1 Introduction
While vowel harmony systems generally involve identical values of particular features, such as height or advanced tongue root (ATR), being shared by all vowels within a certain domain, some vowel harmony languages have neutral vowels that do not harmonize with the shared feature. These neutral vowels can be either transparent or opaque to the harmony process, allowing or disallowing the harmony process to occur beyond it, respectively. How best to account for the behavior of these neutral segments remains an open question within the Optimality Theory framework (Prince and Smolensky, 2002). In this paper I present an analysis of neutral vowels in c’Lela, a Benue Congo language of Nigeria that exhibits vowel height harmony and both transparent and opaque neutral vowels. Of these, the transparent vowels are neutral only when they are word medial (Dettweiler, 2000). I show that the interaction of a violable NOGAP constraint with ALIGN and IDENT provides a straightforward account of this complex system. I further demonstrate how this account not only is more parsimonious than a previous analysis by Pulleyblank (2002) but also predicts the existence of patterns attested in other languages.

2 Data
c’Lela is the language of 90,000 Lélnà who reside in Kebbi State, Nigeria. The following data comes from the Zuru dialect and is shown as originally presented in Dettweiler (2000).

c’Lela has a symmetric vowel space as shown in figure 1. The figure shows which vowels act as high and low in the language.

![Vowel space of c’Lela (IPA).](image)

Figure 1: Vowel space of c’Lela (IPA).

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1 I would like to thank Eric Baković, Sharon Rose, Zoe Ziliak and the San Diego Phonology Interest Group for helpful discussions in developing the ideas in this paper. Any deficiencies in the current work are my own.
2.1 Height harmony

C’Lela exhibits vowel height harmony in a variety of configurations. Root harmony is illustrated in (1), where both vowels of a root are either high or low.

(1) a. *kumu* ‘get’
   b. *dwiri* ‘hyena’
   c. *kwesa* ‘show’
   d. *soma* ‘run’

Harmony will also cross morpheme boundaries, as demonstrated in (2) and (3) where the vowel of the first person possessive marker harmonizes with the vowel of the modified noun.

(2) *in-mi*
   mother+1poss
   ‘my mother.’

(3) *cet-me*
   father+1poss
   ‘my father.’

The data in (4) and (5) show that C’Lela object clitics agree in height with the preceding vowel.

(4) a. *im sipkə vu* ‘I grabbed you’
   b. *im batkə vo* ‘I released you’

(5) a. *a wahalla kum mi* ‘when trouble gets me’
   b. *a wahalla kum bɔ me* ‘when trouble really gets me’

The examples above reveal a straightforward height harmony system in which height features spread rightwards. The key data of interest, however, are the adjectival constructions of C’Lela.

2.2 Neutral vowels in adjectival construction height harmony

C’Lela is a language with a noun class system, and adjectives agree with the noun class of the noun they modify by means of a circumfix. Dettweiler (2000) identifies two forms of adjectival constructions; a ‘long form,’ that uses an additional -ne/ni marker, and a ‘short form,’ which does not. It is unclear what, if any, additional meaning this marker may carry. As such, I have left the gloss of this marker simply as *ne/ni*.

In the examples below COP is the copula, CM is a class marker and ‘a/i-class’ refers to the noun class of the word being modified. As can be seen in (6), the long form of the adjective is CM-adjective-CM-ne/ni. The word *van*, ‘knife,’ is in the ‘i’ noun class and so the CM circumfix in (6) is *i*. Note that the ‘long form’
morpheme surfaces as *ne*, matching the height of the root vowel but not the vowel *i*, which is transparent to the height harmony.

(6)  
\[
\begin{array}{lll}
  i & \text{van} & \text{*-rek-i-ne} \\
  \text{COP} & \text{knife(i-class)} & \text{CM-small-CM-ne}
\end{array}
\]

‘It’s a small knife.’

Taking the same long form construction from (6) and changing the adjective to *zis*, ‘long,’ we see that the ‘long form’ marker now surfaces as *ni*, not *ne*. The class of the modified noun remains the same. Only the adjectival root has changed, and the -ne/ni marker has changed to match the new adjectival root’s height.

