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Catalan (im)possible nativizations in the light of Weighted Scalar Constraints[*]

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1. Introduction and goals

Here we explore the implicational relationships established between two or more phonological processes that are susceptible to co-occur within the same loanword; that is to say, situations in which if a process A applies, so does a process B, but not the other way around. It is well known that loanwords can comply with the markedness constraints satisfied by native words (cf. the Catalan loan *tobogan* 'toboggan', realized as *t*[u]*b*[u]*ga*[∅], with nasal deletion and vowel reduction, as a native word such as *crostó cr*[u]*stó*[∅] 'heel.SING.'; cf. *cr*[ɔ́]*sta* 'scab', *crosto*[n]*s* 'heel.PLUR.'); but usually they comply only with a subset of these markedness constraints (cf. the same Catalan loan, realized as *t*[u]*b*[u]*ga*[n], with just vowel reduction), and, in many cases, with none (cf. again the same Catalan loan, realized as *t*[o]*b*[o]*ga*[n]). It has been argued that this situation reveals a nested core-periphery structure of the lexicon, with three different strata (Itô & Mester 1999, 2008): a. *the core stratum*, in which loanwords behave like native words and satisfy all markedness constraints, and which contains the nativized loanwords (1a); b. *the intermediate stratum*, in which loanwords satisfy only a subset of the markedness constraints active in the core stratum, and which includes the partially nativized loanwords (1b1, 1b2), and c. *the peripheral stratum*, in which loanwords do not satisfy any of the markedness constraints active in the previous strata, and which comprises the non-nativized loanwords (1c).

(1) Core-periphery structure of the lexicon (Itô & Mester 1999, 2008)

In Itô & Mester's model, the differences between these strata are explained by the variable position of a block of faithfulness constraints F1, F2, F3..., to which lexical items in each stratum are indexed, with respect to a language-particular fixed hierarchy of markedness constraints (M1 >> M2 >> M3).

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As illustrated in (2), in the nuclear stratum, all markedness constraints relevant to explain the application of the native processes in a given language outrank faithfulness, and this leads to fully nativized patterns; in contrast, in the peripheral stratum, faithfulness outranks markedness, which leads to non-nativized patterns; finally, in the intermediate stratum, faithfulness is ranked in between the markedness constraints, so that partially nativized patterns — which satisfy both faithfulness and some markedness constraint(s) — are obtained.

As noted by Itô & Mester (2008), a structure of this kind gives rise to asymmetrical implicational patterns in the adaptation of loanwords: “Structures […] are built out of a network of implicational relations involving lexical items and phonological constraints of the following kind: items that are subject to constraint *A* are also always subject to constraint *B*, but not all items subject to *B* are also subject to *A*.” (Itô & Mester 2008: p. 554). For instance, given the structure in (2), items subject to constraint M3 are necessarily also subject to constraints M2 and M1, but items subject to constraint M2 are not necessarily subject to constraint M3, because faithfulness can intervene in between.

(2) Differences across strata (Itô & Mester 1999, 2008)

F1 (c. non-nativized loanwords)
M1
F2 (b2. partially nativized loanwords)
M2
F3 (b1. partially nativized loanwords)
M3
F4 (a. nativized loanwords)

The purpose of this paper is to present the results of two surveys that provide quantitative support for these kinds of interactions in Catalan loanword phonology, and to formally account for them under the *Weighted Scalar Constraints* version of *Harmonic Grammar*, following the recent proposals by Hsu & Jesney (2017, 2018).

2. Data

In Catalan loanwords, several processes may interact in the way just described in (1) and (2); it is the case of word-final nasal deletion and vowel reduction (which affects low and mid vowels in Eastern Catalan), vowel reduction and vowel laxing of high-mid stressed vowels, and vowel reduction and word-final –*r* deletion. This occurs in loans that contain structures susceptible to undergoing these processes, like *t**o**b**o**ga**n***, ***o**r**a**nguta**n***, *x**a**rl**e**sto**n***, *w**o**nto**n***; *p**ò**st**e**r*, *m**ò**d**e**m*, ***e**ur**o***, *r**è**c**o**rd*; *s**o**mmelie**r***, *at**e**lie**r***, *d**o**ssie**r***, *n**e**c**e**sse**r***, respectively. In this paper we deal with the first type of interaction, the one established between word-final –*n* deletion and vowel reduction in loanwords with a word-final –*n* preceded by a stressed vowel and a mid vowel in unstressed position (3). (For a comprehensive study also including the other types of interactions, see Pons-Moll *et al*. 2018/2019a, 2019b).

