalic segment and [a] in Romansh, Majorcan and Lombard, and word finally whether after a front vowel, a front vowel and [a], or any vowel in specific areas of those same dialectal domains (6e); before any vowel and word finally after any vowel in W. Champenois (6f).

- (6) a. Romanian [u'rece] AURICULA “ear”, [ˈveʒa] VIGILARE “to watch”, Calabrian [ˈʝanda], Sicilian [ˈʝanna] GLANDE “acorn” (Nandris 1963: 149–150, Rohlfs 1966: 250).
- b. Forez [ˈcyva] CUPA “cup”, [cja] CLARU “clear”, Ain [ce] Fr. *que* QUE “that”, [cja] CLAVE “key”, Franc-Comtois [ʝjes] GLACIE “ice”, [ɛʝy], ɛʝœj] ACUCULA “needle” (Gardette 1941: 65, 77, Duraffour 1932: 225, 227, Dondaine 1972: 98, 168).
- c. Gallurese [ʝente] GENTE “people”, [ʝanda] GLANDE, [ʝad̥ɖu] GALLU “cock”, Calvados, Seine, N. Eure and Manche [ʝerb] GARBA “sheaf”, [cɛ] CANE “dog”, [cy, cø] CAUDA “tail”, CORIU “leather” (Blasco 1984: 229, Dalbera-Stefanaggi 1991: 368, Brasseur 1997: maps 141, 758, 864, 899).
- d. Friulian [caf] CAPUT “head”, [ʝal] GALLU, Marebano [caˈval] CABALLU “horse”, Nonsberg [ˈpaʝa] PACAT “he/she pays”, [fiç] FICU “fig”, [laç] LACU “lake”, [floç] FLOCCU “snowflake” (Iliescu 1972: 53, 55, 63, Maiden & Perry 1997: 289, Battisti 1908: 129).
- e. Surselvan [caw] CAPUT, [cil] CULU “backside, bottom”, [cern] CORNU “horn”, [aˈmic] AMICU “friend”, [laj] LACU, [rɛc] REGE “king”, Engadine [cac] CALCE “heel”, [cyl] CULU, [aˈmiç] AMICU, [lɛj] LACU, [sac] SACCU “sack”, [poc, pwɔc] PAUCU “little”, Majorcan Catalan [ci] QUI “who”, [ʝera] Cat. *guerra* “war”, [ˈcazə] CASA, [əˈmic] AMICU, [mɔc] Cat. *moc* “I move”, [suc] SUCU “juice”, Lombard [ci] It. *chi*, [ce] It. *che*, [car] CARU “dear”, CLARU, [cyˈnat] COGNATU “brother-in-law”, [cør] COR “heart”, [fic] FICU, [sac] SACCU, Valle Canobbina [tɔc] “a piece” (Caduff 1952: 79, 99, 103, Goebel 1998: maps 89, 612, 678, Haiman & Benincà 1992: 69–70, Recasens 1996: 243–244, Rohlfs 1966: 199, 244, 425–426, Salvioni 1901).

- f. W. Champenois [pi'cɛt] Fr. *piquette* “cheap wine”, [cyl] CULU, [cø] CAUDA, [cɔ'cij] Fr. *coquille* “shell”, [ji] Fr. *gui* “mistletoe”, [kɔc] Fr. *coq* “cock”, [sɔc] Fr. *soc* “ploughshare” (Bourcelot 1978: maps 272, 522, 584, 630, 656, 668, 994).

The formation of (alveolo)palatal stops through blending between a velar stop and a following front vowel or glide occurred in late Latin earlier than the 5th century C.E., and at a later date in sequences composed of front vowels derived from back rounded vowels (e.g., Surselvan [cil] from [cyl] CULU; see 6b, 6c, 6e and 6f above) and of [j] formed from clear [l] presumably through [ʎ] (e.g., Ain [cja] CLAVE; see 6a, 6b, 6c and 6e above). Blending should also apply word finally after a front vowel which is in accordance with front vowels exerting not only anticipatory but also carryover effects on adjacent consonants (see 6e).

On the other hand, strengthening may account for the replacement of velars by (alveolo)palatal stops before low vowels involving no central lingual contact in Galloromance about the 5–7th centuries C.E., as well as in other dialectal domains such as Majorcan (e.g., [cazə] CASA; see 6c through 6f above). It may also operate word finally after a low back vowel or after any vowel (e.g., Engadine [sac] SACCU; see 6d through 6f above). Back rounded vowels block velar palatalization in preceding [k, g] due perhaps to a requirement to enhance their low frequency front cavity resonance.

An alternative explanation for velar stop palatalization before [a] would be to postulate that this process occurred through blending, not through strengthening, in dialects where this vowel had an especially front realization (Buckley 2009). Indeed, a front variety of [a] has been claimed to exist in Old French, Modern Northern French, Francoprovençal, Rhaetoromance, N. Italian and Majorcan Catalan (Pope 1934: 123, Buckley 2009, Meyer Lübke 1974: 569, 573, Haiman & Benincá 1992: 53, Grassi, Sobrero & Telmon 1997: 102–103, Rohlf's 1966: 39–41, Recasens 1996: 244). If so, for example, the outcome [ʃɛ] of [ka] in the French word [ʃɛvr] for Latin CAPRA “goat” would have developed through the successive changes [ka] > [kɛ] > [cɛ] > [tʃɛ] rather than through the evolutionary paths [ka] > [ca] > [cɛ] > [tʃɛ] or [ka] > [ca] > [tʃa] > [tʃɛ]. In principle, this hypothesis appears to be supported by the change of [a] into a mid front vowel in open syllables in languages of the Galloromance family such as French (e.g., [mɛr] MARE “sea”). Several data lead us to believe, however, that [a] raising occurred after, not before, the generation of [c] or [tʃ] out of [k]. First, [a] has stayed unchanged in several Romance domains where [k] has undergone palatalization before this vowel, i.e., in groups 6a, 6c, 6d and 6e above (e.g., Calabrian [ʝjanda] GLANDE “acorn”), and in Northern Occitan and Francoprovençal zones. Moreover, progressive palatalization of [a] by a preceding (alveolo)palatal consonant is a common phenomenon

(Valencian Catalan [λɛrk] LARGU “long”; Recasens 1996: 101), and may operate parallel to progressive [j] insertion as exemplified by Old French *chier* derived from Latin CARU “dear” (Lausberg 1970: 261–262, Pope 1934: 127–128, 163). The absence of forms such as [kɛ:r] for the existing variant [cɛ:r] CARU in Ladin is also indicative that [a] raising was triggered by the (alveolo)palatal stop after velar palatalization (Craffonara 1986, Jodl 2005). In addition, palatographic data for contemporary Northern French reveal a trend to palatalize /k, g/ into a palatal stop before /a/ (also before front vowels) among speakers showing an unfronted low vowel variety; moreover, this trend appears to be related to a reinforced articulation since it occurs mostly word initially (also word finally) and affects /t, d, n/ as well (Rousselot 1899, 1924–25: 607, Durand 1930). It should also be noted that velar softening in French operated before /aw/ where a front realization of /a/ is problematic (Fr. *chose* CAUSA), and that velar softening applies much less frequently before lower than higher front vowels in the world’s languages (Bhat 1974: 30).

2.3 Clusters

Palatalization through blending may also take place in consonant clusters composed of a dental or an alveolar and a velar: [kt] > [c] (see §2.1); [gn] > [ɲn] > [ɲ] or [gn] > [ɲn] > [jɲ] > [ɲ] (7); [ɲt] > [ɲc] > [ɲtʃ, ɲt] (8); [ske] > [sʲc] > [ʃ] (9); [k/gl] > [k/gʲ] > [ʲ] and [ngl] > [ɲgʲ] > [ɲ] (10). The formation of (alveolo)palatal [ɲ] out of the velar stop cluster [ɲg] (11), could be attributed to articulatory overshoot rather than to blending, i.e., to a significant increase in lingual contact over the palatal zone during the execution of a long-lasting dorsovelar gesture.

- (7) Tuscan [ˈlɛjɲo] LIGNU “log” (Rohlf’s 1966: 368).
- (8) Romansh [ˈpu:ənc] PUNCTA “point”, Spanish [ˈsantʃo] personal name *Sancho* SANCTIU, French [dɛ̃intiˈe] DIGNITATE “dignity” (Lutta 1923: 258, Pensado 1984: 270, Pope 1934: 161).
- (9) Catalan [məˈɾɛʃə] MERESCERE “to deserve” (Coromines 1992: 606).
- (10) Spanish [ˈλaβe] CLAVE “key”, [ˈuɲa] UNGULA “nail”, N. Drôme [kʲa] CLARU “clear”, Auvergnat [ˈʲjasa] GLACIA “ice” (Menéndez Pidal 1968: 126, 164, Bouvier 1976: 93, Dauzat 1938: 128).
- (11) Lucanian [ˈlɛjɲə] LINGUA “tongue”, [gɔɲ] LONGU “long” (Rohlf’s 1966: 361).

2.4 Other mechanisms

Dental and alveolar palatalization may also be arrived at through closure or constriction retraction exerted by a postalveolar rhotic in line with the articulatory and aerodynamic requirements involved in the production of the rhotic. This assimilatory change may be progressive if operating on the sequences [rt, rn, rs] in dialects from N. and E. France (12a) and regressive if occurring in the tautosyllabic cluster [tr] (12b). Progressive palatalization may be triggered by an (alveolo) palatal consonant as well, e.g., [s] may be realized [ʃ] after [j, ʃ, ʎ, ɲ] in Catalan dialects (13). The palatalization of [s] may also take place word finally (14a), or else before any heterosyllabic stop or just before a velar stop and, less often, a labial stop (14b). This specific instance of palatalization could be explained assuming that syllable final [s] exhibits an especially large front cavity which causes the noise spectral peak to lower its frequency, thus approaching that for [ʃ].

