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Alignment constraints

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Abstract Alignment is among the principal constraint families found in Optimality Theoretic approaches to phonology. Much of the discussion in the recent literature (Eisner 1997; Kager 2001, 2005; McCarthy 2003; Buckley 2009), however, has focused on difficulties arising within the standard Generalized Alignment (McCarthy and Prince 1993a, 1993b) framework. In this article, I propose a definition of alignment constraints that differs from the Generalized Alignment definition in several fundamental respects. The most important, perhaps, is that the proposed approach does not require alignment directly. It encourages alignment indirectly by prohibiting specific configurations of misalignment (Ellison 1995; Zoll 1996; McCarthy 2003). Additional differences include an alternative to gradient evaluation for deriving distance-sensitive violation assessment and the crucial use of both distance-sensitive and distance-insensitive assessment to produce basic directionality effects. The article draws on examples from metrical stress theory, the area in which alignment constraints have been most heavily employed, to demonstrate that the proposed definition produces the same essential directionality effects as the Generalized Alignment definition while avoiding its most significant shortcomings.

Keywords Alignment · Optimality theory · Harmonic serialism

1 Preliminaries

The Generalized Alignment (GA; McCarthy and Prince 1993a) definition of alignment constraints has played a key role in Optimality Theoretic (Prince and Smolen-

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sky 1993) approaches to phonology. Perhaps more than any other type, phonological analyses have relied on GA constraints to influence the positions of phonological and morphological structures. This is especially true in metrical stress theory, where analyses have employed GA constraints to position feet (McCarthy and Prince 1993a; Kager 1994; Crowhurst and Hewitt 1995; Alber 2005), head syllables of feet (Hyde 2001, 2002), entries on the metrical grid (Gordon 2002), and other key structures. Beyond metrical stress theory, phonological analyses have employed alignment constraints to influence the positions of features, tones, affixes, and other objects (McCarthy and Prince 1993a, 1993b, 1994; Cole and Kisseberth 1995; Akinlabi 1996; Itô and Mester 1994; Parker 1997; Orgun and Sprouse 1999; Piñeros 2001). These are just a fraction of the possible citations.

Despite the central role that GA constraints have played in OT phonology, much of the discussion in the recent literature has focused on their deficiencies. The criticisms center on one particular characteristic: *distance-sensitivity*. GA constraints do not merely distinguish alignment from misalignment; they distinguish between different degrees of misalignment, preferring configurations where a shorter distance intervenes between misaligned edges to configurations where a greater distance intervenes. The criticisms rest on two claims: first, that distance-sensitive alignment is unnecessary (Kager 2001; McCarthy 2003; Buckley 2009) and, second, that distance-sensitive GA constraints yield pathological predictions (Eisner 1997; Buckley 2009).

Though the two claims present a substantial problem for the theory, the most difficult aspect does not arise primarily due to their particular content. It arises because they are not uniformly factual. If both claims were false, we could simply keep the GA formulation, and it could continue to play its central role. If both claims were true, we could simply abandon GA and turn to the distance-insensitive alternatives suggested by its critics. As we shall see, however, the first claim is false and the second true. Distance-sensitive alignment actually is a necessary component of the theory, but distance-sensitive GA constraints can often yield pathological predictions.

The problem requires a more inventive solution than either simply abandoning or retaining GA constraints. It requires a new definition of alignment constraints that preserves distance-sensitive evaluation but that also manages to avoid the pathological predictions associated with distance-sensitivity under GA. The purpose of this paper is to provide just such a definition. Before introducing the proposed formulation in Sect. 2, however, it will be helpful to briefly consider the characteristics of GA constraints that result in the pathologies identified by Eisner. As we shall see, distance-sensitivity is not the only characteristic required for the problematic predictions to emerge. It is also necessary that prohibitions against misalignment be *relation-general*: that they prohibit misalignment regardless of the configuration in which the misaligned categories occur. Section 1.1 discusses how relation-generality and distance-sensitivity both emerge under the GA formulation of alignment. Section 1.2 shows how they combine to produce pathological predictions.

1.1 Two characteristics of generalized alignment

The GA definition of alignment constraints involves five arguments. The first four specify the category edges being aligned: *ACat1* and *ACat2* are the aligned categories, and *Edge1* and *Edge2* are the relevant edges. As the familiar formulation in (1) states, the *Edge1* of every *ACat1* must coincide with the *Edge2* of some *ACat2*. The fifth argument, *SCat*, specifies the 'separator' category, the category whose intervention between the relevant edges constitutes misalignment.[1] When misalignment occurs, a violation mark is assessed for each instance of *SCat* that intervenes between the misaligned edges.

(1) Generalized Alignment
ALIGN (*ACat1*, *Edge1*, *ACat2*, *Edge2*, *SCat*)
The *Edge1* of every *ACat1* coincides with the *Edge2* of some *ACat2*. Assess a violation mark for every *SCat* that intervenes between edges that fail to coincide.

Though GA has several significant characteristics, the two that concern us here are relation-generality and distance-sensitivity. The former derives from the way in which GA defines alignment and the alignment requirement, the latter from the way in which GA assesses violation marks. For concreteness, relation-generality and distance sensitivity are exemplified below using ALIGN (F, L, ω, L, σ), given in (2a).

(2) a. ALIGN (F, L, ω, L, σ): The left edge of every foot coincides with the left edge of some prosodic word. Assess a violation mark for each syllable intervening between misaligned edges.

b. ALIGN (F, R, ω, R, σ): The right edge of every foot coincides with the right edge of some prosodic word. Assess a violation mark for each syllable intervening between misaligned edges.

In conjunction with its oppositely oriented counterpart, (2b), ALIGN (F, L) plays a central role in the standard OT approach to metrical stress (McCarthy and Prince 1993a).

First, consider GA's relation-generality. In requiring that two category edges coincide, as stated in (1), a GA constraint prohibits, in effect, *all* configurations in which they fail to coincide. The prohibition against misalignment applies whether one aligned category contains the other, for example, the first aligned category precedes the second, or the second precedes the first. It is in this sense that GA constraints are relation-general.

To illustrate, consider how ALIGN (F, L) evaluates the candidates in (3). When the foot occurs initially within the prosodic word, as in (3a), the left edges of the foot and prosodic word coincide, and the constraint is satisfied. When the foot occurs in any other position, the left edges fail to coincide, and the constraint is violated. The particular structural relationship that exists between the misaligned foot and prosodic

[1] As McCarthy (2003) notes, the separator category has been crucial from the earliest treatments of alignment. Though it is typically omitted from both the general formulation and individual constraints, alignment constraints have always assessed violation marks for instances of a *particular* category that intervenes between misaligned edges rather than for instances of *any* category whatsoever.

word is of no consequence. It does not matter whether the prosodic word contains the foot, as in (3b), the prosodic word precedes the foot, as in (3c), or the foot precedes the prosodic word, as in (3d). Each of these configurations violates the constraint.

(3)

	ALIGN (F, L)
a. [(σσ) σσσσ]	
b. [σ (σσ) σσσ]	*
c. [σσσσ](σσ)	****
d. (σσ)[σσσσ]	**

Because ALIGN (F, L) prohibits misalignment of left edges regardless of the configuration in which the foot and prosodic word occur, its prohibition against misalignment is relation-general. All GA constraints share this characteristic.

Now, consider how distance-sensitivity emerges in the GA approach. Constraints in the OT literature employ one of two modes of evaluation to assess violation marks. The difference between the two lies in how many violation marks can be assessed per locus of violation (LV), an LV being any instance in an output candidate of the category, feature, or configuration that the constraint prohibits. When each LV corresponds to exactly one violation mark, evaluation is *categorical*. When an LV can correspond to more than one violation mark, evaluation is *gradient*. In the GA approach, where an LV is a pair of misaligned edges, evaluation is typically gradient. As (1) states, GA does not simply assess a violation mark for each pair of misaligned edges; it assesses a violation mark for each *SCat* that intervenes between them. As a result, GA very frequently assesses multiple violation marks per LV.