(7)  
\[
\begin{array}{lll}
  i & \text{van} & \text{*-zis-i-ni} \\
  \text{COP} & \text{knife(i-class)} & \text{CM-long-CM-ni}
\end{array}
\]

‘It’s a long knife.’

Consider, however, the ‘short form’ of these adjectives, which does not have the -ne/ni marker. The example in (8) modifies an unnamed noun belonging to the i-class. Note that in the absence of the final -ne/ni, the form of the second part of the class marker has changed to match the height of the root adjective. The very same underlying /i/ of the class marker that was transparent to height harmony in (6) is no longer transparent in (8) now that it is in word final position.

(8)  
\[
\begin{array}{ll}
  i & \text{*-rek-e} \\
  \text{COP} & \text{CM-small-CM}
\end{array}
\]

‘It’s small (i-class).’

When the root adjective has a high vowel, however, the class marker for an i-class adjective remains *i* as it is already harmonized with the root, as shown in (9).

(9)  
\[
\begin{array}{ll}
  i & \text{*-zis-i} \\
  \text{COP} & \text{CM-long-CM}
\end{array}
\]

‘It’s long (i-class).’

The examples above indicate that *i* is transparent to height harmony word medially but participates in height harmony word finally, shown in (6) and (8), respectively. The same pattern holds for adjectival constructions modifying nouns of the u-class. Adjectives modifying nouns of the a-class, however, demonstrate opacity rather than transparency.

The example in (10) is similar to that in (6) except that the modified noun is now of the a-class. Thus the class marker circumfix on the adjective reflects this. Here the long form marker is *ne*, which matches the root adjective in height, as in (6).
Comparing (7) to (11) however, we see that when the root adjective has a high vowel and is modifying a noun of the a-class, the ‘long form’ marker does not change to harmonize with the root adjective. The low a is opaque to the height harmony process and blocks it.

The opacity of a does not alter based on word position, as demonstrated in the short forms in (12) and (13), below.

Thus, while transparency in c’Lela depends on position, opacity is invariant.

One might be tempted to describe the neutral behavior found above as an idiosyncratic effect of the class marking system, that is, assume it is circumscribed specifically to CM morphemes. One hypothesis could be that the language disfavors changing the class marker circumfix such that the prefix and the suffix differ. This explanation is untenable, however, considering the data in (14) and (15), which show similar behavior in the -ine/-ini morpheme.

The -ine/-ini morpheme marks the perfective in non-cannonical word order (c’Lela is SVO). It contains no class marking information but demonstrates the word internal transparency of i. This would be counterevidence to any analysis that attempted to derive the transparency of i in (6) from a constraint that enforced identity of the segments of the class marking circumfix.
It is most elegant and simple to assume that the pattern in (6) and (14) derive from the same process rather than to posit two separate ones. Thus, any analysis of c’Lela positional transparency cannot rely on the specific behaviors of class markers. Nor can an analysis rely on notions of feature incompatibility since the transparent segment is not always transparent; a blanket prohibition on i harmonizing with a low vowel would be too strong because it would rule out cases such as (8) where the otherwise transparent vowel participates in height harmony when word final.

To summarize the problem, any descriptively adequate analysis must account for both opacity and transparency to the same feature in the same language, and must further account for the positional nature of that transparency. As the transparent vowels are also capable of participating in harmony, a theoretically elegant analysis will additionally avoid depending on strategies of feature incompatibility.

3 Analysis
The analysis below crucially relies on the violability of the constraint NOGAP, as it is from the interaction of NOGAP with ALIGN and IDENT that the complex features of the c’Lela vowel harmony system will arise. This approach is taken with the full realization that some researchers have rejected NOGAP on the basis of the phonology/phonetics interface and/or as too powerful of a constraint, claiming that it overpredicts data (Browman and Goldstein, 1986; Gafos, 1996; Walker, 1998). I do not intend to give a full defense of its use here, but rather, I seek to demonstrate that an ALIGN/NOGAP analysis exactly predicts the existence of systems like c’Lela. Further, I will show how this analysis can be straightforwardly applied to other languages. Opponents of the use of NOGAP may weigh their reservations against the benefits gained from the analysis.