- (12) a. Franc-Comtois [potʃ] Fr. *porte* “door”, [koɲ] Fr. *corne* “horn”, [e'koʃ] Fr. *écorce* “bark” (Dondaine 1972: 126–134).
 b. dialectal Spanish ['otʃo] *otro* “another one” (Lapesa 1980: 480, 578).
- (13) Catalan [peʃ ʃə'lat] *peix salat* “salted fish”, [aɲʃ] *anys* “year (pl.)” (Recasens 1996: 273–275).
- (14) a. Romagnol [neʃ] NASU “nose”, European Portuguese [voʃ] VOCE “voice” (Rohlf's 1966: 434, Parkinson 1988: 138).
 b. Romansh ['veʃpra] VESPA “wasp”, ['feʃta] FESTA “feast”, ['paʃkəs] PASQUA “Easter”, Judeo-Spanish ['boʃke] Sp. *bosque* “wood”, Sardinian areas [soʃ 'paneze, soʃ 'kanεze] Fr. *les pains* “the breads”, *les chiens* “the dogs” (Lutta 1923: 241, Zamora Vicente 1989: 356, Contini 1986: 536).

3. The generation of affricates and fricatives from (alveolo)palatal stops

Velar softening in Romance has given rise essentially to affricates of at least two different places of articulation, palatoalveolar [tʃ, dʒ] and alveolar [ts, dz] (also palatal [tʃ, dʒ]), which may have simplified into the corresponding fricative correlates. In order to account for this double outcome, several Romance philologists and linguists have proposed that the alveolar affricate must have originated from the palatoalveolar one, i.e., [tʃ] > [ts] and [dʒ] > [dz] (Galmés de Fuentes 1962: 66–67, Lapesa 1980: 86, Lausberg 1970: 316–317, Rohlf's 1966: 201, 290, Tekavčić 1980: 188, Tuttle 1986, Videsott 2009). Thus, Latin CI/E would have yielded [tʃ], which still is the prevailing realization in Eastern Romance (Romanian [tʃintʃ], C. and S. Italy

[ˈtʃinkwe] CINQUE “five”), and, at a later date, [tʃ] would have changed into [ts] in Western Romance (Catalan [sen], Spanish [θjen] CENTU “one hundred”).

Articulatory, acoustic and perceptual data (3.1), as well as evidence on lexical alternations (3.2) and on geographical distribution of lexical forms (3.3) presented below, are more in support of the alternative hypothesis that both affricates arose independently from an (alveolo)palatal stop, i.e., [c] > [tʃ, ts] (Bourciez 1967: 161, Bouvier 1976: 54–57, Guarnerio 1918: 530, Meyer Lübke 1974: 339, Pope 1934: 124, Ringenson 1930). This hypothesis does not imply, however, that [tʃ] cannot front into [ts], as it appears to have been the case in Old Milanese and in modern Chilean Spanish (Tuttle 1986, Lipski 1994: 223).

3.1 Articulation, acoustics and perception

In the Romance languages, (alveolo)palatal stops derived from velars may show large differences in closure location occurring in the (medio)postpalatal, whole palatal, alveopalatal and even alveolar zones. Dialects may exhibit all or some of these realizations depending on speaker, vowel context, word position and prosodic condition (Brunner 1963, Dukelski 1960, Recasens & Espinosa 2009, Rousset 1924–25: 607–631). These (alveolo)palatal stop realizations are expected to give rise to [s]-like, [ʃ]-like or [ç]-like affricates depending on whether stop closure and release occur, respectively, in about the alveolar zone, at the postalveolar or alveopalatal zone, or at the hard palate (Guarnerio 1918: 527–531, Ringenson 1922, Scripture 1902: 434–442).

The possibility that front varieties of [c] may be integrated as [tʃ] is consistent with electropalatographic data showing that fronting closure location for an (alveolo)palatal stop from the postpalate to the prepalate causes the front cavity-dependent spectral peak at stop release to increase from about 2500 Hz to an appropriate frequency for [ʃ] at about 3500 Hz (Recasens & Espinosa 2009). Moreover, acoustic and perceptual data indicate that unaspirated [c] may be heard as [tʃ] provided that it exhibits a high energy burst before any vocalic segment and word finally, prominent F2 transitions before low and back rounded vowels, and a long fricated release generated by the airflow passing through a narrow central constriction channel before front vocalic segments. More anterior articulatory realizations of [c] should be heard as [ts] though this possibility has not been tested in the laboratory so far.

3.2 Alternations

Supporting evidence for the generation of different affricate outcomes of [c] also derives from dialectal scenarios where the stop may alternate with those affricate

realizations. These alternations involve mostly, but not exclusively, the palatoalveolar affricate in Rhaetoromance, French and some Francoprovençal areas (see 15a below), and the alveolar affricate in other Francoprovençal zones (15b).

- (15) a. Surmeiran from Bivio [ʃyc, ʃyɪf] IOCU “game”, Sutselvan from Sils [bec, betʃ] BECCU “beak”, Sutselvan [lac, latʃ, lats] LACTE “milk”, Nonsberg Ladin [fwɛc, fwɛtʃ] FOCU “fire”, Fassan Ladin [ˈcawra, ˈtʃawra] CAPRA “goat”, Friulian [ˈcaza, ˈtʃaza] CASA “house”, N. Normandy [ʃɛrb, dʒɛrb] GARBA “sheaf”, Lyonnais [cy, tʃy] CULU “backside, bottom” (Jaberg & Jud 1935: maps 740, 1128, Goebel 1998: map 126, Luzi 1904: 811, Politzer 1967: 34, Elwert 1943: 67, Brasseur 1997: map 141, Gardette 1984: map 1112).
- b. E. Franc-Comtois [tʃjɔʃ, sʃɔtʃ] Fr. *cloche* “bell”, [tʃju, sjo] Fr. *clou* “nail”, Lyonnais [seˈtʃe, seˈtʃi] SECARE “to dry” (Dondaine 1991: maps 114, 425, Gardette 1984: map 29).

Differences in closure fronting in (alveolo)palatal stop productions may also give rise to affricates exhibiting a more anterior or a more posterior closure location at the hard palate. Thus, CA has yielded both alveolopalatal and mediopalatal affricates in Ladin, i.e., [tʃ] in Upper Fassa and Engadine, and [tʃ] in Lower Fassa and Nonsberg where the affricate becomes [ç] word finally (Brunner 1963, Elwert 1943: 67).

3.3 Geographical distribution

Another possible source of evidence for the independent origin of different affricate outcomes of the velar softening process is their geographical distribution. Indeed, the lack of geographical overlap between alveolar and palatoalveolar affricates or fricatives derived from velar stops indicate that those articulations originated from intermediate (alveolo)palatal stops exhibiting a more anterior or more posterior closure location depending on the area. In support of this possibility, there is evidence that (alveolo)palatal variants derived from /tj, kj/ may be integrated perceptually as an underlying dental or as an underlying velar in different dialectal communities of Italy (Aski 2001).

As stated above, a major geographical division occurs between Eastern Romania where CI/E yielded a palatoalveolar affricate, and Western Romania where those Latin sequences yielded an alveolar affricate. Written Latin graphemes from the 5–7th centuries C.E. such as *ss*, *z*, *s* and perhaps *tc* suggest that the alveolar affricate was indeed originated from (alveolo)palatal stop productions (*fesit* FE-CIT “did”, *paze* PACE “peace”, *dissessit* DISCESSIT “he/she quit (past)”, *intcitamente* INCITAMENTO “incitement”; Grandgent 1991: 172, 178–181, Väänänen 1985: 110, Straka 1965: 135).

A complementary areal distribution between the place of articulation for the affricate and fricative outcomes may also be found in specific areas falling along the linguistic border between Eastern and Western Romania. In N. Occitan, CA and CT have given rise to either [(t)f] or [(t)s], and GI/E, GY, GA, DY and J to either [(d)ʒ, j] or [(d)z], in different zones (Bouvier 1976: 47–73, Lafont 1983: 45–47, Ringenson 1922, 1930). This phonetic dichotomy is also found in Francoprovençal. Thus, word initial CA has yielded either [(t)f] or [(t)s, st, f, θ], and word initial GA has become [dʒ] or [dz], in Franc-Comtois (Dondaine 1991: maps 731 CAT-TU “cat”, 1561 CANTARE “to sing”), Lyonnais (Gardette 1984: map 29 SECARE “to dry”, Gardette 1941: 70–73) and Jura and Northern Alps (Martin & Tauillon 1978: map 192 SECARE); moreover, in Suisse Romande, the lexical outcome for Latin CANE “dog” is [tʃɛ̃] in Jura Bernois and Neuchâtel, and [(t)sɛ̃] in Fribourg, Vaud and Valais (Gauchat, Jeanjaquet & Tappolet 1925: 92–93). Also in Italy, the affricate and fricative end products of front velars are basically alveopalatal in the center and south, and alveolar or dental in the north (16). Other relevant dialectal domains are Ladin where the affricate outcome of front /k/ is alveolar in the east and palatoalveolar in the west (Tuttle 1986), Friulian where word initial CI/E and GI/E have become basically [tʃ, dʒ] in the north and west, and [s, θ, z, ð] in the south and east (Francescato 1966: 45–49, Iliescu 1972: 55), and Romansh where Surmeiran differs from the remaining dialects in exhibiting an alveolar rather than a palatoalveolar outcome for [j] (I) and for intervocalic CT, GI/E and GY (17).

- (16) Tuscan [ʃɛnto], S. Italian [tʃɛnto], N. Italian [ʔ(t)sɛnto, ʔθɛnto] CENTU “one hundred” (Grassi, Sobrero & Telmon 1997: 111, Rohlfs 1966: 201–203).
- (17) Sotsés [lats] LACTE “milk”, Bergün [dzukf] IUGU “yoke”, [fu'dzɛkr] FUGIRE “to run away” (Grisch 1939: 104–105, Lutta 1923: 168, 186).

4. Segmental, positional and prosodic factors involved in stop softening

The hypothesis that the affricate and fricative end products of the stop softening process may derive from (alveolo)palatal stop realizations turns out to be consistent with diachronic data pointing to the possibility that differences in place and manner of articulation for the former have been triggered by variations mainly in closure fronting but also in the aerodynamic conditions and in acoustic prominence for the latter. Several contextual and positional characteristics appear to be responsible for differences in closure location and acoustic prominence for (alveolo)palatal stops, and consequently for articulatory differences in the resulting affricates and fricatives in Romance: the place of articulation and voicing status of the original stop consonant where the (alveolo)palatal stop came from (§§4.1,

4.3), the following vocalic segment (§4.2), the position within the word and with respect to lexical stress (§4.4), and the articulatory characteristics of the preceding consonant in consonant clusters (§4.5).

