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Galician geada: In defense of underspecification in Optimality Theory

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Abstract

In Galician geada a voiced velar fricative or approximant surfaces as a voiceless fricative in all contexts except post-nasally, e.g., *pega* [péxa] 'magpie' (non-geada dialects [péɣa]) vs. *longo* [lóŋgo] 'long'. Although geada seems to be a rather basic phonological problem, existing analyses are complex. This paper shows that the analysis becomes quite straightforward once the connection of geada with voiced obstruent alternations is recognized. The proposed account obviates the need to resort to controversial mechanisms such as constraint conjunction and sheds light into the allophonic realizations of voiced obstruents. One crucial aspect of voiced obstruent allophones in Galician is their predictability and their underspecification for continuancy. Underspecification is argued to be compatible with Optimality Theory, as long as the underspecified input is not stipulated, but derived from the constraints and constraint ranking. In Galician the phonological system reveals the need for a three-way contrast in obstruents: [−continuant], [+continuant] and underspecified [continuant]. The findings about voiced obstruents have consequences for NC heterosyllabic clusters, showing that there is no voicing requirement at stake, rather a continuancy one, according to which voiced obstruents must be [−continuant] after nasals. Only voiced obstruents agree in continuancy with nasals, because only voiced obstruents are underspecified for continuancy. Constraint reranking accounts for dialectal variation.

Keywords: Galician; Geada; Voiced obstruent; Voiced velar; Underspecification; Optimality Theory

1. Introduction

Some dialects of Galician, a Romance language of northwestern Spain, have a process referred to as *geada* or *gheada*. Generally, *geada* consists of pronouncing a voiced velar consonantal segment (obstruent or approximant) as a voiceless fricative [x], except for the post-nasal context, where [g], [k], and [x] are possible, depending on the dialect: *pega* [péxa] 'magpie' (non-geada dialects [péɣa]) vs. *longo* [lóŋgo]/[lóŋko]/[lóŋxo] 'long' (Álvarez et al., 1986; Zamora Vicente, 1986; Fernández Rei, 1990). Yet, a wide range of phonetic realizations has been attested for geada (Labraña and Van Oosterzee, 2003; Regueira, 2009). For instance, Labraña and Van Oosterzee (2003), in a recent acoustic study,[1] report dialectal variation in point of articulation, with pharyngeal, glottal, velar and uvular realizations, voiced and unvoiced. Voiced variants appear only intervocalically, and are limited to one geographic area (inland). These authors explain the variation in point of articulation in relation to height, as ''upper'' and ''lower'' realizations of a dorsal segment. The present paper focuses on those dialects in which the result of geada is a (voiceless) velar fricative.

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[1] To my knowledge, this is the only acoustic study to date.

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Geada has generated a significant amount of interest from a descriptive and sociolinguistic perspective (Carballo Calero, 1968; García de Diego, 1984; García González and Santamarina Fernández, 1985; Ferreiro, 1999, among many others). Recent empirical studies investigate speaker and social attitudes toward this phenomenon, often stigmatized as typical of rural and uneducated speakers, and as an indicator of socioeconomic background (Recalde Fernández, 1994, 1995; Thomas, 2005). Others describe phonetic realizations of geada obtained by means of acoustic analysis of recordings from various dialects (Labraña and Van Oosterzee, 2003). By contrast, the phonological account of the phenomenon has only attracted the attention of a few researchers (Prieto Alonso, 1980; Santamarina, 1980; Schroten, 1980; Pensado, 1983; Martínez-Gil, 2004). It is to this aspect of geada that this article intends to contribute.

Geada appears to be a ''rather basic phonological problem'' (Martínez-Gil, 2004), and yet, the few existing attempts at explanation have not been so straightforward. It is reasonable to assume that a basic process should also have a basic explanation and that a less obvious one may be an indication that the theoretical tools at our disposal are not entirely adequate or that, perhaps, some crucial insight remains hidden. In the case of geada, I argue that issues of phonological inventory, feature specification and underspecification hold the key to a more complete, simpler understanding of the process. In particular, one must consider the allophonic variation of voiced obstruents, as done by authors such as Pensado (1983). An analysis of geada must be able to recognize and account for the interaction with voiced obstruent alternations. Once this is accomplished, a simpler analysis emerges.

In Galician, as in many varieties of Peninsular Spanish, voiced obstruents are [−continuant] after a pause, in word-initial position and after a homorganic nasal or lateral. In other contexts, they are [+continuant]. The variety of accounts of the allophonic variation of voiced obstruents in Spanish (Harris, 1984; Mascaró, 1984; Hualde, 1989; Baković, 1997, among others), also applicable to Galician, can be seen as resulting from an imperfect understanding of the phenomenon. Disagreements exist with regard to the form of the underlying representation (underspecified, continuant and non-continuant) and to the post-lateral context, which can be [+continuant] or [−continuant] depending on the point of articulation of the obstruent (i.e., [−continuant], if coronal). In addition to providing for a simpler account of geada, the analysis proposed here makes a contribution to our understanding of voiced obstruents in Galician by showing that the alternation is a consequence of a three-way contrast in continuancy among voiced obstruents, namely [−continuant], [+continuant] and unspecified. Regarding the formalization of the facts, an optimality-theoretic framework, in which all constraints are always present, allows the analyst to capture the connection between geada and voiced obstruent alternations in a much more natural way than a derivational model of phonology with separate, language-specific rules.

The development of any new theory like Optimality Theory (OT) brings about the need to reexamine concepts and tools to determine which are theory-specific, which are compatible or incompatible with new findings and how/if they can be translated into the new framework. Underspecification has been a matter of debate within OT for a while now. Some claim that it contradicts *Richness of the Base* (RoTB), a crucial tenet of OT by which no restrictions are allowed on the form of the underlying representation. As will be seen below, other researchers counter that underspecification is a possibility in OT, as long as it is not determined a priori, and it results from the constraints and constraint ranking (Inkelas, 1995; Harrison and Kaun, 2001; Hale and Kissock, 2007). Another relevant principle, *Lexicon Optimization*, allows the learner to select among several inputs the one that is more harmonious with the output, given the constraint ranking. In other words, if an underspecified input is among several from which the constraints and constraint ranking select the correct output, the underspecified one could be the actual input posed by the learner, as long as this is the one that incurs the fewest constraint violations for that particular output, i.e., the most harmonious input. The current analysis contributes to the discussion on underspecification in OT, showing that, precisely because of RoTB, an underspecified form cannot be ruled out as an input. In Galician geada the constraints and constraint ranking are sufficient to select the correct output for the unspecified input, incurring fewer violations that when in correspondence with specified inputs.

The paper is organized as follows: after presenting the introduction in section 1, section 2 contains the data and a critical review of previous studies on the topic. Section 3 presents the analysis proposed and some related issues. Section 4 is devoted to accounting for dialectal variation and section 5 contains some conclusions.

2. Background

2.1. Data and description

Galician has a process of allophonic variation by which /b, d, g/ are realized as [−continuant] after a nasal, after a pause and after /l/ in the case of /d/ (e.g. *cam*[b]*io* 'change', [g]*ota* 'drop', *tol*[d]*o* 'awning'), and as [+continuant] in other contexts (e.g., *tra*[β]*allo*, 'work', *na*[ð]*a* 'nothing', *pe*[ɣ]*a* 'magpie').[2] This process, often referred to as *spirantization*, is similar to the

[2] These continuant segments have been traditionally described as fricatives. Yet, recent phonetic evidence shows that, despite variation in the degree of aperture, open (spirant) approximants are the most common realization (cf. section 3.1).

one found in many varieties of Spanish. Geada dialects, however, do not have all three points of articulation for the continuant allophones: instead of the voiced dorsal continuant [ɣ] that would result from the allophonic variation of /g/ in other varieties, these dialects exhibit a voiceless velar [x] in all contexts, including word-initial position (1).[3] Additionally, morpheme-internally, after a homorganic nasal, some *geada* varieties have a voiced stop [g] (2), others, a voiceless stop [k] (3), and yet others, a voiceless fricative [x] (4). When the nasal + velar sequence is found across morphemes (and across words, *con gracia* [koŋxrásja] 'with charm'), a voiceless fricative [x] appears in all dialects (5a–b). (2) is the dialect with the most speakers (Fernández Rei, 1990:54).