GA's gradient evaluation is the source of its distance-sensitivity. Because it assesses a violation mark for each instance of *SCat* located between misaligned edges, the number of violation marks assessed is proportional to the distance between them. A greater distance results in a greater number, a lesser distance in a lesser number. Consider how ALIGN (F, L) evaluates the candidates in (4). As the foot's left edge moves further away from the left edge of the prosodic word, more syllables intervene. ALIGN (F, L) employs gradient evaluation to assess the corresponding violation marks, making the overall number of violation marks assessed proportional to the distance between the misaligned edges.

(4)

	ALIGN (F, L)
a. [(σσ)σσσσ]	
b. [σ(σσ)σσσ]	*
c. [σσ(σσ)σσ]	**
d. [σσσ(σσ)σ]	***
e. [σσσσ(σσ)]	****

Cases where distance-sensitivity is crucial are those where it is necessary to influence the position of categories that are necessarily misaligned. Such a case arises, for example, when multiple feet exhibit a general directional orientation within a prosodic word, like the general leftward orientation established by ALIGN (F, L) in (5). In each of the candidates in (5), only the first foot can actually align with the left edge of the prosodic word. The second and third feet are necessarily misaligned. ALIGN (F, L) not only insists that the alignable first foot position itself exactly at the left edge of the prosodic word, it also insists that the necessarily misaligned second and third feet position themselves as near to the left edge as possible. ALIGN (F, L)'s ability to influence the positions of the second and third feet derives from its distance-sensitivity. If it did not assess more violation marks for misaligned edges that are separated by greater distances, it could not insist that the second foot position itself two syllables away from the left edge rather than three and that the third foot position itself four syllables away rather than five.

(5)

	ALIGN (F, L)
☞ a. [(σσ)(σσ)(σσ) σ]	** ****
b. [(σσ)(σσ) σ (σσ)]	** *****!
c. [(σσ) σ (σσ)(σσ)]	*** ****!*
d. [σ (σσ)(σσ)(σσ)]	* *** ***!**

Having seen how relation-generality and distance-sensitivity both arise under GA, we are now in a position to see how the combination of the two results in pathological predictions.

1.2 The midpoint pathology

As Eisner (1997) observes, GA constraints can sometimes draw an object to the center of a domain rather than one of its edges, a result that is both unexpected and uncontroversially pathological. Though Eisner, echoed by Buckley (2009), blames such *Midpoint Pathology* effects on GA's distance-sensitive assessment of violation marks, its relation-general prohibition against misalignment is also required for the problematic predictions to emerge.

Consider the GA constraint ALIGN (σ, L, F, L, σ), which aligns the left edge of every syllable with the left edge of some foot.

(6) ALIGN (σ, L, F, L, σ): The left edge of every syllable coincides with the left edge of some foot. Assess a violation mark for each syllable intervening between misaligned edges.

As (7) illustrates, when there is a single foot in a form, ALIGN (σ, L) draws its left edge to the left edge of the medial syllable. The result depends on distance-sensitive evaluation, since it is necessarily misaligned syllables that determine the foot's position. The misaligned syllables draw the foot towards the center of the form because the overall distance between their left edges and the left foot edge—as reflected in the number of violation marks assessed—is shortest when it occurs in this position. The result also depends on GA's relation-generality. *Every* misaligned syllable must contribute to the overall number of violation marks, regardless of its structural relationship to the foot. In (7), p denotes a violation mark derived from a misaligned syllable that precedes the foot, f denotes a violation mark from a misaligned syllable that follows the foot, and c denotes a violation mark from a misaligned syllable contained within the foot.[2]

[2]Thanks to an anonymous reviewer for the suggestion that violation marks be distinguished in this way.

(7)

	ALIGN (σ, L)
a. [(σσ)σσσσσ]	c ff fff ffff fff!ff ffffff
b. [σ(σσ)σσσσ]	p c ff fff ffff ff!fff
c. [σσ(σσ)σσσ]	pp p c ff fff ffff!
☞ d. [σσσ(σσ)σσ]	ppp pp p c ff fff
e. [σσσσ(σσ)σ]	pppp ppp pp p c ff!
f. [σσσσσ(σσ)]	ppppp pppp ppp p!p p c

A constraint that was *relation-specific* would not have yielded the same result. Unlike relation-general constraints, relation-specific constraints only prohibit misalignment when the aligned categories occur in a particular configuration. A relation-specific version of ALIGN (σ, L) would target only misaligned syllables with a certain relationship to the foot. With its foot at the left edge, for example, (7a) incurs no *p* violation marks. If ALIGN (σ, L) targeted only misaligned syllables that precede the foot, (7a) would be optimal. Similarly, with its foot at the right edge, (7f) incurs no *f* violation marks. If ALIGN (σ, L) targeted only misaligned syllables that follow the foot, (7f) would be optimal. Finally, since each candidate contains a single misaligned syllable within the foot, each candidate incurs a single *c* violation mark. If ALIGN (σ, L) targeted only misaligned syllables contained within the foot, it could not have distinguished between the different candidates, and the decision between them would have fallen to other constraints. None of these (counterfactual) results are problematic.

While it is true that distance-sensitivity is required for Midpoint Pathology effects to emerge, relation-generality is also required. Making prohibitions against misalignment relation-specific, then, would allow alignment constraints to avoid Midpoint Pathology effects without abandoning distance-sensitivity. This is the approach advocated here. As we shall see below, two lines of evidence offer substantial support. First, distance-sensitivity is required in the analyses of several different phenomena (Sect. 3), and, second, relation-specificity allows us to productively extend alignment analyses into new domains (Sect. 4). Having outlined the central issues that it is designed to address, then, we turn in Sect. 2 to the proposed definition of alignment constraints.

1.3 A note on tableaux

In the discussion that follows, one of the most important issues is how different constraints assess violation marks. Since violation tableaux, the type employed in the discussion above, are particularly well suited to demonstrating how individual constraints assess violation marks, I will continue to employ them when this is the primary concern. It will sometimes be necessary, however, to support claims about rankings between constraints. Since ranking arguments are much more transparent when demonstrated with comparative tableaux, I will typically switch to comparative tableaux when rankings are the primary concern. Readers not yet familiar with comparative tableaux are referred to Prince (2002) for a helpful introduction.

2 Introduction

Under the proposed approach, which I will refer to as *Relation-Specific Alignment* (RSA), alignment constraints have two components. The two components appear in the statement of a constraint on opposite sides of a slash mark, as indicated in (8). To the right of the slash is the definition of the *prohibited configuration of misalignment* (PCM). Following Ellison (1995), Zoll (1996), and McCarthy (2003), RSA prohibits specific configurations of misalignment directly.[3] The definition of the PCM determines the constraint's edge orientation: whether it prohibits misalignment between left edges, right edges, or opposite edges. It is also the source of the constraint's relation-specificity: it establishes the particular structural relation that must obtain between the aligned categories in order for the prohibition against misalignment to apply.

(8) *locus of violation / prohibited configuration of misalignment

To the left of the slash is the definition of a *locus of violation*. The definition of the LV determines how the constraint assesses violation marks. In particular, it determines whether the constraint is distance-insensitive or distance-sensitive.

In introducing RSA below, I focus first on the definition of the PCM, demonstrating how it establishes edge orientations and how it ensures relation-specificity (Sect. 2.1). I then turn to the definition of an LV, demonstrating how distance-sensitive and distance-insensitive assessment can both be accommodated under categorical evaluation (Sect. 2.2). Finally, we will see how the different types of LV and PCM permitted under RSA combine to form the proposed schemas for alignment constraints (Sect. 2.3).

