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# *Exceptional prosodification effects revisited in Gradient Harmonic Grammar**

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This paper presents an analysis of exceptional prosodification effects, in which exceptional lexical items appear to follow a regular pattern that is found in a different prosodic context. These patterns have been analysed as cases of prosodic prespecification, where morphemes select a non-default prosodic representation. I argue that prespecification approaches should be reconsidered, and that such patterns are predicted without morpheme-specific prosody in Gradient Harmonic Grammar, a weighted constraint system with gradiently active symbols. Exceptional prosodification effects result from the interaction of two influences on constraint penalties: (i) scaling of constraint violations by prosodic context and (ii) contrastive activity values in underlying forms. This interaction is illustrated with the distribution of French nasal vowels and linking [n]. This approach reduces the amount of structure posited for URs, and provides new arguments for a more uniform syntax–prosody mapping.

## 1 Introduction

Lexical exceptions, patterns in which a restricted set of morphemes unexpectedly undergoes or fails to undergo a phonological process, can shed light on key properties of the phonological grammar. This paper discusses apparent EXCEPTIONAL PROSODIFICATION EFFECTS, in which exceptional lexical items appear to follow a regular pattern that is found in a different prosodic context. I focus on several such cases in the distribution of nasal vowels in Standard French. In brief, the language places

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restrictions on the types of segments that can follow nasal vowels, i.e. possible ṼX sequences (where X = any segment). This distribution is generally sensitive to morphosyntactic constituency: the larger the juncture between Ṽ and X, the more types of segments X are permitted. However, several exceptional items show stronger than expected restrictions on ṼX sequences at junctures; in each case the pattern resembles a regular one that applies within a smaller domain.

Exceptional prosodification effects have generally been accounted for in terms of PROSODIC PRESPECIFICATION (also known as 'prosodic subcategorisation'); some lexical items subcategorise for a non-default prosodic representation (Inkelas 1989, Poser 1990, Zec 2005, Paster 2006, Bennett *et al*. 2018, Tyler 2019). This paper proposes that prespecification approaches should be re-evaluated in light of recent advances in phonological theory. It builds on several arguments advanced in favour of Harmonic Grammar, a constraint-based grammar in which constraints are numerically weighted rather than ranked (Legendre *et al*. 1990, Smolensky & Legendre 2006). In particular, a weighted constraint system can generate many phonological patterns using a smaller constraint set that better predicts attested typologies (Farris-Trimble 2008, Potts *et al*. 2010, Jesney 2011, Pater 2012, 2016), and correctly predicts that optimal outputs can be determined by the interaction of constraints that refer to independent dimensions of structure (Zuraw & Hayes 2017). In addition, I consider recent claims that lexical variability and exceptionality should be accounted for in terms of contrasts in the gradient activity values of underlying representations (Rosen 2016, Smolensky & Goldrick 2016, Zimmermann 2018).

I demonstrate that apparent exceptional prosodification effects are predicted to arise in such a framework, a Gradient Harmonic Grammar (Smolensky *et al*. 2014, Smolensky & Goldrick 2016), without lexically specific variability in the mappings from syntactic to prosodic constituent structure. Instead, these patterns emerge from the interaction of two independently proposed constraint penalty adjustments: (i) scaling of constraint penalties according to the prosodic environments in which they occur (Hsu & Jesney 2016, Inkelas & Wilbanks 2018), and (ii) contrastive specification of featural and segmental activity values (Rosen 2016, Smolensky & Goldrick 2016, Zimmermann 2018). Because both factors contribute to the harmony values of output candidates, changes to the underlying values of otherwise identical input structures can replicate the effects of scaling based on prosodic context.

Anticipating the analysis, I propose that positional markedness constraints against ṼX sequences are scaled according to the size of the smallest prosodic constituent that contains such sequences, such that ṼX sequences contained in smaller domains incur higher markedness penalties. All nasal vowels in French are derived from an underlying form /Ṽn/, but lexical items vary in the underlying activity value of the vowel's [nasal] feature and of /n/'s root node. These contrasts in underlying activity alter the penalties of faithfulness constraints. Because all

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constraint violations contribute to total harmony, changes to underlying activity values can in some instances have the same effect as constraint scaling on the relative harmony of output forms. This approach is able to generate the French pattern from a uniform set of underlying segments for lexical items with a nasal vowel allomorph, without prosodic prespecification, desiderata that have eluded previous analyses.

The proposal has several implications. First, it suggests that contrasts in gradient activity among lexical items can provide a unified analysis for exceptional patterns more generally, both in exceptional prosodification effects and in patterns that do not involve prosodic structure (Rosen 2016, Zimmermann 2018). As this reduces the number of structural prespecifications proposed for underlying forms, it results in a more parsimonious explanation for lexical exceptionality. In addition, this approach to exceptional prosodification effects allows morpheme-specific constraints on syntax–prosody alignment to be dispensed with, in line with recent research that proposes reduced variability in the possible mappings from syntactic to prosodic domains (Selkirk 2011, Elfner 2012, Tyler 2019).

The remainder of the paper is structured as follows. §2 presents the distribution of nasal vowels in French and the apparent exceptional prosodification effects in the language. §3 presents an analysis of regular sensitivity to prosodic structure using scalar markedness constraints, and §4 shows how the apparent exceptional prosodification effects arise from the interaction of scalar markedness constraints and contrastive activity values. §5 argues against approaches which employ prosodic prespecification and lexical constraint indexation, and §6 concludes the paper.

## 2 Effects of prosodic structure on nasal vowels and liaison

This section presents the distribution of the nasal vowels ([ɛ̃ ɔ̃ ɑ̃]) in Standard French, with a focus on the types of segments that can follow nasal vowels. Generally, the larger the boundary between Ṽ and X, the more types of segment X are permitted, such that relatively sonorous segments are dispreferred. This is observed both in static phonotactic generalisations and in alternations observed at morphosyntactic junctures. I then present the exceptional cases, where individual lexical items show stronger than expected restrictions on ṼX sequences. Crucially, I show that there are only three regular patterns, and that all exceptional lexical items pattern in a way that resembles a regular pattern that applies across a smaller juncture.

### 2.1 Stem-internal ṼX

With very few exceptions, when both segments ṼX are contained within a stem, the only sounds that follow nasal vowels are obstruents. Some examples are given in (1a). Nasal vowels followed by non-glide sonorants are extremely rare, and are restricted to a handful of forms, like [ʒɑ̃ʁ] and

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[ãnɥi] in (1b). Lastly, nasal vowels are not found before glides or vowels (Dell 1970), as shown by the absence of forms like those in (1c). Note that the restriction against nasal vowels preceding other vowels is stronger than the general dispreference for vowel hiatus, as hiatus is attested for adjacent oral vowels (VV; e.g. [naif] *naïf* 'naive') and for an oral vowel followed by a nasal vowel (VṼ; e.g. [kameleɔ̃] *caméléon* 'chameleon'), but not for a nasal vowel followed by an oral vowel (*ṼV) or for a sequence of nasal vowels (*ṼṼ).[1] The absence of nasal vowels before glides results to some extent from the restricted distribution of non-initial glides; neither [w] nor [ɥ] is permitted as a singleton onset in non-stem-initial syllables (Tranel 1987). Nonetheless, [j] is permitted in these contexts, and is unattested following nasal vowels.

(1) a. ṼT: Ṽ *before obstruents*

| | | | | | |
|---|---|---|---|---|---|
| [ɛ̃po] | *impôt* | 'tax' | [kɛ̃z] | *quinze* | 'fifteen' |
| [ɔ̃d] | *onde* | 'wave' | [dɑ̃s] | *danse* | 'dance' |
| [lɑ̃g] | *langue* | 'language' | [ɑ̃fɑ̃] | *enfant* | 'child' |
| [tɑ̃t] | *tante* | 'aunt' | [lɛ̃ʒ] | *linge* | 'laundry' |

b. ṼR: Ṽ *before non-glide sonorants* [m n l ʁ] (*extremely rare*)

| | | | | | |
|---|---|---|---|---|---|
| [ʒɑ̃ʁ] | *genre* | 'genre' | [ãnɥi] | *ennui* | 'boredom' |

c. ṼG/ṼV: Ṽ *before glides and vowels* (*unattested*)

| | |
|---|---|
| *[kɑ̃ju] | *[ɔ̃œʁ] |

## 2.2 ṼX across prefix boundaries

Restrictions on nasal vowels preceding morpheme boundaries can be observed on prefixes that have an allomorph that ends with a nasal vowel. The general pattern is illustrated in the alternations of [ã(n)] *en-* 'to make X', [nɔ̃(n)] *non-* 'non-', [bjɛ̃(n)] *bien-* 'well-' (Tranel 1981, Hannahs 1995). Before a vowel-initial stem, each prefix ends in a nasal vowel and coronal nasal, as shown in (2a). Before a consonant-initial stem, it ends in a nasal vowel, regardless of the following consonant's sonority, as in (2b). In contrast to stem-internal nasal vowels, nasal vowels in prefixes are permitted before sonorant consonants.

(2) a.

| | | |
|---|---|---|
| [ãn-ivʁe] | *enivrer* | 'to intoxicate' |
| [ãn-ɔʁgœjiʁ] | *enorgueillir* | 'to make proud' |
| [nɔ̃n-ɛ̃skʁi] | *non-inscrit* | 'unregistered' |
| [nɔ̃n-inisje] | *non-initié* | 'uninitiated' |
| [bjɛ̃n-œʁœ] | *bienheureux* | 'joyful' |
| [bjɛ̃n-ɛme] | *bien-aimé* | 'well-liked' |

[1] Tranel (1981) questions Dell's (1970) generalisation about the absence of stem-internal ṼV sequences, noting that ṼV is found in proper names like *Panhard* [pɑ̃aʁ]. However, this can be understood as the result of a positional privilege afforded to proper nouns (Smith 2014, Moreton *et al.* 2017) that does not alter the basic generalisation about stem-internal phonotactic restrictions.

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| | | | |
|---|---|---|---|
| b. | [ɑ̃-kɛse] | *encaisser* | 'to cash' |
| | [ɑ̃-nɔbliʁ] | *ennoblir* | 'to ennoble' |
| | [nɔ̃-fɔ̃ksjɔnmɑ̃] | *non-fonctionnement* | 'non-function' |
| | [nɔ̃-ʁœspe] | *non-respect* | 'non-respect' |
| | [bjɛ̃-ʒwe] | *bien joué* | 'well-played' |
| | [bjɛ̃-ʁœsy] | *bien reçu* | 'well-received' |

As described by Tranel (1976), the negative prefix *in-* has a pattern of allomorphy which is distinct from other prefixes, in that it is sensitive to the sonority of stem-initial consonants. *In-* surfaces as [in] before vowel-initial and glide-initial stems (3a), as [i] before other sonorant-initial stems (b) and as [ɛ̃] before obstruent-initial stems (c).[2]

| | | | | |
|---|---|---|---|---|
| (3) a. | [in-abil] | *inhabile* | 'unskilful' |
| | [in-wi] | *inouï* | 'unheard of' |
| b. | [i-mɔʁal] | *immoral* | 'immoral' |
| | [i-legal] | *illégal* | 'illegal' |
| c. | [ɛ̃-fekɔ̃] | *infécond* | 'unfruitful' |
| | [ɛ̃-pɔsibl] | *impossible* | 'impossible' |

The key observation here is that this pattern of allomorph selection shows the same distribution as for stem-internal ṼX sequences, where nasal vowels can precede obstruents, but not sonorant consonants or vowels.

## 2.3 ṼX across word boundaries

The patterning of ṼX sequences separated by a morphological word boundary shows the greatest degree of variation across lexical items. The analysis of this variability, as well as identifying which patterns should be treated as exceptional, has been the subject of many analyses in generative phonology (see Tranel 1981, 1995 for detailed overviews). Here, I focus on prenominal adjectives ending in a nasal vowel when pronounced in isolation, and how they surface when they precede a vowel-initial word. Three patterns emerge in this context (Sampson 2001). First, certain prenominal adjectives end in a nasal vowel, with no change from their pronunciation in isolation, as in (4a). The second class of adjectives, in (b), retains the final nasal vowel, but surfaces with a linking (liaison) consonant [n]. The third class also surfaces with linking [n], but with an oral vowel in place of the nasal vowel that would appear in isolation, as in (c). The observed patterns are conditioned by the prenominal adjective, rather

[2] An exception to this patterning of *in-* is observed when it attaches to adjectives formed by the suffix *-able* (Tranel 1976). Here, the prefix surfaces as [in] before vowel-initial stems and [ɛ̃] before consonant-initial stems, regardless of sonority (cf. [inɔfisjalizabl] *inofficialisable* 'that cannot be officialised', [ɛ̃tʁɑ̃sfɔʁmabl] *intransformable* 'that cannot be transformed', [ɛ̃memɔʁizabl] *immémorisable* 'that cannot be memorised').