(1)

gato	[xáto]	'cat'	pega	[péxa]	'magpie'
galego	[xaléxo]	'Galician'	faga	[fáxa]	'do-subjunctive, 3p. sg.'
gaita	[xáita]	'bagpipe'	paga	[páxa]	'salary'
guerra	[xɛ́ra]	'war'	pegues	[pɛ́xes]	'hit-subj, 2p.sg'
guiso	[xíso]	'stew'	agro	[áxro]	'field'
gorra	[xóɾ̊a]	'cap'	sigla	[síxla]	'acronym'
gusto	[xústo]	'taste'	agua	[áxwa]	'water'
grasa	[xráʃa]	'fat'	legua	[lɛ́xwa]	'league'
grelo	[xrélo]	'rapini'	algo	[álxo]	'something'
grilo	[xrílo]	'cricket'	folga	[fɔ́lxa]	'strike'
globo	[xlóβo]	'balloon'	cargar	[karxár]	'load's

(data from Pensado (1970); transcriptions mine)

(2)

longo	[lóŋgo]	'long'
domingo	[domíŋgo]	'Sunday'
lingua	[líŋgwa]	'language'

(3)

longo	[lóŋko]	'long'
domingo	[domíŋko]	'Sunday'
lingua	[líŋkwa]	'language'

(4)

longo	[lóŋxo]	'long'
domingo	[domíŋxo]	'Sunday'
lingua	[líŋxwa]	'language'

(5)

a.

gordo	[xórðo]	'fat'
grande	[xráŋde]	'big'
gracias	[xrásjas]	'thank-you'

b.

en + gordar	[eŋxorðár]	'to gain weight'
en + grandecer	[eŋxraŋdesér]	'to become larger'
con + graciar	[koŋxrasjár]	'to obtain favor'

(Martínez-Gil, 2004:300–301)

c. con + gracias [koŋxrásjas] 'with charm'

2.2. Phonological literature

In this section, I review existing phonological studies of geada. The origin of geada, one of the most controversial issues in the literature, has also drawn attention from phonologists. Given that Galician does not have [x] in its native inventory,[4] the discussion centers around whether geada originated as the result of an internal change or it is due to external factors. Proponents of the view that geada is due to external causes claim that Galician, a language in a contact situation, adopted features of the at-one-point politically dominant Spanish. Under this view, some speakers would have attempted to imitate the sound [x] of the more prestigious language, in contexts different than those where it appears in Spanish. According to this view, Galician speakers would produce [x] in contexts corresponding to the continuant

[3] As mentioned in section 1, pharyngeal, glottal and uvular realizations are possible. This paper, however, focuses on varieties with [x] because this is the most widespread pronunciation and because this is the dialect in Martínez-Gil (2004) and the studies referred to here.

[4] Spanish borrowings, very numerous in Galician, are an exception. Spanish forms with [x] often preserve this sound in Galician, e.g., *cole*[x]*io* 'school'.

allophone of a voiced velar obstruent in Spanish (also in the non-geada dialects of Galician). Some phonologists argue against Spanish influence (Prieto Alonso, 1980; Santamarina, 1980; Schroten, 1980), while others take the opposite view (Pensado, 1983).[5] Pensado (1983) and Schroten (1980), despite taking opposite positions on the origin question, come to the conclusion that, regardless of how geada originated, the phonological process needs to be explained. For Pensado, the introduction of [x] produced adjustments that need to be accounted for phonologically (1983:118). Schroten states: ''. . .la verdad. . .carecerá de interés mientras no se explique la mecánica del cambio (1980:212). . .'' ''the truth will be of no interest, as long as the change mechanism remains unexplained. . . [translation mine]''. The current proposal takes a similar stance. Regardless of how [x] entered the phonology of the geada dialects, speakers have incorporated it into their phonological systems. Furthermore, a contact account falls short in that it offers no explanation for the described dialectal variation or for the absence of [x] in the post-nasal position in [g] dialects.

Some derivational accounts consider *geada* a type of lenition because the output is a continuant phone (Prieto Alonso, 1980; Santamarina, 1980). Yet, this cannot be a sufficient explanation for the presence of [x] instead of [ɣ], because [x] is also a lenited consonant. In other words, lenition accounts do not explain why [x] is preferred to [ɣ], given that both are the result of weakening.[6] Pensado (1983) proposes that the introduction of [x] creates an asymmetry in a system where the labial and coronal obstruents alternate in continuancy, but not in voicing, as the velars [x] ~ [g] do. Such asymmetry triggers additional changes in the post-nasal context for some dialects ([k] and [x]). She also argues, as I do here, that geada is closely related to the voiced obstruent alternation. Despite some valuable insights, Pensado does not propose a formal analysis that can be easily compared to the current proposal.

Martínez-Gil (2004) offers a more recent, much more comprehensive formal analysis that does not face the issues mentioned above with regards to derivational approaches. His is the only optimality-theoretic account of geada to date and the focus of this section. A fundamental claim of Martínez-Gil (2004), as well as of the current proposal, is that [x] and [g]/[k] correspond to one underlying segment. As Martínez-Gil (2004) notes, there are no morphophonological alternations involving geada, which would make a clearer case for a single phoneme. Nevertheless, it is reasonable to assume that [x] and [g]/[k] are allophonic variants of a single phoneme, rather than two separate phones, because [x] and [g]/[k] are in complementary distribution. Consequently, one key element of this proposal will be determining the form of the underlying representation.

Martínez-Gil argues that, regardless of the form of the underlying representation posed by the analyst, a serial account of *geada* is untenable because it requires a lexical rule that leads to violations of Structure Preservation (Kiparsky, 1982) by introducing a segment, [x], which is not part of the underlying inventory of the language. To solve this problem, he proposes an optimality-theoretic analysis that does not face the issue of Structure Preservation, typical of a derivational lexical phonology approach. Crucial components of his analysis are /x/ as the underlying representation, and *constraint conjunction*. His proposal rests on the five essential constraints in (6) and the ranking in (7). Constraints linked by & are conjoined constraints:

(6) *N C̥: Voiceless consonants are not allowed after nasals.
NC[cont]: Post-nasal obstruents must agree in continuancy with the preceding coda nasal, i.e. they must be [−continuant].[7]
*Dor Pl: No dorsal place of articulation.
Ident-[voice]: The specification for [voice] in the input must match its correspondent in the output.
Ident-[cont]: The specification for [continuant] in the input must match its correspondent in the output.

(7) NC[cont] & *Dor Pl, *N C̥ & Ident-[cont] ≫ Ident-[voice], Ident-[cont]

For a candidate to violate a conjoined constraint, it must violate each of the conjuncts. In other words, a candidate that satisfies one of the two constraints does not incur a violation of the conjoined constraint. NC[cont] &*Dor Pl guarantees

[5] Prieto Alonso (1980:237) attributes to Schroten a mixed position on the matter. Yet, Schroten agrees with Zamora Vicente (1952) that that type of change could not have had its origins in Spanish (1980:211–212).