2.1 Prohibited configurations of misalignment

The RSA definition of a PCM involves three arguments: the aligned categories, *ACat1* and *ACat2*, and the separator category, *SCat*. The two principles determining how these arguments can be deployed are given in (9). The Basic Relations Requirement, (9a), establishes the terms in which prohibited configurations are defined. It requires that they be defined in terms of category *containment* and *precedence*, reflecting the possible relationships between categories in phonological strings in a fairly concrete way. [4]

[3] While there is some similarity between RSA and these earlier proposals in how they define PCMs, the recognition that the PCMs result in relation-specificity, and the claim that relation-specificity is crucial to the theory of alignment, are both novel. RSA differs from the earlier proposals in other key respects, as well. It offers a more complete account, accommodating both same-edge constraints and opposite-edge constraints (the earlier proposals accommodate only the former), and it provides an explicit set of principles for constructing the necessary PCMs. It also differs from the earlier proposals in how it assesses violation marks.

[4] McCarthy (2003) uses *dominance* and *precedence* to define prohibited configurations. RSA substitutes the more flexible *containment* for *dominance* because the dominance relation is limited to categories in the same hierarchy, and the theory must be able to capture both this and the similar relationship that can arise between categories of different hierarchies. This is necessary, for example, to allow for alignment between prosodic categories and morphological categories or between prosodic categories and entries on the metrical grid.

(9) a. Basic Relations Requirement:
Prohibited configurations are defined in terms of category containment and precedence.
b. Adjacency Requirement:
In a PCM, the separator category must intervene between one aligned category and the adjacent edge of the other aligned category.

Of the numerous possible configurations that might be defined in these terms, the Adjacency Requirement, (9b), picks out those that are prohibited by alignment constraints. In particular, by insisting that the separator category intervene between one aligned category and an adjacent edge of the other, it picks out configurations where the separator category crucially intervenes between misaligned edges.

Under the Basic Relations Requirement and the Adjacency Requirement, the only PCMs permitted are those in (11) below. The demonstration is straightforward. Under the Basic Relations Requirement, the aligned categories must arrange themselves in one of two structural relations: one aligned category must contain the other, as in (10a), or one aligned category must precede the other, as in (10b).

(10) a. [...*ACat2* ...] $_{ACat1}$

b. *ACat1* ... *ACat2*

The Adjacency Requirement restricts the positions in which the separator category can occur in conjunction with these two configurations. When one aligned category contains the other, the separator category will only intervene between one aligned category and the adjacent edge of the other if it occurs between their left edges, as in (11a), or their right edges, as in (11b). When one aligned category precedes the other, the separator category will only intervene between one aligned category and the adjacent edge of the other if it occurs between the right edge of the first and the left edge of the second, as in (11c).

(11) a. Left-edge misalignment: *[... *SCat* ... *ACat2* ...] $_{ACat1}$
b. Right-edge misalignment: *[... *ACat2* ... *SCat* ...] $_{ACat1}$
c. Opposite-edge misalignment: **ACat1* ... *SCat* ... *ACat2*

The three configurations in (11), then, exhaust the options permitted under the Basic Relations Requirement and the Adjacency Requirement.[5]

Because the Adjacency Requirement always positions the separator category so that it crucially intervenes between misaligned edges, the location of the separator category determines the edge orientation of the PCMs in (11). For example, by prohibiting *SCat* from preceding *ACat2* within *ACat1*, the (11a) schema prohibits misalignment between the left edges of *ACat1* and *ACat2*. Because the Basic Relations Requirement requires that a constraint specify in its PCM whether one aligned category contains the other or one aligned category precedes the other, however, the

[5] As it happens, the prohibited configurations in (11) are also the only configurations where alignment is actually achievable. Same-edge alignment is only achievable when one aligned category contains the other. Opposite-edge alignment is only achievable when one aligned category precedes the other.

prohibition against misalignment is always relation-specific. A constraint can discourage misalignment only when the aligned categories actually occur in the relation specified. Though the (11a) schema prohibits misalignment between the left edges of *ACat1* and *ACat2*, for example, it only does so when *ACat1* contains *ACat2*. Similarly, by prohibiting *ACat2* from preceding *SCat* within *ACat1*, (11b) prohibits misalignment between the right edges of *ACat1* and *ACat2*, but only when *ACat1* contains *ACat2*. By prohibiting *ACat1* from preceding *ACat2* with *SCat* intervening, (11c) prohibits misalignment between the right edge of *ACat1* and the left edge of *ACat2*, but only when *ACat1* precedes *ACat2*.

To demonstrate how the schemas in (11) prohibit misalignment—and to better illustrate the relation-specific nature of their prohibitions—we can consider some examples that are a bit more concrete. In the prohibited configurations in (12), the aligned categories are *prosodic word* and *foot*, and the separator category is *syllable*.

(12) a. Left-edge misalignment: $*[\ldots\sigma\ldots F\ldots]_\omega$
b. Right-edge misalignment: $*[\ldots F\ldots\sigma\ldots]_\omega$
c. Opposite-edge misalignment: $*\omega\ldots\sigma\ldots F$

By prohibiting a syllable from preceding a foot within a prosodic word, $*[\ldots\sigma\ldots F\ldots]_\omega$ distinguishes between alignment and misalignment of the left edges of feet and prosodic words, but only when the prosodic word contains the foot, as in (13a, b). It prefers a candidate where no syllable intervenes between the left edges, as in (13a), to a candidate where one or more syllables intervene, as in (13b). When the prosodic word does not contain the foot, as in (13c, d), $*[\ldots\sigma\ldots F\ldots]_\omega$ does not discourage misalignment. It offers no objection in this context even though the left edges are necessarily misaligned.

(13)

	$*[\ldots\sigma\ldots F\ldots]_\omega$
a. [(σσ) σσσσ]	
b. [σ (σσ)σσσ]	*
c. [σσσ] σ (σσ)	
d. (σσ) σ [σσσ]	

Similarly, by prohibiting a foot from preceding a syllable within the prosodic word, $*[\ldots F\ldots\sigma\ldots]_\omega$ discourages misalignment between the right edges of prosodic words and feet, but only when the prosodic word contains the foot. By prohibiting a prosodic word from preceding a foot with a syllable intervening, $*\omega\ldots\sigma\ldots F$ discourages misalignment between the right edges of prosodic words and the left edges of feet, but only when the prosodic word precedes the foot.

2.2 Assessment of violation marks

Having seen how RSA defines prohibited configurations of misalignment, we turn now to the ways in which it assesses violation marks. Two principles provide the foundation for the proposed approach. The Two Measures Requirement in (14a) addresses the types of assessment that the theory requires. It mandates that alignment constraints come in both distance-insensitive and distance-sensitive varieties. The

Categoricality Hypothesis (McCarthy 2003) in (14b) addresses the modes of evaluation that the theory employs to assess violation marks. It insists that the grammar rely solely on categorical evaluation. It may not resort to gradient evaluation.

(14) a. Two Measures Requirement:
The definition of alignment constraints provides for both distance-insensitive assessment of violation marks and distance-sensitive assessment.

b. Categoricality Hypothesis (McCarthy 2003):
A constraint assesses no more than one violation mark per locus of violation.

At first glance, the Two Measures Requirement and the Categoricality Hypothesis seem to be incompatible. It is a straightforward matter to implement distance-insensitive assessment under categorical evaluation, but it is not as obvious how to implement distance-sensitive assessment. Distance-insensitive constraints only distinguish alignment from misalignment. If an LV is a pair of misaligned edges, as it is in GA, assessing a single violation mark for each pair is an effective way to make the needed distinction. In contrast, distance-sensitive constraints distinguish between different degrees of misalignment, and assessing a single violation mark for each pair of misaligned edges is not sufficient. It is for this reason that GA implements distance-sensitivity through gradient evaluation. It allows GA constraints to assess whatever number of violation marks is necessary in order to distinguish between different degrees of misalignment.