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than the following word (cf. Zymet 2018 for discussion of effects of the first word in liaison with consonants other than [n]).

(4) *Prenominal adjective classes before* V*-initial words*

a. *No liaison*

| | | | |
|---|---|---|---|
| [miɲɔ̃] + [ɔbʒe] → [miɲɔ̃ ɔbʒe] | *mignon objet* | 'cute object' |
| [lwɛ̃tɛ̃] + [avniʁ] → [lwɛ̃tɛ̃ avniʁ] | *lointain avenir* | 'distant future' |

b. *Nasal vowel with liaison* [n]

| | | |
|---|---|---|
| [kɔmɛ̃] + [ɔbʒe] → [kɔmɛ̃ nɔbʒe] | *commun objet* | 'common object' |
| [sɛʁtɛ̃] + [ami] → [sɛʁtɛ̃ nami] | *certain ami* | 'certain friend' |

c. *Oral vowel with liaison* [n]

| | | |
|---|---|---|
| [bɔ̃] + [ɔbʒe] → [bɔ nɔbʒe] | *bon objet* | 'good object' |
| [ãsjɛ̃] + [ami] → [ãsjɛ nami] | *ancien ami* | 'old friend' |

This distinction is observed only before vowel-initial words. When followed by a consonant-initial word, all of the adjectives above surface with a final nasal vowel before both sonorant and obstruent consonants, as in (5).

(5) *Prenominal adjective classes before* C*-initial words*

a. [miɲɔ̃] + [lãgaʒ] → [miɲɔ̃ lãgaʒ] *mignon langage* 'cute language'
[miɲɔ̃] + [pʁɔblɛm] → [miɲɔ̃ pʁɔblɛm] *mignon problème* 'cute problem'

b. [kɔmɛ̃] + [lãgaʒ] → [kɔmɛ̃ lãgaʒ] *commun langage* 'common language'
[kɔmɛ̃] + [pʁɔblɛm] → [kɔmɛ̃ pʁɔblɛm] *commun problème* 'common problem'

c. [bɔ̃] + [lãgaʒ] → [bɔ̃ lãgaʒ] *bon langage* 'good language'
[bɔ̃] + [pʁɔblɛm] → [bɔ̃ pʁɔblɛm] *bon problème* 'good problem'

Although there is some correlation between the properties of these adjectives and their patterning before vowel-initial words, none are fully predictable or without exceptions. For instance, while adjectives that trigger liaison with an oral vowel (4c) commonly end in [ɛ̃] (orthographic *-ien, -ain*, *-ein*), this vowel-quality generalisation does not extend to *bon* ([bɔ̃]/[bɔn]). Furthermore, the liaison forms of these prenominal adjectives frequently resemble their feminine allomorphs (*-enne*, *-aine*, *-eine* [ɛn]), suggesting an analysis of these forms in terms of gender suppletion (Tranel 1981, 1992, Steriade 1999, but cf. Bermúdez-Otero 2018). Nonetheless, many prenominal adjectives that end in [ɛ̃] in isolation and have a feminine allomorph ending in [ɛn] either do not trigger liaison for most speakers (Encrevé 1986, Sampson 2001), e.g. [lwɛ̃tɛ̃ avniʁ], or surface with final [ɛ̃n], e.g. [sɛʁtɛ̃ nami] (Steriade 1999).

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The liaison with nasal vowel pattern (4b) also applies in the standard dialect to non-adjectival prenominal items like the masculine indefinite article *un* and the possessive pronouns *mon*, *ton* and *son*. However, some speakers apply liaison with an oral vowel to indefinite articles and possessive pronouns (Tranel 1981). More generally, there is interspeaker and interdialectal variability in the patterning of certain adjectives; some adjectives, e.g. *ancien* and *lointain*, have been described as following each of the three patterns for different sets of speakers (Tranel 1981, Encrevé 1988, Sampson 2001).

While there are difficulties in eliciting production studies with novel adjective + noun sequences, given the preference for most adjectives to appear postnominally, Sampson (2001) shows that the no liaison pattern is to a large extent the productive one applied by speakers to novel sequences, and that it is possible to treat the two classes of liaison-triggering items as being finite. Similarly, Durand & Lyche (2008) find liaison with prenominal adjectives to be rare in the *Phonologie du Français Contemporain* corpus, which includes scripted, semi-directed and informal speech. On the criterion of productivity, no liaison is the regular pattern for prenominal adjectives preceding vowel-initial words, while the liaison with [n] patterns are exceptional. I will adopt this perspective in the remainder of this work.

The crucial generalisation here is that each pattern in which a linking consonant surfaces replicates a regular phonotactic generalisation that is attested word-internally. *Commun*-class adjectives (4b), which trigger liaison with a preserved nasal vowel, replicate the regular pattern found at prefix boundaries; nasal vowels surface before obstruents and sonorant [n], but not vowels. *Bon*-class adjectives (4c), which trigger liaison with an oral vowel, replicate the stem-internal pattern; nasal vowels do not surface before either vowels or sonorant consonants. Aspects of this generalisation have been noted in previous work. Bybee (2001: 347) observes that liaison (including with consonants other than [n]) is 'very similar to morphologically and lexically conditioned alternations that occur word-internally'. Sampson (2001: 255) characterises the patterning of *bon*-class adjectives as a type of partial lexicalisation in which adjective + noun sequences are 'treated effectively as phonological words'. The similarity between the *commun objet* pattern of liaison with a nasal vowel and the allomorphic patterning of prefixes like *en-*, *non-* and *bien-* is also noted by Tranel (1981) and Prunet (1986).

In summary, there are three basic patterns in the distribution of permissible $\tilde{V}X$ sequences in Standard French. Each pattern applies regularly at some level of constituent structure. In the regular case, the larger the boundary between $\tilde{V}$ and X, the more types of segment X are permitted. The behaviour of all exceptional items resembles a pattern that regularly applies across a smaller boundary. This distribution is summarised in Table I.

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| | | regular | exceptional |
|---|---|---|---|
| Pattern 1 | $\tilde{V}$ precedes obstruents ($\tilde{V}$T only) | stem-internal $\tilde{V}$X (no juncture) | *bon* class prenominal adjectives, *in-* prefix |
| Pattern 2 | $\tilde{V}$ precedes obstruents and sonorant consonants ($\tilde{V}$C only) | $\tilde{V}$X across prefix boundary | *commun* class prenominal adjectives |
| Pattern 3 | $\tilde{V}$ precedes all segments (all $\tilde{V}$X possible) | $\tilde{V}$X across word boundary | |

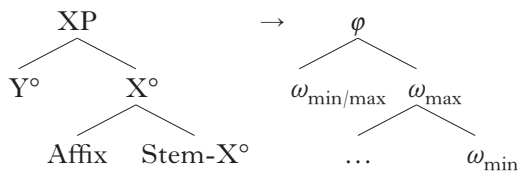
*Table I*
Summary of regular and exceptional distributions of $\tilde{V}$X sequences.

## 3 Scalar constraint analysis of restrictions on $\tilde{V}$X

### 3.1 Restrictions on $\tilde{V}$X sequences and prosodic structure

I first turn to developing an analysis of the regular sensitivity of restrictions on $\tilde{V}$X sequences to morphosyntactic contexts. Following standard claims in Prosodic Phonology, I assume that the domains of segmental restrictions are defined in terms of prosodic constituents (Selkirk 1980, Nespor & Vogel 1986, Flack 2009, Ito & Mester 2013, among others), which are themselves defined in relation to, though they are not always isomorphic with, syntactic constituents (e.g. Selkirk 1981, 2011, Nespor & Vogel 1986).[3] In addition, prosodic constituency can be recursive; any prosodic category can dominate an instance of the same category (Elfner 2012, Ito & Mester 2013, Myrberg 2013). Domain-sensitive phonological processes can target specific subcategories of a recursive structure (Ito & Mester 2013), such as a maximal projection (a prosodic category not dominated by a category of the same type) or a minimal projection (a prosodic category that does not dominate a category of the same type).

Given the focus in this paper on the patterning of nasal vowels within morphological words and nominal phrases, I restrict my attention to two prosodic constituents: the prosodic word ($\omega$) and the phonological phrase ($\varphi$). The syntax–prosody mapping that I assume is given in (6).

(6)



[3] The claims of Prosodic Phonology differ from so-called direct reference theories, in which phonological processes have a syntactic constituent or phasal spell-out domain as their domain of application (Kaisse 1985, Odden 1987, Pak 2008, among many others). Because my analysis of French assumes an isomorphic mapping between syntax and prosodic structure, it can be easily reformulated using direct reference to syntactic constituents. Nonetheless, I will present my analysis using prosodic domains for ease of comparison with prosodic prespecification alternatives.

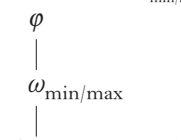
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Syntactic phrases (XPs) are mapped to φ's (Selkirk 2009, 2011, Elfner 2012). At the word level, both the stem and the complete morphological word are mapped to ω nodes. In affixed words, the stem corresponds to a minimal prosodic word ($\omega_{min}$) because it does not itself dominate a ω, while the full morphological word corresponds to a maximal prosodic word ($\omega_{max}$) because it is not itself dominated by a ω. An unaffixed stem (here Y°) is mapped to a prosodic word that is both minimal and maximal, and thus subject to restrictions that apply to both constituent types. This structure predicts that all stems are subject to restrictions that apply to $\omega_{max}$ and $\omega_{min}$, while affixes are not subject to restrictions that apply to $\omega_{min}$.[4] Because the recursive ω structure is the most faithful mapping from syntactic to prosodic constituency, as previously argued for φ-level structure, I assume that it holds for Standard French.

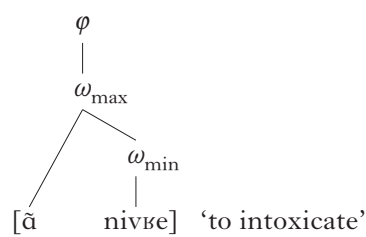
I now turn to the predicted prosodic representations that correspond to the morphosyntactic contexts discussed in the previous section. The crucial observation is that all restrictions on possible ṼX sequences can be stated in terms of the size of the smallest prosodic constituent domain that contains the relevant sequence. Consider first the status of ṼX sequences that are fully contained within stems. Regardless of whether other affixes are present, all stem material is contained within a $\omega_{min}$. This is shown in (7a) for an unaffixed stem, dominated by a single ω node that is simultaneously maximal and minimal. In this context, only obstruents can follow nasal vowels.

(7) *Predicted prosodic structures*

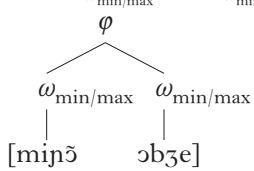
a. $((\ldots\tilde{V}X\ldots)_{\omega_{min/max}})_{\varphi}$




b. $((\ldots\tilde{V}(X\ldots)_{\omega_{min}})_{\omega_{max}})_{\varphi}$




c. $((\ldots\tilde{V})_{\omega_{min/max}}(X\ldots)_{\omega_{min/max}})_{\varphi}$




Prefixes are syllables dominated directly by $\omega_{max}$, but are not contained within the $\omega_{min}$ that contains the stem. I assume that [n] associated with

[4] The potential for ω-level recursion accounts for the strong cross-linguistic tendency for affixes or a subset of them to be exempt from generalisations that apply to stems, suggesting that stems form a distinct prosodic domain from affixes (Booij & Rubach 1984, Nespor & Vogel 1986, Hannahs 1995).