In what follows we describe the two processes of Eastern Catalan under analysis (see § 2.1 and 2.2) and we show how they can interact within the same loanword.

2.1. *Word-final* –n *deletion and vowel reduction in Eastern Catalan*

Word-final –*n* deletion (ND) and vowel reduction (VR) are general processes in the native lexicon of

Eastern Catalan. This can be seen in the alternations of (4), where a stem-final alveolar nasal [n] alternates with [∅] in word-final position and after a stressed vowel; and in the alternations of (5), where the stressed low vowel [á] and the stressed mid-front vowels [ɛ́] and [é] alternate with [ə] in unstressed position and where the stressed mid-back vowels [ɔ́] and [ó] alternate with [u] also in unstressed position. As shown in the examples of (5), this process of VR affects vowels placed in any position within the word, and also explains the realization of non-alternating *a* and *e* as [ə] and of non-alternating *o* as [u] in unstressed position: *esperança* [əspəránsə], *home* [ɔ́mə], *hospital* [uspitál], *carro* [káru], etc. (Throughout the paper, acute marks indicate stress.)

(3) ND (Mascaró 1976, Bonet & Lloret 1998, Faust & Torres-Tamarit 2017)
plans [pláns] ~ *planíssim* [plənísim] ~ *pla* [plá∅] ‘flat.PL’ ~ flat.SUPERL’ ~ ‘flat.SG’
cosins [kuzíns] ~ *cosinet* [kuzinét] ~ *cosí* [kuzí∅] ‘cousin.PL’ ~ ‘cousin.DIM’ ~ ‘cousin.SG’

(4) VR (Mascaró 1976, Bonet & Lloret 1998)
casa [kázə] ~ *caseta* [kəzɛ́tə] ‘house’ ~ ‘house.DIM’
terra [tɛ́rə] ~ *terrestre* [tərɛ́strə] ‘earth’ ~ ‘terrestrial’
esquerrà [əskərá] ~ *esquerranisme* [əskərənízmə] ‘leftist’ ~ ‘leftism’
fera [férə] ~ *feroç* [fərós] ‘beast’ ~ ‘fierce’
porta [pɔ́rtə] ~ *portal* [purtál] ‘door’ ~ ‘hallway’
poma [pómə] ~ *pomera* [puméɾə] ‘apple’ ~ ‘apple tree’
bastó [bəstó] ~ *bastonet* [bəstunét] ‘stick’ ~ ‘stick.DIM’

2.2. *Underapplication of ND and VR in loanwords*

ND and VR, though, tend to underapply in loanwords, as shown in (5) and (6), independently of when in the history of the Catalan language were introduced (cf. *cancan* vs. *Vuitton*) and of the donor language (cf. *futon* from Japanese *vs*. *paston* from Spanish; *gadget* from English *vs*. *ramen* from Japanese). In (6) we find examples with an alveolar nasal in the context of application of ND: that is, in word-final position and after a stressed vowel. In (7) we find examples with [e] and with [o] in the context of application of VR: that is, in unstressed position.

(5) Underapplication of ND in loanwords (Pons-Moll 2012, 2015; Pons-Moll *et. al* 2018/2019)

divan	[diβán]	‘divan’	*maton*	[mətón]	‘bully’
futon	[futón]	‘futon’	*paston*	[pəstón]	‘a bundle’
cancan	[kaŋkán]	‘cancan’	*Pakistan*	[pəkistán]	‘Pakistan’
xaman	[ʃəmán]	‘shaman’	*Afganistan*	[əvɣənistán]	‘Afganistan’
catamaran	[kətəməɾán]	‘catamaran’	*Sudan*	[suðán]	‘Sudan’
taliban	[təliβán]	‘taliban’	*Vuitton*	[bujtón]	‘Vuitton’
catipén	[kətipén]	‘odor, slang’	*Nissan*	[nisán]	‘Nissan’