[6] In addition, as an anonymous reviewer suggests, [x] is less lenited than [ɣ]. This implies a fortition process in comparison with [ɣ].

[7] The wording of NC[cont] is slightly different in Martínez-Gil (2004), i.e., ''Continuant consonants are not allowed after nasals''. The intent, however, clearly is to require agreement. Martínez-Gil explains that NC[cont] is a markedness constraint requiring agreement of the feature continuant in a NC sequence, as in (6) (2004:307). Since he does not consider underspecified candidates, wording the constraint as ''continuant consonants are not allowed'' has no consequences for his analysis. For the sake of consistency with the formulation in (9), the wording of Ident-[voice] and Ident-[cont] has also been slightly modified with respect to Martínez-Gil (2004) which reads ''The specification for [voice] in the input must have a correspondent in output'' and ''The specification for [continuant] in the input must have a correspondent in output'', respectively. The substance remains the same as in Martínez-Gil (2004).

that a post-nasal velar must be a stop ((8a) and (8b) are eliminated because they violate this constraint). *Dor Pl serves to restrict this condition to velar consonants. This is necessary since non-velar post-nasal consonants can be fricatives [+continuant], as in *canso* [kanso] 'tired'. The effect of *NC̥ & IDENT-[cont] is to assure that, in a post-nasal context, input /x/ does not correspond to [k] (8c) (i.e., an output with a post-nasal voiceless consonant that does not match the continuancy of the input is ruled out).

(8) Martínez-Gil (2004) (37)

/lonxo/ 'long'	NC[cont] & *Dor Pl	*NC̥ & IDENT-[cont]	IDENT-[voice]	IDENT-[cont]
a. lóŋxo	*!			
b. lóŋɣo	*!		*	
c. lóŋko		*!		*
d. ☞lóŋgo			*	*

Martínez-Gil (2004) posits an underlying /x/. He shows that the input cannot be /g/, because, according to his ranking in (7), this would result in the selection of incorrect outputs. In particular, in order to retain the underlying contrast between /k/ and /g/ in post-nasal contexts ([manga] 'sleeve' vs. [maŋka] 'one-armed female'), identity constraints would have to dominate NC markedness constraints. Yet, even assuming a *VCDVLR constraint against voiced velars and the domination of identity over markedness, [k] will always be more faithful to the input /g/ than [x], resulting in the selection of an unintended output, /pega/ *[peka].

While Martínez-Gil's analysis works, it resorts to at least one complex formal mechanism. All else being equal, a simpler analysis would be preferred. The mechanism referred to is constraint conjunction, a controversial type of constraint in OT. Constraint conjunction has been widely discussed in the literature. The idea behind it is that multiple constraint violations are worse when they occur in one location, rather than in separate ones. Consider, for instance, the well-known constraints *LABIAL and *CODA banning labial consonants and coda segments, respectively. Under constraint conjunction, [map] is a worse output than [mat], because it contains violations of both constraints in the same location [p] (i.e., a violation of the conjoined constraint *LABIAL&*CODA), while [mat] violates *LABIAL and *CODA in two separate segments, [m] and [t]. Despite its intuitiveness and a few empirical arguments in its favor (see Lubowicz, 2005 and references therein), constraint conjunction remains controversial because it undermines the optimality-theoretic assumption of strict domination and because of its potential for overgeneration (Padgett, 2002). Multiple attempts have been made to limit the scope of conjoined constraints, by restricting their domain to a local one (e.g., Kirchner, 1996; Alderete, 1997; Itô and Mester, 2002; Lubowicz, 2005) and by defining the nature of the constraints that can be conjoined. Among the latter, it has been proposed that constraints should belong to the same family (Fukazawa and Miglio, 1998); that they should only be conjoined with themselves or with closely related constraints (Kirchner, 1996); that faithfulness and markedness are the only constraints that cannot be conjoined (Itô and Mester, 2002), etc. As Padgett (2002) points out, the answers to these questions remain elusive, suggesting that the problem is constraint conjunction itself. Consequently, he proposes eliminating constraint conjunction and replacing it with constraint subhierarchies. While it is unclear if all analyses in the literature that use constraint conjunction can be accounted for by means of constraint subhierarchies, the fact remains, as noted by Padgett, that the mechanism of conjunction capitalizes on complex generalizations, compared to the simple, unitary generalizations provided by constraint subhierarchies. Bearing in mind the controversial and complex nature of constraint conjunction, an analysis that is capable of explaining the data by means of individual, well-motivated constraints should be superior to one that uses constraint conjunction. In other words, in assessing the benefits of optimality-theoretic accounts, the burden of proof rests on those that do so by means of constraint conjunction. Martínez-Gil (2004:315), in his analysis of geada, questions whether constraint conjunction should be allowed at all, explaining that it is justified to the extent that it provides a way to capture certain aspects of phonological structure that cannot otherwise be expressed by individual constraint interaction. The current analysis shows that the phonological phenomena involved in geada can be expressed by individual constraint interaction and therefore constraint conjunction can be disposed with.

When addressing the form of the input, Martínez-Gil rules out the possibility that an input could be underspecified because in his view this would contravene the principle of *Richness of the Base* (Prince and Smolensky, 2004), which allows for no restrictions on the form of the underlying representation. Yet, as I show below (sections 3.2 and 3.4), an underspecified input does not necessarily go against *Richness of the Base*. In fact, underspecification has been proposed within Optimality Theory by authors such as Inkelas (1995) and Harrison and Kaun (2001) who argue that OT allows for principled underspecification and that it "...leaves room for the possibility that partially underspecified lexical entries will on occasion be posited (Harrison and Kaun, 2001:212)."

In contrast with Martínez-Gil (2004), the current proposal takes a voiced velar obstruent, unspecified for continuancy, as the input. It also shows, in agreement with Pensado (1983), that Galician geada is crucially connected to the voiced obstruent alternation between stop and spirant. Once this connection is recognized and incorporated into the analysis, a much simpler and more intuitive account emerges, one in which the need for constraint conjunction is obviated. The core insight to be argued for in this section is that post-nasal [g] does not result simply from a requirement to agree in continuancy and voice with the preceding nasal, as some analyses have proposed, but from the fact that voiced obstruents do not exhibit a contrast for continuancy.

3. Analysis

In this section, the analysis is presented first, followed by a discussion of its main assumption – underspecified inputs are legitimate in OT. A first approximation to the analysis of geada takes as its point of departure the marked nature of voiced velar obstruents in non-nasal environments (section 3.1) and considers various potential inputs. However, once the set of geada contexts is expanded to include the post-nasal position (section 3.2), it becomes clear that the initial set of constraints and the constraint ranking have to be revised, also showing that the underlying representation must be a voiced obstruent underspecified for the feature [continuant]) (represented by /G/). Unlike what happens in intramorphemic post-nasal position, [x] surfaces across morphemes in post-nasal position, a fact that is explained as the result of antiallomorphy (section 3.3). After the presentation of the analysis is complete, the discussion turns to underspecification in OT and the alternation of voiced obstruents in Galician, both crucial factors in our understanding of geada.