Despite initial appearances, the Two Measures Requirement and the Categoricality Hypothesis are not incompatible. To satisfy both at once, however, the different characteristics of distance-insensitive constraints and distance-sensitive constraints must be derived from a source other than their modes of evaluation. As it happens, it is a relatively simple matter to implement both types under categorical evaluation when LVs are appropriately defined.

In RSA, an LV is either a set of two categories—the aligned categories, *ACat1* and *ACat2*—or it is a set of three categories—*ACat1*, *ACat2*, and the separator category, *SCat*. The presence or absence of the separator category determines whether evaluation is distance-sensitive or distance-insensitive.

(15) a. Distance-insensitive constraints: $\langle ACat1, ACat2\rangle$
b. Distance-sensitive constraints: $\langle ACat1, ACat2, SCat\rangle$

When the definition of an LV omits the separator category, the result is a distance-insensitive constraint. A single LV derives from each instance of misaligned edges, regardless of the number of separator categories that intervene. When the definition of an LV includes the separator category, the result is a distance-sensitive constraint. The number of LVs that derive from any one instance of misaligned edges depends on the number of intervening separator categories. When multiple separator categories intervene, they help to establish multiple LVs.

Consider a constraint that aligns the right edges of a foot and a prosodic word. It would be formulated under RSA as a constraint that prohibits a syllable from following a foot within a prosodic word: $*[\ldots F \ldots \sigma \ldots]_{\omega}$. A distance-insensitive version of the constraint would define an LV as a pair consisting of the aligned categories, *prosodic word* and *foot*: $\langle\omega, F\rangle$. Because the separator category, *syllable*, is omitted, no more than one LV derives from any given misaligned foot and prosodic word, regardless of the number of intervening syllables.

(16)

	$*\langle\omega, F\rangle$ / [… F … σ … $]_\omega$
a. [$\sigma_1\,\sigma_2\,\sigma_3$ ($\sigma_4\,\sigma_5$ $)_\alpha$ $]_A$	
b. [$\sigma_1\,\sigma_2$ ($\sigma_3\,\sigma_4$ $)_\alpha$ σ_5 $]_A$	$\langle\omega_A, F_\alpha\rangle$
c. [σ_1 ($\sigma_2\,\sigma_3$ $)_\alpha$ $\sigma_4\,\sigma_5$ $]_A$	$\langle\omega_A, F_\alpha\rangle$
d. [($\sigma_1\,\sigma_2$ $)_\alpha$ $\sigma_3\,\sigma_4\,\sigma_5$ $]_A$	$\langle\omega_A, F_\alpha\rangle$

In (16a), the foot and prosodic word align at the right edge, so there are no LVs, and no violation mark is assessed. When the foot moves one syllable away, as in (16b), so that the foot and prosodic word are misaligned, there is a single LV, $\langle\omega_A, F_\alpha\rangle$, and categorical evaluation would assess the corresponding single violation mark. Moving the foot further to the left in (16c, d), so that additional syllables intervene, fails to produce additional LVs and additional violation marks. There is a still only a single LV, $\langle\omega_A, F_\alpha\rangle$, and just a single violation mark is assessed.

A distance-sensitive version of the constraint would define an LV as a triplet consisting of the aligned categories, *prosodic word* and *foot*, and the separator category, *syllable*: $\langle\omega, F, \sigma\rangle$. Because the separator category is included, the number of LVs derived from any given misaligned foot and prosodic word depends on the number of intervening syllables.

(17)

	$*\langle\omega, F, \sigma\rangle$ / [… F … σ … $]_\omega$
a. [$\sigma_1\,\sigma_2\,\sigma_3$ ($\sigma_4\,\sigma_5$ $)_\alpha$ $]_A$	
b. [$\sigma_1\,\sigma_2$ ($\sigma_3\,\sigma_4$ $)_\alpha$ σ_5 $]_A$	$\langle\omega_A, F_\alpha, \sigma_5\rangle$
c. [σ_1 ($\sigma_2\,\sigma_3$ $)_\alpha$ $\sigma_4\,\sigma_5$ $]_A$	$\langle\omega_A, F_\alpha, \sigma_4\rangle, \langle\omega_A, F_\alpha, \sigma_5\rangle$
d. [($\sigma_1\,\sigma_2$ $)_\alpha$ $\sigma_3\,\sigma_4\,\sigma_5$ $]_A$	$\langle\omega_A, F_\alpha, \sigma_3\rangle, \langle\omega_A, F_\alpha, \sigma_4\rangle, \langle\omega_A, F_\alpha, \sigma_5\rangle$

In (17a), no syllables intervene, so there are no LVs, and no violation mark is assessed. When the foot moves one syllable away, as in (17b), there is a single LV, $\langle\omega_A, F_\alpha, \sigma_5\rangle$, and categorical evaluation would assess a single violation mark. When the foot moves two syllables away, as in (17c), there are two LVs, $\langle\omega_A, F_\alpha, \sigma_4\rangle$ and $\langle\omega_A, F_\alpha, \sigma_5\rangle$, and categorical evaluation would assess a single violation mark for each. When the foot moves three syllables away, as in (17d), there are three LVs, $\langle\omega_A, F_\alpha, \sigma_3\rangle$, $\langle\omega_A, F_\alpha, \sigma_4\rangle$, and $\langle\omega_A, F_\alpha, \sigma_5\rangle$, and categorical evaluation would assess a single violation mark for each.

Even under the limitations imposed by the Categoricality Hypothesis, then, the approach accommodates both distance-insensitive and distance-sensitive constraints. The result is significant, as the Categoricality Hypothesis has been assumed to exclude distance-sensitivity and was, as it happens, proposed for just this purpose. In general, however, categorical evaluation easily captures the effects commonly associated with gradient evaluation when the LV is appropriately defined. Note that there is nothing special about this qualification. A constraint of any type must define an LV, and the definition must be appropriate to achieve the desired effect. Given the ability of categorical evaluation to capture the effects of gradient evaluation, the Categoricality Hypothesis is adopted here primarily to eliminate a redundancy. It would be undesirable to posit two modes of evaluation—categorical and gradient—within the OT framework when only one is actually necessary.

2.3 Alignment constraint schemas

To provide an overall picture of the alignment constraints that are possible under the proposed approach, we combine the two LV definitions in (15) into a single definition that indicates the separator category's optionality: ⟨*ACat1*, *ACat2*, (*SCat*)⟩. We then pair this combined definition with each of the three PCMs in (11). The result is the three schemas for alignment constraints in (18).

(18) Alignment constraint schemas

a. Left-edge: *⟨*ACat1*, *ACat2*, (*SCat*)⟩ / [… *SCat* … *ACat2* … $]_{ACat1}$
'Assess a violation mark for every ⟨*ACat1*, *ACat2*, (*SCat*)⟩ such that *SCat* precedes *ACat2* within *ACat1*.'

b. Right-edge: *⟨*ACat1*, *ACat2*, (*SCat*)⟩ / [… *ACat2* … *SCat* … $]_{ACat1}$
'Assess a violation mark for every ⟨*ACat1*, *ACat2*, (*SCat*)⟩ such that *ACat2* precedes *SCat* within *ACat1*.'

c. Opposite-edge: *⟨*ACat1*, *ACat2*, (*SCat*)⟩ / *ACat1* … *SCat* … *ACat2*
'Assess a violation mark for every ⟨*ACat1*, *ACat2*, (*SCat*)⟩ such that *ACat1* precedes *ACat2* with *SCat* intervening.'

The schemas in (18) prohibit the categories in the set to the left of the slash from occurring in the configuration of misalignment to the right of the slash. The set of categories to the left of the slash (the set that defines an LV) always includes the two aligned categories, *ACat1* and *ACat2*. Whether or not a constraint also includes the separator category, *SCat*, determines whether its assessment of violation marks is distance-sensitive or distance-insensitive. In the PCM to the right of the slash, the containment and precedence relations between *ACat1*, *ACat2*, and *SCat* define the particular configuration of misalignment that a schema targets. Constraints based on a given schema assess violation marks for the particular configuration targeted by that schema and no others. Finally, assessment of violation marks is always categorical. A constraint assesses a single violation mark for each LV, but it is possible for a candidate to have multiple LVs.