(6) Underapplication of VR in loanwords (Mascaró 2002, Cabré 2009, Pons-Moll 2012, Pons-Moll *et. al* 2019)

cutre	[kútre]	‘crap’	*gore*	[góre]	‘gore’

flyer	[flájer]	‘flyer’	*contàiner*	[kontájner]	‘container’
gadget	[gád͡ʒet]	‘gadget’	*mojito*	[moxíto]	‘mojito’
hípster	[xípster]	‘hipster’	*pesto*	[pésto]	‘pesto’
màster	[máster]	‘master’	*judo*	[ʒúðo]	‘judo’
cúter	[kúter]	‘cuter’	*sado*	[sáðo]	‘sado’
blíster	[blíster]	‘blister’	*crono*	[króno]	‘chrono’
Twitter	[twíter]	‘Twitter’	*taco*	[táko]	‘taco’
youtuber	[jutúber]	‘youtuber’	*pàrkinson*	[párkinson]	‘Parkinson’
tempura	[tempúrə]	‘tempura’	*gastrobar*	[gastroβár]	‘gastrobar’
serotonina	[serotonínə]	‘serotonin’	*collage*	[koláʃ]	‘collage’

2.3. *Interaction of ND and VR in the same loanword*

Interestingly, according to the results of our production and judgment tests (see §3), loans susceptible to undergoing both processes (7) show a consistent behavior in which underapplication of the two processes is the most common solution (Pat1: *t*[o]*b*[o]*ga*[n]; 8a), followed closely by just underapplication of ND (Pat2: *t*[u]*b*[u]*ga*[n]; 8b), followed a long way behind by application of both processes (Pat3: *t*[u]*b*[u]*ga*[∅]; 8c), and in which underapplication of VR and application of ND (Pat4: **t*[o]*b*[o]*ga*[∅]; 8d) is unattested. From now on, we illustrate our arguments with the loan *tobogan* (which is, in fact, an old loanword), although the patterns described can be extended to all loans with a parallel structure (see 7). (Note that in the examples of 7, only the stressed vowel is transcribed, because, as said, these forms can be realized diversely; see 8.)

(7) Convergence of word-final –*n* and unstressed mid-vowels in Catalan loanwords

t**o**b**o**g[á]**n**	‘toboggan’	fi**e**st[ó]**n**	‘big party’
orangut[á]**n**	‘orangutan’	**O**T[á]**N**	‘toboggan’
xarl**e**st[ó]**n**	‘charleston’	M**e**g[á]**ne**	‘car brand’
s**e**d[á]**n**	‘Sedan’	T**e**h**e**r[á]**n**	‘Teheran’
P**e**qu[í]**n**	‘Beijing’	D**e**cathl[ó]**n**	‘sports shop’
B**e**rl[í]**n**	‘Berlin’	**O**ptalid[ó]**n**	‘medicine brand’
w**o**nt[ó]**n**	‘wonton’	Vall d’H**e**br[ó]**n**	‘place name’
l**e**viat[á]**n**	‘leviathan’		

(8) Interaction of ND and VR in loanwords

↓	Most common (non-nativized)	Underapplication of ND and VR	*t*[o]*b*[o]*ga*[n]	Pat1
	Less common (partially nativized)	Underapplication of ND and application of VR	*t*[u]*b*[u]*ga*[n]	Pat2
	Least common (fully nativized)	Normal application of ND and VR	*t*[u]*b*[u]*ga*[∅]	Pat3
	Unattested (impossible nativization) (partially nativized)	Underapplication of VR and application of ND	**t*[o]*b*[o]*ga*[∅]	Pat4

That is to say, underapplication of both processes can co-occur, as can application of both processes, application of VR and underapplication of ND, but underapplication of VR and application of ND cannot. As for the implicational relations established between these processes, we can thus state that if ND applies so does VR, but not viceversa; in parallel, if VR is blocked so is ND, but not viceversa.

3. Experimental surveys

These generalizations are drawn from two experimental surveys, a production test (§3.1) and a perception test (§3.2), carried out in 31 Barcelona Catalan speakers aged 18-23 during the period 2017-2018. The speakers were students at the Universitat de Barcelona, mostly from the BA degree Comunicació i Indústries Culturals. The selected students were all born in Barcelona, with parents also from Barcelona, and with Catalan as their habitual language. The students were recruited on the courses Gèneres i Formats de la Comunicació Escrita (2nd year), Llengua Catalana II (1st year), and via several Facebook advertisements.