Further assumptions for the current analysis include that the root adjective has the same underlying form as it surfaces with, as does the class marker circumfix. I assume that the -ne/ni ‘long form’ marker is underspecified, represented below as /nI/, indicating a front vowel unspecified for height.

While it is not shown for simplicity, I also assume an autosegmental system in which a single height feature can be shared across multiple segments. However, as the data indicate that harmony proceeds from the root and that the word initial class marker does not influence or interact with the remainder of the word, I assume that an undominated constraint prevents the alignment or sharing of features from the word initial class marker rightwards onto the root. Thus any potential violations incurred by the word initial class marker are ignored.2 There may be principled reasons for this behavior, perhaps to be found in the nature of the circumfix; if the second part of the class marker interacts with its surroundings, there may be a prohibition from the first part from doing so as well.

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2 This strategy is also employed in the analysis of Pulleyblank (2002), who does not include these word initial class markers in the tableaux presented (see (24), below).
This explanation is purely speculative at this point, however, and I leave the question to future research.

With these assumptions articulated, (16) defines the five constraints used in the current analysis.

\[
\text{(16) a. NOGAP: } * F
\]

\[
\sigma \sigma \sigma
\]

A single feature may not be assigned to multiple syllables\(^3\) without also being assigned to each intervening syllable.

b. IDENT LO: Every [lo] in the input must be [lo] in the output
c. IDENT HI: Every [hi] in the input must be [hi] in the output
d. ALIGN HI R: Align every [hi] feature to the right edge of the word
e. ALIGN LO R: Align every [lo] feature to the right edge of the word\(^4\)

### 3.1 Opacity

The simplest data to account for in the c’Lela vowel harmony system is the opacity of\(a\) as it is not sensitive to word position. Opacity is obtained straightforwardly by ranking \{ALIGN LO R, NOGAP, IDENT LO\} >> ALIGN HI R. The tableau in (17) demonstrates this ranking applied to a root adjective with a high vowel that modifies an a-class noun. In order for the attested candidate to be selected, ALIGN HI R may not dominate any of the other constraints.

<table>
<thead>
<tr>
<th>a-zis-a-nI ‘long(^{(a\text{-class})})’</th>
<th>ALIGN LO R</th>
<th>NOGAP</th>
<th>IDENT LO</th>
<th>ALIGN HI R</th>
</tr>
</thead>
<tbody>
<tr>
<td>a-zis-a-ne</td>
<td></td>
<td></td>
<td>**</td>
<td></td>
</tr>
<tr>
<td>a-zis-i-ni</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a-zis-a-ni</td>
<td>*!</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This ranking also accounts for root adjectives with a low vowel that modifies an a-class noun, as shown in (18).

<table>
<thead>
<tr>
<th>a-rek-a-nI ‘small(^{(a\text{-class})})’</th>
<th>ALIGN LO R</th>
<th>NOGAP</th>
<th>IDENT LO</th>
<th>ALIGN HI R</th>
</tr>
</thead>
<tbody>
<tr>
<td>a-rek-a-ne</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a-rek-i-ni</td>
<td><em>!</em></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>a-rek-a-ni</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^3\) In the tableaux that follow, violations are counted for each vowel skipped.
\(^4\) Note that in the tableaux presented here, no candidate is crucially ruled out based on a second violation of ALIGN; thus the current analysis is compatible with either a gradient or non-gradient view of ALIGN.
3.2 Transparency
Basic word medial transparency requires the introduction of the IDENT Hi constraint, which, along with ALIGN LO R, must be ranked above NOGAP. Note that the use of two separate ALIGN constraints, one for a [hi] feature and one for a [lo] feature allow each to have its own relationship with respect to NOGAP. Specifically, since ALIGN HI R is dominated by NOGAP, the spreading of the [hi] feature may not ‘pass over’ the opaque a. However, since ALIGN LO R dominates NOGAP, the [lo] feature is able to ‘pass over’ the transparent i, as shown in (19).