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prefixes like *en-*, *non-* and *bien-* before a vowel-initial root is dominated by $\omega_{min}$, since it is syllabified as an onset with the stem-initial vowel, as in (7b). However, an alternative representation in which [n] is dominated by $\omega_{max}$ but not $\omega_{min}$ is equally compatible with the proposed analysis. As long as the prefix nasal vowel is not dominated by $\omega_{min}$, the Ṽn sequence in either structure is fully contained within the $\omega_{max}$ that dominates the full morphological word, but not the $\omega_{min}$ that dominates the stem.[5]

Prenominal adjectives constitute morphological words that are independent from the nouns that they modify, but are contained within the same nominal phrase. In terms of the prosodic representation predicted by an isomorphic mapping, prenominal adjectives and their following nouns are dominated by distinct $\omega_{max}$ nodes. The ṼX sequence in a form like [miɲɔ̃ ɔbʒe] in (7c) is fully contained only within a $\varphi$.

In summary, restrictions on possible ṼX sequences depend on the types of prosodic constituents that contain them. ṼX sequences that are fully contained in smaller prosodic constituents are subject to more restrictions on X.

### 3.2 Scalar domain-span constraints

We now turn to the formalisation of the restrictions discussed in §3.1 in a weighted constraint grammar. Previous work has shown that many influences on phonological patterns can be successfully modelled by scalar constraints, whose penalties are adjusted on the basis of some contextual property. Constraint scaling can account for a range of phonological patterns that depend on a scale or hierarchy, including continuous phonetic values (Flemming 2001, Cho 2011, McAllister Byun 2011, Ryan 2011), perceptual distance (McCollum 2018), the sonority scale (Pater 2012, 2016, Jesney 2015), trigger and target strength in vowel harmony (Kimper 2011), morphological locality in vowel harmony (McPherson & Hayes 2016), prosodic boundary strength (Hsu & Jesney 2016), distance from prosodic boundaries (Inkelas & Wilbanks 2018), lexical category and frequency (Coetzee & Kawahara 2013, Linzen *et al*. 2013) and degree of nativisation (Hsu & Jesney 2017, 2018).

The present type of scalar pattern, in which a phonological process or restriction applies only up to a cut-off point on a hierarchy, has often been analysed in ranked constraint grammars using sets of stringently related constraints (de Lacy 2002) or fixed constraint rankings. However, there is empirical support in favour of applying weighted scalar constraints to these cases. Hsu & Jesney (2016, 2017) show that in

[5] The recursive $\omega$ representation can be extended to account for other prefix–stem asymmetries in French, noted by Hannahs (1995). For example, a glide-formation process that causes prevocalic /i/ to surface as [j] applies at stem–suffix boundaries (e.g. [kɔlɔni] *colonie* 'colony' *vs*. [kɔlɔnjal] *colonial* 'colonial'), but not across prefix–stem boundaries (e.g. [antialkɔlik] *antialcoolique* 'anti-alcohol'; cf. *[antjalkɔlik]). This can easily be accounted for in the recursive $\omega$ structure by positing that the restriction against prevocalic [i] is only enforced when both segments are contained within $\omega_{min}$ (or $\omega_{non\text{-}max}$, if suffixes are not contained in $\omega_{min}$ with the root).

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instances where more than one type of constraint is indexed to the same hierarchy, both fixed rankings and stringently related constraints generate unattested 'level-skipping' patterns, in which a process applies at non-adjacent points on the hierarchy, whereas scalar constraints avoid this overgeneration problem. Constraint scaling also has the advantage of theoretical parsimony. It accounts for scalar phenomena in different empirical domains using a single grammatical mechanism: numerical adjustment of constraint violations.

I will employ a scaling system in which scaling involves the addition of a penalty to the basic weight $w$ of a constraint (Hsu & Jesney 2016, Shih & Inkelas 2016). This amount is determined by a constraint-specific scaling factor $s$, whose value is multiplied by a numerical value $d$, which is determined by the corresponding point on the hierarchy of the constraint violation. The contribution to total harmony of a single violation of a scalar constraint is calculated as in (8).[6]

(8) $\mathcal{H} = w + (s \times d)$

*where* $w$ is the weight of the constraint C
$s$ is the scaling factor applied to constraint C
$d$ is the candidate's value along the scale 0, 1, … $n$ defined for constraint C

For any scalar constraint, I assume that values of $w$ and $s$ are language-specific, and acquired by the learner. However, the type of scaling factor $s$ associated with a given constraint is plausibly universally predetermined, based on the type of structure penalised by the constraint and the contextual influences that can adjust its contribution to harmony.

Here, I propose that markedness constraint violations are scaled according to the size of the smallest prosodic constituent type that fully contains the marked structure. Schematically, a constraint against a marked sequence $M$ is defined in such a way that its total penalty is adjusted on the basis of the size of the smallest prosodic category that contains all segments in $M$. The restriction to full containment within a prosodic constituent resembles that of Selkirk's (1980) domain-span rules, which apply only to segments that are dominated by a specified prosodic category. The analysis makes use of two scalar markedness constraints.[7]

[6] Alternative constraint scaling systems have been proposed. For instance, we can consider scaling systems in which the constraint weight itself is multiplied by a value along the scale, $\mathcal{H} = w \times d$ (McPherson & Hayes 2016, McCollum 2018), or in which the value along the scale is an exponent of the base weight, $\mathcal{H} = w^d$ (Inkelas & Wilbanks 2018). An important difference between additive scaling and the other systems is that in cases where two constraints are scaled along the same hierarchy ($\mathcal{H}_1 = w_1 + (s_1 \times d)$, $\mathcal{H}_2 = w_2 + (s_2 \times d)$), their relative weights can change at an intermediate value on the scale (Hsu & Jesney 2016).

[7] A reviewer suggests an alternative constraint set, in which there is a single markedness constraint *ṼX, with two scaling factors: one for the sonority of the segment X, and one for the smallest prosodic constituent containing the sequence, i.e. a penalty calculation of $\mathcal{H} = w_1 + (s_1 \times d_1) + (s_2 \times d_2)$. While such an analysis appears to be

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The first scalar constraint *ṼR, in (9a), penalises sequences of nasal vowels followed by sonorant consonants. A penalty of the basic weight $w$ is incurred by any nasal vowel followed by a sonorant, regardless of where it occurs in the prosodic structure. In this analysis, I will use the scale ($\varphi = 0$, $\omega_{max} = 1$, $\omega_{min} = 2$).[8]

(9) a. *ṼR
For any nasal vowel + sonorant consonant sequence fully contained within a domain $\in (\varphi, \omega_{max}, \omega_{min})$, assign a weighted violation score of $w + (s \times d)$, where $\varphi = 0$, $\omega_{max} = 1$, $\omega_{min} = 2$.

b. *ṼV
For any nasal vowel + vowel sequence fully contained within a domain $\in (\varphi, \omega_{max}, \omega_{min})$, assign a weighted violation score of $w + (s \times d)$, where $\varphi = 0$, $\omega_{max} = 1$, $\omega_{min} = 2$.

The second scalar constraint, *ṼV, in (9b), penalises a sequence of a nasal vowel followed by another vowel. A non-scalar version of this constraint is used to motivate the appearance of linking [n] in Smith's (2015) analysis. While both constraints in (9) have constraint-specific values for their base weights $w$ and scaling factors $s$, they refer to the same scale.

Sample penalty calculations associated with *ṼR violations in the three relevant prosodic contexts are given in (10), assuming a base weight of 1 and a scaling factor of 2.

(10) *Sample calculations of penalties for* *ṼR
weight: $w = 1$
scale: $\varphi = 0$, $\omega_{max} = 1$, $\omega_{min} = 2$
scaling factor: $s = 2$
ṼR across word boundary: $w + s(\varphi) = 1 + (2 \times 0) = 1$
ṼR across prefix boundary: $w + s(\omega_{max}) = 1 + (2 \times 1) = 3$
ṼR within stem: $w + s(\omega_{min}) = 1 + (2 \times 2) = 5$

We can now address the weighting and scaling conditions that generate the distribution of French nasal vowels. For illustrative purposes,

feasible, for explanatory ease I will use two separate constraints, and leave to future work the issue of which constraint system is ultimately preferable.

[8] The assumption that the numerical values on the scale are evenly spaced by values of one is plausibly grounded in the fact that size of the smallest prosodic constituent type that contains a structure can be restated in terms of the number of prosodic constituent types that contain it (i.e. depth of embedding), due to the principle of Headedness (Selkirk 1996): each $PCat_i$ must be dominated by a $PCat_{i+1}$. However, I leave open the questions of whether uneven spacing is possible and in which domains it can arise. For an analysis that employs a scale with uneven spacing, see Pater's (2016) account of sonority-driven stress.

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I assume that vowels are nasalised underlyingly, and that linking [n] in an output is epenthesised. A different representation will be proposed for the final analysis, as the adoption of gradient activity allows different input structures to be considered. In this example, the scalar markedness constraints in (9) interact with two faithfulness constraints: MAX[nas], violated by output segments that differ from their input correspondent in not having a [nasal] feature, and DEP, violated by output segments with no input correspondent (McCarthy & Prince 1995).[9]

One set of weights and scaling factors that generates the regular pattern is shown in the tableaux in (11). The input for each tableau contains an underlying ṼV sequence. For ease of presentation, I only consider output candidates that resemble one of the three attested surface patterns found in this context: (a) faithful surfacing of ṼV, (b) insertion of [n] following Ṽ and (c) insertion of [n] and change from a nasal to oral vowel. Each tableau reflects a different prosodic representation, illustrated by a regular prenominal adjective (11a), a regular prefix (b) and a stem (c). Although each set of output candidates violates the same constraints, scaling applied to the markedness constraints alters the relative harmony in each context. Penalty calculations for the scalar markedness constraints are shown in each relevant cell. By convention, each constraint violation is represented by a negative integer. The optimal candidate in each tableau is the one whose harmony score is closest to zero.

Consider (11a), in which the prenominal adjective and noun surface in separate $\omega_{max}$ constituents. The optimal, faithful candidate, (i), violates only *ṼV; because the smallest prosodic constituent that contains the ṼV sequence is a $\varphi$, the constraint's scaling factor $s$ is multiplied by the corresponding value of the scale ($\varphi = 0$). This results in a total *ṼV penalty of $w + s(\varphi) = 3 + (6 \times 0) = 3$. Candidate (ii), which maintains vowel nasalisation and epenthesises a nasal consonant, violates both DEP (incurring a penalty $w = 4$) and *ṼR (incurring a penalty $w + s(\varphi) = 1 + (3 \times 0) = 1$). Candidate (iii), which removes vowel nasalisation and epenthesises a nasal consonant, violates only the faithfulness constraints DEP ($w = 4$) and MAX[nas] ($w = 6$).

[9] In principle, we expect that positional faithfulness constraints can also be scaled, such that violation penalties increase in more deeply embedded domains. For instance, Hsu & Jesney (2016) argue that both markedness and faithfulness constraints must be scaled in order to account for the typology of segmental restrictions at larger prosodic boundaries (Flack 2009). However, given the absence of evidence for increased tolerance of marked structures in more embedded domains in the French pattern, my analysis will not apply positional scaling to faithfulness constraints.