3.1. *Picture-naming production test*

In the production task, speakers were asked to utter 16 loanwords, for which referent pictures were provided in a PowerPoint. All loanwords presented the relevant structures, that is, a word-final /n/ after a stressed vowel and the unstressed mid vowels *e* and *o* or the low vowel *a* (*t**o**b**o**ga**n***, *c**a**ima**n***). The test was completed with loanwords with just one of the relevant structures, that is, loans either with a word-final nasal after a stressed vowel or with a mid vowel in unstressed position (*i.e. diva**n***, *màst**e**r*, respectively), and was presented to the speakers in a randomized way. The results of this test, which can be seen in (9), indicate that speakers produced these loanwords following Pat1 in around 65% of the cases, Pat2 in 25%, and Pat3 in around 10%. No speaker produced these loanwords following Pat4. The table in (9) reflects the results considering loans with *a* and loans with *e* or *o* altogether. When they are considered separately, it can be observed that vowel reduction is more frequent when the affected vowel is low (as in *c**a**iman*) than when it is mid (as in *t**o**b**o**gan*), as shown in Table 1 in the appendix; the differences, though, are less noticeable than expected, since vowel reduction of the low vowel has traditionally been considered compulsory – unlike vowel reduction of the mid vowels, which has more exceptions and behaves differently in loanwords. Note, in this respect, that the speakers showed regular vowel reduction of *a* to schwa in filler native words.

(9) Results of the picture-naming production test (*tobogan*, *caiman*, etc.)

Patterns	% of answers
a. PAT1 t[o]b[o]ga[n]	65,2%
b. PAT2 t[u]b[u]ga[n]	25%
c. PAT3 t[u]b[u]ga[∅]	9,8%
d. PAT4 t[o]b[o]ga[∅]	0%

3.2. *Judgment test*

The same 31 speakers were asked to evaluate the naturality of the four possible patterns for the same 16 loanwords (22 x 4 patterns = 88 items) on a Likert scale of 1-5 according to the following categories: very natural, fairly natural, neutral, fairly unnatural, very unnatural. The test was presented to the speakers in an audio file via a Google form available on the Internet. The test was also completed with loanwords with just one of the relevant structures (*i.e.*, *diva**n***, *màst**e**r*), and was presented in a randomized way. The results of the test, shown in (11), are slightly more variable than those in the production test, but some consistent tendencies can be observed. Pat1 received a high score for the very natural and fairly natural categories, with Pat2 not far behind. Pat3 and Pat4, in contrast, received very low scores for these categories, and a high score for the very unnatural and fairly unnatural categories. Note that no significant differences were detected with respect to the quality of the unstressed vowels (*i.e.* low /a/, as in *c*[a]*iman*, *vs*. mid /e/, /o/, as in t[o]*b*[o]*gan*), as shown in Tables 2 in the Appendix.

(10) Results of the judgment tests (*tobogan*, *caiman*, etc.)

PatA1 t[o]b[o]ga[n]	% of answers
Very natural	47.6%
Fairly natural	17.3%
Neutral	14.1%
Fairly unnatural	15.1%
Very unnatural	5.8%

PatA2 t[u]b[u]ga[n]	% of answers
Very natural	35.5%
Fairly natural	25.6%
Neutral	17.7%
Fairly unnatural	15.7%
Very unnatural	5.4%

PatA3 t[u]b[u]ga[∅]	% of answers
Very natural	12.1%
Fairly natural	16.0%
Neutral	16.8%
Fairly unnatural	27.1%
Very unnatural	28.1%

PatA4 t[o]b[o]ga[∅]	% of answers
Very natural	10.9%
Fairly natural	15.1%
Neutral	15.9%
Fairly unnatural	25.2%
Very unnatural	32.9%

These results, which for the most part conform to the gradations presented in §2, deserve a number of comments. First, again we attribute the low scores for Pat3 *t*[u]*b*[u]*ga*[Ø] (*i.e.*, nativized patterns) to the age of the speakers interviewed: it is well-known that older speakers are more conservative (*i.e.* Labov 1980) and tend to make utterances that conform to the native phonology (fully nativized patterns), whereas younger speakers tend to follow the non-nativized patterns. Second, as already clarified, no significant differences were detected with respect to the quality of the unstressed vowels, especially in the judgment test. Third, as expected, the results are more conclusive in the production test than in the judgment test, where there is more variability: whereas the production test reproduces the actual utterances of speakers, the judgment test reproduces the utterances of the speakers themselves but also the ones they are used to hearing in their speech community, that is, the utterances they are familiar with.

We can conclude that the results of the judgment test reproduce *grosso modo* the production test results, except for the close relative well-formedness of Pat4 in relation to Pat3. The reasons why we discard Pat4 and we include Pat3 as possible realizations (see again 8) are that Pat4 received 0% of answers in the production test, whereas Pat3 received a 9,8%, and that the low scores for Pat3, both in the production and the judgment test, must be relativized, as said, by the age of the speakers.