The above tableau shows a root adjective with a low vowel modifying an i-class noun. As the alternate candidates that either alter the class marker, violating IDENT Hi, or spread a [hi] feature from the CM rather than the [lo] feature from the root are worse than the NOGAP violation, the candidate with transparency is optimal. This ranking also accounts for root adjectives with a high vowel that modify i-class nouns without amendment, as shown in (20).

3.3 Positional transparency
The crucial case of c’Lela positional transparency, where the very same vowels that are transparent to height harmony word medially are found to participate in height harmony word finally, falls out of the analysis thus far by simply ranking ALIGN LO R >> IDENT Hi.

The tableau in (21) shows the short form adjective with a low vowel modifying an i-class noun. Because it is worse to not align the [lo] feature rightwards to the end of the word than to maintain the identity of the underlying i, the normally transparent nature of i is overridden. The interaction of ALIGN LO R and IDENT Hi results in two patterns: medial transparency when there is no conflict between the constraints, as in (19), and word final participation in harmony in (21) as ALIGN LO R wins the conflict between these two constraints.
As in the examples above, the ranking in (21) also trivially accounts for the data when the root adjective with a high vowel is in the short form modifying a noun of the i-class. This is shown in (22).

### 3.4 Summary

The ALIGN/NoGAP analysis presented here is able to straightforwardly account for both opacity and transparency in the same language and capture the position specific phenomenon of c’Lela transparency while making use of constraints that do not need to reference the internal structure of the word. Only the ALIGN constraints make reference to any word position, as they must by definition, but they both refer only to the word end. There is no need for referencing the root or stem in order to show positional context sensitivity of the transparent vowels. Rather than rely on tightly targeted, stipulative constraints, the current analysis benefits from the interactions of simply and broadly defined constraints, which is beneficial in cross-linguistic application, as will be shown in section 5, and is a reason to favor it over Pulleyblank’s (2002) analysis.

### 4 Previous analysis

Pulleyblank (2002) analyzed the c’Lela data presented above, but unlike the current analysis, Pulleyblank avoided the use of NoGAP and ALIGN and instead relied on disallowing disharmony, following Smolensky (1993). The basic idea of this approach is that, for vocalic features, the grammar should not have subsequent (ignoring consonants) alternating values of features. Constraints thus take the form shown in (23), adapted from Pulleyblank (2002).

(23) a. *[…HI-C0-NONHI…]Root: Within a root, a high vowel may not be followed by a nonhigh vowel (ignoring consonants) (*[…I-C0-E…]Re)
   b. *[…NONHI-∞-HI]Word: A word-final high vowel may not be preceded by a nonhigh vowel (*E-∞-I]Wd) (Pulleyblank’s (27))

The constraint in (23a) specifies that within a root domain, a high vowel may not be followed by a nonhigh vowel as this would be disharmonious. There may
be any number of intervening consonants between the two vowels in question. In (23b), the constraint prohibits a high vowel that is word final from following a nonhigh vowel with any number of intervening consonants or vowels of any height.

Note then, that Pulleyblank’s account needs to specify a root domain and a word domain in (23a) and (23b), respectively, even though Pulleyblank criticizes alignment approaches for “equating featural domains with prosodic or morphosyntactic domains” (Pulleyblank, 2002). Specific positions within these domains are also stipulated, with (23a) applying anywhere within a root domain and (23b) applying only finally in the word domain. Additionally, each constraint in (23) must further specify a distance over which it can operate. (23a) is a ‘medium range’ constraint in that a nonhigh vowel cannot follow a high vowel, ignoring possible intermediate consonants, but not vowels, while (23b) on the other hand is a ‘long distance’ constraint where a high vowel cannot follow a nonhigh vowel, ignoring intervening consonants and vowels.

Compare this to the current ALIGN/NOGAP analysis which consistently makes reference to only one word position, namely the right word edge, and which has no need to stipulate any notion of distance or intervening material. Pulleyblank (2002) derives the c’Lela positional transparency effect directly from the constraint in (23b), which is simply a stipulation that a word may not end in a high vowel if there was a low vowel anywhere preceding it in the word. This is demonstrated in (24), adapted from Pulleyblank’s (34) (2002). Pulleyblank does not include the word initial class marker in the tableau, and rather than the i-class being used as in the examples above, the u-class is used.