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(11)

| | | MAX [nas] $w$=6 | DEP $w$=4 | *ṼR $s$=3 $w$=1 | *ṼV $s$=6 $w$=3 | $\mathcal{H}$ |
|---|---|---|---|---|---|---|
| a. | /miɲɔ̃ ɔbʒe/ | | | | | |
| | ☞ i. $(((\text{miɲɔ̃})_{\omega_{\min}})_{\omega_{\max}}$ $((\text{ɔbʒe})_{\omega_{\min}})_{\omega_{\max}})_{\varphi}$ | | | | $-1_{\varphi}$ = $-1\times(3+(6\times0))$ | −3 |
| | ii. $(((\text{miɲɔ̃})_{\omega_{\min}})_{\omega_{\max}})$ $((\text{nɔbʒe})_{\omega_{\min}})_{\omega_{\max}})_{\varphi}$ | | −1 | $-1_{\varphi}$ = $-1\times(1+(3\times0))$ | | −5 |
| | iii. $(((\text{miɲɔ})_{\omega_{\min}})_{\omega_{\max}})$ $((\text{nɔbʒe})_{\omega_{\min}})_{\omega_{\max}})_{\varphi}$ | −1 | −1 | | | −10 |
| b. | /ɑ̃ ivʁe/ | | | | | |
| | i. $((\tilde{\text{a}}(\text{ivʁe})_{\omega_{\min}})_{\omega_{\max}})_{\varphi}$ | | | | $-1_{\omega_{\max}}$ = $-1\times(3+(6\times1))$ | −9 |
| | ☞ ii. $((\tilde{\text{a}}(\text{nivʁe})_{\omega_{\min}})_{\omega_{\max}})_{\varphi}$ | | −1 | $-1_{\omega_{\max}}$ = $-1\times(1+(3\times1))$ | | −8 |
| | iii. $((\text{a}(\text{nivʁe})_{\omega_{\min}})_{\omega_{\max}})_{\varphi}$ | −1 | −1 | | | −10 |
| c. | /ɔ̃œʁ/ | | | | | |
| | i. $(((\tilde{\text{ɔ}}\text{œʁ})_{\omega_{\min}})_{\omega_{\max}})_{\varphi}$ | | | | $-1_{\omega_{\min}}$ = $-1\times(3+(6\times2))$ | −15 |
| | ii. $(((\tilde{\text{ɔ}}\text{nœʁ})_{\omega_{\min}})_{\omega_{\max}})_{\varphi}$ | | −1 | $-1_{\omega_{\min}}$ = $-1\times(1+(3\times2))$ | | −11 |
| | ☞ iii. $(((\text{ɔnœʁ})_{\omega_{\min}})_{\omega_{\max}})_{\varphi}$ | −1 | −1 | | | −10 |

Compare this with tableau (11b), in which the nasal vowel is associated with a prefix, and is contained in the same $\omega_{\max}$ as the stem. Because the ṼV sequence in the faithful candidate, (i), is contained within a $\omega_{\max}$, its violation of *ṼV is scaled to the next value on the scale ($\omega_{\max} = 1$), resulting in a total penalty of $w + s(\omega_{\max}) = 3 + (6 \times 1) = 9$. Candidate (ii)'s violation of *ṼR is adjusted to the same value on the scale, incurring a penalty of $w + s(\omega_{\max}) = 1 + (3 \times 1) = 4$. Although both candidates now incur greater total penalties, (i) has a relatively larger increase, which is sufficient to make (ii) optimal. Finally, (11c) compares output candidates for a hypothetical input stem /ɔ̃œʁ/. Because all segments in the output candidates are contained within a $\omega_{\min}$, the first two candidates' violations of *ṼV and *ṼR are scaled to the highest value on the scale ($\omega_{\min} = 2$). The increased penalty of *ṼR results in another change in relative harmony, such that (iii) is optimal.

Figure 1 shows a more abstract representation of these effects of markedness scaling on relative harmony, using different weights and scaling factors as an expository simplification. The total penalties incurred by various constraint violations are shown on the $y$-axis, while the $x$-axis represents values on the scale. For illustration, non-faithful candidates are assumed to violate a single FAITH constraint, and both markedness constraints have the same scaling factor $s = 2$. In this example, the base weight of FAITH, $w = 4$, exceeds that of *ṼR, $w = 1$, and *ṼV, $w = 3$. When the

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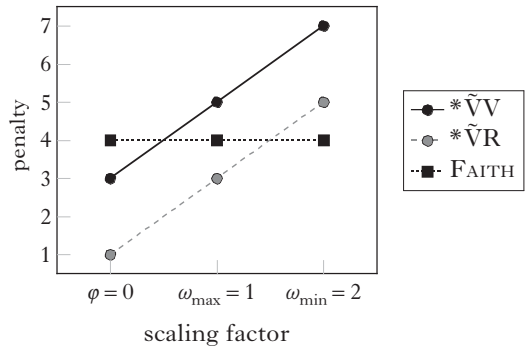



*Figure 1*
Prosodic context sensitivity generated by scalar markedness constraints.

smallest prosodic constituent that fully contains the ṼX sequence is $\varphi$, these weights are unaffected by the scaling factor, as $\varphi$ corresponds to 0 on the scale. Nasal vowel + oral vowel sequences and nasal vowel + sonorant consonant sequences surface faithfully. If the ṼX sequence is contained within a $\omega_{max}$, the scaled penalty of *ṼV, $3 + (2 \times 1) = 5$, now exceeds the penalty for FAITH, predicting that nasal vowel + oral vowel sequences will be repaired. Because the penalty for FAITH still exceeds the scaled penalty for *ṼR, $1 + (2 \times 1) = 3$, nasal vowels remain permitted before sonorant consonants. Finally, for ṼX sequences contained in a $\omega_{min}$, the scaled penalties for *ṼV, $3 + (2 \times 2) = 7$, and *ṼR, $1 + (2 \times 2) = 5$, both exceed the penalty for FAITH, predicting that both marked sequences will be repaired.

## 4 Interaction of scalar constraints and gradient activity

### 4.1 Gradient Harmonic Grammar

Smolensky *et al.* (2014) and Smolensky & Goldrick (2016) propose that individual discrete symbols manipulated by grammars have a degree of presence in their input representation, and that the degree of presence of a symbol, its ACTIVITY, can take continuously gradient values. These gradient activity values are directly relevant to grammatical computation in a weighted constraint system like Harmonic Grammar. The penalty of a constraint violation is proportional to the activity of the structure that incurs the violation. In the present analysis, I assume that gradient activity is a property of both segments and features.

Given that grammatical outputs are determined by comparing the harmony scores of competing output candidates, a key consequence of this proposal is that changes to the underlying activity value of otherwise identical segments can lead to different optimal outputs, while a uniform

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set of constraints and constraint weights is maintained. Following Smolensky *et al.* (2014) and Smolensky & Goldrick (2016), I assume that input structures can have continuous activity values between 0 and 1, while all structures in output candidates, being discrete segments, have an activity value of 1 (cf. Zimmermann 2018 for arguments for gradient activity in outputs). Because markedness constraints refer only to output structures, which must be fully active, their evaluation is not dependent on the underlying activity value of the relevant structure. However, differences in gradient activity affect the penalties of faithfulness constraint violations, which are proportional to the activity value of the non-correspondent structure. For example, I use the definitions in (12) for the faithfulness constraints DEP and MAX (based on Zimmermann 2018).

(12) a. DEP
Assign a violation $A$ for every segment whose output activity $A$ is absent in the input.

b. MAX
Assign a violation $A$ for every segment whose input activity $A$ is absent in the output.

The basic interaction is illustrated in the simplified example in (13). Both tableaux contain the same input /pak/, but differ in the activity value of /k/, 0.75 in (13a) and 0.25 in (b). Because markedness constraints refer only to output structures, the candidate [pak] incurs the same penalty in both tableaux for violation of NOCODA, regardless of the underlying activity value of /k/. However, the violation of the faithfulness constraint DEP is proportional to the amount of activity that needs to be added to bring a segment's activity to 1. Thus DEP's contribution to the total harmony of (13a.i), which realises [k] in the output, is the weight of the constraint (2) multiplied by 1 minus its underlying activity, i.e. $2 \times (1 - 0.75) = 0.5$. Likewise, the violation of MAX is proportional to the underlying activity value of a segment that is deleted in the output. MAX's contribution to the total harmony of (13a.ii), in which /k/ is deleted, is the weight of the constraint (4) multiplied by its underlying activity, $4 \times 0.75 = 3$. Compare this interaction with the one in tableau (13b), in which /k/ has an activity value of 0.25. This alters the harmony scores of both candidates, such that the coda-deletion candidate now has the highest total harmony.

(13) a.

| /$p_1a_1k_{0.75}$/ | DEP $w$=2 | MAX $w$=4 | NOCODA $w$=1 | $\mathcal{H}$ |
|---|---|---|---|---|
| ☞ i. pak | −0.25 | | −1 | −1.5 |
| ii. pa | | −0.75 | | −3 |

b.

| /$p_1a_1k_{0.25}$/ | | | | |
|---|---|---|---|---|
| i. pak | −0.75 | | −1 | −2.5 |
| ☞ ii. pa | | −0.25 | | −1 |

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From this example, we see that a contrast in the gradient activity values of two otherwise identical input structures can change the relative harmony values of competing output candidates by affecting the evaluation of faithfulness constraints. In the previous section, it was shown that the scaling of positional markedness constraints similarly alters the relative harmony of segmentally identical output candidates in different prosodic contexts. Because both gradient activity and constraint scaling contribute to total harmony values in Gradient Harmonic Grammar, we expect to find patterns in which contrasts in gradient activity values of otherwise identical inputs replicate the effects of scaling based on prosodic context. In the remainder of the section, I show that this predicted type of interaction successfully accounts for the distribution of nasal vowels in French, in both regular and exceptional patterns. I now turn to the representation of nasal vowels, and how the interaction between contrasts in gradient activity and prosodic constraint scaling can be applied to the analysis of ṼX sequences with a full constraint set.

### 4.2 Gradient symbols analysis of the regular pattern

Smolensky & Goldrick (2016) show that the greater representational power of Gradient Harmonic Grammar allows new analytical solutions to recalcitrant problems in formal grammars. Specifically, certain patterns where discrete symbolic approaches find conflicting evidence for representations A and B can be generated from representations that contain both gradiently active A and gradiently active B. There is a parallel to this general line of analysis in the problem of nasal vowels and linking [n], as many underlying representations have been proposed for nasal vowels in Standard French, each on the basis of a different set of generalisations. For example, nasal vowels have been claimed to have the underlying form /Vn/ (Schane 1968, Dell 1970), /Ṽ/ (Tranel 1981), /Ṽn/ or /Vn/, depending on lexical item (Selkirk 1972), or /V/ followed by a floating nasal segment unassociated with a timing slot (Prunet 1986). Note that this range of proposed representations essentially reflects the variety of surface forms associated with lexical items that surface with a nasal vowel in some environment.

The main generalisation to be captured is that lexical items that end with nasal vowels in isolation can in some environments vary in their propensity to maintain vowel nasalisation and to surface with linking [n]. I propose that this can be captured in Gradient Harmonic Grammar by positing a unique underlying representation /Ṽn/ for nasal vowels in the language.[10]

[10] The proposed /Ṽn/ representation is consistent with Hajek's (1997) claim that contrastive nasal vowels in a language develop from a prior stage in which contrastive vowel nasality appears only before nasal consonants, /ṼN/. On this view, Modern French has not completely lost this underlying /n/, but due to systematically lower activity values in the regular case only realises it in exceptional forms. The proposal is also potentially linked to other claims that nasal vowels consist of an underlying /VN/ sequence, based on loanword-adaptation patterns (Paradis & Prunet 2000). I thank Nicholas Rolle for this discussion.

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However, lexical items can vary in two ways: the underlying activity value of the vowel's [nasal] feature, and the underlying activity value of the nasal consonant's root node.[11]

Variation in these two dimensions of activity in part determines whether the vowel maintains its [nasal] feature and whether the nasal consonant is deleted in the optimal output. The analysis will thus consider two relevant faithfulness constraints: MAX, violated by deleted root-node activity, and MAX[nas] in (14), violated by loss of underlying nasalisation.

(14) MAX[nas]

Assign a violation *A* for every [nasal] feature whose input activity *A* is absent in the output.

The penalty for MAX[nas] depends on the input activity value of the deleted [nasal] feature, while the penalty for MAX depends on the input activity value of the deleted segment. These faithfulness constraints will interact with the scalar markedness constraints *ṼR and *ṼV.

Given this constraint set, we first establish the weighting and scaling conditions necessary to generate the regular pattern of sensitivity to prosodic embedding. The grammar compares the relative harmony of three relevant output candidates: one that deletes /n/ while maintaining vowel nasalisation, [Ṽ], one that realises vowel nasalisation and /n/ faithfully, [Ṽn], and one that realises /n/ but not vowel nasalisation, [Vn]. For an input that contains the sequence /ṼnV/, the constraint violations in (15) are associated with each mapping.

| (15) *Input–output mapping* | *Constraints violated* |
|---|---|
| /ṼnV/ → [ṼV] | *ṼV, MAX |
| /ṼnV/ → [ṼnV] | *ṼR |
| /ṼnV/ → [VnV] | MAX[nas] |

The weighting conditions can be stated as in (16). In this notation, the name of each constraint stands for the total penalty incurred by a single violation of that constraint, taking into account both scaling and gradient activity. Parentheses following markedness constraints indicate the step on the scale used to assess the constraint penalty. For example, *ṼR(*φ*) stands for 'the penalty incurred by a *ṼR violation contained within a *φ*'. Parentheses following faithfulness constraints

[11] In Smolensky & Goldrick's (2016) analysis, liaison consonants at word junctures arise as blends of underlying consonants in the final position of the first word and the initial position of the second word. My analysis abstracts away from blending, due to differences between [n] and other liaison consonants. First, the surfacing of [n] is more predictable from context; it only occurs following a word that ends with Ṽ or has a final Ṽ allomorph (e.g. *bon*), while other linking consonants can follow oral or nasal vowels. Second, liaison with [n] is more productive across all contexts than liaison with other consonants (Malécot 1975, Mallet 2008).