4. Analysis with Weighted Scalar Constraints

Implicational patterns of the sort exemplified in the previous sections are expected to exist in a model with weighted constraints like Harmonic Grammar (Smolensky & Legendre 2006), and more specifically with Weighted Scalar Constraints, as developed in Hsu & Jesney (2017, 2018). In § 4.1 we briefly introduce Harmonic Grammar, and in § 4.2 we explain how Weighted Scalar Constraints can be applied to strata, in order to account for the possible and impossible nativizations under study and for the implicational relationships between processes depicted in the previous sections.

4.1. *Harmonic Grammar: a brief overview*

According to Harmonic Grammar (Smolensky 1986, Smolensky & Legendre 2006), cross-linguistic variation is not explained through different constraint rankings (as in Optimality Theory), but through constraints with different weights. The violation of a constraint implies the assignment of a negative value, and this value is multiplied by the constraint weight: if a constraint has a weight of 5.5, its violation by a candidate implies the assignment of the negative value –5.5; if the candidate violates this constraint twice, the assignment will be –11, and so on. The sum of the negative values obtained depending on the violations of the different constraints constitutes the harmony of a candidate. The winning candidate is the one that obtains the highest negative value, *i.e.*, the lowest penalty. In (12), we illustrate HG with an example of vowel reduction in Catalan. The two competing constraints are $*e,o_{\sigma UNSTR}$, against mid vowels in unstressed position and with a weight of 5.5, and IDENT-V_{UNSTR}, protecting the underlying featural specification of vowels in unstressed position and with a weight of 2. The former outweighs the latter, and this explains why the candidate with vowel reduction (with a penalization of –2) is selected as optimal rather than the faithful candidate (with a more severe penalization of –5.5).

(11) *HG illustrated through VR*

/mez+ɛt/	$*e,o_{\sigma UNSTR}$ w = 5.5	IDENT-V_{UNSTR} w = 2	H
a. [mezɛ́t]	–1		–5.5 (–1x5.5)
☞ b. [məzɛ́t]		–1	–2 (–1x2)

4.2. *Weighted Scalar Constraints applied to strata*

Weighted Scalar Constraints pivot on the *scaling factor*. Within HG, what the scaling factor does is to increase progressively and proportionately the weight of either faithfulness or markedness constraints. Thus, the weight relations between markedness and faithfulness constraints vary as the scaling factor for faithfulness or markedness increases and, at a certain scaling factor, these relations can vary so much that this results in the selection of a different candidate than the one selected with an inferior scaling factor. Applied to strata, the scaling factor determines the transition from one stratum to another and thus the different levels of nativization of the speaker's lexicon (Hsu & Jesney 2017, 2018). The specific proposal of Hsu & Jesney (2018) works as follows: "the penalty associated with the violation of a constraint is scaled based on distance from the core lexicon. The total penalty for a constraint violation is *w* x *s(d)*, where *w* is the base constraint weight, *s* is the scaling factor, and *d* is a measure of distance from the core. Values for *d* begin at 0, in the case of words within the core lexicon, and increase as the degree of nativization decreases." (p. 4). In order to account for the behavior of loanwords and for the organization of the lexicon into strata, it is faithfulness violations that are scaled, so their weight values increase from the nuclear stratum to the peripheral one. A general definition for the scaled version of faithfulness constraints is given in (12).

(12) *Scaled Faithfulness*
Given a basic constraint weight *w*,
a scaling factor *s*, and a distance from the core *d*,
for each input structure that is not realized faithfully in the output,
assign a weighted violation score of ***w* x *s*(*d*)**.

The virtue of this proposal, in opposition to Itô & Mester's (see §5), is that, given certain weights and given any scaling factor, there are certain weight constraint relations, and thus certain patterns, that are systematically and permanently excluded from the grammar. The model, thus, straightforwardly captures the asymmetrical relationships between processes observed in natural languages. This approach, for instance, is pursued in Hsu & Jesney (2017) to account for the possible patterns of adaptation of loanwords of English in Quebec French. In Quebec French, English loans with a rhotic [ɹ] and a final affricate [ʧ] can be adapted by repairing both segments (*scratch* [skʀaʃ]), by just repairing the rhotic ([skʀaʧ]), and by not repairing any segment ([skɹaʧ]), but it is not possible to adapt them by repairing the affricate and not the rhotic (*[skɹaʃ]). That is, if the affricate is repaired, so is the rhotic, but this does not apply the other way around (Hsu & Jesney 2017: 250).