<table>
<thead>
<tr>
<th>(24)</th>
<th>rek-u-ni</th>
<th>*…[C-0-E]…</th>
<th>[E-∞-I]</th>
<th>[MAX]RT</th>
<th>[MAX]WD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>‘long(u-class)’</td>
<td></td>
<td></td>
<td>NONHI</td>
<td>Hi</td>
</tr>
<tr>
<td>![rek]Ri u-ni</td>
<td>![rek]Ri u-ne</td>
<td>![rek]Ri o-ne</td>
<td>![rik]Ri u-ni</td>
<td>![rek]Ri u</td>
<td>![rek]Ri o</td>
</tr>
</tbody>
</table>

Pulleyblank does not provide a tableau for the non-transparent word final case, but we can reconstruct how this would be accounted for, shown in (25). Here it is apparent that the only constraint responsible for the attested outcome is the very specifically targeted constraint from (23b).

<table>
<thead>
<tr>
<th>(25)</th>
<th>rek-u</th>
<th>*…[C-0-E]…</th>
<th>[E-∞-I]</th>
<th>[MAX]RT</th>
<th>[MAX]WD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>‘long(u-class)’</td>
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<td>Hi</td>
</tr>
<tr>
<td>![rek]Ri u</td>
<td>![rek]Ri o</td>
<td></td>
<td>![rek]Ri u</td>
<td>![rek]Ri o</td>
<td></td>
</tr>
</tbody>
</table>
While Pulleyblank’s (2002) analysis descriptively accounts for the data, I argue that it is not an improvement over the ALIGN/NoGAP account, and in fact, it should be dispreferred on the grounds of parsimony.

5 Application to other languages

An additional benefit the current analysis has over an analysis with more targeted, stipulative, constraints is that it can more straightforwardly be generalized to harmonic patterns in other languages. Below I sketch how ALIGN/NoGAP constraints can be applied to Wolof ATR harmony, which also has both transparency and opacity. Following this I demonstrate how these constraints are able to generate all and only the attested patterns of variation in Canadian French ATR harmony.

5.1 Wolof

Wolof demonstrates rightward ATR harmony from the root with both opacity and transparency in the harmony system (Ka, 1988; Pulleyblank, 1996). While the analysis for c’Lela generates positional transparency based on the strict domination of ALIGN LO R over IDENT Hi, absence of this domination generates ‘standard’ transparency. This predicts the data reported for Wolof ATR harmony. Only a preliminary sketch is possible due to space limitations, but as the current c’Lela analysis has shown, the use of ALIGN and NoGAP is well suited for analysis of languages with both transparency and opacity.

High vowels in Wolof, such as i, are transparent to ATR harmony. This is shown in the optimal candidate in (26) where i is transparent to the process that results in the remainder of the vowels being [-ATR]. This is obtained by IDENT +ATR and ALIGN -ATR R dominating NoGAP and ALIGN +ATR R. Examples are adapted from Ka (1988).

(26)\[\begin{array}{|c|c|c|c|c|c|}
\hline
\text{t\text{\`e}kki-\text{\text{\`e}n} } & \text{IDENT +ATR} & \text{IDENT -ATR} & \text{ALIGN -ATR R} & \text{NoGAP} & \text{ALIGN +ATR R} \\
\hline
\text{\text{\`e}n} & \text{\text{\`e}n} & \text{\text{\`e}n} & \text{\text{\`e}n} & \text{\text{\`e}n} & \text{\text{\`e}n} \\
\hline
\text{tekki-\text{\text{\`e}n}} & \text{\text{\`e}n} & \text{\text{\`e}n} & \text{\text{\`e}n} & \text{\text{\`e}n} & \text{\text{\`e}n} \\
\text{tekki-\text{\text{\`e}n}} & \text{\text{\`e}n} & \text{\text{\`e}n} & \text{\text{\`e}n} & \text{\text{\`e}n} & \text{\text{\`e}n} \\
\hline
\end{array}\]

The [-ATR] a in Wolof, on the other hand, is opaque to ATR harmony. In the optimal candidate in (27), spreading of the [+ATR] feature is prevented by a. This is accomplished in (27) by IDENT -ATR and ALIGN -ATR R dominating NoGAP and ALIGN +ATR R.