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indicate the activity value of the non-correspondent structure. Here, the activity value for non-exceptional lexical items is shown as the variable $\alpha$. For example, MAX($\alpha$) stands for 'the penalty incurred by a MAX violation for a structure with activity value $\alpha$'. Note that the actual activity values of /n/ and the vowel's [nasal] feature need not be identical, as we will see below. Finally, the plus sign indicates the summed penalties of two constraints, while the comma indicates that the inequality statements apply individually to two items (e.g. '$C_1$, $C_2 > C_3 + C_4$' indicates that the individual penalties of $C_1$ and $C_2$ both exceed the summed penalties of $C_3$ and $C_4$).

(16) *Weighting conditions for* $\tilde{V}X$

a. *Across word boundaries*
MAX[nas]($\alpha$), *$\tilde{V}R(\varphi) >$ *$\tilde{V}V(\varphi)$ + MAX($\alpha$)

b. *Across prefix boundaries*
MAX[nas]($\alpha$), *$\tilde{V}V(\omega_{max})$ + MAX($\alpha$) > *$\tilde{V}R(\omega_{max})$

c. *Stem-internally*
*$\tilde{V}V(\omega_{min})$ + MAX($\alpha$), *$\tilde{V}R(\omega_{min}) >$ MAX[nas]($\alpha$)

For structures in which output $\tilde{V}X$ sequences would span a word boundary, (a), the lowest level of scaling ($\varphi$) applies to the markedness constraints. Here, the penalties for MAX[nas]($\alpha$), violated by the input–output mapping /$\tilde{V}$nV/ → [VnV], and for *$\tilde{V}R(\varphi)$, violated by /$\tilde{V}$nV/ → [$\tilde{V}$nV], both exceed the combined penalties for *$\tilde{V}V(\varphi)$ + MAX($\alpha$), violated by the optimal mapping /$\tilde{V}$nV/ → [$\tilde{V}$V]. At the next level of scaling ($\omega_{max}$), (b), the combined penalty for *$\tilde{V}V(\omega_{max})$ + MAX($\alpha$) must now exceed that of *$\tilde{V}R(\omega_{max})$, making /$\tilde{V}$nV/ → [$\tilde{V}$nV] the optimal mapping. This indicates that *$\tilde{V}V$ needs to have a greater scaling factor than that of *$\tilde{V}R$. Finally, (c), the highest level of scaling ($\omega_{min}$) must cause the penalties of *$\tilde{V}R(\omega_{min})$ and the combined penalties of *$\tilde{V}V(\omega_{min})$ + MAX($\alpha$) to exceed that of MAX[nas]($\alpha$).

One set of activity values, constraint weights and scaling factors that satisfies these conditions is shown in (17). Each of the three prosodic contexts is illustrated using a regular prenominal adjective (a), a regular prefix (b) and a stem (c). Just as before, the output candidates in each tableau differ in the prosodic context in which $\tilde{V}X$ sequences surface, resulting in different penalties for the scalar markedness constraints. In each case, the input structure /$\tilde{V}$n/ has the same underlying activity value: the [nasal] feature of /$\tilde{V}$/ has 0.75 activity, and /n/ 0.25. In all tableaux, deletion of /n/ incurs a penalty for MAX of its base weight, 4, multiplied by the segment's underlying activity, $4 \times 0.25 = 1$, while loss of [nasal] incurs an MAX[nas] penalty of $15 \times 0.75 = 11.25$.

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| (17) | /miɲɔ̃$_{[nas]0.75}$ n$_{0.25}$ ɔbʒe/ | MAX $w$=4 | MAX [nas] $w$=15 | *ṼR $s$=3 $w$=5.5 | *ṼV $s$=7 $w$=4 | $\mathcal{H}$ |
|---|---|---|---|---|---|---|
| ☞ | i. (((miɲɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$ ((ɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.25 | | | $-1_{\varphi} = -1\times$ (4+(7×0)) | −5 |
| | ii. (((miɲɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$) ((nɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | $-1_{\varphi} = -1\times$ (5.5+(3×0)) | | −5.5 |
| | iii. (((miɲɔ)$_{\omega_{min}}$)$_{\omega_{max}}$) ((nɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | | | −11.25 |
| b. | /ɑ̃$_{[nas]0.75}$ n$_{0.25}$ ivʁe/ | | | | | |
| | i. ((ɑ̃(ivʁe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.25 | | | $-1_{\omega_{max}} = -1\times$ (4+(7×1)) | −12 |
| ☞ | ii. ((ɑ̃(nivʁe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | $-1_{\omega_{max}} = -1\times$ (5.5+(3×1)) | | −8.5 |
| | iii. ((a(nivʁe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | | | −11.25 |
| c. | /ɔ̃$_{[nas]0.75}$ n$_{0.25}$ œʁ/ | | | | | |
| | i. (((ɔ̃œʁ)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.25 | | | $-1_{\omega_{min}} = -1\times$ (4+(7×2)) | −19 |
| | ii. (((ɔ̃nœʁ)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | $-1_{\omega_{min}} = -1\times$ (5.5+(3×2)) | | −11.5 |
| ☞ | iii. (((ɔnœʁ)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | | | −11.25 |

As a segue to the analysis of exceptionality below, I consider the patterns that could arise from inputs associated with different underlying activity values, given the principle of Richness of the Base (Prince & Smolensky 1993). I begin by noting that there is no set of input activity values that allows a *ṼV sequence to surface within a $\omega_{max}$ or $\omega_{min}$, i.e. candidates (17b.i) and (c.i) are never optimal, consistent with the observation that word-internal ṼV sequences are unattested in French. This is because the scaled penalty of *ṼV exceeds that of *ṼR in these contexts, and because any candidate that deletes underlying /n/ also incurs a MAX violation.

We can also observe that changes to the input activities of /n/ and the [nasal] feature of /Ṽ/ result in outputs that resemble various exceptional patterns. First, consider hypothetical inputs with varying activities of [nasal] on /Ṽ/. For all increased activity values that cause the penalty of MAX[nas] to exceed *ṼR($\omega_{min}$), in this example any value greater than 0.766, stem-internal nasal vowels will not denasalise before sonorant consonants. While this is not the regular pattern, such inputs would generate the very limited but attested forms like [ʒɑ̃ʁ] and [ɑ̃nɥi] (cf. (1b)). Reductions in the activity value of [nasal] will cause underlying nasal vowels to denasalise before sonorants across larger prosodic boundaries. For example, if the MAX[nas] penalty falls below the *ṼR($\omega_{max}$) penalty (at values lower than 0.566), denasalisation will occur on prefix nasal

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vowels preceding sonorant-initial words, as observed for the exceptional prefix *in-*. If the MAX[nas] penalty falls below the *$\tilde{\text{V}}$R($\varphi$) penalty (values lower than 0.366), denasalisation before sonorants will take place across word boundaries, as observed for prenominal adjectives like *bon*. A final possible pattern arises from increases in the activity value of /n/. For any activity value that causes the combined MAX and *$\tilde{\text{V}}$V($\varphi$) penalties to exceed that of *$\tilde{\text{V}}$R($\varphi$), for instance /n/ = 0.5, the realisation of [n] becomes obligatory, in order to prevent $\tilde{\text{V}}$V sequences from surfacing across word boundaries. This resembles the patterning of both exceptional classes of prenominal adjectives. In the remainder of this section, I show that the overall French pattern is generated by such systematic differences in activity values between regular and exceptional items.

### 4.3 Prenominal adjectives and exceptionality

We can now demonstrate how the exceptions to the regular pattern can be generated from differences in underlying activity. Recall that the three classes of prenominal adjectives differ in whether they surface with linking [n] before vowel-initial words, and that the items that surface with [n] further vary in whether or not vowel nasalisation is maintained. This translates straightforwardly into a gradient symbolic analysis in terms of variation in the input activity values of the vowel's [nasal] feature and the nasal consonant's root node.

Again, we first consider in the abstract the conditions on weighting, scaling and activity that generate the exceptional prenominal adjective patterns. The weighting conditions that generate the regular pattern, discussed in §4.2, are repeated in (18a). The activity values of lexical items that generate the *commun objet* pattern (linking [n] with a nasal vowel) are represented by the variable $\beta$ in (b). The activity values of items that generate the *bon objet* pattern (linking [n] with a oral vowel) are represented by the variable $\gamma$ in (c).

(18) *Weighting conditions for prenominal adjective patterns*

a. *Regular* (*no liaison*)
MAX[nas]($\alpha$), *$\tilde{\text{V}}$R($\varphi$) > *$\tilde{\text{V}}$V($\varphi$) + MAX($\alpha$)

b. *Exceptional pattern 1* (*linking* [n] *with nasal vowel*)
MAX[nas]($\beta$), MAX($\beta$) + *$\tilde{\text{V}}$V($\varphi$) > *$\tilde{\text{V}}$R($\varphi$)

c. *Exceptional pattern 2* (*linking* [n] *with oral vowel*)
*$\tilde{\text{V}}$V($\varphi$) + MAX($\gamma$), *$\tilde{\text{V}}$R($\varphi$) > MAX[nas]($\gamma$)

The crucial observation is that changes in activity values, which affect the penalties of faithfulness constraints, can alter the relative harmony scores of different types of output candidates. Taking the regular pattern's weights and activity values as a starting point of comparison, exceptional pattern 1 is obtained by an increase in the underlying activity value of /n/, where the increased MAX penalty is sufficient to reverse the relative penalties of *$\tilde{\text{V}}$R($\varphi$) and MAX($\beta$) + *$\tilde{\text{V}}$V($\varphi$). Again taking the regular

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pattern as the starting point, exceptional pattern 2 is obtained by a decrease in the activity value of the vowel's [nasal] feature, where the proportional decrease in the MAX[nas] penalty is sufficient to make it lower than the penalties of both *ṼR($\varphi$) and *ṼV($\varphi$) + MAX($\gamma$).

Retaining the constraint weights and scaling factors from §4.2, the exceptional prenominal adjective patterns are generated by the activity values in the three tableaux in (19). All output candidates in each tableau have the prosodic representation in (7c); all violations of *ṼR and *ṼV incur the same penalties. Tableau (17a) above, showing the regular *mignon objet* pattern with no linking [n], is repeated as (19a). Exceptional pattern 1 in (19b) is generated by an increase in the activity value of /n/ from 0.25 to 0.5; the resulting increase in the penalty for MAX from $4 \times 0.25 = 1$ to $4 \times 0.5 = 2$ alters the harmony of the candidate that deletes underlying /n/ relative to the one that realises it in the output. Exceptional pattern 2 in (c) is generated by a decrease in the activity value of [nasal] from 0.75 to 0.3, proportionally reducing the penalty of MAX[nas]. It is important to note that the exact activity values chosen here are not crucial; there is a range of values that can be used to generate each of the three weighting conditions.