In what follows we present the modelling of the possible and impossible patterns presented in § 2 and § 3 according to this framework.

4.3. *Analysis of the interaction between ND and VR*

For Catalan, we assume a structure made up of three lexical strata: *a*) the core one, for speakers and loans with application of VR and ND (*t*[u]*b*[u]*ga*[∅]); *b*) the intermediate one, for speakers and loans with just application of VR (*t*[u]*b*[u]*ga*[n]); *c*) the peripheral one, for speakers and loans with underapplication of both VR and ND (*t*[o]*b*[o]*ga*[n]). For all loanwords in all strata, we assume an underlying form with a low or a mid vowel and a word-final alveolar nasal (/kajman/; /tobogan/); this is because we understand that most of these loanwords are introduced into Catalan either through the written form (with a spelling with *e*, *o* and *a*, and a final *n: o*r*a*nguta*n*) or through Spanish (where the structures involved are pronounced faithfully: [oraŋgután]). The two markedness constraints involved are $*e,o_{\sigma UNSTR}$ (against unstressed high-mid vowels) (13a) and $*n]_{WD}$ (against word-final posttonic *–n*) (13b), which receive stable weights of 5.5 and 2.5 respectively across all three possible strata. These two markedness constraints interact with the faithfulness constraints IDENT-V_{UNSTR} (against featural changes for unstressed vowels) (13c) and MAX-IO (against deletion) (13d), which receive stable weights of 2 and 1.5 respectively across all three possible strata. (Note that these weights have been calculated considering both the interaction of nasal deletion and vowel reduction and the interaction of vowel reduction and vowel laxing in Catalan loanwords; see Pons-Moll *et al*. 2018/2019a, 2019b, for evidence in this direction.)

(13)

a. $*n]_{WD}$: Assign one violation for every nasal in word-final position and after a stressed V.
b. $*e,o_{\sigma UNSTR}$: Assign one violation mark for every unstressed high-mid vowel.
c. MAX-IO: Assign one violation mark for every segment in the input that has no correspondent in the output.
d. IDENT-V_{UNST}: Assign one violation mark for every unstressed vowel in the output whose input correspondent has a different featural specification.

As illustrated in the tableaux in (14), scaled faithfulness ensures that the weight values for the faithfulness constraints increase from the core stratum (in which *s* = 1), towards the intermediate stratum (which starts with *s* = 1.8), until reaching the peripheral stratum (which starts with *s* = 2.8). Faithfulness values thus acquire higher relevance the closer they are to the peripheral stratum. Given the constraint weights, no scaling factor can yield the impossible nativization Pat4 **t*[o]*b*[o]*ga*[∅] (as shown by the strata cross overpoints in 15, which will be discussed below). At the *core stratum*, markedness constraints outweigh faithfulness constraints, which explains why the selected candidate is the one with the application of all "native" processes. At the *intermediate stratum*, the scaling factor of 1.8 is enough for the constraint MAX-IO to outweigh the markedness constraint $*n]_{WD}$, with which it interacts, but not for the constraint IDENT-V_{UNSTR} to outweigh $*e,o_{\sigma UNSTR}$, and this explains the selection of the candidate with the mixed pattern (with vowel reduction but no word-final –*n* deletion). At the *peripheral stratum*, the scaling factor of 2.8 is high enough for both faithfulness constraints to outweigh the markedness constraints with which they are in conflict, and this explains the selection of the pattern with underapplication of both processes and non-nativization. Note that, in order to maintain these predictions in which Pat4 is permanently excluded, the scaling factor cannot be applied to a single faithfulness constraint, or cannot differ depending on the faithfulness constraint involved: the scaling factor must affect MAX-IO and IDENT-V$_{\text{UNSTR}}$ as a whole, since the weight proportion between them must be maintained across strata.

At this point, it is important to note that the same speaker may associate one set of words with one stratum, another set with another stratum, and yet another set with a third stratum. That is, there are two factors that determine the selection of patterns: the speaker's grammar itself and the stratum to which each set of words is associated in the grammar of this speaker. The tableau in (14), thus, abstractly reproduces the nativization patterns available in Catalan grammar.