3 The essential directionality effects

In general, directionality-dictating devices like alignment and iterative parsing algorithms (Halle and Vergnaud 1987; Hayes 1995) create one of two basic effects. In the first, they hold sway over all instances of a particular category, giving them a general directional orientation relative to instances of another category. In the second, they hold sway over just a single instance of a particular category, potentially creating an exception to a general directional orientation.

(19) Two basic directionality effects

a. Establish general directional orientations.
b. Create exceptions to general directional orientations.

To illustrate, many accounts of metrical stress adopt the structural assumptions of Weak Layering (Itô and Mester 1992), which provide two options for dealing with the syllable that is leftover in odd-parity forms once disyllabic footing is no longer possible.[6] The leftover syllable can remain unfooted, as in (20), or it can be parsed as a monosyllabic foot, as in (21). The position of these irregular structures—unparsed syllable or monosyllabic foot—is the primary indication of a directional device's influence. When the device establishes a general directional orientation only, the irregular structure appears peripherally. When it also creates an exception to a general directional orientation, the irregular structure appears internally.

When the leftover syllable remains unfooted, the position of the stray syllable is the clearest indication of a directional device's influence. General directional orientations are most obvious in simple unidirectional patterns. In (20a), the feet have all been pushed to, pulled to, or laid out from one edge of the prosodic word, and the stray syllable emerges at the opposite edge. Exceptions to general directional orientations are most conspicuous in bidirectional patterns. In (20b), one foot (the exception) anchors itself at one edge of the form; the remaining feet position themselves at the opposite edge; and the stray syllable sits in between, marking the boundary between the exceptional foot and the others.

(20) Directional orientations for feet in underparsing systems

a. General: unidirectional
$[(\sigma\sigma)(\sigma\sigma)(\sigma\sigma)\sigma]$
$[\sigma(\sigma\sigma)(\sigma\sigma)(\sigma\sigma)]$

b. General + exception: bidirectional
$[(\sigma\sigma)\sigma(\sigma\sigma)(\sigma\sigma)]$
$[(\sigma\sigma)(\sigma\sigma)\sigma(\sigma\sigma)]$

When the leftover syllable is parsed as a monosyllabic foot, the clearest indication of a directional device's influence is the monosyllabic foot's position. General directional orientations are most obvious in simple unidirectional patterns, such as those in (21a), where the disyllabic feet are strung together to one side of the prosodic word and the monosyllabic foot appears at the other. Exceptions to general directional orientations are most conspicuous in bidirectional patterns, such as those in (21b), where the monosyllable marks the boundary between two groups of disyllabic feet. One disyllabic foot (the exception) positions itself at one edge of the form; the remaining

[6] Since many of the issues to be addressed here were originally framed within it, and it is the approach that will be most familiar to the majority of readers, I will use the Weak Layering approach to illustrate throughout. This is not to imply that Weak Layering provides the best foundation for a theory of metrical stress. As Hyde (2008b, 2009) demonstrates, a number of difficulties arise under Weak Layering in the parsing of odd-parity forms, difficulties that can be avoided under an alternative Weak Bracketing approach (Hyde 2001, 2002). Though length considerations preclude any meaningful discussion of Weak Bracketing here, its omission does not materially affect the results established below.

disyllabic feet are strung together at the opposite edge; and the monosyllabic foot sits in between.

(21) Directional orientations for feet in exhaustive parsing systems

a. General: unidirectional
$[(\sigma\sigma)(\sigma\sigma)(\sigma\sigma)(\sigma)]$
$[(\sigma)(\sigma\sigma)(\sigma\sigma)(\sigma\sigma)]$

b. General + exception: bidirectional
$[(\sigma\sigma)(\sigma)(\sigma\sigma)(\sigma\sigma)]$
$[(\sigma\sigma)(\sigma\sigma)(\sigma)(\sigma\sigma)]$

Though the effects described in (19) and illustrated in (20) and (21) are fairly basic, it is not the case that all directional devices produce them in the same circumstances. Differences in the ways that they establish directional orientations result in disparate abilities in different contexts, and these, in turn, lead to divergent predictions. Iterative parsing algorithms produce both effects—general directional orientations and exceptions to general directional orientations—whether instances of the specified category fail to exhaust the phonological string, as in the underparsing patterns in (20), or actually do exhaust the phonological string, as in the exhaustive parsing patterns in (21). (See Hyde 2008b for discussion.) In contrast, alignment produces both effects only when instances of the specified category fail to exhaust the phonological string. Of the underparsing patterns in (20), it produces both the unidirectional patterns in (20a), and the bidirectional patterns in (20b). When instances of the specified category actually do exhaust the phonological string, alignment can establish general directional orientations, but it cannot create exceptions to general directional orientations. Of the exhaustive parsing patterns in (21), it produces the unidirectional patterns in (21a) but not the bidirectional patterns in (21b).

(22) Alignment's essential directionality effects

a. When instances of the aligned category do not exhaust the string:
   i. Alignment establishes general directional orientations.
   ii. Alignment creates exceptions to general directional orientations.

b. When instances of the aligned category do exhaust the string:
   Alignment establishes general directional orientations only.

The asymmetry in its ability to create exceptions to general directional orientations is one of alignment's most interesting characteristics. It is also one of its most fortunate. As it happens, the stress patterns that would emerge from the bidirectional exhaustive parsing schemes are unattested, and alignment's inability to produce them gives it an advantage over alternatives, like iterative parsing, which produce them quite naturally.

In the discussion that follows, I demonstrate how alignment's essential directionality effects emerge under RSA. I will continue to employ a Weak Layering account of binary stress patterns as the primary example, essentially replicating the account of McCarthy and Prince (1993a), the standard OT account. I will also demonstrate that alternative Weak Layering accounts such as Rhythmic Licensing (Kager 2001,

2005) and Iterative Foot Optimization (Pruitt 2008) fall short of the standard in crucial cases.

3.1 Alignment effects in underparsing systems

In any prosodic word, at most one foot can align with a given edge. Due to the intervention of that foot, and possibly others, any remaining feet are necessarily misaligned. A constraint that establishes a general directional orientation for feet, then, is a constraint that influences the position of both the alignable foot and any necessarily misaligned feet. A constraint that creates an exception to a general directional orientation is a constraint that influences the position of the alignable foot only. In RSA, the ability to establish general directional orientations derives from distance-sensitive assessment, and the ability to create an exception to a general directional orientation derives from distance-insensitive assessment. Since alignment constraints produce both effects in underparsing systems, we begin with underparsing here and consider exhaustive parsing further below.

Consider the RSA constraints ALL-FEET-LEFT and ALL-FEET-RIGHT given in (23). Both encourage same-edge alignment between feet and prosodic words. ALL-FEET-LEFT encourages left-edge alignment by prohibiting a syllable from preceding a foot within a prosodic word, and ALL-FEET-RIGHT encourages right-edge alignment by prohibiting a foot from preceding a syllable. Since they include the separator category, *syllable*, in the definition of an LV, the constraints are both distance-sensitive. The number of LVs to which any given pair of misaligned edges contributes equals the number of syllables that intervene between them.

(23) a. ALL-FEET-LEFT: $*\langle \omega, F, \sigma \rangle / [\ldots \sigma \ldots F \ldots]_\omega$
'Assess a violation mark for every $\langle \omega, F, \sigma \rangle$ such that σ precedes F within ω.'

b. ALL-FEET-RIGHT: $*\langle \omega, F, \sigma \rangle / [\ldots F \ldots \sigma \ldots]_\omega$
'Assess a violation mark for every $\langle \omega, F, \sigma \rangle$ such that F precedes σ within ω.'