(19)

| | /miɲɔ̃$_{[nas]0.75}$ n$_{0.25}$ ɔbʒe/ | MAX<br>$w$=4 | MAX [nas]<br>$w$=15 | *ṼR<br>$s$=3<br>$w$=5.5 | *ṼV<br>$s$=7<br>$w$=4 | $\mathcal{H}$ |
|---|---|---|---|---|---|---|
| a. | ☞ i. (((miɲɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$ ((ɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.25 | | | $-1_{\varphi} = -1\times$ (4+(7×0)) | −5 |
| | ii. (((miɲɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$) ((nɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | $-1_{\varphi} = -1\times$ (5.5+(3×0)) | | −5.5 |
| | iii. (((miɲɔ)$_{\omega_{min}}$)$_{\omega_{max}}$) ((nɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | | | −11.25 |
| b. | /kɔmɛ̃$_{[nas]0.75}$ n$_{0.5}$ ɔbʒe/ | | | | | |
| | i. (((kɔmɛ̃)$_{\omega_{min}}$)$_{\omega_{max}}$ ((ɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | | | $-1_{\varphi} = -1\times$ (4+(7×0)) | −6 |
| | ☞ ii. (((kɔmɛ̃)$_{\omega_{min}}$)$_{\omega_{max}}$) ((nɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | $-1_{\varphi} = -1\times$ (5.5+(3×0)) | | −5.5 |
| | iii. (((kɔmy)$_{\omega_{min}}$)$_{\omega_{max}}$) ((nɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | | | −11.25 |
| c. | /bɔ̃$_{[nas]0.3}$ n$_{0.5}$ ɔbʒe/ | | | | | |
| | i. (((bɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$ ((ɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | | | $-1_{\varphi} = -1\times$ (4+(7×0)) | −6 |
| | ii. (((bɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$) ((nɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | $-1_{\varphi} = -1\times$ (5.5+(3×0)) | | −5.5 |
| | ☞ iii. (((bɔ)$_{\omega_{min}}$)$_{\omega_{max}}$) ((nɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.3 | | | −4.5 |

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In summary, we see that allowing lexical items to vary in the activity values assigned to underlying /ṽn/ allows us to predict the three patterns observed with prenominal adjectives before vowel-initial words. In the remainder of this section, I first extend the analysis to the regular and exceptional patterns of prefix allomorphy, before returning to the patterning of prenominal adjectives before consonant-initial words and in phrase-final position.

### 4.4 Prefix allomorphy and exceptionality

We return to the analysis of prefix allomorphy, first discussing the general patterning of prefixes with nasal vowels before turning to exceptional *in-*. In §4.2, I presented a set of weights, scaling factors and regular activity values to account for the surfacing of both input segments of prefix /ṽn/ before vowel-initial stems, as in [bjɛ̃n-ɛme]. However, (20) shows that they incorrectly predict the same output form to be optimal before sonorant-initial stems like [ʁœspe] *respect* 'respect'. This is because *ṼR is violated by the two candidates that retain a nasal vowel (regardless of whether /n/ is deleted), but deletion of /n/ incurs an additional MAX violation.

(20)

| /nɔ̃$_{[nas]0.75}$ n$_{0.25}$ ʁœspe/ | MAX<br>$w$=4 | MAX [nas]<br>$w$=15 | *ṼR<br>$s$=3<br>$w$=5.5 | *ṼV<br>$s$=7<br>$w$=4 | $\mathcal{H}$ |
|---|---|---|---|---|---|
| a. ((nɔ̃(ʁœspe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.25 | | $-1_{\varphi}$ = −1×(5.5+(3×1)) | | −9.5 |
| ☞ b. ((nɔ̃n(ʁœspe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | $-1_{\varphi}$ = −1×(5.5+(3×1)) | | −8.5 |
| c. ((nɔn(ʁœspe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | | | −11.25 |

This can be resolved by including a constraint against sequences of nasal consonants followed by another consonant, *NC, which independently accounts for the underattestation of NC sequences in Standard French (Schane 1968, Dell 1970). While in principle we may expect this constraint to be scaled like the other markedness constraints, there are no patterns that require a scalar constraint for this analysis.

(21) *Weighting conditions for regular prefix allomorphy*

a. /ṽn/ → [ṽn] *before vowel-initial stems*
*ṼV($\omega_{max}$) + MAX($\alpha$), MAX[nas]($\alpha$) > *ṼR($\omega_{max}$)

b. /ṽn/ → [ṽ] *before sonorant-initial stems*
*NC + MAX[nas]($\alpha$), *NC + *ṼR($\omega_{max}$) > MAX($\alpha$) + *ṼR($\omega_{max}$)

c. /ṽn/ → [ṽ] *before obstruent-initial stems*
*NC + MAX[nas]($\alpha$), *NC + *ṼR($\omega_{max}$) > MAX($\alpha$)

Given the existing weights, scaling factors and activity values, the inclusion of *NC with a weight of 3.5 ensures that /n/ is not realised before a

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sonorant consonant. As shown in (22), this correctly generates the patterning of regular prefixes before vowel-initial, sonorant-initial and obstruent-initial stems. The inclusion of *NC will again be necessary in selecting the correct output forms of the exceptional prefix *in-* and prenominal adjectives before sonorant-initial stems (see §4.5).

(22)

| | | MAX $w$=4 | MAX [nas] $w$=15 | *NC $w$=3.5 | *ṼR $s$=3 $w$=5.5 | *ṼV $s$=7 $w$=4 | $\mathcal{H}$ |
|---|---|---|---|---|---|---|---|
| a. | /nɔ̃$_{[nas]0.75}$ n$_{0.25}$ inisje/ | | | | | | |
| | i. ((nɔ̃(ini-sje)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.25 | | | | $-1_{\omega_{max}} = -1\times$ (4+(7×1)) | −12 |
| | ☞ ii. ((nɔ̃(nini-sje)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | | $-1_{\omega_{max}} = -1\times$ (5.5+(3×1)) | | −8.5 |
| | iii. ((nɔ(nini-sje)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | | | | −11.25 |
| b. | /nɔ̃$_{[nas]0.75}$ n$_{0.25}$ ʁœspe/ | | | | | | |
| | ☞ i. ((nɔ̃(ʁœ-spe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.25 | | | $-1_{\omega_{max}} = -1\times$ (5.5+(3×1)) | | −9.5 |
| | ii. ((nɔ̃(nʁœ-spe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | −1 | $-1_{\omega_{max}} = -1\times$ (5.5+(3×1)) | | −12 |
| | iii. ((nɔ(nʁœ-spe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | −1 | | | −14.75 |
| c. | /nɔ̃$_{[nas]0.75}$ n$_{0.25}$ fɔ̃ksjɔ̃/ | | | | | | |
| | ☞ i. ((nɔ̃(fɔ̃-ksjɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.25 | | | | | −1 |
| | ii. ((nɔ̃(nfɔ̃-ksjɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | −1 | $-1_{\omega_{max}} = -1\times$ (5.5+(3×1)) | | −12 |
| | iii. ((nɔ(nfɔ̃-ksjɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | −1 | | | −14.75 |

Again, we can see that changes to the underlying activity value of /Ṽn/ can result in the selection of different output candidates. This can be illustrated with attested dialectal variation involving the prefix *non-*, which is produced by some speakers with an oral vowel before vowel-initial words (Hannahs 1995), e.g. [nɔ̃-ʁœspe] *non-respect* 'non-respect', [nɔ̃-fɔ̃ksjɔ̃] *non-fonction* 'non-function', [nɔn-inisje] *non-initié* 'non-initiated'. Maintaining the same set of weights, this dialect is generated by a lower activity value of [nasal] for *non-*. For example, this pattern arises by lowering the activity value of [nasal] to 0.5.

We now turn to the exceptional patterning of *in-*, which surfaces as [in] before vowel-initial and glide-initial stems, [i] before other sonorant-initial stems and [ɛ̃] before obstruent-initial stems. This pattern is unique, in that

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it is the only prefix that has an output form that deletes both /n/ and the vowel's [nasal] feature. I thus consider four possible output mappings of /Ṽn/, given in (23): one that removes the nasal consonant, [Ṽ], one that realises both segments, [Ṽn], one that removes nasality on the vowel, [Vn], and one that removes both the consonant and vowel nasality, [V]. In addition, I give the markedness constraints violated depending on whether /Ṽn/ precedes a vowel (a), a sonorant consonant (b) or an obstruent (c). I will have to leave aside the question of why the oral vowel + /n/-deletion candidate /Ṽn/ → [V] only surfaces with *in-*, but not with prenominal adjectives.

| (23) | *Input–output mapping* | *Constraints violated* |
|---|---|---|
| a. | /Ṽ**n**V/ → [Ṽ**V**] | *ṼV, Max |
| | /Ṽ**n**V/ → [Ṽ**n**V] | *ṼR |
| | /Ṽ**n**V/ → [V**n**V] | Max[nas] |
| | /Ṽ**n**V/ → [**V**V] | Max[nas], Max |
| b. | /Ṽ**n**R/ → [Ṽ**R**] | *ṼR, Max |
| | /Ṽ**n**R/ → [Ṽ**n**R] | *NC, ṼR |
| | /Ṽ**n**R/ → [V**n**R] | *NC, Max[nas] |
| | /Ṽ**n**R/ → [**V**R] | Max[nas], Max |
| c. | /Ṽ**n**T/ → [Ṽ**T**] | Max |
| | /Ṽ**n**T/ → [Ṽ**n**T] | *NC, ṼR |
| | /Ṽ**n**T/ → [V**n**T] | *NC, Max[nas] |
| | /Ṽ**n**T/ → [**V**T] | Max[nas], Max |

From this, we can establish the weighting conditions that generate the *in-* pattern, with the three allomorphs [in], [i] and [ɛ̃]. The activity values needed to generate this pattern are represented by the variable $\delta$ in the weighting conditions given in (24).

(24) *Weighting conditions for exceptional patterning of the prefix* in-

a. /Ṽn/ → [Vn] *before vowel-initial stems*
$\text{Max}(\delta) + \text{Max[nas]}(\delta)$, $*\tilde{V}R(\omega_{max})$, $\text{Max}(\delta) + *\tilde{V}V > \text{Max[nas]}(\delta)$

b. /Ṽn/ → [V] *before sonorant-initial stems*
$\text{Max[nas]}(\delta) + *NC$, $*NC + *\tilde{V}R(\omega_{max})$, $\text{Max}(\delta) + *\tilde{V}R(\omega_{max}) > \text{Max}(\delta) + \text{Max[nas]}(\delta)$

c. /Ṽn/ → [Ṽ] *before obstruent-initial stems*
$*NC + *\tilde{V}R(\omega_{max})$, $*NC + \text{Max[nas]}(\delta)$, $\text{Max}(\delta) + \text{Max[nas]}(\delta) > \text{Max}(\delta)$

With the previously used constraint weights and scaling factors, one concrete set of activity values that generates this pattern is 0.5 for the vowel's [nasal] feature and 0.5 for /n/, as shown in (25).[12]

[12] While the presented analysis abstracts away from the differences in vowel height, the pattern can be accounted for by positing an underlying form with a high front nasal

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(25)

| | /ɛ̃$_{[nas]0.5}$ n$_{0.5}$ abil/ | MAX *w*=4 | MAX [nas] *w*=15 | *NC *w*=3.5 | *ṼR *s*=3 *w*=5.5 | *ṼV *s*=7 *w*=4 | $\mathcal{H}$ |
|---|---|---|---|---|---|---|---|
| a. | i. ((ɛ̃(a-bil)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | | | | $-1_{\varphi} = -1\times(4+(7\times0))$ | −13 |
| | ii. ((ɛ̃(na-bil)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | | $-1_{\omega_{max}} = -1\times(5.5+(3\times1))$ | | −8.5 |
| | ☞ iii. ((i(na-bil)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.5 | | | | −7.5 |
| | iv. ((i(a-bil)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | −0.5 | | | | −9.5 |
| b. | /ɛ̃$_{[nas]0.5}$ n$_{0.5}$ legal/ | | | | | | |
| | i. ((ɛ̃(le-gal)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | | | $-1_{\omega_{max}} = -1\times(5.5+(3\times1))$ | | −10.5 |
| | ii. ((ɛ̃(nle-gal)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | −1 | $-1_{\omega_{max}} = -1\times(5.5+(3\times1))$ | | −12 |
| | iii. ((i(nle-gal)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.5 | −1 | | | −11 |
| | ☞ iv. ((i(le-gal)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | −0.5 | | | | −9.5 |
| c. | /ɛ̃$_{[nas]0.5}$ n$_{0.5}$ pɔsibl/ | | | | | | |
| | ☞ i. ((ɛ̃(pɔ-sibl)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | | | | | −2 |
| | ii. ((ɛ̃(npɔ-sibl)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | −1 | $-1_{\omega_{max}} = -1\times(5.5+(3\times1))$ | | −12 |
| | iii. ((i(npɔ-sibl)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.5 | −1 | | | −11 |
| | iv. ((i(pɔ-sibl)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | −0.5 | | | | −9.5 |

## 4.5 Contexts without lexical exceptionality

Finally, the proposed grammar should account for the fact that adjectives with final Ṽ and final ṼN or VN alternants (e.g. [bɔ̃] ~ [bɔn], [kɔmɛ̃] ~ [kɔmɛ̃n]) always surface with final Ṽ in *φ*-final position or when they precede consonant-initial words. Turning first to *φ*-final prenominal adjectives, the most important difference between this case and those we have seen before is that it is not possible for the /Ṽn/ → [Ṽ] mapping to violate *ṼV in phrase-final position. The necessary weighting condition here is that the penalty for MAX needs to be lower than that for MAX[nas](*φ*) and *ṼR(*φ*), for both the regular and exceptional activity patterns, as shown in (26).

vowel /ĩ/ that does not surface faithfully, due to a highly weighted constraint against [ĩ] (cf. Schane 1968, Tranel 1974 for rule-based accounts in this vein).