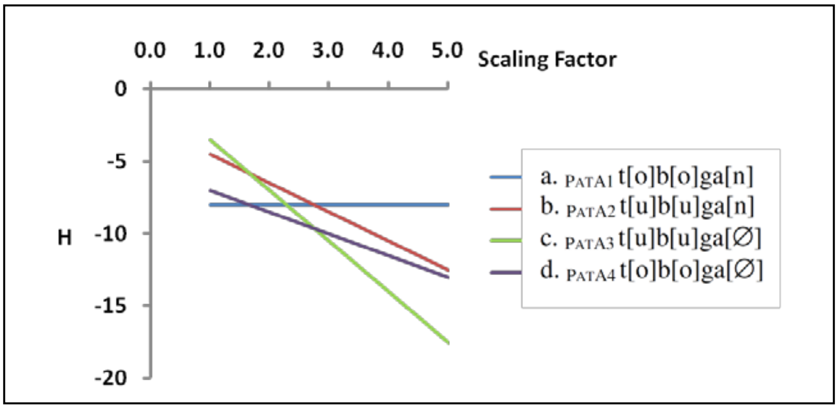
Summarizing what we have said so far, in our proposal all markedness constraints are satisfied at the core stratum, only the markedness constraint *e,o$_{\sigma\text{UNSTR}}$ at the intermediate stratum, and, finally none of the markedness constraints at the peripheral stratum.

(14) HG with *weighted scalar constraints* tableau for the interaction between VR and ND

i. /tobogan/	*e,o$_{\sigma\text{UNSTR}}$ w = 5.5	*n]$_{\text{WD}}$ w = 2.5	IDENT-V$_{\text{UNSTR}}$ w = 2	MAX-IO w = 1.5	H	*Scaling factor for F*	*Strata*
a. [toβoɣán]	–1	–1			–8 (–5.5)+(–2.5)	1	*Core stratum*
b. [tuβuɣán]		–1	–1		–4.5 (–2.5)+(–2)		
☞c. [tuβuɣá∅]			–1	–1	–3.5 (–2)+(–1.5)		
d. [toβoɣá∅]	–1			–1	–7 (–5.5)+(–1.5)		
ii. /tobogan/	*e,o$_{\sigma\text{UNSTR}}$ w = 5.5	*n]$_{\text{WD}}$ w = 2.5	IDENT-V$_{\text{UNSTR}}$ w = 2	MAX-IO w = 1.5	H	*Scaling factor for F*	
a. [toβoɣán]	–1	–1			–8 (–5.5)+(–2.5)	1.8	*Intermediate stratum*
☞ b. [tuβuɣán]		–1	–1		–6.1 (–2.5)+(–2x1.8)		
c. [tuβuɣá∅]			–1	–1	–6.3 (–2x1.8)+(–1.5x1.8)		
d. [toβoɣá∅]	–1			–1	–8.2 (–5.5)+(–1.5x1.8)		
iii. /tobogan/	*e,o$_{\sigma\text{UNSTR}}$ w = 5.5	*n]$_{\text{WD}}$ w = 2.5	IDENT-V$_{\text{UNSTR}}$ w = 2	MAX-IO w = 1.5	H	*Scaling factor for F*	
☞ a. [toβoɣán]	–1	–1			–8 (–5.5)+(–2.5)	2.8	*Peripheral stratum*
b. [tuβuɣán]		–1	–1		–8.1 (–2.5)+(–2x2.8)		
c. [tuβuɣá∅]			–1	–1	–9.8 (–2x2.8)+(–1.5x2.8)		
d. [toβoɣá∅]	–1		–1		–11.1 (5.5)+(–2x2.8)		

In the illustration in (15), finally, we present the chances of selection of each pattern given the weights assigned to each constraint and depending on the scaling factor. The most important point here is that Pat4 (the purple line) is always harmonically bounded by some of the other patterns, so there is no chance for this pattern to be selected in the language. Pat1, the blue line, harmonically bonds Pat2 and Pat3 at any scaling factor equal or higher than 2.8; Pat2, the red line, does so at the scaling factor interval {1.8-2.7} and Pat3, the green line, at the scaling factor interval {1-1.7}.