Because they distinguish between different degrees of misalignment, ALL-FEET-LEFT and ALL-FEET-RIGHT can establish general directional orientations for feet within prosodic words. Not only can they require that alignable feet locate themselves at the appropriate edge of the prosodic word, they can also require that necessarily misaligned feet position themselves as near to the appropriate edge as possible.

Consider how ALL-FEET-RIGHT establishes a general rightward orientation. In (24), only the third foot can actually align with the right edge of the prosodic word. The first and second feet are necessarily misaligned. ALL-FEET-RIGHT insists that the third foot occur exactly at the prosodic word's right edge, but it also draws the necessarily misaligned first and second feet as far to the right as possible. It insists that the second foot occur two syllables away from the right edge, rather than three, and it insists that the first foot occur four syllables away, rather than five. In drawing all feet towards the right edge, ALL-FEET-RIGHT also has the effect of pushing the stray syllable to the left.

(24)

	ALL-FEET-RIGHT
a. [(σσ)(σσ)(σσ) σ]	***** **!* *
b. [(σσ)(σσ) σ (σσ)]	***** **!*
c. [(σσ) σ (σσ)(σσ)]	***** **!
☞ d. [σ (σσ)(σσ)(σσ)]	**** **

In establishing general directional orientations for feet, the distance-sensitive ALL-FEET-LEFT and ALL-FEET-RIGHT produce two unidirectional parsing schemes. Since the two schemes can be implemented with either trochees or iambs, they yield four different stress patterns, three of which are attested. These are the same unidirectional underparsing patterns that GA predicts in the standard OT account.

(25) Unidirectional underparsing patterns [7]

a. ALL-FEET-LEFT
   i. Trochaic: Pintupi-type
      $(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)$
      $(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)\sigma$
   ii. Iambic: Araucanian-type
      $(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})$
      $(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})\sigma$

b. ALL-FEET-RIGHT
   i. Trochaic: Nengone-type
      $(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)$
      $\sigma(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)$
   ii. Iambic: *unattested*
      $(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})$
      $\sigma(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})$

Now consider two additional RSA constraints, FOOT-LEFT and FOOT-RIGHT, given in (26). Though FOOT-LEFT and FOOT-RIGHT also encourage same-edge alignment between feet and prosodic words, prohibiting the same configurations of misalignment as ALL-FEET-LEFT and ALL-FEET-RIGHT, respectively, they omit the separator category, *syllable*, from the definition of an LV, making them distance-insensitive. The number of LVs resulting from any given pair of misaligned edges is *one*, regardless of the number of syllables that intervene.

(26) a. FOOT-LEFT: $*\langle\omega, F\rangle/[\ldots\sigma\ldots F\ldots]_{\omega}$
   'Assess a violation mark for every $\langle\omega, F\rangle$ such that σ precedes F within ω.'

b. FOOT-RIGHT: $*\langle\omega, F\rangle/[\ldots F\ldots\sigma\ldots]_{\omega}$
   'Assess a violation mark for every $\langle\omega, F\rangle$ such that F precedes σ within ω.'

[7] For Pintupi, see Hansen and Hansen (1969); for Araucanian, see Echeverria and Contreras (1965); for Nengone, see Tryon (1967).

Because FOOT-LEFT and FOOT-RIGHT only distinguish between alignment and misalignment, rather than different degrees of misalignment, they can require that the alignable foot locate itself at the appropriate edge of the prosodic word but not that necessarily misaligned feet position themselves as near as possible. Their ability to influence the position of a single foot in this fashion allows them to establish an exception to a general directional orientation.

Consider how a high-ranked FOOT-LEFT creates an exception to the general rightward orientation established by a lower-ranked ALL-FEET-RIGHT. In (27), the first foot can align with the prosodic word's left edge, but the second and third feet are necessarily misaligned. FOOT-LEFT insists that the first foot occur at the left edge, but it cannot insist that the remaining feet occur as near as possible. The second foot contributes to a single LV whether it is two syllables away or three, and the third foot contributes to a single LV whether it is four syllables away or five. It is left to the distance-sensitive ALL-FEET-RIGHT, then, to determine the position of the second and third feet. ALL-FEET-RIGHT draws both towards the right edge, so that the stray syllable separates the initial foot from the others.

(27)

	FOOT-LEFT	ALL-FEET-RIGHT
a. [(σσ)(σσ)(σσ) σ]	* *	***** ***! *
b. [(σσ)(σσ) σ (σσ)]	* *	***** ***!
☞c. [(σσ) σ (σσ)(σσ)]	* *	***** **
d. [σ (σσ)(σσ)(σσ)]	* * *!	**** **

In creating exceptions to general directional orientations, FOOT-LEFT and FOOT-RIGHT help to produce two bidirectional parsing patterns. Whether implemented with trochaic footing (attested) or iambic footing (unattested), bidirectional parsing schemes always yield stress patterns with an internal lapse in odd-parity forms. These are the same bidirectional patterns that GA produces in the standard account.[8]

(28) Bidirectional underparsing patterns[9]

a. FOOT-LEFT ≫ ALL-FEET-RIGHT

i. Trochaic: Garawa-type

$(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)$

$(\acute{\sigma}\sigma)\sigma(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)$

ii. Iambic: *unattested*

$(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})$

$(\sigma\acute{\sigma})\sigma(\sigma\acute{\sigma})(\sigma\acute{\sigma})$

[8] As an anonymous reviewer points out, distance-sensitive alignment can also establish exceptions to general directional orientations, if the exception happens to be a sub-category of the category being aligned. For example, it might create a bidirectional parsing pattern by aligning a head foot in one direction and aligning feet generally in the opposite direction. This would suffice to create bidirectional patterns where the head foot is the isolated foot but not bidirectional patterns where a non-head foot is the isolated foot.

[9] For Garawa, see Furby (1974). For Piro, see Matteson (1965).

b. FOOT-RIGHT ≫ ALL-FEET-LEFT
   i. Trochaic: Piro-type
      $(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)$
      $(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)\sigma(\acute{\sigma}\sigma)$
   ii. Iambic: *unattested*
      $(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})$
      $(\sigma\acute{\sigma})(\sigma\acute{\sigma})\sigma(\sigma\acute{\sigma})$

Internal lapse patterns are significant not only because they illustrate both of alignment's essential directionality effects, but also because they present a clear case where the alternative Rhythmic Licensing (Kager 2001, 2005) approach cannot effectively replicate the effects of distance-sensitive alignment. We pause to consider this point.

3.2 Evidence supporting distance-sensitivity

As McCarthy (2003) points out, the strongest evidence for distance-sensitive alignment comes from cases where the grammar must fix the position of categories that are necessarily misaligned. Since distance-insensitive constraints have no influence over the position of these categories, the grammar must employ distance-sensitive constraints in such cases, if equally successful alternatives cannot be found. Rhythmic Licensing (RL) is an attempt to provide just such an alternative in the context of binary stress systems.

Like the RSA implementation of the standard alignment account discussed above, RL often employs distance-insensitive alignment constraints to fix the positions of alignable feet. To fix the positions of feet that are necessarily misaligned, however, RL replaces the standard account's distance-sensitive constraints with constraints that either prohibit lapse or license it in certain positions. Because both accounts have the use of distant-insensitive constraints in common, diverging only in the use of distance-sensitive constraints, we can gauge the relative effectiveness of distance-sensitive alignment and its most plausible alternative fairly directly.

Since I take it to be uncontroversial that prohibiting lapse or licensing it at prosodic word edges can be an effective method for producing simple unidirectional patterns, I limit my attention here to the crucial case of bidirectional patterns. RL produces bidirectional patterns by manipulating the position of the lapse that arises in odd-parity forms rather than the position of the feet themselves. It creates an internal lapse and then fixes its position in such a way that the stray syllable separates the appropriate edgemost foot from its companions.