4.1 Place of articulation of the original stop

The role of the place of articulation of the original stop in closure or constriction location for its affricate and fricative end products may be investigated through an analysis of the sequences TY and CY in intervocalic position, which share the same contextual vocalic segment while differing in the place of articulation of the stop consonant. In the Romance languages, the affricate and fricative outcomes of Latin TY and CY may agree in fronting or not, and in the latter event the outcome for TY is more anterior than that for CY. As shown in Table 1, the most widespread scenario involves a more anterior alveolar affricate for TY and a more posterior alveolopalatal one for CY (group B), or else the same alveolar affricate or fricative outcomes for both TY and CY (group C).² Just a few dialectal domains exhibit a palatoalveolar affricate or fricative end product not only for CY but also for TY (group A).

The reason why the outcome of [t] before [j] is basically alveolar while that of [k] before [j] may be alveolar or alveolopalatal is to be sought in differences in closure fronting between the (alveolo)palatal stops formed from front velars and from palatalized dentals. Articulatory data for different Romance languages indicate that a gain in back contact for dentals and in front contact for velars in palatalizing contexts may yield (alveolo)palatal stop realizations agreeing completely or partially in contact fronting and contact degree. Moreover, the most common scenario is for these (alveolo)palatal stop productions to occur in the alveolar zone while not reaching the medio-postpalate if developed from dentals, and to attain the alveolar zone whether staying palatal or not if developed from velars (Dukelski 1960: 41, Rousselot 1924–25: 607). This articulatory pattern appears to have perceptual consequences. Thus, while (alveolo)palatal stop realizations derived from [t] and [k] may be assigned to either /t/ or /k/ and cause reversals such as ['kattʃa] *caccia* *CAPTIA “hunting” and ['kaltsa] *calza* CALCEA “tights, stockings” to occur in dialectal areas of Italy (Aski 2001, Rousselot 1924–25: 612–615), phonetic

2. In the W. Romance zones of group C, [kj] yielded an alveolar affricate if derived from CY but a palatoalveolar affricate if derived from CL through [kʌ] at a later date (Portuguese [ʃave], Ligurian [tʃave], E. Provençal [tʃjaw] CLAVE “key”; Lausberg 1970: 333, Rohlf's 1966: 244, Ronjat 1930–32, vol. II: 34). Romanian belongs basically to group C in spite of exhibiting the solution [tʃ] for both TY and CY in several lexical items ([təʃʃune] TITONE “burning piece of wood”, [ʉrtʃor] URCEOLU “small pitcher”).

Table 1. Phonetic outcomes for intervocalic TY and CY in Romance. The label BACK has been assigned to palatoalveolar and (alveolo)palatal articulations, and the label FRONT to alveolar and dental articulations. Data have been taken from the references listed below the table.

	-TY-	-CY-
GROUP A	BACK	BACK
1. <i>W./N. Friulian</i>	[potʃ] PUTEU “well”	[bratʃ] BRACCHIU “arm”
2. <i>Picard</i>	[kaʃø] CAPTIATORE “hunter”	[glɑʃ] GLACIE “ice”
GROUP B	FRONT	BACK
3. <i>Corsican</i>	[pɔʈtsu] PUTEU	[ˈfattʃa] FACIE “face”
4. <i>W. Ladin</i> (Fassan)	[pɔts] PUTEU	[ˈatʃa] ACIE “ax”
5. <i>Romansh</i> (Sutselvan)	[ˈplatsa] PLATEA “square”	[ˈfatʃa] FACIE
6. <i>Tuscan</i>	[ˈprettso] PRETIU “price”	[ˈbrattʃo] BRACCHIU “arm”
GROUP C	FRONT	FRONT
7. <i>Catalan</i>	[mɔˈlezə] MALITIA “wickedness”	[əˈser] ACIARIU “steel”
8. <i>Francoprovençal</i> (Valais)	[pʰasə] PLATEA	[ˈðasə] GLACIE
9. <i>French</i>	[reˈzɔ̃] RATIONE “reason”	[fas] FACIE
10. <i>E. Friulian</i>	[pos] PUTEU	[bras] BRACCHIU
11. <i>N. Italian</i> (Venitian)	[kaˈveso] CAPITIU “hood”	[ˈbraso] BRACCHIU
12. <i>S. Italian</i> (Calabrian)	[ˈputtsu] PUTEU	[ˈvrattsu] BRACCHIU
13. <i>E. Ladin</i> (Comelican)	[pɔθo] PUTEU	[ˈaθa] ACIE
14. <i>Romanian</i>	[puts] PUTEU	[brats] BRACCHIU
15. <i>Sardinian</i> (Campidanesese)	[ˈpettsa] *PETTIA “piece”	[ˈattsa] ACIE
16. <i>Vegliote</i>	[ˈplasa] PLATEA	[glas] GLACIE

(1) Iliescu 1972: 69, 73. (2) Boutier: maps 14, 47, 50, 65. (3) Dalbera-Stefanaggi 1991: 365–366. (4, 10, 13) Tuttle 1986: 316, 322, 327. (5) Luzi 1904: 816–817. (6, 11, 12) Rohlfs 1966: 387–388, 409–411. (7) Badia 1951: 202, 210. (8) Frankhauser 1910: 315. (9, 14, 15) Lausberg 1970: 387–389, 394–395. (14) Nandris 1963: 124, 149. (16) Bartoli 1906: 366.

transcriptions from the literature reveal that these misidentifications are not random. The fact is that the (alveolo)palatal stops [ç, ʝ] developed from velars are taken more often for dental or palatalized dental stops (18a) than those derived from dental stops are identified as palatalized velar stops (18b), presumably because of the differences in closure fronting indicated above.

- (18) a. Haute Loire [tʃu] CULU “backside, bottom”, [ˈtʃitar] Fr. *quintal* “quintal”, Drôme [ˈkeci, keˈti] Fr. *celui-ci* “this one” where *ci* derives from ECCE HIC, Lyonnais [kʃɛˈdi, tʃɛˈdi] CONDIRE “to season”, Franc-Comtois

- [kʰør, tʰør] Fr. *cueillir* COLLIGERE “to pick”, colloquial Tuscan [ˈcave, ˈtjave] CLAVE “key”, [ˈmasco, ˈmastjo] MASCULU “male” (Nauton 1974: 166–167, Bouvier 1976: 77, 83, Duraffour 1932: 225, Dondaine 1972: 136, Rohlf’s 1966: 244, 351).
- b. Franc-Comtois [kʰjo] TILIOLU “lime tree”, [gʰjœ] DURU “tough”, Lyonnais [djø, gjø] Fr. *Dieu* DEUS “God”, Angevin *guire* for Fr. *dire* DICERE “to say” (Dondaine 1972: 120, Duraffour 1932: 225, Rousselot 1924–25: 614).

Arguments for why palatalized velars show a larger tongue contact surface than palatalized dentals have been proposed in the literature. According to Straka (1965), this may be so since raising the posterior tongue body involves the activation of the sublingual elevator muscles as well as of intrinsic tongue muscles which cause tongue fronting to occur. Another account is based on palate shape: the fact that the palate surface is higher and more curved at the mediopalate and postpalate than in the postalveolo-prepalatal zone renders the formation of a firm and precise linguopalatal target harder at the former location than at the latter; consequently, a consonantal closure or constriction must spread over a relatively large area if performed in the medio-postpalatal zone with the tongue dorsum (cf. Scripture 1902). This argument is consistent with the presence of small or larger areas devoid of contact at the hard palate during the production of alveolopalatal and palatal stop consonants (Millardet 1910, Rousselot 1924–25). More phonologically oriented approaches would probably attribute the integration of ambiguous (alveolo)palatal realizations like those referred to above as variants of /t/ to the unmarked nature of the dentoalveolar stop with respect to the bilabial and velar stop correlates (Lahiri & Reetz 2002).

4.2 Following vocalic element

4.2.1 *Front vowels vs. front glide*

Differences in the vocalic segment following the originally front velar stop, i.e., a front vowel or [j], may have caused the affricate and fricative outcomes of the velar softening process to be more or less anterior. Indeed, according to Table 2, a good number of Romance languages and dialects show a more anterior affricate or fricative for original CY than for CI/E in intervocalic position. This is so for languages and dialects under group B in the table where velar softening has yielded an alveolar affricate or fricative for CY and a palatoalveolar one for CI/E, and for Logudorese Sardinian where CI/E has stayed velar and CY has yielded a dental stop ([ˈkelu] CAELU “sky”, [ˈnuyel] NUCE “walnut”, [ˈatta] ACIE “ax”; Lausberg 1970: 316, 362, 395). In other Romance territories, the degree of fronting for the

Table 2. Phonetic outcomes for intervocalic CI/E and CY in Romance. See Table 1 caption for details and for glosses for -CY-.