3.1. Geada as antimarkedness: first approximation

Although [x] may have its origins in a contact situation with Spanish, I hypothesize that currently geada serves to avoid a marked segment, a voiced velar obstruent (cf. below for phonetic justification). Acoustic analysis has shown that this sound is frequently a (spirant) approximant (Martínez-Celdrán and Regueira, 2008), also a highly marked phone, which occurs in all contexts except for in post-nasal position and after a pause. Despite the acoustic descriptions, I retain the fricative label here for reasons of presentation, since referring to a 'fricative' facilitates comparison with existing analyses which also use this term (Martínez-Gil, 2004), but also for more substantive phonological reasons: (i) phonologically, the output appears to behave as an obstruent, as it alternates with stops; (ii) the greater degree of aperture of the approximant when compared to that of a fricative can be argued to be a matter of phonetic implementation and coarticulatory effect, with regard to aperture. This is in agreement with the findings in Martínez-Celdrán and Regueira (2008), who report that these segments encompass a continuum of openness, from a close approximant more like a stop, to an open approximant, closer to a vowel. In Aperture Theory (Steriade, 1993), approximants and vowels belong to the same aperture class (maximal), while non-continuants have minimal aperture; fricatives are sounds with medium aperture.[8]

The preliminary constraints and constraint rankings are in (9–10). I take as a point of departure the working hypothesis that a markedness constraint penalizing voiced velars is more highly ranked than the faithfulness constraints against modifying input featural specifications for voice and continuancy. The relevant constraint against voiced velar obstruents can be justified on the basis of aerodynamic constraints on voicing. In order to maintain the airflow needed for voicing during the production of obstruents, the size of the oral cavity must be expanded, but the options for enlargement of the vocal tract are few for velars because of the small size of the vocal cavity volume during back articulated sounds (Ohala, 1983, 1994; Maddieson, 1984).

(9) *Voiced velar (*VcdVlr): No voiced velar obstruents.
Ident-[voice] (Id-[voi]): The specification for [voice] in the input must match its correspondent in the output.
Ident-[cont] (Id-[cont]): The specification for [continuant] (and [consonantal]) in the input must match its correspondent in the output.

(10) *VcdVlr ≫ Id-[voi], Id-[cont]

[8] An anonymous reviewer points out that in Peninsular Spanish, while /b, d/ tend to be approximants, /g/ is more often a fricative than an approximant (González, 2002). If this were also the case in Galician, it could help explain the shift to a true fricative, i.e., [x]. Martínez-Celdrán and Regueira (2008) is the only phonetic study I am aware that speaks to this matter. These authors find that Galician has mostly approximant realizations (79.3 % average), with no significant point of articulation effects (2008:61).

The spirant approximant referred to above is not shown in tableaux (11) and following, for simplicity. Since this approximant never surfaces in geada dialects because it is replaced by [x] ([g]/[x]/[k] in post-nasal position), it is difficult to ascertain whether it is fact an approximant (cf. footnote 8). Notwithstanding, a few observations are in order with regard to a candidate containing this segment. The argument could be made that an approximant realization does not violate *VcdVlr since it is not an obstruent. Yet, because a candidate with a voiced velar approximant loses to [x], it must be that the approximant is also ruled out by *VcdVlr or some other markedness constraint, as it is in fact a highly marked segment (because of the same phonetic reasons as the voiced velar fricative). In consonance with the above explanation on phonetic implementation of voiced velar obstruents, I hypothesize that the hypothetical approximant would be eliminated by *VcdVlr, which bans not only voiced velar obstruents, but also their various phonetic implementations, all consonantal, differing only on aperture. Furthermore, the candidate with an approximant would incur an additional violation (vs. the fricative) of Ident[consonantal] as the input is [+consonantal]. One can think of this as an automatic consequence of the change in degree of aperture involved in a spirant (open) approximant, which would differ from stops in being [+continuant] and from fricatives in having a [−consonantal] specification. Both features are related to aperture.

One important issue in the analysis of geada is the form of the *underlying representation*. The tableaux in (11–13) show candidate evaluation for three possible inputs: /g/, /x/, and /G/, where /G/ stands for a voiced velar obstruent underspecified for the feature [continuant]. For the initial set of constraints and the constraint ranking, /g/ results in the selection of the wrong output [káto] in (11b). The correct output (11a) [xáto] loses to (11b) because it contains an additional violation of Id-[cont]: since the input /gato/ is [−continuant], (11a), being [+continuant], is worse than (11b) that is [−continuant], and thus matches the input specification for this feature. Positing /x/ in the input, as in (12), the constraint and constraint ranking select (12a) [xáto] as the correct output, because it has the fewest number of violations. (12a) is a voiceless velar, thus satisfying *VcdVlr; it also matches the input with regard to voice and continuancy, therefore incurring no violation of the relevant faithfulness constraints, namely Id-[voi] and Id-[cont]. As seen in (13) the input with an underspecified voiced velar obstruent results in a tie between the two voiceless outputs. The candidates with voiced velars (13c–e) are eliminated on account of violations of the highly ranked *VcdVlr. The tie between voiceless candidates occurs because the input does not contain a continuancy specification, and consequently, neither candidate violates Id-[cont].[9] Being voiceless, (13a–b) incur Id-[voi] violations. Given the constraints in (9–10), /Gato/ will always be a less harmonious input for output [xáto] than /xato/, because /Gato/ is underspecified for the feature [continuant] and, as a consequence, a faithfulness constraint needs to be violated to provide for a phonetic realization of continuancy in the output. For the sake of completeness, an underspecified output candidate has been considered for (11–13); in all, the underspecified output is ruled out by *VcdVlr violations. It must be noted that outputs underspecified for continuancy do not violate Id-[cont] due to the fact that there is no continuancy specification that could correspond to that of the input.[10]

(11) Underlying /g/

/gato/ [xáto]	*VcdVlr	Id-[voi]	Id-[cont]
a. xáto		*	*!
b. ☞káto		*	
c. gáto	*!		
d. ɣáto	*!		*
e. Gáto	*!		

(12) Underlying /x/

/xato/ [xáto]	*VcdVlr	Id-[voi]	Id-[cont]
a.☞ xáto			
b. káto			*!
c. gáto	*!	*	*
d. ɣáto	*!	*	
e. Gáto	*!	*	

[9] The underspecified input will turn out to the most harmonious one, as the tie will be resolved in the final version of the analysis (cf. 23).

[10] For specified inputs, an underspecified output violates the constraint against deletion of the feature [continuant], Max-[cont]. This is not shown in the tableaux for reasons of presentation.

(13) Underspecified input /G/

/Gato/ [xáto]	*VcdVlr	Id-[voi]	Id-[cont]
a.☞ xáto		*	
b. ☞káto		*	
c. gáto	*!		
d. ɣáto	*!		
e. Gáto	*!		

3.2. Post-nasal position (intramorphemic)

As seen in section 2.1, post-nasally, some *geada* varieties have a voiced stop [g], others, a voiceless stop [k], and others, a voiceless fricative [x]. The [g] dialect is the one with the most speakers and the focus of this section (cf. section 4 for other dialects). It will be shown that the facts about the post-nasal position in the g-dialect support the proposal that the input must be a voiced velar obstruent underspecified for continuancy (rather than /x/, cf. section 3.1). In this regard, there are two issues to consider: (i) voiceless fricatives do not become stops in post-nasal position; (ii) [g] surfaces in the post-nasal position; therefore, a more highly ranked constraint must dominate *VcdVlr to force its violation. These two matters are tied to the underspecification of voiced obstruents (section 3.4).

Voiceless fricatives, unlike voiced obstruents, are always fricatives after a nasal, *canso* [kánso] 'tired'. These facts have a straightforward explanation if voiceless fricatives are specified for continuancy in the input and the faithfulness constraint requiring preservation of input [cont] is highly ranked. Assuming that the dominated constraint is NC[cont] (cf. (6) obstruents must agree in continuancy with a preceding nasal), fricatives can be explained through the ranking Id-[cont] ≫ NC[cont]. Fricatives also retain their voiceless specification after a nasal, suggesting that Id-[voi] also plays a role in candidate selection. Since *VcdVlr dominates Id-[voi] and NC[cont] dominates *VcdVlr (cf. [15]), by transitivity NC [cont] ≫ Id-[voi]. In (14), (c) and (d) are ruled out by the top-ranked constraint, Id-[cont]. (14a) and (14b) both contain fricatives, thus violating NC[cont]; however, (14b) is worse than (14a) because it incurs an additional violation mark for Id-[voi] as the [voice] specification of input and output differ. Note that, regardless of the ranking of Id-[voi] in (14), (14b) is worse than (14a) because it contains one more constraint violation. As a result, (14a), the candidate with a voiceless fricative, is the optimal candidate.