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(26) *Weighting conditions to ensure no exceptionality in phrase-final position*
*$\tilde{\text{V}}$R($\varphi$), MAX[nas]($\alpha$) > MAX($\alpha$)
*$\tilde{\text{V}}$R($\varphi$), MAX[nas]($\beta$) > MAX($\beta$)
*$\tilde{\text{V}}$R($\varphi$), MAX[nas]($\gamma$) > MAX($\gamma$)

The activity values previously proposed are consistent with these conditions, as shown in (27) for phrase-final *commun* and *bon*.

(27) a.

| /…kɔmɛ̃$_{[nas]0.75}$ n$_{0.5}$/ | MAX<br>$w$=4 | MAX [nas]<br>$w$=15 | *NC<br>$w$=3.5 | *$\tilde{\text{V}}$R<br>$s$=3<br>$w$=5.5 | *$\tilde{\text{V}}$V<br>$s$=7<br>$w$=4 | $\mathcal{H}$ |
|---|---|---|---|---|---|---|
| ☞ i. …kɔmɛ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | | | | | −2 |
| ii. …kɔmɛ̃n)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | | $-1_{\varphi} = -1\times$ (5.5+(3×0)) | | −8.5 |
| iii. …kɔmyn)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | | | | −11.25 |
| b. /…bɔ̃$_{[nas]0.3}$ n$_{0.5}$/ | | | | | | |
| ☞ i. …bɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | | | | | −2 |
| ii. …bɔ̃n)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | | $-1_{\varphi} = -1\times$ (5.5+(3×0)) | | −8.5 |
| iii. …bɔn)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.3 | | | | −4.5 |

Finally, the analysis must ensure that all of these prenominal adjectives surface with final $\tilde{\text{V}}$ before all consonant-initial words, regardless of the sonority of the initial consonant. The tableaux in (28)–(30) examine the predicted patterning of each class of adjective before a sonorant-initial word [nunuʁ] *nounours* 'teddy bear' and obstruent-initial [gaʁsɔ̃] *garçon* 'boy', and show that the /$\tilde{\text{V}}$n/ → [$\tilde{\text{V}}$] mapping is optimal in these contexts, given the weights, scaling factors and activity values already established. $\tilde{\text{V}}$V is not violated in the tableaux in this subsection, and is omitted for reasons of space.

(28) a.

| /miɲɔ̃$_{[nas]0.75}$ n$_{0.25}$nunuʁ/ | MAX<br>$w$=4 | MAX [nas]<br>$w$=15 | *NC<br>$w$=3.5 | *$\tilde{\text{V}}$R<br>$s$=3<br>$w$=5.5 | $\mathcal{H}$ |
|---|---|---|---|---|---|
| ☞ i. (((miɲɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$ ((nunuʁ)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.25 | | | $-1_{\varphi} = -1\times$ (5.5+(3×0)) | −6.5 |
| ii. (((miɲɔ̃n)$_{\omega_{min}}$)$_{\omega_{max}}$ ((nunuʁ)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | −1 | $-1_{\omega_{min}} = -1\times$ (5.5+(3×2)) | −15 |
| iii. (((miɲɔn)$_{\omega_{min}}$)$_{\omega_{max}}$ ((nunuʁ)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | −1 | | −14.75 |
| b. /miɲɔ̃$_{[nas]0.75}$ n$_{0.25}$gaʁsɔ̃/ | | | | | |
| ☞ i. (((miɲɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$ ((gaʁsɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.25 | | | | −1 |
| ii. (((miɲɔ̃n)$_{\omega_{min}}$)$_{\omega_{max}}$ ((gaʁsɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | −1 | $-1_{\omega_{min}} = -1\times$ (5.5+(3×2)) | −15 |
| iii. (((miɲɔn)$_{\omega_{min}}$)$_{\omega_{max}}$ ((gaʁsɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | −1 | | −14.75 |

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(29)

| | /kɔmɛ̃$_{[nas]0.75}$ n$_{0.5}$nunuʁ/ | Max<br>$w$=4 | Max [nas]<br>$w$=15 | *NC<br>$w$=3.5 | *ṼR<br>$s$=3<br>$w$=5.5 | $\mathcal{H}$ |
|---|---|---|---|---|---|---|
| a. | ☞ i. (((kɔmɛ̃)$_{\omega_{min}}$)$_{\omega_{max}}$ ((nunuʁ)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | | | $-1_{\varphi} = -1\times$ (5.5+(3×0)) | −7.5 |
| | ii. (((kɔmɛ̃n)$_{\omega_{min}}$)$_{\omega_{max}}$ ((nunuʁ)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | −1 | $-1_{\omega_{min}} = -1\times$ (5.5+(3×2)) | −15 |
| | iii. (((kɔmyn)$_{\omega_{min}}$)$_{\omega_{max}}$ ((nunuʁ)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | −1 | | −14.75 |
| b. | /kɔmɛ̃$_{[nas]0.75}$ n$_{0.5}$gaʁsɔ̃/ | | | | | |
| | ☞ i. (((kɔmɛ̃)$_{\omega_{min}}$)$_{\omega_{max}}$ ((gaʁsɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | | | | −2 |
| | ii. (((kɔmɛ̃n)$_{\omega_{min}}$)$_{\omega_{max}}$ ((gaʁsɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | −1 | $-1_{\omega_{min}} = -1\times$ (5.5+(3×2)) | −15 |
| | iii. (((kɔmyn)$_{\omega_{min}}$)$_{\omega_{max}}$ ((gaʁsɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.75 | −1 | | −14.75 |

(30)

| | /bɔ̃$_{[nas]0.3}$ n$_{0.5}$nunuʁ/ | Max<br>$w$=4 | Max [nas]<br>$w$=15 | *NC<br>$w$=3.5 | *ṼR<br>$s$=3<br>$w$=5.5 | $\mathcal{H}$ |
|---|---|---|---|---|---|---|
| a. | ☞ i. (((bɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$ ((nunuʁ)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | | | $-1_{\varphi}$= −1×(5.5+(3×0)) | −7.5 |
| | ii. (((bɔ̃n)$_{\omega_{min}}$)$_{\omega_{max}}$ ((nunuʁ)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | −1 | $-1_{\omega_{min}}$ = −1×(5.5+(3×2)) | −15 |
| | iii. (((bɔ̃n)$_{\omega_{min}}$)$_{\omega_{max}}$ ((nunuʁ)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.3 | −1 | | −8 |
| b. | /bɔ̃$_{[nas]0.3}$ n$_{0.5}$gaʁsɔ̃/ | | | | | |
| | ☞ i. (((bɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$ ((gaʁsɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −0.5 | | | | −2 |
| | ii. (((bɔ̃n)$_{\omega_{min}}$)$_{\omega_{max}}$ ((gaʁsɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | −1 | $-1_{\omega_{min}}$ = −1×(5.5+(3×2)) | −15 |
| | iii. (((bɔ̃n)$_{\omega_{min}}$)$_{\omega_{max}}$ ((gaʁsɔ̃)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −0.3 | −1 | | −8 |

### 4.6 Summary

In this section, I have shown that the complex distribution of nasal vowels in Standard French, which is sensitive to both prosodic organisation and lexical exceptionality, can be generated in Gradient Harmonic Grammar with a uniform underlying form, /Ṽn/, for lexical items with a nasal vowel allomorph, and without lexical exceptionality in prosodic organisation. Regular and exceptional items differ only in the activity values associated with underlying nasal vowels. Proportional changes to faithfulness

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constraint penalties mimic the effects of scalar markedness constraints on total harmony, creating exceptional prosodification effects.

It is important to emphasise that although constraint scaling and gradient activity influence the calculation of harmony in similar ways, the functions of the two mechanisms in the grammar should not be conflated. On the assumption that outputs contain only quantised (discrete) structures with full activity, differences in input gradient activity do not affect the evaluation of markedness constraints. The relative ill-formedness of output structures that vary in their context within a hierarchy can only be accounted for by markedness scaling, which imposes relative harmony thresholds for the surfacing of marked structures in different contexts. While changes in input activity can result in the exceptional surfacing of marked forms, they cannot alter the relative thresholds determined by scalar markedness constraints.

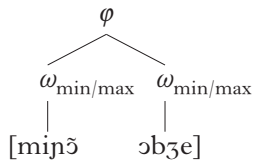
## 5 Alternative approaches

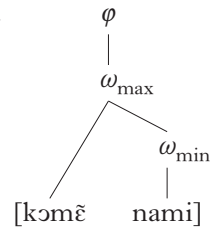
### 5.1 Prosodic prespecification

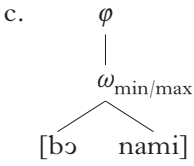
Broadly speaking, early work in generative phonology takes two basic approaches to the analysis of lexical exceptionality involving nasal vowels and nasal liaison (for more detailed overviews, see Tranel 1981, 1992 and Prunet 1986). The DIFFERENT RULES approach posits that the exceptional items are subject to either distinct rules or rule orderings. For instance, Schane (1968, 1973) proposes an underlying /Vn/ form for both the *bon* and *commun* classes of preverbal adjectives, but marks forms like *commun* as exceptions to a requirement that vowels are not nasalised before NV sequences. Dell (1970, 1973) similarly maintains underlying /Vn/ for both classes, but proposes that they are subject to different orderings of vowel nasalisation and resyllabification rules. Tranel (1981) posits a /Ṽ/ underlying form for both classes; only the *bon* class undergoes a minor rule of vowel denasalisation before NV sequences. Alternatively, the DIFFERENT UNDERLYING SEGMENTS approach claims that exceptional items have distinct underlying segments. For example, Selkirk (1972) maintains a single set of rules, but posits that *commun*-type items with non-alternating vowel quality have /V̆n/ underlying forms, in contrast to /Vn/ for the *bon* class.

The crucial drawback to both of these analyses is that the resemblance of each exceptional pattern to a regular pattern that applies in a smaller domain is purely accidental. Hsu (2014, 2015) presents a prosodic prespecification analysis that directly accounts for the relationship between the regular and exceptional patterns. In this approach, prenominal adjectives have three possible prosodic representations. Regular prenominal adjectives bear no prespecification, and are mapped to their own maximal prosodic word nodes in accordance with the default syntax–prosody mapping, as in (31a) (cf. (7c) above).

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(31) a. 


b. 


c. 


The first class of exceptions, prenominal adjectives that trigger the *commun ami* pattern of liaison with a retained nasal vowel, are prespecified as being dominated by the $\omega_{max}$ node of the following word, as in (31b). Note that this is the default prosodic organisation of prefixes. The second class of exceptions, those that trigger the *bon ami* pattern of liaison with an oral vowel, are prespecified as being contained within the $\omega_{min}$ node that dominates the following word, as in (c). These items are in essence phrased as if they are part of the same stem as the following word.

An advantage of this approach is that all three classes of prenominal adjectives have a uniform segmental underlying form in final position. For instance, the representation proposed for the final segment of *mignon*, /Ṽ/, can also be used for the *commun*- and *bon*-class exceptions, as in (32). The difference in their optimal output forms is generated by the regular pattern of constraint interaction that applies at the prespecified level of prosodic constituency.