	-CI/E-	-CY-
GROUP A	BACK	BACK
1. <i>Corsican</i>	[vi'tʃinu] VICINU “neighbour”	['fattʃa] FACIE
2. <i>W./N. Friulian</i>	[a'zɛjt] ACETU “vinegar”	[bratʃ] BRACCHIU
3. <i>W. Ladin</i> (Fassan)	['kɛzɛr] *COCERE “to cook”	['atʃa] ACIE
4. <i>Romansh</i> (Surselvan)	[vi'zɪn] VICINU	[bratʃ] BRACCHIU
5. <i>Tuscan</i>	['kroʃe] CRUCE “cross”	['brattʃo] BRACCHIU
GROUP B	BACK	FRONT
6. <i>N. Italian</i> (Ligurian)	[ve'zɪn] VICINU	['bratsʊ] BRACCHIU
7. <i>S. Italian</i> (Calabrian)	['dɛtʃi] DECE “ten”	['vrattʃʊ] BRACCHIU
8. <i>E. Ladin</i> (Ampezzan)	[ve'tʃɪn] VICINU	['zatsʊ] GLACIE
9. <i>Romanian</i>	[ve'tʃɪn] VICINU	[brats] BRACCHIU
10. <i>Sardinian</i> (Campidanese)	['nuʒi] NUCE “walnut”	['attsa] ACIE
11. <i>Vegliote</i>	[vi'tʃajn] VICINU	[glas] GLACIE
GROUP C	FRONT	BACK
12. <i>Picard</i>	<i>crois</i> CRUCE	[glɑʃ] GLACIE
GROUP D	FRONT	FRONT
13. (<i>Old</i>) <i>Catalan</i>	[və'ði] VICINU	[ə'ser] ACIARIU
14. <i>Francoprovençal</i> (Vaud)	[ve'zɛ̃] VICINU	[g'las] GLACIE
15. <i>French</i>	[vwa'zɛ̃] VICINU	[fas] FACIE
16. <i>E. Friulian</i>	[a'zɛt] ACETU	[bras] BRACCHIU
17. <i>N. Italian</i> (Venitian)	[vi'ziŋ] VICINU	['braso] BRACCHIU
18. <i>E. Ladin</i> (Comelican)	[pia'ði] PLACERE “to please”	['aθa] ACIE

(1) Dalbera-Stefanaggi 1991:366, 372. (2, 16) Iliescu 1972:55, 62, 64, 69, Francescato 1966:207. (3) Elwert 1941:66, 73, 97. (4, 9, 15) Lausberg 1970:316–317, 363–364, 394–395. (5, 6, 7, 17) Rohlf's 1966:201–202, 289–291, 387–389. (8) Gartner 1910:175, 189. (10) Viridis 1978:43, 64. (11) Bartoli 1906:366, 375. (12) Boutier: maps 19, 47, Gossen 1976:94. (13) Badia 1951:175, 183, 210. (14) Gauchat Jeanjaquet & Tappolet 1925:14–15, 118–119, 158–159. (18) Tagliavini 1926:64–65.

affricate or fricative does not seem to depend on the identity of the vocalic segment following the velar stop, i.e., both original sequences CI/E and CY have given rise to either back (group A) or front (group D) outcomes. Occasionally, CI/E may yield a more anterior outcome than CY (group C).

Parallel to the scenario characterized in §4.1, a trend for the affricate and fricative to be more anterior when the vocalic segment following the velar stop is a front glide than a front vowel appears to be in line with differences in closure

fronting for the intermediate (alveolo)palatal stop which arose from the former vs. latter sequence. This possibility is in agreement with phonetic data showing that [j] may exhibit a narrower and more advanced lingual constriction, and a higher F2 and F3, than [i] (Chafcouloff 1980, Grammont 1971:77, Haden 1938:56).

The same contextual factor could be at work for dental stops. Thus, in dialectal zones exhibiting an alveolar affricate or fricative end product for TY or for TY and DY, dentals before a front vowel may have given rise to either a more retracted palatoalveolar affricate (19a) or else to the same alveolar realization (19b; also Canadian French according to Posner 1997:244).

- (19) a. Forez [pe'tʃi] Fr. *petit* “small (masc. sing.)”, [dʒi] DICIT “he/she says”, Romansh [ʃi, dʒi] DICIT, Brazilian Portuguese [tʃiu] Port. *tio* “uncle” (Gardette 1941:59, Bourciez 1967:612, Parkinson 1988:140).
- b. Francoprovençal [dzi] DECE “ten”, [zardzê] Fr. *jardin* “garden”, Surmeiran [dzekr] DICERE “to say”, Romanian [awzi] AUDIRE “to hear”, [tots] TOTI “everybody” (Durauffour 1932:226, Lutta 1923:138, Lausberg 1970:358–359).

4.2.2 *Front vs. low vowels*

Differences in fronting for the affricate and fricative outcomes of the velar softening process may also be related to differences in height and fronting in the vowel following the velar stop. As a general rule, CA has yielded more retracted results than CI/E, or else the former sequence still preserves the original (alveolo)palatal stop while the latter has given rise to a palatoalveolar or alveolar affricate or fricative. The former evolution accounts for the outcomes [ʃ] for CA and [s] for CI/E in French ([ʃevr] CAPRA “goat”, [sʒel] CAELU “sky”), and for [tʃ] for CA and [ts, s] for CI/E in Walloon and Francoprovençal areas such as Neuchâtel and Jura Bernois (Boutier 1953: maps 9 CAMERA “room”, 15 *CALCEA “tights, stockings”, 19 CINQUE “five”; Gauchat, Jeanjaquet & Tappolet 1925: maps 92 CANE “dog”, 158 CENTU “one hundred”). The second scenario occurs in N. Italian zones where CA and CI/E have yielded [c] and [tʃ, ts, s], respectively (Rohlf 1966:199–203).

While it conforms to our predictions, the situation in Rhaetoromance is particularly interesting. Excluding cases where the (alveolo)palatal stop has regressed to [k], we find [c] for CA and [tʃ, ʃ] for CI/E in conservative Romansh and Friulian and in the W. Ladin areas Nonsberg, Badiot and Marebban, or else [tʃ] for CA and more anterior outcomes for CI/E such as [ts] in Nonsberg, [ts, s, θ] in E. Ladin, and [s, θ] in Friulian varieties (Caduff 1952:79–83, Luzi 1904:801–802, Frau 1984:46, Iliescu 1972:53–55, Kramer 1977:108–109, Politzer 1967, Pellegrini 1954–55:349–355, Tagliavini 1926:62–65).

Differences in anteriority between the phonetic outcomes for CA and CI/E have been attributed to differences in fronting in the (alveolo)palatal stops which arose from those two original sequences.³ Thus, it has been argued that CA has yielded more posterior articulatory results than CI/E since low vowels cause (alveolo)palatal stops to exhibit more tongue contact retraction than front vowels (Straka 1965: 143). Contrary to this claim, however, electropalatographic data reported in the literature show small variations in the articulatory implementation of alveolopalatal and palatal consonants as a function of vowel context at and behind the place of articulation (Recasens 1999). This is so because the involvement of the blade, predorsum and/or mediodorsum in the production of these consonants leaves just the tongue tip and the postdorsum free to coarticulate with the surrounding phonetic segments. In fact, it may be claimed that low vowels allow for a large tongue contact area and thus, for much closure fronting for (alveolo)palatal stops because their production does not require any active involvement of the tongue blade and predorsum. The absence of vowel coarticulation is consistent with the existence of the same phonetic output for both CA and CI/E in several dialectal domains, i.e., an (alveolo)palatal stop in the Lombard Alps (Salvioni 1901), an alveolopalatal affricate in Gardenesse, Fassan and Livinallonghesse Ladin (Kramer 1977: 108–109), and an alveolar affricate or fricative in N. Occitan and in Francoprovençal areas such as Vaud, Valais and S. Franc-Comtois (Gauchat, Jeanjaquet & Tappolet 1925: maps 92 CANE “dog”, 158 CENTU “one hundred”, Dondaine 1991: map 731 CATTU “cat”, Martin & Tauillon 1978: map 5 CALIDU “hot”).

More plausible conditioning phonetic cues for the frequent generation of [tʃ] out of (alveolo)palatal stop realizations derived from CA are the high energy level and the relatively long duration of the (alveolo)palatal stop burst, as well as the long [j]-like vowel transitions associated with the considerable distance that the tongue dorsum must travel from the (alveolo)palatal stop to the low vowel. Analysis and perception data reveal that Majorcan Catalan speakers may hear productions of [ca] and [aca] taken from real speech sequences as /tʃa/ and /atʃa/, respectively, provided that the burst is sufficiently intense and long (Recasens & Espinosa 2009). Moreover, as shown by the following examples, the vowel transitions for [ka] (CA) and [ga] (GA) may be categorized as an independent glide (20a), which may then turn into an alveolopalatal affricate or contribute to its generation (20b).

- (20) a. Müstair [c^haw], Friulian [kʃaf] CAPUT “head”, Sutselvan [ʃcɛɣla]
SCALA “staircase”, Old Venitian *chian* CANE “dog”, *chiamp* CAMPU

3. Differences in fronting and in geographical distribution between the phonetic outcomes of CA and CI/E have also been taken as evidence that the palatalization of CA may be of Germanic origin and hence has occurred in more recent times than that of CI/E (see §2.2, Wartburg 1971).

“field”, Walloon and Picard XIX c. *quéamp* CAMPU, *géampe* GAMBA
 “leg” (Luzi 1904: 802, Jaberg & Jud 1935: map 93 CAPUT, Videsott 2001, Carton 1972).

- b. Walloon and Picard [tʃ(j)ɛr, k(j)ɛr, tʃjɛr] CARU “dear”, [dʒjãb] GAMBA
 (Boutier 1953: map 16 CARU, Bruneau 1913: 410).

4.3 Voicing

4.3.1 Voiced vs. voiceless consonants

The end product of velar softening has also been conditioned by the voicing status of the original stop consonant. If affricates and fricatives have been generated from (alveolo)palatal stops, the main prediction is that they ought to be more, not less, anterior if derived from voiceless [c] than if derived from voiced [j]. This prediction is based on articulatory data showing that voiceless consonants of a given place and manner of articulation are produced with a larger linguopalatal contact surface and consequently may show more contact fronting than their voiced correlates (Farnetani 1990).

In agreement with this hypothesis, data for all three pairs of sequences TY-DY, CY-GY and CI/E-GI/E reveal that Romance languages and dialects may exhibit more anterior outcomes for the voiceless sequences TY, CY and CI/E (alveolar or dental affricates and fricatives) than for the voiced ones DY, GY and GI/E (palatoalveolar affricates and fricatives, [j] and [ʝ]). This pattern is represented essentially by group B for the pair TY-DY (Table 3), and by group C for the pairs CY-GY and CI/E-GI/E (Tables 4, 5a and 5b). Differences in fronting as a function of stop voicing must have been available already in late Latin or early Western Romance where CI/E and GI/E were possibly pronounced [ts] and [dʒ], respectively, according to a 10th century C.E. text written by Abbon, abbot of Fleury (see Wright 1982: 211).

Another possibility not running against the expected trend is for the original voiceless and voiced stops to exhibit the same or similar outcomes regarding place of articulation, whether alveolar or dental (group C in Table 3; group D in Tables 4, 5a and 5b), or palatoalveolar or (alveolo)palatal (group A in Tables 3, 4, 5a and 5b). Exceptionally, the outcome for the voiceless sequence is more posterior than that for the voiced one (see group B in Tables 4, 5a and 5b).