(14) Post-nasal voiceless fricatives

/kanso/ [kanso] 'tired'	Id-[cont]	NC[cont]	Id-[voi]
a.☞ kanso		*	
b. kanzo		*	*!
c. kanto	*!		
d. kando	*!		*

Bearing in mind that the ranking is Id-[cont] ≫ NC[cont], geada outputs must satisfy Id-[cont] in order to be selected as the output. For geada outputs to satisfy Id-[cont] the input must be either: (i) unspecified for [continuant], OR (ii) it must match the continuancy specification of the input. I argue that (i) is the correct assumption. The argument is as follows. As the output alternates between [−continuant] (after a nasal) and [+continuant] (elsewhere), inputs specified as [−continuant] or [+continuant] (i.e. /g/ or /x/) will violate Id-[cont] in one of the two contexts. For instance, if the input were /x/, as (11–13) seemed to indicate, [loŋgo] would incur one Id-[cont] violation in /lonxo/ [loŋgo], while /xato/ [xato] would satisfy the Id-[cont] constraint. If the underlying segment were /g/, [xato] in /gato/ [xato] would violate Id-[cont], but [loŋgo] in /longo/ [loŋgo] would satisfy it. Consequently, only an underspecified input /G/ will satisfy Id-[cont] in both contexts: /Gato/ [xato], /lonGo/ [loŋgo] [cf. Id-[cont] in (16) and (18)]. The view that the underlying representation of voiced velar obstruents is underspecified for continuancy is further supported by the allophonic variation of Galician voiced obstruents that are also stops after a homorganic nasal or lateral, and after a pause, e.g., *cam*[b]*io* 'change', [b]*ota* 'boot', *tol*[d]*o* 'awning' and spirants in other contexts, e.g., [xlóβo] , 'work', *na*[ð]*a* 'nothing' (Regueira, 1996; Freixeiro Mato, 1998). An underspecification analysis has also been proposed for Spanish /b, d, g/ (Mascaró, 1984; Hualde, 1989).

Proposing an underspecified input as part of an optimality-theoretic account has been objected to by some scholars (e.g., for Galician, Martínez-Gil, 2004), on the grounds that underspecification places a restriction on the form of the underlying representation. According to the *Richness of the Base*, in OT no restrictions are possible regarding the form of the input. Yet, an underspecified form places no more restrictions on the input than /g/ or /x/. In the interest of the presentation, I first show how the analysis would proceed with /G/ as the input, to then return to the controversy about underspecification in OT.

As mentioned above, for [g] to surface in the post-nasal position, a more highly ranked constraint must force a violation of *VcdVlr. I assume for now that it is a constraint that requires all obstruents to agree in continuancy with a preceding nasal, i.e., NC[cont] (Martínez-Gil, 2004). Earlier we established that *VcdVlr dominates Id-[voi] and that Id-[cont] ≫ *NC [cont]. Thus, by transitivity, Id-[cont] must also dominate *VcdVlr, contrary to the preliminary ranking in (10), which must be modified, as seen in (15).

(15) Id-[cont] ≫ *NC[cont] ≫ *VcdVlr ≫ Id-[voi]

(16) Post-nasal voiced obstruents: incorrect output selected

/lonGo/ [loŋgo] 'long'	Id-[cont]	NC[cont]	*VcdVlr	Id-[voi]
a. loŋgo			*!	
b.✗ loŋko				*
c. loŋxo		*!		*
d. loŋɣo		*!	*	
e. loŋGo		*!	*	

The ranking and candidates in (16) result in the selection of the incorrect candidate [loŋko] (identified with ✗)[11]: (16c)–(16e) are eliminated because they have a post-nasal fricative, violating NC[cont]; (16a) is ruled out on account of the voiced velar (*VcdVlr violation); (16b), with a voiceless stop, only violates the lowest ranked constraint (Id-[voi]) and is thus incorrectly selected as the winner. Although one may attempt to solve the problem through reranking of Id-[voi], so that the voice specification of the input is retained, this solution will have to be ruled out, as in other positions the output candidate is voiceless [x], suggesting that Id-[voi] cannot be highly ranked. Therefore, it must be that a higher-ranking constraint, not yet considered, selects [g]. I argue that it is *Merge, a constraint that penalizes the neutralization of contrasts. Given that /k/ is part of the phonemic inventory of Galician, [k] would merge the outputs of input /k/ and input /G/ in the sense that an output [k] could correspond to two inputs, namely /k/ and /G/. A merged output like [k] incurs a violation of *Merge.

(17) *Merge: Two inputs cannot correspond to one output, i.e. contrast must be maintained (Bradley, 2006; Holt, 2006; Padgett, 2009).

Thus, as seen in (18), [loŋko] (18b) loses to [loŋgo] (18a), because of the violation of highly-ranked *Merge. [loŋko] (18b) violates *Merge because it corresponds to two inputs, one listed, as usual, at the top of the candidate column and the other one shown next to the fatal violation, in the relevant cell in (18). A few words are in order regarding the nature of *Merge. *Merge is inspired by Dispersion Theory (Flemming, 2002; Padgett, 2003a,b, 2009) and its systemic markedness constraints that require contrast maintenance in the system. It is not, however, a true markedness constraint, as it does not refer to markedness and it is not based on perceptual contrastiveness. The intuition behind *Merge is that it is preferable for one output segment to correspond to only one input; in other words, it is better for an output to appear in either a derived environment or a non-derived one, but not in both. The situation penalized by *Merge is the mirror image of allophonic variation, in which one input corresponds to two outputs, because it prohibits one output from being in correspondence to two inputs. *Merge is not a constraint on specific segments, (i.e., [k] /k/ /G/), but on any output that is in correspondence with two inputs. As is customary in OT, such situation is still possible (*Merge violation) under domination from a more highly ranked constraint. The justification for *Merge is cognitive: the child learning the language would have to learn that the output [k], in our Galician example, could come from two sources. As usual in OT, a form does not have to actually exist (be included in the lexicon) to be excluded from the input.

(18) Post-nasal voiced obstruents: underspecified input

/lonGo/ [loŋgo] 'long'	*Merge	Id-[cont]	NC[cont]	*VcdVlr	Id-[voi]
a☞ loŋgo				*	
b. loŋko	*! //lonko/				*
c. loŋxo			*!		*
d. loŋɣo			*!	*	
e. loŋGo			*!	*	

[11] Note that [loŋko] is the correct output in other geada dialects (cf. 4).

As seen in (19), /x/ cannot be the correct input in post-nasal position because, given /x/, the constraint ranking would select the wrong output, a voiceless fricative (19c). Candidates (a) and (b), with stops, violate ID-[cont] since their continuancy specification differs from that of the input. (b), in addition, incurs a violation of *MERGE as [loŋko] from /lonxo/ could merge with [loŋko] from a potential /lonko/. (19d), the candidate with a voiced fricative, is worse than (19c), because, in addition to a NC[cont] violation due to a post-nasal fricative, it contains violations of *VCDVLR and ID-[voi] (on account of the voiced velar and the change in voicing specification with respect to the input, respectively). (19e) incurs the same violations as (19d): VCDVLR and ID-[voi], for the same reasons as (19d), and NC[cont] because a consonant underspecified for continuancy does not agree with the continuancy specification of the nasal.