Whether or not a lapse emerges in an odd-parity form and whether or not it emerges internally both depend on the positions of the peripheral feet. To create an internal lapse, the leftmost foot must occur at the left edge, and the rightmost foot at the right edge. Since the peripheral feet are actually alignable, it is a simple matter to locate them in these positions using distance-insensitive alignment constraints. Once the positions of the peripheral feet are fixed and an internal lapse established, RL fixes the position of medial feet by licensing the internal lapse in an appropriate position. Since the position of the lapse cannot be appropriately constrained by licensing it at an edge of the prosodic word, Kager takes the primary stress to be the licensor in this context.[10]

(29) LAPSE-AT-PEAK: Lapse must be adjacent to the peak (primary stress).

If the initial foot is the head foot, LAPSE-AT-PEAK requires the stray syllable to follow, as in (30a), so that the lapse occurs next to the primary stress. This separates the initial foot from any remaining feet. If the final foot is the head foot, LAPSE-AT-PEAK requires the stray syllable to precede, as in (30b). This separates the final foot from the others.

(30) Bidirectional underparsing patterns under Rhythmic Licensing

a. Head foot leftmost
   i. Trochaic: Garawa-type
      $(\acute{\sigma}\sigma)(\grave{\sigma}\sigma)(\grave{\sigma}\sigma)$
      $(\acute{\sigma}\sigma)\sigma(\grave{\sigma}\sigma)(\grave{\sigma}\sigma)$
   ii. Iambic: *unattested*
      $(\sigma\acute{\sigma})(\sigma\grave{\sigma})(\sigma\grave{\sigma})$
      $(\sigma\acute{\sigma})\sigma(\sigma\grave{\sigma})(\sigma\grave{\sigma})$

b. Head foot rightmost
   i. Trochaic: Piro-type
      $(\grave{\sigma}\sigma)(\grave{\sigma}\sigma)(\acute{\sigma}\sigma)$
      $(\grave{\sigma}\sigma)(\grave{\sigma}\sigma)\sigma(\acute{\sigma}\sigma)$
   ii. Iambic: *unattested*
      $(\sigma\grave{\sigma})(\sigma\grave{\sigma})(\sigma\acute{\sigma})$
      $(\sigma\grave{\sigma})(\sigma\grave{\sigma})\sigma(\sigma\acute{\sigma})$

Where the standard alignment account predicts that an internal lapse might occur next to a primary stress or between secondary stresses, RL predicts that it always occurs next to the primary stress. RL's adequacy as a replacement for distance-sensitive alignment depends, then, on whether or not this narrower range is sufficient to account for the internal lapse languages that are actually attested. This does not appear to be the case.

Proponents might offer two lines of defense for the assertion that lapse only arises next to a primary stress. The first, of course, is simply to deny the existence of patterns where it arises between secondary stresses. This is an impossible position to maintain given the number of prima facie counterexamples. Internal lapse between secondary stresses can be found in the initial dactyl patterns of Indonesian (Cohn 1989), Norwegian (Lorentz 1996), Spanish (Harris 1983), and, possibly, Brazilian Portuguese (Abaurre et al. 2001).[11] The second line of defense is to attribute lapse

[10] Kager (2001) proposes to license lapse only next to the primary stress. However, to address the criticism of Alber (2005) that such an approach yields several unwanted predictions, Kager (2005) proposes to prohibit lapse between secondary stresses. The particular formulation involved in ensuring that the lapse occurs next to the primary stress need not concern us here.

[11] Though Abaurre et al. (2001) explicitly compare Brazilian Portuguese initial dactyls to Spanish initial dactyls, they do not provide forms long enough to confirm that the lapse can occur between secondary stresses.

between secondary stresses to factors beyond the basic stress algorithm itself, either to morphological considerations or, perhaps, to the influence of a donor language's stress pattern.[12]

Consider the case of Spanish, where there are two potential opportunities for morphology to influence the stress pattern. It might be influenced by suffixation in the lexical phonology or by the presence of clitics in the postlexical phonology. Citing Roca (1986), Kager (2001) asserts that the latter option is the source of the Spanish initial dactyl. Initial dactyls, he claims, arise only when a word that would otherwise have initial secondary stress occurs after a clitic (e.g. *èl constantìnopléño*; cf. *cònstantìnopléño*).

Counterexamples are not difficult to find. In the forms in (31) initial dactyls appear word-internally, unaccompanied by clitics. In forms long enough to support three stressed syllables, the lapse occurs between secondary stresses.[13]

(31) Initial dactyls in Spanish

a. gèneratívo
b. bùrocratìzación
c. nàturalísta
d. nàturalìzación
e. ràcionalísta
f. ràcionalìzación
g. gràmaticàlidád

Though clitics are not the source of initial dactyls in Spanish—at least not in the forms in (31)—it is still possible that initial dactyls are the result of suffixation. Under such an analysis, earlier applications of the stress algorithm to base forms prevent free reapplication of the algorithm to suffixed forms. When a suffix is added, the algorithm applies to the suffix (and, often, to adjacent unparsed portions of the base), but the base's original stress pattern is essentially preserved. This frequently results in a pattern that is different than the one that would have emerged had the algorithm applied to the entire word at once. In the Spanish case, the claim would be that it just happens to result in initial dactyls whenever an odd number of syllables precedes the primary stress.

There appear to be no concrete proposals based on this possibility, making it difficult to assess fully, but there is ample evidence suggesting that it is incorrect. First, as Harris notes, the initial dactyl pattern emerges in words that have no relevant internal structure, such as the toponyms *Tègucigálpa*, *Tròmpipendécuaro*, and *Tlàtlauquìtepéc*. (In *Tlàtlauquìtepéc*, the adjacent /a/ and /u/ are heterosyllabic:

[12] In Indonesian, forms long enough to contain initial dactyls are typically borrowings. Kager (2001) speculates that the initial dactyls arise under the influence of the donor language's (Dutch's) stress pattern.

[13] According to Harris (1983), Spanish has two stress patterns: a unidirectional 'rhetorical' pattern where secondary stresses occur on alternate syllables preceding the primary stress, and a bidirectional 'colloquial' pattern that results in initial dactyls in odd-parity forms. The forms in (31), as well as the toponyms in the second paragraph below, are examples of the latter. They were either confirmed or supplied by native speakers from Mexico City and surrounding areas. Roca's (1986) analysis seems to focus exclusively on the rhetorical pattern, ignoring the colloquial pattern.

Tlà.tla.u.quì.te.péc.) *Tlàtlauquìtepéc* is especially significant, as its lapse occurs between secondary stresses. Second, as Harris and Roca both note, suffixed forms do *not* preserve the stress pattern of base forms, the unique exception to this rule being those with the adverbial suffix -*mente*. For example, the stress pattern of *burócrata* is preserved in *buròcrataménte*, and that of *nàturál* is preserved in *nàturàlménte*. In contrast, the stress pattern is not preserved between *nàturál* and *nàturalísta* or between *burócrata*, *bùrocràtizár*, and *bùrocratìzación*.[14] Finally, the Spanish initial dactyl pattern appears to be entirely predictable given a form's length and the position of its primary stress, and distance-sensitive alignment provides a transparent analysis given just these factors. Introducing suffixation as an additional crucial factor, assuming for the sake of the argument that such an approach is even workable, would only render the analysis opaque and more complex.

The existence of Spanish and the other initial dactyl patterns demonstrates that RL is inadequate as a replacement for distance-sensitive alignment in the context of binary stress patterns. (See Hyde 2008a for additional discussion.) Based on her examination of a related problem in left-oriented moraic trochee languages, Alber (2005) also concludes that RL is inadequate. The problem arises in forms where the placement of heavy syllables isolates an odd-parity string of light syllables. The feet used to parse these odd-parity strings exhibit a clear leftward orientation, as in (32a), but RL constraints discourage the clash and lapse configurations that result, preferring rightward orientation, as in (32b). Since RL constraints cannot promote the necessary leftward orientation, RL does not offer a viable alternative to alignment in this context. (See Alber 2005 for a more thorough discussion.)