A closer look at Tables 3 through 5b also reveals the existence of differences in manner of articulation between the phonetic outcomes for the original voiceless and voiced consonants, i.e., affricates and fricatives vs. [j] and [ʝ], and affricates vs. fricatives. A lower intensity burst for voiced stops than for voiceless stops resulting from a lower intraoral pressure level during the closure period and less airflow and a wider lingual constriction at stop release, accounts for why, in comparison to voiceless stops, voiced stops are categorized less often as affricates, may be

Table 3. Phonetic outcomes for intervocalic TY and DY in Romance. See Table 1 caption for details and for glosses for -TY-, and Tables 1 and 6a for references.

	-TY-	-DY-
GROUP A	BACK	BACK
1. <i>W./N. Friulian</i>	[potʃ] PUTEU	[poʃja] PODIARE “to go up”
2. <i>Picard</i>	[kaʃø] CAPTIATORE	[mɔʃø/œ] MODIOLU “hub”
3. <i>Sardinian</i> (Campidanese from Sulcis)	[ˈputʃu] PUTEU	[ˈvi] HODIE “today”
GROUP B	FRONT	BACK (BACK-FRONT)
4. <i>Catalan</i>	[mɔˈlezə] MALITIA	[əmbʲɛzə] INVIDIA “envy”
5. <i>Corsican</i>	[ˈpɔʦsu] PUTEU	[ˈoʃi] HODIE, [ˈmeddzu] MEDIU “half (masc.)”
6. <i>Francoprovençal</i> (Valais)	[ˈpθasə] PLATEA	[bataʃi] BAPTIDIARE “to baptise”
7. <i>French</i>	[reˈzɔ̃] RATIONE	[wi] HODIE
8. <i>E. Friulian</i>	[pos] PUTEU	[poʃja] PODIARE
9. <i>S. Italian</i> (Calabrian)	[ˈputʃu] PUTEU	[ˈraju] RADIU “ray”
10. <i>Sardinian</i> (Campidanese)	[ˈpetʃsa] *PETTIA	[ˈvi] HODIE
11. <i>Tuscan</i>	[ˈpreʦso] PRETIU	[ˈradɔʒo] RADIU
GROUP C	FRONT	FRONT
12. <i>N. Italian</i> (Venitian)	[kaˈveso] CAPITIU	[ˈraz/ðo] RADIU
13. <i>E. Ladin</i> (Comelican)	[ˈpoθo] PUTEU	[ˈmɛðo] MEDIU
14. <i>W. Ladin</i> (Fassan)	[ˈpetʃa] *PETTIA	[ˈmeza] MEDIA “half (fem.)”
15. <i>Romanian</i>	[puts] PUTEU	[ˈrazə] RADIA
16. <i>Romansh</i> (Sutselvan)	[ˈplatsa] PLATEA	[ˈmɛzə] MEDIA
17. <i>Vegliote</i>	[ˈplasa] PLATEA	[ˈvidza] VADEAT “he/she go (subj.)”

Table 4. Phonetic outcomes for intervocalic CY and GY in Romance. See Table 1 caption for details and for glosses for -CY-, and Tables 1 and 6a for references.

	-CY-	-GY-
GROUP A	BACK	BACK
1. <i>Corsican</i>	[ˈfattʃa] FACIE	[ˈpjaʃa] PLAGEA “beach”
2. <i>W./N. Friulian</i>	[bratʃ] BRACCHIU	[koˈrɛ(j)e] CORRIGIA “strap”
3. <i>W. Ladin</i> (Fassan)	[ˈatʃa] ACIE	[koˈrea] CORRIGIA
4. <i>Picard</i>	[glɑʃ] GLACIE	[ɛj] HAGIA “beech”
5. <i>Romansh</i> (Sutselvan)	[ˈfatʃa] FACIE	[kuˈrɛj/za] CORRIGIA
6. <i>Sardinian</i> (Campidanese from Sulcis)	[ˈatʃa] ACIE	[koˈria] CORRIGIA

Table 4. (continued)

	-CY-	-GY-
7. <i>Tuscan</i>	[ˈbrattʃo] BRACCHIU	[koˈreddʒa] CORRIGIA
GROUP B	<i>BACK</i>	<i>FRONT</i>
8. <i>Romansh</i> (Surmeiran)	[ɡlatʃ] GLACIE	[kuˈrɛdʒa] CORRIGIA
GROUP C	<i>FRONT</i>	<i>BACK</i>
9. <i>Catalan</i>	[əˈser] ACIARIU	[əsəˈʒa] *EXAGIARE “to test”
10. <i>Francoprovençal</i> (Valais)	[ˈðasə] GLACIE	[kjœˈraja] CORRIGIA
11. <i>French</i>	[fas] FACIE	[eseˈje] *EXAGIARE
12. <i>E. Friulian</i>	[bras] BRACCHIU	[koˈrɛ(j)e] CORRIGIA
13. <i>S. Italian</i> (Calabrian)	[ˈvrattsu] BRACCHIU	[kuˈria] CORRIGIA
14. <i>E. Ladin</i> (Comelican)	[ˈaθa] ACIE	[troˈuj] *TROGIU “path”
15. <i>Romanian</i>	[brats] BRACCHIU	[kuˈrɛɡa] CORRIGIA
16. <i>Sardinian</i> (Campidanese)	[ˈattsa] ACIE	[koˈria] CORRIGIA
GROUP D	<i>FRONT</i>	<i>FRONT</i>
17. <i>N. Italian</i> (Venitian)	[ˈbraso] BRACCHIU	[ˈtrozo] *TROGIU
18. <i>Vegliote</i>	[ɡlas] GLACIE	[ˈsudʒa] SUGIA “soot”

Table 5a. Phonetic outcomes for word initial CI/E and GI/E. See Table 1 caption for details, and Tables 2 and 6a for references.

	CI/E-	GI/E-
GROUP A	<i>BACK</i>	<i>BACK</i>
1. <i>Corsican</i>	[tʃiˈβɔda] CEPULLA “onion”	[ʒelu] GELU “ice”
2. <i>W./N. Friulian</i>	[tʃiŋk] QUINQUE	[dʒeˈnoli] GENUCULU
3. <i>S. Italian</i> (Calabrian)	[ˈtʃena] CENA “supper”	[jeˈlare] GELARE “to freeze”
4. <i>W. Ladin</i> (Fassan)	[ˈtʃɛndɛr] CINERE “ashes”	[ʒeˈlɛr] GELARE
5. <i>Romanian</i>	[tʃɛr] CAELU “sky”	[dʒɛr] GELU
6. <i>Romansh</i> (Surmeiran)	[ˈtʃiəl] CAELU	[ˈdʒɛla] GELAT, [ʒnuː] GENU- CULU
7. <i>Romansh</i> (Surselvan)	[tʃin] CINQUE “five”	[ʒaˈnuː] GENUCULU “knee”
8. <i>Sardinian</i> (Campidanese)	[tʃɛntu] CENTU “one hundred”	[dʒɛneru] GENERU “gender”
9. <i>Tuscan</i>	[ʃitˈta] CIVITATE “city”	[dʒɛnte] GENTE “people”
GROUP B	<i>BACK</i>	<i>FRONT</i>
10. <i>Vegliote</i>	[ˈtʃiŋko] CINQUE	[dʒjant] GENTE
GROUP C	<i>FRONT</i>	<i>BACK (BACK-FRONT)</i>

Table 5a. (*continued*)

	CI/E-	GI/E-
11. <i>Catalan</i>	[sen] CENTU	[ʒen] GENTE
12. <i>French</i>	[sʒɛl] CAELU	[ʒe'le] GELARE
13. <i>E. Friulian</i>	[siŋk] QUINQUE	[ʒe'noli] GENUCULU, ['zinar] GENERU
GROUP D	FRONT	FRONT
14. <i>Francoprovençal</i> (Valais)	[θɛ̃] CENTU	[dzɛ̃] GENTE
15. <i>N. Italian</i> (Venitian)	['θera] CERA “wax”	[z/ðe'naro] GENERU
16. <i>E. Ladin</i> (Comelican)	['θɛrvu] CERVU “deer”	[d/ðente] GENTE

Table 5b. Phonetic outcomes for intervocalic CI/E and GI/E. See Table 1 caption for details, Table 2 for glosses for -CI/E-, and Tables 2 and 6a for references.

	-CI/E-	-GI/E-
GROUP A	BACK	BACK
1. <i>Corsican</i>	[v'itʃinu] VICINU	[leʒa] LEGERE “to read”
2. <i>S. Italian</i> (Calabrian)	['dɛtʃi] DECE	[leʒere] LEGERE
3. <i>W. Ladin</i> (Fassan)	['keʒer] *COCERE	[leʒer] LEGERE
4. <i>Romanian</i>	[ve'tʃin] VICINU	[ledʒe] LEGE “law”
5. <i>Romansh</i> (Surselvan)	[vi'ʒin] VICINU	[fu'ʃi, fu'ʒir] FUGIRE “to run away”
6. <i>Sardinian</i> (Campidanese)	['nuʒi] NUCE	['suiʀi] SUGERE “to suck”
7. <i>Tuscan</i>	['kroʃe] CRUCE	[ledʒe] LEGE
GROUP B	BACK	FRONT (BACK-FRONT)
8. <i>W./N. Friulian</i>	[a'ʒɛjt] ACETU	[ru'(d)ʒ/zin] AERUGINE “rust”, [leʒ] LEGERE
9. <i>Romansh</i> (Surmeiran)	[pla'ʒɛkr] PLACERE	[fu'dʒɛkr] FUGIRE
10. <i>Vegliote</i>	[vi'tʃajn] VICINU	[fre'dʒjal] FLAGELLU “whip”
GROUP C	FRONT	BACK
11. <i>Catalan</i>	[və'ði] VICINU	[sə'ʒɛtə] SAGITTA “arrow”
12. <i>Francoprovençal</i> (Valais)	[vi'zɔʒi] VACIVU “sterile”	[pa'ʒi] PAGESE “peasant farmer”
13. <i>French</i>	[vwa'zɛ̃] VICINU	[liʀ] LEGERE
14. <i>E. Friulian</i>	[a'zɛt] ACETU	[leʒ] LEGERE
GROUP D	FRONT	FRONT
15. <i>N. Italian</i> (Venitian)	[vi'ʒin] VICINU	[leʒ/ðe] LEGERE
16. <i>E. Ladin</i> (Comelican)	[pja'ði] PLACERE	[d/ðɛʒðo] DIGITU “finger”

perceived as [j] and may fail to undergo velar softening (Chang, Plauché & Ohala 2001, Guion 1998, Jaeger 1978, Stevens 1971).