(19) Post-nasal voiced obstruents: /x/ in the input

/lonxo/ [loŋgo] 'long'	*MERGE	ID-[cont]	NC[cont]	*VCDVLR	ID-[voi]
a. loŋgo		*!		*	*
b. loŋko	*! /lonko/	*			
c. ✗ loŋxo			*		
d. loŋɣo			*	*!	*
e. loŋGo			*	*!	*

While in post-nasal position, input /g/ results in the selection of the correct output, because the ranking selects a voiced stop, as in (20), the same input does not fare equally well in other positions, for example, word-initially as illustrated in (21).

(20) Post-nasal voiced obstruents: /g/ in the input

/longo/ [loŋgo] 'long'	*MERGE	ID-[cont]	NC[cont]	*VCDVLR	ID-[voi]
a.☞ loŋgo				*	
b. loŋko	*! /lonko/				*
c. loŋxo		*!	*		*
d. loŋɣo		*!	*	*	
e. loŋGo			*!	*	

(21) Word-initial geada: /g/ in the input

/gato/ [xáto] 'cat'	*MERGE	ID-[cont]	NC[cont]	*VCDVLR	ID-[voi]
a. xáto		*!			*
b. káto	*! /kato/				*
c.✗gáto				*	
d. ɣáto		*!		*	
e.✗Gáto				*	

Thus, the only input that, in conjunction with the constraints and constraint ranking, selects the correct output is the underspecified /G/, as seen in (18), (repeated here as [22]), and in (23). (22e) violates NC[cont] because it is not [−continuant]; (23e) is ruled out on the basis of a *VCDVLR violation. (22a) and (23a), the winning candidates, only contain violations of *VCDVLR and ID-[voi] respectively, both ranked lower than the constraints violated by their competitors. Notice that the selection of the underspecified input is not any different from that of fully specified inputs. Due to *Richness of the Base*, an underspecified input cannot be excluded as a possibility, i.e., it needs to be considered as well as the specified ones. When the input is the one underspecified for continuancy, the constraint ranking selects the correct output in the post-nasal context and in non-nasal contexts. The constraints and constraint ranking were determined on independent grounds (as shown above, cf. (14)–(16) and related discussion).

(22) Post-nasal voiced obstruents: underspecified input

/lonGo/ [loŋgo] 'long'	*MERGE	ID-[cont]	NC[cont]	*VCDVLR	ID-[voi]
a. ☞loŋgo				*	
b. loŋko	*!/lonko/				*
c. loŋxo			*!		*
d. loŋɣo			*!	*	
e. loŋGo			*!	*	

(23) Word-initial geada: /G/ in the input

/Gato/ [xáto] 'cat'	*MERGE	ID-[cont]	NC[cont]	*VCDVLR	ID-[voi]
a. ☞ xáto					*
b. káto	*!/kato/				*
c. gáto				*!	
d. ɣáto				*!	
e. Gáto				*!	

Notice that the input does not have a continuancy specification; however, the output does. As a result, the presence of this feature in the output must be explained. In OT terms, the output incurs a cost, that is, one or more constraint violations. In this case, the relevant constraints are DEP[cont] and LINK, both ranked under the constraint that requires the presence of a featural specification for continuancy, HAVE-CONT (24).

(24) DEP-[cont]: A feature [continuant] in the output must have a correspondent in the input.
LINK: No double association of features.
HAVE-CONT: Assign one violation mark for every segment that has no continuancy specification (after HAVE-PLACE in McCarthy, 2008, and others).

Postnasal obstruents share their point of articulation with the following heterosyllabic consonant; in other words, their point of articulation assimilates to that of the following onset, e.g., /kaNpo/ [kámpo] 'field', /andar/ [aⁿdár] 'floor'. As will be shown in section 3.4, in a feature geometry model like that of Padgett (1994), a shared PA node, doubly associated to the nasal and the obstruent, entails a shared [−continuant] specification with the nasal (also through double association) (cf. (27a–b) for the representation). Thus, a voiced obstruent acquires its [−continuant] specification through its association with the nasal. This, however, means that LINK becomes relevant in the post-nasal context through the violation incurred by a doubly associated [−continuant] feature. DEP-[cont] shows its effects in the non-nasal context where the [+continuant] feature is inserted. LINK could not be the constraint at stake in the non-nasal context (under the assumption that continuant segments are also the result of assimilation in continuancy with the previous segment, and that results in a doubly associated feature), because the output is always [+continuant]. If continuancy was always acquired through assimilation to continuant segments (i.e., double association or LINK violation), one would expect more allophonic variation, including the surfacing of [−continuant] segments in positions other than after a homorganic nasal, (e.g., word-initially), as well as greater phonetic variation in the output. Thus, I propose that the [+continuant] specification of the output results from insertion or, in OT terms, a DEP-[cont] violation. The feature inserted is [+continuant] rather than [−continuant] because insertion of [−continuant] would incur a violation of *MERGE. An alternative candidate to rule out is one in which the [−continuant] specification of the post-nasal obstruent is not the result of double association, but of insertion. This candidate would be eliminated because the output representation would incur a violation of the Obligatory Contour Principle (Goldsmith, 1976) against adjacent identical elements in the representation. Finally, regarding their ranking, LINK and DEP-[cont] are both low ranked constraints, dominated by HAVE-CONT. There is, however, little evidence to indicate a specific ranking with regard to the other constraints mentioned here. One can surmise that in the post-nasal context NC[cont] dominates LINK.

3.3. Post-nasal position (across morphemes)

As mentioned above, when the nasal and the obstruent are separated by a morpheme boundary, the output is [x], just as in the non-nasal contexts. I argue, in agreement with Martínez-Gil (2004), that the reason for this behavior is the need to avoid allormorphy. In other words, it is more important for morphologically derived forms to be identical to their base (i.e., derivational stem) than to agree in continuancy with the preceding nasal.

An antiallomorphy constraint, ranked higher than the other constraints, is responsible for geada in these cases (25). Antiallomorphy constraints are output-to-output constraints that been proposed in OT and in Spanish to model transderivational effects (Benua, 1995; Wiltshire, 2006; Colina, 2009a). Similar effects have been observed in Galician with regard to velar nasals in the coda (Colina and Díaz-Campos, 2006), which retain their velar allomorph when resyllabified in the onset, *benestar* /benestár/ [be.ŋis.tár] *[be.nis.tár] 'well-being'; *tren alemán* /trenaleman/ [tre.ŋa.li.mán] 'German train'.

(25) IDENT[seg]-BD: Each segment in the output of a morphologically derived form must be identical to its correspondent in the output of its base (derivational stem).

The derivational stem serves as the base for prefixation, compounding and suffixation, which produce the morphologically derived forms referred to in (25). Following Bermúdez-Otero's proposal for Spanish (2006, 2013), I argue that the derivational stem includes the theme vowel (e.g., *gord-**o*** 'fat', *en-gord-ar* 'to gain weight') which is deleted before suffixation. (25) is in the spirit of Martínez-Gil's OO-IDENT. The differences are in form rather than in substance: (25) refers to a specific case

of output-to-output correspondence, Base-Derived Form (BD), and to correspondence between segments (represented with subindices), rather than the more general requirement of identity of the root and the base in Martínez-Gil (2004).[12]

Evaluation and comparison proceed as follows. The form *engordar* 'to gain weight' is derived from the derivational stem *gord-o* 'fat', through prefixation and suffixation, i.e., *en-gord-ar*. The output of the base [xórðo] stands in output correspondence with the output of the derived form [eŋxorðár], as in [x_3ó$_4$r$_5$ð$_6$o$_7$] [e$_1$ŋ$_2$x$_3$o$_4$r$_5$ð$_6$á$_8$r$_9$], where subindices identify correspondents. Notice that, by definition, the prefix [e$_1$ŋ$_2$] and suffix [á$_8$r$_9$] have no correspondent in the output of the base, (i.e., subindices 1, 2, 8, 9 have no correspondent in the output of the base).[13] As shown in (26), since the base for /en/ + /Gordar/ is [xórðo] (from /Gordo/), all candidates without [x] are ruled out by high-ranking Id[x]-BD. The only candidate in which the third segment (identified with the subindex 3) is identical to [x_3] in the base is (26c), is the winner.