(15) Strata cross overpoints



5. Alternative analyses

The type of implicational patterns analyzed in this paper have been accounted for in the previous literature by resorting either to the indexation of constraints that apply to individual lexical strata (Itô & Mester 1995, 1999) or to separate co-phonologies associated with individual lexical strata (Inkelas & Zoll 2007). These approaches predict all possible patterns, but nothing prevents the *overgeneration* of the impossible ones: given intrinsic OT constraint reranking (in this specific case across strata or across co-phonologies), nothing prevents rankings such as, for instance, *n]$_{WD}$ >> MAX-IO, IDENT-V$_{UNST}$ >> IDENT-V$_{UNST}$, from leading to the impossible pattern *t[o]b[o]ga[∅]. This is why Itô & Mester (1999) resort to the metacondition "Ranking consistency", which "forces" certain ranking relations between markedness and faithfulness, and which therefore ensures the same rankings across strata: "Let F and G be two types of I-O faithfulness constraints […], there are no strata A, B such that the relative rankings of the indexed versions of F and G are inconsistent with each other. If F/$_A$ >> G/$_A$ for some stratum A, then there is no stratum B such that G/$_B$ >> F/$_B$" (p. 27). According to Itô & Mester (1999), "[t]here is an underlying unity behind the various stratal incarnations of a given faithfulness constraint" (p. 28). As shown in this paper, metaconditions are not necessary within Harmonic Grammar with Scalar Constraints, where the weight of the constraints, along with any scaling factor, gives no chance to the impossible patterns (*t[o]b[o]ga[∅], *c[a]ima[∅]).

6. Concluding remarks

In this paper we have explored phonological nativization patterns in Catalan loanwords, and we have shown, on the basis of a production and a judgment test, that the two processes under scrutiny (word-final –*n* deletion and vowel reduction) interact in an asymmetrical way. We have argued that these asymmetrical interactions can be straightforwardly formalized resorting to Harmonic Grammar with Scalar Weighted Constraints (Hsu & Jesney 2017, 2018), in which faithfulness constraints acquire an increasing relevance from the core stratum to the peripheral stratum and in which, if a process fails to apply in a given stratum, it will also fail to apply in more peripheral strata, but not the other way around. Future research should seek to verify whether similar predictions are borne out by descaling the weight of markedness constraints from the nuclear stratum to the peripheral one, or by scaling the weight of the markedness constraints from the peripheral stratum to the nuclear one. It should also be investigated whether considering the whole lexicon of Catalan (including, therefore, native and non-native words), the preferred factor is the closest to 1 and whether there is indeed an attraction towards this factor in the process of nativization of the non-native lexicon. Finally, from a sociolinguistic point of view, it is interesting to note that young speakers in the Barcelona area show a clear preference for patterns with a lack of nativization and thus far from regular phonology, which we interpret as a consequence of the innovative nature of the speech of this segment of speakers (Labov 1980, Milroy & Milroy 1985). In future studies, it will be necessary to check to which extent the same trends are detected in speakers of other areas of the Catalan-speaking territory and in speakers of older age groups.

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Appendix

TABLE 1. Results of the picture-naming production task
(*considering only loans with the low vowel* a *of the type* caiman)

Patterns	% of answers
a. PAT1 c[a]ima[n]	54%
b. PAT2 c[ə]ima[n]	37%
c. PAT3 c[ə]ima[∅]	8.2%
d. PAT4 c[a]ima[∅]	0%

TABLES 2. Results of the judgment task
(*distinguishing the type of unstressed vowels*: *mid vs. low*)

PAT1 t[o]b[o]ga[n]	% of answers
Very natural	42.9%
Fairly natural	13.8%
Neutral	15.2%
Fairly unnatural	20.3%
Very unnatural	7.8%

PAT1 k[a]ima[n]	% of answers
Very natural	51.3%
Fairly natural	20.1%
Neutral	13.3%
Fairly unnatural	11.1%
Very unnatural	4.3%

PAT2 t[u]b[u]ga[n]	% of answers
Very natural	26.3%
Fairly natural	22.1%
Neutral	21.2%
Fairly unnatural	23.5%
Very unnatural	6.9%

PAT2 k[ə]ima[n]	% of answers
Very natural	42.7%
Fairly natural	28.3%
Neutral	15.1%
Fairly unnatural	9.7%
Very unnatural	4.3%

PAT3 t[u]b[u]ga[∅]	% of answers
Very natural	10.6%
Fairly natural	13.9%
Neutral	18.5%
Fairly unnatural	26.9%
Very unnatural	30.1%

PAT3 k[ə]ima[∅]	% of answers
Very natural	13.3%
Fairly natural	17.6%
Neutral	15.4%
Fairly unnatural	27.2%
Very unnatural	26.5%

PAT4 t[o]b[o]ga[∅]	% of answers
Very natural	7.8%
Fairly natural	8.8%
Neutral	14.3%
Fairly unnatural	26.7%
Very unnatural	42.4%

PAT2 k[a]ima[∅]	% of answers
Very natural	13.3%
Fairly natural	20.1%
Neutral	17.2%
Fairly unnatural	24.0%
Very unnatural	25.4%