In principle, the pair CA-GA appears to be exceptional in that, as shown by the following dialectal scenarios, both the voiceless and the voiced stops have given rise to stop, fricative or affricate articulations sharing the same or a similar place of articulation in word initial position (Gauchat, Jeanjaquet & Tappolet 1925: maps 6, 92, 20, Iliescu 1972: 53, 55, Kramer 1977: 109, 113, Politzer 1967: 33): [c] and [tʃ] in N. and W. Friulian, Romansh, Nonsberg areas and Badiot; [c] and [j] in Marebban; [tʃ] and [dʒ] in E. Friulian ([tʃaf] CAPUT “head”, [dʒal] GALLU “cock”), Francoprovençal and Ladin areas; [ʃ] and [ʒ] in French ([ʃef] CAPUT, [ʒwa] GAUDIUM “pleasure”); [ts] and [dz] in other Francoprovençal zones and N. Occitan. In agreement with our initial hypothesis, closer inspection reveals, however, that velar palatalization and velar softening may affect CA more frequently than GA, e.g., the phonetic outcomes for CA and GA are, respectively, [c] and [g] in Osco and [tʃ] and [j] in Penia and in Fassan Ladin (Jaberg & Jud 1935: maps 395 CASA “house”, 159 GAMBIA “leg”, 842 CARU “dear”, 1121 GALLU). Also in intervocalic position, both CA and GA have given rise to the same phonetic end product (Friulian [pajá] PACARE “to pay”, [le(j)á] LIGARE “to tie”; Iliescu 1972: 62–63), or else velar softening has operated on the voiceless stop but not on the voiced one (Nonsberg [pádʒ/ja] PACAT, [liám] LIGAMEN “tie”; Battisti 1908: 131, Politzer 1968: 33).⁴

4.3.2 Voiced consonants

Original voiced velar and dental stops in the sequences GI/E, GY and DY, as well as the palatal approximant [j] (I), have often given rise to outcomes sharing the same or a similar place of articulation in Romance. Indeed, according to Tables 6a and 6b reporting data for those sequences in the word initial and intervocalic positions, respectively, the final outcomes may be either palatoalveolar or (alveolo) palatal (group A in both tables) or else dental or alveolar (group D in Table 6a and group F in Table 6b).⁵ In intervocalic position and to some extent word initially as

4. The Romance languages show no differences in fronting between the late voiceless and voiced affricate and fricative outcomes of CL and GL arose presumably from [c] and [tʃ] through the derivations [kl] > [kʌ] > [kj] > [c] and [gʌ] > [gj] > [tʃ] or [gʌ] > [yʌ] > [ʌ] > [j] > [tʃ] (Repetti & Tuttle 1987: 107). Some illustrative examples follow: Lombard [tʃa'ma] CLAMARE “to call”, [dʒas] GLACIE “ice”, Francoprovençal from Illiez [θɔ] CLAVE “key”, [ʃasə] GLACIE, E. Provençal [tʃjaw] CLAVE, [ˈdʒasa] GLACIA (Rohlf 1966: 244, 250, Frankhauser 1910: 328, Ronjat 1930–32, vol. II: 34–35).

5. Minor phonetic solutions deviating from the general pattern have not been included in the tables, e.g., [j] or zero for GI/E and an alveolar affricate for DY in Tuscan Italian words ([ˈdito] DIGITU “finger”, [sarˈtana] SARTAGINE “pan”, [ˈmeddzo] MEDIU “half (masc. sing.)”).

Table 6a. Phonetic outcomes for word initial GI/E, DY and I. See Table 1 caption for details and Table 5a for glosses for GI/E-.

GROUP A	GI/E-	DY-	I-
	BACK	BACK	BACK
1. <i>Catalan</i>	[ʒen] GENTE	[ʒorn] DIURNU “day”	[ʒoβə] IUUVENE “young”
2. <i>Corsican</i>	[ʒelʉ] GELU	[ʒɛrnʉ] DIURNU	[ʒogu] IOCU “game”
3. <i>French</i>	[ʒel] GELARE	[ʒur] DIURNU	[ʒœn] IUUVENE
4. <i>W./N. Friulian</i>	[dʒe'noli] GENUCCULU	[ju] DEORSU “downwards”	[ʔ(d)ʒvɪn] IUUVENE, [juʃ] IUGU “yoke”
5. <i>S. Italian</i> (Calabrian)	[je'lare] GELARE	[jurnu] DIURNU	[jo'kare] IOCCARE “to play”
6. <i>W. Ladim</i> (Fassan)	[ʒe'lɛr] GELARE	[ʒu] DEORSU	[ʒowf] IUGU
7. <i>Romanian</i>	[dʒer] GELU	[ʒos] DEORSU	[ʒune] IUUVENE
8. <i>Romansh</i> (Sutselvan)	[ʒa'nuʌ] GENUCCULU	[ʃ/ʒaw] DEORSU	[ʃ/ʒuʃ] IUGU
9. <i>Sardinian</i> (Campidanese)	[dʒeneru] GENERU	[ʔdʒana] DIANA “Diana”	[dʒu] IUGU
10. <i>Tuscan</i>	[dʒente] GENTE	[ʔdʒorno] DIURNU	[dʒa] IA “already”
GROUP B	FRONT (BACK-FRONT)	BACK	BACK (BACK-FRONT)
11. <i>Aromanian</i>	[dzer] GELU	[dʒos] DEORSU	[dʒuk] IUGU
12. <i>E. Friulian</i>	[ʒe'noli] GENUCCULU, [zinar] GENERU	[ju] DEORSU	[ʒuʌ] IOCCARE, [juʃ] IUGU, [ʒvɪn] IUUVENE
GROUP C	BACK	FRONT	FRONT
13. <i>Romansh</i> (Surmeiran)	[dʒela] GELAT, [ʒnuʌ] GENUCCULU	[dzo] DEORSU	[dʒukʃ] IUGU
GROUP D	FRONT	FRONT	FRONT
14. <i>Francoprovençal</i> (Valais)	[dʒɛ] GENITU	[dʒœ] DIURNU	[(d)zu] IUGU

Table 6a. (continued)

	GI/E-	DY-	I-
15. (Old) N. Italian (Venitian)	[z/ðenaro] GENERU	[dzorno] DIURNU	[z:go, ðugo] IOCU
16. E. Ladin (Comelican)	[d/ðente] GENTE	[ðu, do] DEORSU	[dow] IUGU
17. N. Occitan (Vinzelles)	[dza'la] GELARE	[dzur] DIURNU	[dza] IA
18. Vegliote	[dzjant] GENTE	[dzor'nwota] DIURNATA "work-ing day"	[dzawk] IOCU

- (1) Badia 1951: 175, 177, 184, 203–204, 210. (2) Dalbera-Stefanaggi 1991: 228, 365–368, 432, 491. (3, 7, 9) Lausberg 1970: 322–324, 327–329, 342, 364–365, 389, 397. (4, 12) Iliescu 1972: 56, 61, 63, 190, 208, 218; Francescato 1966: 206, 209, 216. (5, 10, 15) Rohlfis 1966: 210–211, 213–214, 247, 300–301, 304–305, 390, 393, 395. (6) Elwert 1941: 68, 70, 75, 78, 95, 97. (6, 8, 13, 16) Gartner 1910: 164. (8, 13) Lutia 1923: 154–155, 168, 186, 195, 273–274, 284; Luzi: 1904: 789, 802, 803, 807. (9) Viridis 1978: 50, 62–64, 68. (11) Křepinský 1968: 148–149 (14) Frankhauser 1910: 322, 323, 325, 331; Gauchat Jeanjaquet & Tappolet 1926: 42–43, 62–63. (16) Tagliavini 1926: 50, 52, 65. (17) Dauzat 1897: 15–16, 18, 23. (18) Bartoli 1906: 367, 376, 379.

Table 6b. Phonetic outcomes for intervocalic GI/E, GY, DY and I. See Table 1 caption for details, Tables 3, 4 and 5b for glosses for -GI/E-, -GY- and -DY-, and Table 6a for references.

GROUP A	-GI/E- BACK	-GY- BACK	-DY- BACK	-I- BACK
1. Catalan	[sə'ʒete] SAGITTA	[əsə'ʒa] *EXAGIARE	[əm'bɛʒə] INVIDIA	[də'ʒu] IEIUNU "fasting"
2. Francoprovençal (Valais)	[pa'ji] PAGESE	[kʃœ'raja] CORRIGIA	[bata'ji] BAPTIDIARE	[tru'j] TROIA "sow"
3. French	[liʁ] LEGERE	[ese'je] *EXAGIARE	[wi] HODIE	[me] MAIU "may"
4. E. Friulian	[ləj] LEGERE	[ko're(j)e] CORRIGIA	[po'ja] PODIARE	[bo(j)e] BOIA "hobble"
5. S. Italian (Calabrian)	[lɛjere] LEGERE	[ku'ria] CORRIGIA	[raju] RADIU	[maju] MAIU
6. Sardinian (Campidanese)	[sui'ri] SUGERE	[ko'ria] CORRIGIA	[ɔi] HODIE	[ma(j)u] MAIU
7. Tuscan	[lɛddʒe] LEGE	[ko'reddʒa] CORRIGIA	[radɔʒo] RADIU	[maddʒo] MAIU

Table 6b. (continued)