\[\text{t\text{\`e}kki-\text{\text{\`e}n}}\]

The E in (26) and (27) represent vowels unspecified for ATR. In Wolof, the following vowels are [+ATR]: i, e, è and a. All others are [-ATR].
The straightforward application of an ALIGN/NoGAP analysis to Wolof ATR harmony serves as an additional example of how this approach can account for both transparency and opacity in the same language. Another benefit of such an approach, namely the ability to elegantly account for positional effects, is demonstrated in its application to another ATR harmony system, namely Canadian French.

5.2 Canadian French

Poliquin (2006) reports on a pattern of variation in Canadian French with respect to ATR harmony and denies that any constraint-based approach is sufficient to account for the attested patterns. The four attested patterns are shown in (28) with the word for 'similitude.' [-ATR] harmony, when present, spreads leftwards from the right word edge. In the examples that follow /r and /l are [-ATR].

Lack of harmony is shown in (28a) while (28b) shows across the board (ATB) harmony where every vowel is [-ATR]. The more complex cases are (28c), labeled ‘non-local harmony’ by Poliquin, in which only the initial vowel harmonizes and (28d) labeled ‘adjacent non-iterative’ in which only the vowel closest to the source of [-ATR] harmony participates, but no others do. Also included in (28) are the rankings that, using an ALIGN/NoGAP analysis, I propose will generate them, presented in the tableaux below.

<table>
<thead>
<tr>
<th>(27)</th>
<th><code>door-aat-E</code></th>
<th>IDENT +ATR</th>
<th>IDENT -ATR</th>
<th>ALIGN -ATR R</th>
<th>NoGAP</th>
<th>ALIGN +ATR R</th>
</tr>
</thead>
<tbody>
<tr>
<td>服务中心</td>
<td><code>door-aat-ɛ</code></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td><code>door-ɛɛt-ɛ</code></td>
<td></td>
<td>******</td>
<td>******</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>door-ɛɛt-ɛ</code></td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><code>door-aat-ɛ</code></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>***</td>
<td></td>
</tr>
</tbody>
</table>

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(28) Attested patterns ‘similitude’ ALIGN/NoGAP ranking
a. No harmony: `si.mi.li.ɛr` IDENT >> ALIGN
b. ATB harmony: `st.mɛ.lɛt` NoGAP >> ALIGN >> IDENT
c. Non-local harmony: `st.mɛ.lɛt` ALIGN >> IDENT >> NoGAP
d. Adjacent non-iterative: `si.mi.lɛt` NoGAP >> ALIGN >> IDENT

Equally important to the discussion of variation of Canadian French ATR harmony are those patterns that are not attested, shown in (29). Patterns not attested include: all but the initial vowel participating (29e), an ‘every-other’

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6 Alternatively, this candidate can be realized with a violation of NoGAP.
pattern (29f), all but the closest vowel to the source of harmony participating (29g) and all but a non-adjacent and non-initial vowel participating (29h).

(29) Unattested patterns: (from Poliquin, 2006)
  e. local 2 iterations: *si.ml.i.t'ɣd
  f. non-local, non-initial: *si.ml.i.t'ɣd
  g. non-local, non-initial iterative: *si.ml.i.t'ɣd
  h. non-local and adjacent non-iterative: *si.ml.i.t'ɣd

As has been shown above, the ALIGN/NOGAP analysis of c’Lela is able to derive process sensitivity to word position by means of the interaction of broad, general constraints. Assuming that variation can properly be captured by alternate rankings of constraints, the interacting constraints of the c’Lela analysis can be straightforwardly applied to account for all and only the attested patterns in the variation of Canadian French ATR harmony with only one additional point of variation.

Focusing first on the pattern in (28d) where it is only the adjacent vowel that participates in ATR harmony, one could relate this pattern to either that of (28b) or (28c). In the ATB harmony of (28b), the [-ATR] feature aligns all the way to the left word edge. The same process could be responsible for (28d), except that the alignment is limited to a smaller unit, the foot. Thus one way to account for this variation is in whether the [-ATR] harmony aligns to the word or foot edge. Another option is that the status of the foot in Canadian French is variable because it is unclear and/or not salient. In this case, alignment could always occur to the foot, but the foot may either be binary or unbounded. While both options would result in the same attested surface patterns, I will present only the former for reasons of clarity. I leave it to future research to decide between them.