(32) a.

| /kɔmɛ̃ ɔbʒe/ | MAX [nas] $w$=6 | DEP $w$=4 | *ṼR $s$=3 $w$=1 | *ṼV $s$=6 $w$=3 | $\mathcal{H}$ |
|---|---|---|---|---|---|
| i. ((kɔmɛ̃(ɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | | $-1_{\omega_{max}} = -1\times(3+(6\times1))$ | −9 |
| ☞ ii. ((kɔmɛ̃(nɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −1 | $-1_{\omega_{max}} = -1\times(1+(3\times1))$ | | −8 |
| iii. ((kɔmɛ(nɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −1 | −1 | | | −10 |

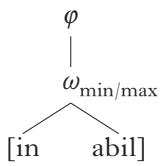
b.

| /bɔ̃ ɔbʒe/ | | | | | |
|---|---|---|---|---|---|
| i. (((bɔ̃ɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | | | $-1_{\omega_{min}} = -1\times(3+(6\times2))$ | −15 |
| ii. (((bɔ̃nɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | | −1 | $-1_{\omega_{min}} = -1\times(1+(3\times2))$ | | −11 |
| ☞ iii. (((bɔnɔbʒe)$_{\omega_{min}}$)$_{\omega_{max}}$)$_{\varphi}$ | −1 | −1 | | | −10 |

The exceptional allomorphy of the prefix *in*- is accounted for with the same prosodic prespecification of *bon*-class adjectives: *in*- is prespecified as being contained in the $\omega_{min}$ node of what it attaches to, as in (33).

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(33)




The allomorphic pattern of *in-* is sensitive to the sonority of the following consonant simply because the constraint against nasal vowels followed by sonorants is enforced within $\omega_{min}$; cf. (34).

(34)

| /ɛ̃ abil/ | MAX [nas] $w$=6 | DEP $w$=4 | *ṼR $s$=3 $w$=1 | *ṼV $s$=6 $w$=3 | $\mathcal{H}$ |
|---|---|---|---|---|---|
| a. $(((\tilde{\varepsilon}abil)_{\omega_{min}})_{\omega_{max}})_{\varphi}$ | | | | $-1_{\omega_{min}}$ = $-1\times(3+(6\times2))$ | −15 |
| b. $(((\tilde{\varepsilon}nabil)_{\omega_{min}})_{\omega_{max}})_{\varphi}$ | | −1 | $-1_{\omega_{min}}$ = $-1\times(1+(3\times2))$ | | −11 |
| ☞ c. $(((inabil)_{\omega_{min}})_{\omega_{max}})_{\varphi}$ | −1 | −1 | | | −10 |

In summary, the prosodic prespecification analysis and the Gradient Harmonic Grammar proposal differ in the locus of variation between regular and exceptional lexical items. The two approaches are compared in Table II. The prespecification analysis posits a uniform structure for all nasal vowels, but requires exceptional items (b), (c) and (e) to surface in an exceptional prosodic structure. In contrast, the gradient activity

| | morphosyntactic context | prosodic prespecification analysis | gradient activity analysis | activity value | |
|---|---|---|---|---|---|
| | | | | /[nas]/ | /n/ |
| a. | regular adjective (no liaison) | separate $\omega$ | separate $\omega$ | 0.75 | 0.25 |
| b. | *commun*-class adjective (liaison with nasal vowel) | adjunct to $\omega_{max}$ | | 0.75 | 0.5 |
| c. | *bon*-class adjective (liaison with oral vowel) | part of $\omega_{min}$ | | 0.3 | 0.5 |
| d. | regular prefix | adjunct to $\omega_{max}$ | adjunct to $\omega_{max}$ | 0.75 | 0.25 |
| e. | exceptional prefix | part of $\omega_{min}$ | | 0.5 | 0.5 |
| f. | stem | part of $\omega_{min}$ | part of $\omega_{min}$ | 0.75 | 0.25 |

*Table II*

Comparison of prosodic prespecification and gradient activity analyses.

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analysis assumes no item-specific variation in syntax–prosody mapping, but posits that lexical items can vary in the activity values associated with underlying final nasal vowels. All the regular patterns, (a), (d) and (f), can be generated by the same set of activity values, /[nasal]$_{0.75}$/ and /n$_{0.25}$/, while each exceptional pattern is associated with different activity values. It is worth repeating here that the exact values are not crucial, as long as they fall within ranges that satisfy the correct weighting conditions.[13]

Like the gradient activity analysis, prosodic prespecification captures the generalisation that each exceptional pattern resembles the regular pattern at a different level of prosodic constituency. However, it introduces additional complexity to the phonological grammar. First, it requires underlying representations to contain information about surface prosodic structure. This is unexpected, given the absence of evidence for prespecification of surface syllable structure, generally considered to be the lowest level of prosodic constituency (Hayes 1989).[14] Second, in order to enforce morpheme-specific syntax–prosody mismatches in a constraint-based theory, the grammar must include constraints that enforce morpheme-specific prespecifications. While these claims may ultimately receive independent justification from other phonological patterns, the analysis proposed in this paper obviates the need for these additions to the theory.

The prosodic prespecification analysis also faces an empirical difficulty, in that *in-* displays a mix of prefix-like and stem-like phonological properties. Tranel (1976) notes that for some speakers *in-* preceding a sonorant-initial stem is optionally realised with a geminate version of the stem-initial segment (e.g. [illegal], [immɔʁal]). Tranel shows that the optional degemination pattern is a general characteristic of Standard French prefixes, such as those in (35). Although some speakers permit stem-internal geminates in forms like [gʁammɛʁ] *grammaire* 'grammar', optional degemination seems to be a property specific to prefixes.

(35) [tʁɑ̃(s)saaʁjɛ̃] *transsaharien* 'trans-Saharan'
[di(s)sɑ̃blabl] *dissemblable* 'dissimilar'
[sy(ʁ)ʁealism] *surréalisme* 'Surrealism'

[13] Although the preceding analysis uses distinct activity values for the *commun*-class prenominal adjective pattern in (b) and the *in-* prefix pattern in (e), it is possible to generate both patterns using the same exceptional activity values. For instance, the *commun*-class prenominal adjective pattern can also be generated with activity values /[nasal]$_{0.55}$/ and /n$_{0.5}$/ (see tableaux (19b), (27a), (29)).

[14] It should be noted that syllables pattern differently from larger prosodic categories in crucial ways. For example, the internal organisation of syllables follows well-formedness principles which are distinct from those of larger categories (Nespor & Vogel 1986: 12–13). In addition, while prosodic constituents at the $\omega$ level and above generally correspond to syntactic constituents, syllables do not (Selkirk 2011). While it could turn out that the possibility of prespecification is simply another difference between these prosodic category types, I know of no principled reason to expect this distinction.

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If the optional degemination process reflects the basic prosodic organisation of prefixes, the prespecification analysis leads to a paradox, as *in-* is predicted to obey all prosody-sensitive generalisations that apply to stems but not to regular prefixes. Although I cannot pursue an analysis of the optional degemination pattern here, we can note that the gradient activity analysis allows for patterns in which exceptional activity causes a morpheme to behave exceptionally with respect to one prosody-sensitive restriction but not to another.

Finally, it is important to note that the gradient activity analysis resembles both the prosodic prespecification and different underlying segments approaches in that the difference between regular and exceptional patterns arises from the underlying representations associated with each class. However, the gradient activity analysis is superior on the following criteria. First, it allows a reduction in the types of structures that a learner needs to posit for underlying forms; the learner needs to posit only the structures that are necessary for the regular pattern, and acquire item- or class-specific differences in activity values. Second, systematic differences in activity values across lexical items can be plausibly grounded in quantifiable substantive factors that are known to influence lexical exceptionality, such as morpheme frequency, perceptual cue strength and informativity (Inkelas 2015, Smolensky & Goldrick 2016). On the other hand, it is difficult to envision how these factors should determine the different segmental representations or prespecified prosodic structures that have been used to account for lexical exceptions.

## 5.2 Lexical constraint indexation

In constraint-based grammars, morpheme-specific phonological patterns can also be captured by positing lexically indexed constraints (Pater 2000, 2009) that apply only to exceptional morphemes that possess a relevant index. For instance, the exceptional patterning of *commun-* and *bon*-class prenominal adjectives can be accounted for in a grammar with ranked constraints by including lexically indexed versions of *ṼV and *ṼR that outrank the constraints that prevent denasalisation and [n]-insertion with regular adjectives. While such an approach could generate the distribution of nasal vowels in French, the resemblance of exceptional patterns to regular patterns applying in smaller domains would again be entirely coincidental, as with the different rules and different underlying segments analyses.

It is worth noting that gradient activity analyses of exceptionality can generate both exceptional blocking and exceptional triggering patterns (cf. Pater 2009 on indexed constraints). Exceptional blocking arises in conditions where a markedness penalty exceeds a faithfulness penalty when the input contains items with regular activity, while exceptional items incur a greater faithfulness penalty that exceeds the markedness penalty. Exceptional triggering occurs if the faithfulness penalty at the regular activity value exceeds the markedness penalty, while exceptional items incur a faithfulness penalty less than the markedness penalty.

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To the best of my knowledge, any exceptional pattern that arises through a difference in gradient activity can also be generated in an indexed constraint analysis. Although the issue requires further study, we can note several ways in which the approaches differ in their restrictiveness. In the Gradient Harmonic Grammar proposal, each change in the underlying gradient activity value of a segment or feature affects the violations of *all and only* the faithfulness constraints that refer to that structure. On the other hand, in the indexed constraint analysis there is in principle no necessary connection between the indices assigned to a morpheme, that morpheme's phonological properties and the inventory of indexed constraints (see Smith 2018 for similar discussion). This leads to distinct predictions. The gradient activity analysis of exceptionality readily predicts the existence of patterns in which morphemes pattern exceptionally with respect to multiple processes or constraints referring to the same structure (see Zimmermann 2018 for one such case), while such clustering of exceptional processes can only be accidental in an indexed constraint approach. A conclusive evaluation of these broader predictions awaits further investigation.

## 6 Conclusion

This paper has shown that the adoption of scalar constraints and gradient symbolic structures in a weighted constraint grammar can provide novel analyses and explanations for challenging cases of lexical exceptionality. In Gradient Harmonic Grammar, apparent exceptional prosodification effects arise from the fact that contrasts in activity across lexical items can produce the same effects on output selection as constraint scaling. The existence of this type of interaction across apparently separate dimensions of structure is a key prediction of a weighted constraint grammar in which all constraint violations contribute to total harmony.

The proposal predicts other possible interactions between contrasts in gradient activity and prosodic constraint scaling. In the Standard French case, the activity values associated with exceptional lexical items have the same effect on total harmony as an increase in the prosodic scaling factor. As a result, exceptional items pattern as if they are contained within more prosodic categories than expected from the default syntax–prosody mapping. This approach also predicts the existence of patterns where exceptional items behave as if they are contained within *fewer* prosodic categories than expected. This type of pattern is described by Poser (1990) for Aoyagi prefixes in Standard Japanese, i.e. morphological prefixes whose tonal patterns suggest that they introduce a $\varphi$ boundary within morphological words. While Poser analyses these apparent cases of 'word-internal phrase boundary' as the result of prosodic prespecification, the proposal in this paper suggests that an alternative analysis without prespecification is possible. More broadly, it predicts similar interactions between lexical exceptionality and other patterns of context-

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sensitivity that can be modelled through constraint scaling, such as lexical category (Smith 2011) or degree of nativisation (Hsu & Jesney 2017, 2018).

This paper, like analyses by Smolensky & Goldrick (2016), Rosen (2016) and Zimmermann (2018), has shown that contrastive gradient activity can account for important cases of lexical exceptionality in phonology. Taken together, the results of these proposals allow for a more restrictive theory of possible phonological representations. Contrasts in the gradient activity value of segmentally identical underlying forms obviate the need to propose additional structures or prespecifications for each individual exceptional pattern.

Finally, the proposal invites a broader reconsideration of current approaches to syntax–prosody mapping parameters. For instance, the observation that the exponents of functional heads and phrases are often exempt from phonological generalisations that hold for exponents of lexical ones has been taken to indicate that functional heads and projections are ignored by syntax–prosody mapping constraints (Selkirk 1996, Truckenbrodt 1999). The present study suggests that some of these patterns can be explained in a syntax–prosody mapping that does not distinguish between lexical and functional projections, if the exponents of functional items differ systematically in their activity from the exponents of lexical ones, as potentially expected if activity values are grounded in factors like frequency or informativity. This follows recent work that similarly questions the need for mapping parameters to distinguish between lexical and functional categories (Elfner 2012, Tyler 2019), permitting a more restrictive theory of syntax–prosody correspondence.

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