GROUP B	-GI/E-		-GY-		-DY-		-I-	
	BACK (BACK-FRONT)	BACK	BACK (BACK-FRONT)	BACK	BACK (BACK-FRONT)	BACK	BACK (BACK-FRONT)	BACK
8. Corsican	[ˈleʝa] LEGERE	[ˈpjaja] PLAGEA			[ˈoʝi] HODIE [ˈmeddzu] MEDIU		[ˈpeʝu] PEIU “worse” [maˈʝɔri] MAIORES “elder (pl.)” [ˈbo(ʝ)e] BOIA	
9. W./N. Friulian	[ru(d)ʝ/zin] AERUGINE [leʝ] LEGERE	[koˈɾɛ(ʝ)e] CORRIGIA			[poˈʝa] PODIARE			
GROUP C	BACK	BACK			FRONT		BACK	
10. W. Ladin (Fassan)	[ˈleʝer] LEGERE	[koˈrea] CORRIGIA			[ˈmeza] MEDIA		[ʝaˈʝun] IEIUNU	
11. Romanian	[ˈledʝe] LEGE	[kuˈɾea] CORRIGIA			[ˈraza] RADIA		[ˈmaju] MAIU	
12. Romansh (Sutselvan)	[fuˈʝi, fuˈʝir] FUGIRE	[kuˈreʝ/ʝa] CORRIGIA			[ˈmeza] MEDIA		[ʝiˈʝina, ʝiˈʝinar] IEIUNARE “to fast”	
GROUP D	FRONT	BACK			FRONT		FRONT	
13. E. Ladin (Comelican)	[d/ðeʝðo] DIGITU	[troˈuj] *TROGIU			[ˈmeðo] MEDIU		[ˈpeðu] PEIU	
GROUP E	FRONT	FRONT			FRONT		BACK	
14. Veglìote	[freˈdzja] FLAGELLU	[ˈsudza] SUGIA			[ˈvidza] VADIAT		[ˈplwaja] PLOIA “rain”	
GROUP F	FRONT	FRONT			FRONT		FRONT	
15. (Old) N. Italian (Venetian)	[ˈlez/ðe] LEGERE	[ˈtrozo] *TROGIU			[ˈraz/ðo] RADIU		[ˈpezo] PEIOR	
16. N. Occitan (Vinzelles)	[ˈfudze] FUGERE	[isaˈdza] *EXAGIARE			[ˈiˈvedza] INVIDIA		[ˈtrodza] TROIA	
17. Romansh (Surmeiran)	[fuˈdzekr] FUGIRE	[kuˈredza] CORRIGIA			[ˈmjadza] MEDIA		[dzidziˈner] IEIUNARE	

well, however, GI/GE and/or DY may have yielded more anterior phonetic realizations than GY and/or I, i.e., see groups B, C, D and E in Table 6b and groups B and C in Table 6a.

In order to account for the common evolution of GY, DY and I, it has been assumed that the voiced stop assimilated to [j] in the two former sequences after which [jj] turned into a stop ([ʃʃ]) or an affricate ([ddʒ]), or else stayed as a glide, depending on factors such as dialect, context and word position (Straka 1965: 135–137). Thus, the glide was reinforced word initially as a general rule, and intervocalically in languages like Italian ([mad'dʒore] MAIORE “older”, [meddzo] MEDIU “half (masc. sing.)”) and Romanian ([mjez] MEDIU) but not in other languages like Spanish ([ˈmajo] MAIU “may”). Within the framework of the present study, it is hypothesized that GI/E, GY and DY must have joined I in yielding a voiced (alveolo)palatal stop articulation differing in fronting and constriction degree depending on sound source and word position. More especially, the finding that GI/E and DY may give rise to more anterior outcomes than GY and I suggests that the (alveolo)palatal stop [ʃ] developed from the two former sequences was more anterior than the one derived from the two latter ones. A reason [ʃ] was more posterior if it came from GY than from GI/E might be related to the fact that GY did not occur in word initial position in Latin.

4.4 Position within the word and with respect to stress

Evidence in support of the role of word position in the degree of fronting and articulatory strength for the phonetic outcomes of the stop softening process becomes apparent from inspection of Table 7 (voiceless stops) and Tables 6a and 6b (voiced stops). According to the phonetic forms listed in Table 7, the end products for CI/E may exhibit a stronger manner of articulation word initially than intervocalically, i.e., [tʃ] vs. [ʒ] (see group A). Likewise, a stronger articulation may also hold word initially than intervocalically for one or more of the voiced consonant sources presented in Tables 6a and 6b, i.e., [(d)ʒ] vs. [j] and [dʒ] vs. [ʒ] in French, W./N. Friulian, Romanian and Sardinian, and [(d)z] vs. [j] and [dz] vs. [z, ð] in Francoprovençal, E. Friulian, N. Italian and Vegliote. In line with experimental data for present day Majorcan Catalan (Recasens & Espinosa 2009), it appears that these articulations were derived from (alveolo)palatal stops exhibiting more linguopalatal contact and a more acute and intense burst in the stronger word initial position than in the weaker intervocalic position.

Velar palatalization and velar softening may also be favored by stressed vs. unstressed syllables since stops are expected to exhibit a larger and more anterior closure, and a more intense burst, in the former prosodic condition than in the latter. Indeed, CA may have yielded an (alveolo)palatal stop if stressed while keeping

Table 7. Phonetic outcomes for word initial and intervocalic CI/E in Romance. See Table 1 caption for details, Tables 2 and 5a for glosses, and Table 2 for references.

	CI/E-	-CI/E-
GROUP A	BACK	BACK
1. <i>Corsican</i>	[tʃi'βoda] CEPULLA	[vi'tʃinu] VICINU
2. <i>W./N. Friulian</i>	[tʃiŋk] QUINQUE	[a'ʒejt] ACETU
3. <i>S. Italian</i> (Calabrian)	[tʃena] CENA	[dɛtʃi] DECE
4. <i>W. Ladin</i> (Fassan)	[tʃɛnder] CINERE	[kɛzɛr] *COCERE
5. <i>Romanian</i>	[tʃer] CAELU	[ve'tʃin] VICINU
6. <i>Romansh</i> (Surselvan)	[tʃun] CINQUE	[vi'ʒin] VICINU
7. <i>Sardinian</i> (Campidanese)	[tʃentu] CENTU	[nuʒi] NUCE
8. <i>Tuscan</i>	[ʃit'ta] CIVITATE	[kruʃe] CRUCE
9. <i>Vegliote</i>	[tʃiŋko] CINQUE	[vi'tʃajn] VICINU
GROUP B	BACK	FRONT
10. <i>Picard</i>	[ʃɔk] CINQUE	<i>crois</i> CRUCE
GROUP C	FRONT	BACK
11. <i>N. Italian</i> (Ligurian)	[sɛŋna] CENA	[ve'ʒin] VICINU
12. <i>E. Ladin</i> (Ampezzan)	[tʃento] CENTU	[ve'tʃin] VICINU
GROUP D	FRONT	FRONT
13. (<i>Old</i>) <i>Catalan</i>	[sɛn] CENTU	[və'ði] VICINU
14. <i>Francoprovençal</i> (Vaud)	[sɛ] CENTU	[ve'zɛ] VICINU
15. <i>French</i>	[sɛl] CAELU	[vwa'zɛ] VICINU
16. <i>E. Friulian</i>	[siŋk] QUINQUE	[a'zet] ACETU
17. <i>N. Italian</i> (Venitian)	[θera] CERA	[vi'ziŋ] VICINU
18. <i>E. Ladin</i> (Comelican)	[θɛrvu] CERVU	[pia'ði] PLACERE

the velar stop realization if unstressed in Surselvan, Surmeiran places and Friulian (Caduff 1952: 81, Grisch 1939: 57, Jaberg & Jud 1935: maps 269, 395).

4.5 Clusters

As a general rule, Latin dental and velar stops before a front vowel or glide have given rise to affricates and fricatives sharing the same or a similar place of articulation independently of whether they occurred intervocalically or postconsonantly. Thus, parallel to the intervocalic outcomes presented in Tables 1–7, the postconsonantal end product is alveolar if derived from TY, CI/E and CY and

alveopalatal if derived from DY, GI/E and GY in Catalan (22a), and alveolar for TY and CY and alveopalatal for CI/E and GI/E in S. Italian (22b).

- (22) a. Catalan [f'orsə] FORTIA “force”, [b'ensə] VINCERE “to win”, [bər'(d)ʒe] VIRIDIARIU “garden”, [əs'pɔn(d)ʒə] SPONGIA “sponge” (Badia 1951: 193, 203–204, 211),
 b. S. Italian [t'ertsu] TERTIU “third”, [l'antsa] LANCEA “spear”, [fawtʃe] FALCE “sickle”, S.E. Sicilian [muntʃiri] MULGERE “to milk” (Repetti & Tuttle 1987: 96, Rohlf 1966: 378, 388, 413).

In specific cases, the affricate or fricative end products of GI/E, DY and I turn out to be more anterior (as in 23a) and also stronger (as in 23b and 23c) postconsonantly than intervocally (see also Meyer Lübke 1974: 460).

- (23) a. Tuscan [o'rdzo] HORDEU “barley”, [p'randzo] PRANDIU “lunch”, [ar'dʒento] ARGENTU “silver”, [raddʒo] RADIU “ray” (Rohlf 1966: 362, 377, 394).
 b. Spanish [berθa] VIRIDIA “cabbage”, [ber'gwenθa] VERECUNDIA “shame”, [ar'θi.ɫa] ARGILLA “clay”, [en'θia] GINGIVA “gum”, Asturian [esmu'θir] EX-MULGERE “to milk”, [rajo] RADIU, [sa'eta] SAGITTA “arrow” (Lloyd 1993: 407–412, Menéndez Pidal 1968: 138, 148)
 c. Calabrian [o'rdʒu] HORDEU, [c'jandʒere] PLANGERE “to pity”, [raju] RADIU, [lejere] LEGERE “to read” (Rohlf 1966: 301, 362, 393–394).

Differences in fronting degree may also be associated with the contextual consonant. Thus, a more anterior output may be found after the rhotic than after [n] and [l]. Indeed, in a good number of Rhaetoromance and N. Italian locations surveyed by ALD (Goebel 1998), GI/E is realized [dʒ] after [n] in ANGELU “angel” (map 35) and [(d)z] and [ð] after [r] in ARGENTU “silver” (map 43). Moreover, while NGI/E, NGY, NDY and LGI/E may yield the (alveolo)palatal realizations [ɲ] and [ʎ] (24a), the presumable (alveolo)palatal stop outcome of CI/E and GI/E has undergone depalatalization into [t, d] after an alveolar and before [r] in French (24b) and has turned into a dental fricative after [r] in Spanish (see 23b).