Just as the adjacent pattern (28d) can be related to the ATB pattern, so too can it be related to (28c) in which only the word initial vowel participates. As above, the same alignment process can be driving the pattern, but the difference is in the target of that alignment; either word or foot initial, or two different footing options. As such, two possible derivations of (28d) will be presented below.

In the tableaux that follow I present the rankings that will result in the attested patterns. The last four candidates of each tableau are the unattested patterns, which are never selected as optimal. I leave it as an exercise for the reader to see that no reordering of the three constraints used will result in an unattested form being chosen as optimal. The no harmony pattern (28a) is easily captured by having IDENT [+ATR] undominated, so a tableau is not shown.

The tableau in (30) corresponds to the ATB harmony pattern in (28a). If the alignment constraint is altered to align to the foot rather than word, then the adjacent non-iterative pattern in (28d) will be optimal. This is shown in (31).
The non-local harmony of (28c) is optimal under the ranking shown in (32). If the alignment is changed to the foot, (28d) will again be optimal, as in (33).

<table>
<thead>
<tr>
<th>(30)</th>
<th>si.mi.li.tʰyd</th>
<th>NOGAP</th>
<th>ALIGN -ATRWORD L</th>
<th>IDENT +ATR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>si.mi.li.tʰyd</td>
<td><em>!</em></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>st.mi.li.tʰyd</td>
<td><em>!</em>*</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>st.mi.li.tʰyd</td>
<td><em>!</em>*</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(31)</th>
<th>si.mi.li.tʰyd</th>
<th>NOGAP</th>
<th>ALIGN -ATRFOOT L</th>
<th>IDENT +ATR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>si.mi.li.tʰyd</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>st.mi.li.tʰyd</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>st.mi.li.tʰyd</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>st.mi.li.tʰyd</td>
<td>*!</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

The non-local harmony of (28c) is optimal under the ranking shown in (32). If the alignment is changed to the foot, (28d) will again be optimal, as in (33).

<table>
<thead>
<tr>
<th>(32)</th>
<th>si.mi.li.tʰyd</th>
<th>ALIGN -ATRWORD L</th>
<th>IDENT +ATR</th>
<th>NOGAP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>si.mi.li.tʰyd</td>
<td><em>!</em></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>st.mi.li.tʰyd</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>st.mi.li.tʰyd</td>
<td></td>
<td><em>!</em>*</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>si.mi.li.tʰyd</td>
<td></td>
<td><em>!</em></td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>st.mi.li.tʰyd</td>
<td></td>
<td><em>!</em>*</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>si.mi.li.tʰyd</td>
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<td><em>!</em></td>
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<td><em>!</em>*</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>st.mi.li.tʰyd</td>
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<td><em>!</em></td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>st.mi.li.tʰyd</td>
<td></td>
<td><em>!</em></td>
<td>*</td>
</tr>
</tbody>
</table>
While the Wolof examples show how the ALIGN/NoGAP analysis can easily handle languages with both opacity and transparency, the extension of the analysis to the Canadian French data shows how the interaction of these constraints predicts and accounts for complex word position effects. Thus, rather than being beyond the capability of constraint based analyses, as Polaquin (2006) suggests, or being too powerful as has been previously suggested, the types of constraints used to account for c’Lela positional transparency actually predict the Canadian French data by generating all and only the attested patterns.

6 Conclusion
I have presented an analysis of the complex system of height harmony in c’Lela, accounting for the vowels neutral to this process, both opaque and transparent, the latter being dependent on word position. Using a combination of ALIGN constraints and NoGAP, I have accounted for the data more parsimoniously than a previous analysis in that these constraints do not need to reference multiple domains, edges and distances. The simplicity of the constraints allows them to be easily applied to the harmony patterns of other languages such as Wolof ATR harmony and variation in Canadian French ATR harmony.

References