(26) /en/+/Gordar/ [eŋx$_3$orðár]

base= [$x_3$órðo]	Id[x]-BD	*Merge	Id-[cont]	NC[cont]	*VcdVlr	Id-[voi]
a. eŋg$_3$ordár	*!				*	
b. eŋk$_3$ordár	*!	*				*
c. ☞eŋx$_3$ordár				*		*
d. eŋɣ$_3$ordár	*!			*	*	

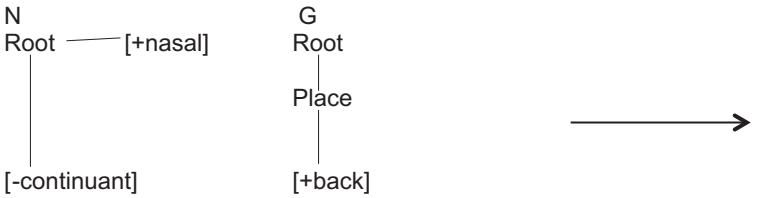
3.4. Voiced obstruent alternations and underspecification

In order to fully understand Galician *geada*, it is necessary to refer to two independent aspects of the phonology of the language: (i) NC sequences agree in continuancy; (ii) voiced obstruents are underspecified for continuancy. A full understanding of *geada* is dependent on recognizing the connection with these two phenomena.

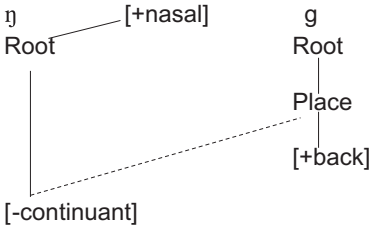
The need for obstruents to agree in continuancy with a preceding, homorganic nasal (captured by the constraint NC[cont]) can be motivated in a model of feature geometry like the one proposed by Padgett (1994) in which sharing place features means sharing the aperture nodes dominated by them.[14] The connection noted by many researchers between homorganic clusters and voiced stops is a consequence of the domination of aperture nodes by place features in feature geometry models. In (27a) a sequence of a nasal, underspecified for point of articulation, and a voiced velar obstruent, without a continuancy specification, becomes a velar nasal + velar stop through sharing of the place and aperture nodes (27b) (Link violation).

(27) Feature-geometric representation for nasal + voiced obstruent clusters

a.



b.



[12] Martínez-Gil's OO-Ident: ''A root in a morphologically derived word must be identical to its base (2004:316)''.

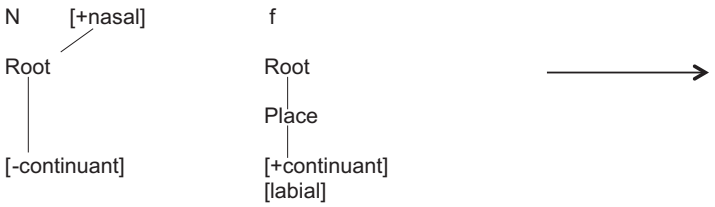
[13] In addition, 7 has no correspondent in the output, in accordance with Bermúdez-Otero's (2006, 2013) proposal that stems are stored with thematic vowels, which are then deleted in morphological derivation.

[14] In fact, NC[cont] must also refer to laterals, as voiced obstruents also agree in continuancy with homorganic laterals. I retain the current form of the constraint to be consistent with Martínez-Gil (2004) and because the distinction has no consequences for the current analysis.

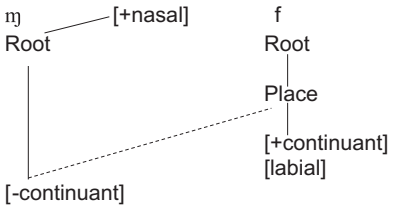
Agreement in continuancy with a preceding nasal only affects voiced obstruents: voiceless fricatives are not affected. This is because in Galician the sharing of aperture nodes only takes place when it does not require altering the aperture node of the post-nasal segment (in OT terms: Id-[cont] dominates NC[cont]). Segments underlyingly specified as [+continuant], such as voiceless fricatives, retain their [+continuant] specification (28). Voiced obstruents, being unspecified for continuancy, can share the [−continuant] specification of the nasal (27b).

(28) Feature-geometric representation for nasal + voiceless fricative clusters

a.



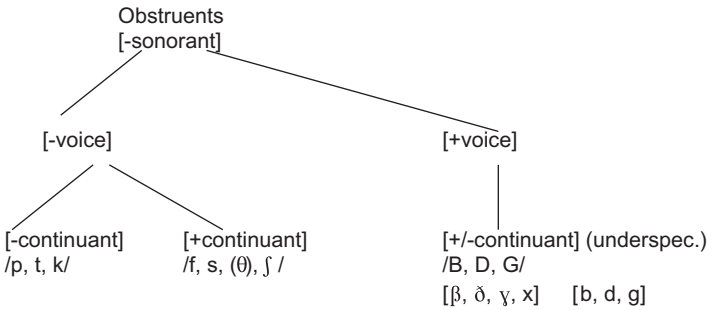
b.



There is no evidence for voicing agreement between the nasal and the stop. I argue that the agreement in voice in NC sequences is only apparent, as it is a consequence of the fact that the obstruents that alternate in continuancy are voiced. Voiceless stops and voiceless fricatives remain voiceless after a nasal. In an OT analysis this is the result of the high ranking of Id-[voi] over the constraint banning nasals followed by voiceless consonants (*N C̥ in (6)).

Geada illustrates the presence of a three-way contrast in Galician between obstruents that are always [−cont] (voiceless stops), those that are always [+cont] (voiceless fricatives) and others that alternate between [+cont] and [−cont] (voiced obstruents, underspecified) (29). Alternating voiced obstruents surface as stops (i.e., [−continuant]) in word initial position and after a homorganic nasal or lateral and, as spirants (i.e., [+continuant]) in all other contexts. Another language with a three-way contrast, in this case in voicing (+voice, -voice and underspecified), is Turkish. In Turkish in root-final position some plosives alternate between voiceless and voiced, and others are consistently voiced and yet others consistently voiceless (Inkelas, 1995:288). As seen below, the three-way voicing alternation in Turkish is presented by Inkelas as evidence for input underspecification in this language; the same argument is made by Iosad (2012) with respect to a three-way contrast in voicing in Friulan. Along those lines, continuancy alternations in Galician support an analysis in which continuancy is underspecified for voiced obstruents in this language, while contributing to the growing body of evidence for input underspecification in OT.