- (24) a. Spanish [re'ɲir] RINGERE “to scold”, Tuscan [ver'goɲɲə] VERECUNDIA “shame”, [spuɲɲa] SPONGIA “sponge”, [kɔ.ʎere] COLLIGERE “to pick up” (Menéndez Pidal 1968: 138, Rohlf 1966: 362, 392, 396).
 b. French *peindre* PINGERE “to paint”, *veindre* VINCERE “to win”, *plaindre* PLANGERE “to pity”, *foudre* from *foldre* FULGERE “lightning”, *naître* from *naistre* NASCERE “to be born”, *sourdre* SURGERE “to emerge” (Meyer Lübke 1974: 478, Pope 1934: 126).

According to Lloyd (1993: 410), the fact that NGI/E (> [ɲ, nθ]) but not RGI/E (> [rθ]) may have evolved into an (alveolo)palatal consonant in Old Spanish is due to the presence of a syllable boundary after [n] but not after the rhotic at the time that those clusters were realized [ɲj] and [rj]. Malkiel attributed differences in fronting between those phonetic outcomes to the generation of an intermediate realization [dj] after [r] but not after [n] (Malkiel 1974). It seems to us that these contextual effects and others indicated above are associated with differences in closure fronting in the (alveolo)palatal stop realizations derived from GI/E, GY and DY after consonants involving different degrees of tongue blade and predorsum raising (see Monjour 1992 for a similar rationale): less tongue blade involvement for the rhotic than for the nasal stop and for the lateral may have caused the following (alveolo)palatal stop to exhibit a less extensive and more anterior closure after the former consonant than after the two latter ones. This special role of rhotics is consistent with the world's languages not favoring palatalized rhotics (Maddieson 1984). It is also in agreement with (alveolo)palatals being avoided next to a rhotic consonant, as shown by the evolutions RY> [r] instead of [rj] and RNY> [rn] instead of [rɲ] in Italian dialects (Umbrian -[ˈaro] suffix -ARIU, [orˈnano] place name *Ornano* derived from ORNIUS; Rohlfs 1966: 399, 401), and ŪLTR > [jtr] instead of [utʃr] in Spanish ([ˈbujtre] VULTURE “vulture”; Menéndez Pidal 1968: 140).

The place of articulation of the voiceless (alveolo)palatal stop appears to have been influenced by preceding [s] as well. In particular, in dialects where the fricative has presumably a centroalveolar or postalveolar realization (see Recasens & Espinosa 2007 for Catalan), STY, SCI/E, SCY and SCA may have yielded more posterior affricate and fricative outcomes (palatoalveolar) than TY, CI/E, CY and CA (alveolar or dental) (25).

- (25) Catalan [ˈfa(j)ʃa] FASCIA “strip”, [pe(j)ʃ] PISCE “fish”, [əˈser] ACIARIU “steel”, [vəˈði] VICINU “neighbour”, Tuscan [anˈgoffa] ANGUSTIA “anguish”, [ˈpretso] PRETIU “price”, Haute Loire [ˈmuʃa] MUSCA “fly”, [tsɔ] CAMPU “field” (Badia 1951: 183, 210, 233, Rohlfs 1966: 409, 413, Nauton 1974: 158–159).

A plausible evolutionary path for clusters with an initial alveolar fricative must have been [sc]> [ʃc] > [tʃ] > [(j)ʃ] and [sc]> [sts] > [ts] > [s, θ], as suggested by realizations such as [tre ʃʃiβudɔza] for [tres tʃiβudɔs] “three onions” in Sestu Campidanese (Bolognesi 1998: 223), and by specific lexical variants for MUSCA in N. Italian and Rhaetoromance areas ([ˈmoʃca, ˈmoʃtsja, ˈmoʃtʃa, ˈmoʃa]; Jaberg & Jud 1935: map 477, Goebel 1998: map 482) and in French dialects ([ˈmustso, ˈmustʃo, ˈmutso, ˈmuʃa]; Nauton 1961: map 353).

5. Conclusion

Based on historical, geolinguistic and experimental evidence, this paper has argued that velar and dental stop softening in different segmental context and positional conditions in Romance has been triggered by (alveolo)palatal stops differing mainly in closure location and in degree of palatal contact but also in acoustic prominence and other phonetic characteristics. Firstly, it has been shown that (alveolo)palatal stops and (alveolo)palatal consonants of other manners of articulation occur fairly frequently in the Romance domain, and that velar palatalization and velar softening have not only taken place before front vocalic segments but also before low vowels and word finally. Moreover, the place of articulation for (alveolo)palatal stops, whether derived from dentals or from velars, may be highly variable which suggests that those stops may give rise to more alveolar-like or more palatal-like affricates and fricatives; in these circumstances, (alveolo)palatal stops derived from [k] are often confused with those derived from [t] while the opposite holds to a lesser extent. The integration of (alveolo)palatal stops as affricates is consistent with acoustic data showing that the spectral properties of an (alveolo)palatal stop burst approach those of the frication period of [tʃ], while other cues appear to play a salient role depending on the case, i.e., a prominent frication period in front vowel contexts, and an intense burst and long and large frequency range formant transitions in low vowel contexts. In addition, (alveolo)palatal stops have been shown to alternate with alveolopalatal and alveolar affricates and fricatives in specific locations and dialectal domains. The lack of overlap between the geographical domains where the two solutions are found also suggests that both have arisen independently from (alveolo)palatal stop productions.

Arguments for an articulatory account of stop softening may also be sought in the historical evolution of specific segmental sequences. The degree of closure fronting and the prominence of the release burst in (alveolo)palatal stop realizations and thus, the possibility that those realizations may be heard as affricates or not, is influenced by several factors: closure location and the voicing status for the original stop, the vocalic element following the stop, the consonant preceding the stop in clusters, word position and stress placement. As a general rule, an increase in fronting and in constriction degree in the affricate and fricative final outcomes has been favored by the dental vs. velar place of articulation and by the voiceless vs. voiced status of the Latin stop, by a high degree of tongue height and fronting for the vocalic element following the stop and for the preceding consonant in clusters, and by the word initial and stressed positions.

Among those factors, stop voicing appears to be a highly reliable indicator of differences in fronting and manner of articulation in the affricate or fricative output. Indeed, for all pairs of sequences with a voiceless and a voiced stop (i.e.,

TY-DY, CI/E-GI/E, CY-GY, CA-GA), the voiceless correlate may yield more anterior and stronger outcomes than the voiced one. Differences in contact size and in acoustic prominence of the release burst in (alveolo)palatal stop productions may be responsible for this finding.

Romance linguists in the past have argued that affricates and fricatives have been derived from unaspirated velar and dental stops through intermediate (alveolo)palatal stop realizations, but could not explain successfully why the stop softening output may differ in place and manner of articulation depending on factors such as the articulatory characteristics of the original stop and the contextual and prosodic conditions involved. This paper has shown the relevance of phonetic detail in the reconstruction and explanation of this sound change. It is hoped that evidence for the articulation-based hypothesis of velar softening provided in the present study will help to improve the formulation of phonological analyses and sound change processes dealing with (alveolo)palatal consonants not only in the case of the Romance languages but of other language families as well (see Calabrese 2005 and Minkova 2003).

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Zusammenfassung

Experimentelle und deskriptive Evidenz aus den romanischen Sprachen suggeriert, dass die Abschwächung (Softening) der velaren und dentalen Plosive, (d.h. der Prozess in dem diese Plosive meistens zu palatoalveolaren und alveolaren Affrikaten oder Frikativen werden), allmählich über die Verwendung von Zwischenstufen der (alveolo-) palatalen Realisierungen der Verschlusslaute vollzogen wurde. Mehrere Argumente unterstützen diese These: a) Vorkommen der (alveolo)palatalen Verschlusslaute und der (alveolo)palatalen Konsonanten anderer Artikulationsmodi in romanischen Sprachen und Dialekten, entstanden durch Überlagerung der Gesten, deren Stärkung oder auch durch die Nutzung anderer Produktionsstrategien; b) Alternation zwischen (alveolo)palatalen Verschlusslauten und Affrikaten in mehreren Dialektgebieten; c) Variabilität in der Artikulationsstelle der Verschlussphase, die die Verwechslung mit dentalen oder velaren Verschlusslauten erklärt; d) experimentelle Evidenz aus Produktions- und Perzeptionsstudien. Ferner besteht e) eine plausible Relation zwischen den Realisierungen der (alveolo)palatalen Verschlusslaute, die sich im Fronting der Verschlussphase unterscheiden und der Variabilität im Fronting der Affrikaten- und Frikative, die ursprünglich von lateinischen dentalen und velaren Verschlusslauten abgeleitet worden sind. Aus der historischen Perspektive sind die Unterschiede meistens von der Artikulationsstelle und Stimmhaftigkeit der ursprünglichen Verschlusslaute abhängig sowie von den kontextuellen und positionellen Bedingungen unter denen der Verschlusslaut aufgetreten ist. Die vorliegende Untersuchung zeigt, dass feine artikulatorische Details bei der Formulierung der phonetischen Erklärung des Lautwandels in Betracht gezogen werden sollten.

Résumé

L'évidence expérimentale et descriptive des langues romanes suggère que le changement des occlusives vélares et dentales du latin en affriquées ou fricatives palatoalvéolaires ou alvéolaires a eu lieu graduellement à travers de réalisations occlusives (alveolo)palatales. Plusieurs arguments soutiennent cette interprétation: la présence d'occlusives (alveolo)palatales et de consonnes (alveolo)palatales d'autres modes d'articulation dans les langues et dialectes romans, qu'elles aient été générées par des processus de fusion ou de renforcement gestuels ou par d'autres mécanismes de production; l'alternance entre réalisations occlusives (alveolo)palatales et réalisations affriquées dans certaines aires dialectales; la variabilité d'emplacement de l'occlusion des occlusives (alveolo)palatales en général, ce qui explique que ces consonnes puissent se confondre avec des occlusives dentales ou vélares; l'évidence expérimentale fournie par des études de production et de perception de la parole. De plus, il semble y avoir une relation entre les différences d'antériorité de l'occlusion des réalisations occlusives (alveolo)palatales et celles des affriquées ou fricatives issues des occlusives vélares et dentales du latin. Ces différences dépendent surtout du lieu d'articulation et de la sonorité de l'occlusive originelle, et également des conditions contextuelles et de position. Cette recherche démontre l'importance du détail articuloire dans l'interprétation des changements phonétiques.

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