(29) Three-way contrast in continuancy in Galician



Underspecification constitutes an important aspect of the current proposal. As mentioned earlier, underspecification is also a controversial concept in OT. However, OT allows for what has been called principled underspecification: underlying forms, including underspecified forms, are determined by the learner through the principle of *Lexicon Optimization* (LO) and not by any constraints holding directly on underlying forms (Inkelas, 1995:289). Inkelas offers an alternation-sensitive definition of LO:

(30) Lexicon Optimization (Inkelas, 1995:289)
Given a set $S = \{S_1, S_2, S_3\}$ of surface phonetic forms for a morpheme M, suppose that there is a set of inputs $I = \{I_1, I_2, I_3\}$, each of whose members has a set of surface representations equivalent to S. There is some $I_i \in I$ such that the mapping between I_i and the members of S is the most harmonic, i.e., incurring the fewest marks in the grammar for the highest ranked constraints. The learner should choose that I_i as the underlying representation for M.

Using LO and thus giving the learner a central position in her proposal, Inkelas shows that sometimes the grammar (i.e., the constraints and the constraint ranking) selects the underspecified input, sometimes a fully specified one. The underspecified input is selected as the input among various possibilities when the mapping between that underspecified input and the output is the most harmonious in comparison with the mapping for other inputs. Recall that, since *Richness of the Base* requires that no restrictions be placed on the form of the input, an underspecified input cannot be excluded from consideration. Examples in which an underspecified candidate is selected include Yoruba ATR harmony, Walpiri vowel harmony and Turkish vowel-glide alternations. Here (section 3.2) I have demonstrated that Galician geada is a similar case, in which the grammar (the set of independently established constraints and constraint ranking) selects the correct output only when it is in correspondence with an underspecified input.

Furthermore, Kager (1999:33) states, with regard to *Richness of the Base* – the principle which is the source of the controversy – that ''whenever the learner has no evidence (from surface forms) to postulate a specific diverging lexical form, (s)he will assume that the input is identical to the surface form.'' The analysis of geada in section 3.2 has shown that the Galician learner has evidence to postulate an underspecified input for voiced obstruents (i.e., most crucially, non-alternating voiceless fricatives, and the high ranking of Id-[cont]).

In addition to Inkelas (1995), various other authors have shown the need for input underspecification in OT (Itô et al., 1995; Inkelas et al., 1997; Harrison and Kaun, 2001; Inkelas, 2006). Also within the OT framework, Hale and Kissock (2007) argue for a different type of underspecification that they call *perseverant underspecification*, on the basis of Marshallese, acquisition data, and loanwords. This is underspecification that persists from underlying representation through phonetic representation, resulting in forms which are never fully specified featurally and that are realized variably according to the surrounding segments, i.e., in the phonetic component. It is also known as phonetic or output underspecification and was originally proposed by Keating (1988). Keating convincingly argues that the velar fricative in Russian /ixa/ is underspecified for the feature [back] because it shows the continuous, transitional features characteristic of sounds which are dependent in their articulation upon their adjacent sounds. Pending detailed phonetic evidence, geada does not appear to involve phonetic underspecification, as the variation observed is dialectal, not contextual (cf. however, Bradley and Delforge, 2006a; Bradley and Delforge, 2006b; Bradley, 2007; Colina, 2009b for output underspecification in various dialects of Spanish). This is confirmed by the constraint ranking and candidate evaluation (cf. 22, 23) that rule out unspecified outputs (22e, 23e).

4. Dialectal variation

In section 3 I presented an analysis of the g-dialect of geada, i.e., dialects with [g] in the intramorphemic post-nasal position. In this section I show how the constraints, constraint-ranking and underlying representation account for the two other dialects, those with [k] and [x] in post-nasal position, shown in (3) and (4) respectively.

4.1. k-dialects

k-dialects prefer to create a merger with input /k/ rather than have a voiced velar in the output. This can be captured through the reranking of *Merge under *VcdVlr, which is sufficient to obtain the correct output:

(31) Id-[cont] ≫ *NC[cont] ≫ *VcdVlr ≫ *Merge ≫ Id-[voi]

(32) k-dialects

/lonGo/ [loŋko] 'long'	ID-[cont]	NC[cont]	*VCDVLR	*MERGE	ID-[voi]
a. loŋgo			*!		
b. ☞loŋko				* /lonko/	*
c. loŋxo		*!			*
d. loŋɣo		*!	*		
e. loŋGo		*!	*		

NC[cont] rules out (c) and (d) because these two candidates have a fricative after a nasal, thus disagreeing in continuancy. (e) also disagrees in continuancy with the preceding nasal. (b) is better than (a) because (a) violates *VCDVLR, which is more highly ranked than *MERGE, the highest constraint violated by (b).

4.2. x-dialects

Reranking of another of the highly ranked constraints in g-dialects, NC[cont], results in the selection of [x] post-nasally in the x-dialects.

(33) x-dialects

/lonGo/ [loŋxo]	*MERGE	ID-[cont]	*VCDVLR	ID-[voi]	NC[cont]
a. loŋgo			*!		
b. loŋko	*!/lonko/			*	
c. ☞ loŋxo				*	*
d. loŋɣo			*!		*
e. loŋGo			*!		*

In (33), candidates (a), (d), and (e) are ruled out because they violate *VCDVLR; (b) loses on account of a violation *MERGE; (c) is thus the optimal candidate and the winner.

The standard mechanism for explaining dialectal variation in OT is constraint reranking; however, input restructuring, through Lexicon Optimization, is another possibility (Bermúdez-Otero and Hogg, 2003; Holt, 2006). It is well known that language change sometimes occurs when the learner reinterprets the surface data, posing an underlying representation different from that of the adult speakers (King, 1969; Kiparsky, 1965, 1995). Therefore, it is reasonable to assume that the frequency of forms with [x] (vs. [g] or [k]) in x-dialects will eventually will lead to restructuring of the underlying representation, from [+voice] to [-voice] and from [continuant] to [+continuant]. Once /x/ appears in the input, geada will be regularized to all contexts.

5. Conclusion

This article is a contribution to the study of geada in Galician. The focus is on a generative account of what appears to be a somewhat straightforward process. To this date, very few generative analyses exist. Martínez-Gil (2004), in a recent account, argues that an optimality-theoretic analysis is needed. While his proposal works well, I show that a simpler analysis becomes available once the connection of geada with voiced obstruent alternations is recognized and incorporated in the analysis. The current proposal also obviates the need to resort to controversial mechanisms such as constraint conjunction.

The proposed analysis sheds light into the allophonic realizations of voiced obstruents in Galician and, possibly, in other languages with a similar phenomenon, such as Spanish. One crucial aspect of voiced obstruent allophones is their predictability and, I argue, their underspecification for the feature continuancy. As shown by Inkelas (1995), underspecification is perfectly compatible with OT, as long as the underspecified input is not imposed, but obtained (like specified ones) from the constraints and constraint ranking. This is the case of Galician obstruents, where the phonological system reveals the need for a three-way contrast: [−continuant], [+continuant] and underspecified [continuant] (non-contrastive). [+/−continuant] is contrastive for voiceless obstruents, and non-contrastive (i.e., predictable) in the voiced series. A better understanding of voiced obstruents also has consequences for our understanding of nasal + consonant heterosyllabic clusters: it shows that the requirement that post-nasal voiced obstruents agree in voice with the nasal,

observed in many languages (Ferguson, 1975), is not what is at stake here (*N C̥), rather the fact that voiced obstruents are always [−continuant] after a nasal. It is only voiced obstruents that agree in continuancy with the nasals, because it is only voiced obstruents that are underspecified. The account of geada highlights the ability of the OT framework, in which all constraints are always present, to formalize interactions among various phonological phenomena. It also reveals the impact that improved understanding in one area (e.g., geada) can have on another (e.g., voiced obstruent allophony) and vice versa.

Finally, as predicted by OT, reranking of the constraints proposed for the g-dialects of geada produces the correct outputs for the other dialects, along with a possible restructuring of the underlying representation later in the evolution of the language.

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