(32)		a. Leftward orientation	b. Rightward orientation
	Initial	[(ĹL) L (H́)...	[L (ĹL)(H́)...
	Medial	... (H́)(ĹL) L (H́) ...	...(H́) L (ĹL)(H́)...
	Final	... (H́)(ĹL) L]	... (H́) L (ĹL)]

Though alignment is clearly capable of producing the necessary leftward orientation, note that it is the final two cases of (32a), in particular, that demonstrate the need for distance-sensitivity. Since the feet used to parse the light syllables are necessarily misaligned in these cases, only distance-sensitive constraints can draw them leftward.

We find additional support for distance-sensitivity in foot extrametricality and related effects, where a head foot has a rightward orientation but is necessarily misaligned because it cannot be the rightmost foot. Since it is necessarily misaligned, only distance-sensitive alignment can locate it in the appropriate position.[15] Con-

[14]Roca (1986) argues that primary stress is lexical and secondary stress postlexical. Suffixation directly affects the position of primary stress, then, but not the position of secondary stress. The grammar does not position secondary stresses until after suffixation is already complete.

[15]McCarthy (2003) points out that many of the languages traditionally cited as examples of foot extrametricality are not completely convincing. Though a right-oriented primary stress is set back the appropriate distance from the right edge of the word, there is no evidence that it is actually followed by a secondary stress, which is the clearest indication of an extrametrical foot. For example, of the potential cases discussed by Hayes (1995), Bedouin Arabic (Blanc 1970), Cayuga (Chafe 1977; Foster 1982; Michelson 1988), Delaware (Goddard 1979, 1982), and Palestinian Arabic (Kenstowicz and Abdul-Karim 1980; Kenstowicz 1983) fall short in this respect, though Piggott (1983) does note the presence of post-tonic

sider, for example, the foot extrametricality effects in Paumari (Everett 2003) and Banawá (Buller et al. 1993; Everett 1996, 1997). In forms long enough to contain two stresses, the primary stress is always the penultimate stress.

(33) Foot extrametricality in Paumari

a.	kabáhakì	'to get rained on'
b.	àhakábarà	'dew'
c.	athànarárikì	'sticky consistency'
d.	bikànathàrarávinì	'to cave in, to fall apart quickly'

(34) Foot extrametricality in Banawá

a.	abárikò	'moon'
b.	mètuwásimà	'find them'
c.	tìnarífabùne	'you are going to work'

Since the primary stress is always the penultimate stress, it is clear that the head foot has a rightward orientation, but it also clear that there is another foot further to the right. Since the head foot is not the final foot, it is necessarily misaligned and must be coerced into penultimate position by a distance-sensitive alignment constraint.

Though they do not conform exactly to the traditional foot extrametricality pattern, other languages exhibit similar effects. In Buriat and Khalka Mongolian (Walker 1997), stress occurs on the initial syllable and every heavy syllable. The rightmost stress is primary, unless it occupies the final syllable, in which case the penultimate stress is primary.

(35) Buriat pattern

a.	H̀H́LLL	tàːrúːlagdaxa	'to be adapted to'
b.	L̀H̀H́L	nàmàːtúːlxa	'to cause to be covered with leaves'
c.	L̀H́LH̀	xùdáːlingdàː	'to the husband's parents' (collective)
d.	H̀LH́H̀	xỳːxengéːrèː	'by one's own girl'

(36) Khalka pattern

a.	H̀H́LL	bàegúːlagdax	'to be organized'
b.	L̀H̀H́L	xø̀ndìːrýːlen	'to separate' (modal)
c.	H̀H́LH̀	bàigúːllagàːr	'by means of the organization'
d.	L̀H̀H́LH̀	ùlàːnbáːtaràːs	'Ulaanbaatar' (ablative)

Primary stress exhibits a clear rightward orientation in both languages, then, but it is not always the final stress. In situations where it is not, only distance-sensitive alignment can distinguish among the various non-final positions in which it might occur and ensure that it occurs in the rightmost.

secondary stresses in the case of Ojibwa. Languages described in the more recent literature, however, such as those discussed here, do have the post-tonic secondary stresses necessary to make the strongest case possible.

3.3 Alignment effects in systems with exhaustive parsing

Alignment's influence on the position of monosyllabic feet differs in two ways from its influence on the position of stray syllables. The first difference can be seen most clearly in unidirectional patterns. Where the distance-sensitive constraints prefer that stray syllables occur as far as possible from the designated edge, they prefer that monosyllabic feet occur as near as possible. The reason for the divergent preferences is fairly straightforward. Since it is feet that are being aligned, a stray syllable does not contribute to the assessment of violation marks through its own misalignment; it contributes only through its intervention between a foot and the designated edge of the prosodic word. Positioning a stray syllable as far from the designated edge as possible gives it less opportunity to intervene between the edge and a foot. In contrast, a foot contributes to the assessment of violation marks both through its own misalignment and through the intervention of its constituent syllables. Although a foot's size is irrelevant to the number of violation marks assessed due to its own misalignment—feet incur the same number of violation marks for the same degree of misalignment regardless of their size—a larger foot contributes to the assessment of more violation marks through the intervention of its constituent syllables than a smaller foot. In other words, a larger foot's intervention leaves its fellow feet further from the designated edge than a smaller foot's intervention. It is better to have smaller feet intervening between larger feet and the designated edge, then, than to have larger feet intervening between smaller feet and the designated edge.

RSA's distance-sensitive constraints have exactly this effect. For example, as (37) illustrates, ALL-FEET-LEFT is best satisfied when the monosyllabic foot occurs at the prosodic word's left edge with the disyllabic feet following. When the monosyllabic foot is the first foot, as in (37d), each foot in the form is as close as it can be to the left edge. Moving the monosyllabic foot one position to the right, as in (37c), so that a disyllabic foot is first and the monosyllabic foot second, simply means that the second foot is one syllable further from the left edge and participates in an additional LV. Moving the monosyllable one position further, as in (37b), so that the first two feet are disyllabic, means that the third foot is also one syllable further away. Moving the monosyllable foot into fourth position, as in (37d), means that the fourth foot is one syllable further away as well.

(37)

	ALL-FEET-LEFT
a. [(σσ)(σσ)(σσ) (σ)]	** **** ****!**
b. [(σσ)(σσ) (σ) (σσ)]	** **** ****!*
c. [(σσ) (σ) (σσ)(σσ)]	** *** *****!
☞d. [(σ) (σσ)(σσ)(σσ)]	* *** *****

When ALL-FEET-LEFT and ALL-FEET-RIGHT establish general directional orientations in exhaustive parsing systems, the result is two different unidirectional parsing schemes. When implemented with both iambic and trochaic feet, the general directional orientations yield four stress patterns, three of which are attested. These are the same four unidirectional exhaustive parsing patterns that GA predicts in the standard account.

(38) Unidirectional exhaustive parsing patterns[16]

a. ALL-FEET-LEFT

i. Trochaic: Passamaquoddy-type
$(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)$
$(\acute{\sigma})(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)$

ii. Iambic: Suruwaha-type
$(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})$
$(\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})$

b. ALL-FEET-RIGHT

i. Trochaic: Maranungku-type
$(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)$
$(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma})$

ii. Iambic: *unattested*
$(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})$
$(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\acute{\sigma})$

The second difference in exhaustive parsing systems is that alignment loses its ability to create exceptions to general directional orientations. RSA constraints are no different in this respect. Since edgemost feet *necessarily* occur at their corresponding edges of the prosodic word when parsing is exhaustive, the distance-insensitive FOOT-LEFT and FOOT-RIGHT cannot distinguish between the various candidates and, therefore, cannot create an exception to a general directional orientation. Since exhaustive parsing candidates tie on FOOT-LEFT and FOOT-RIGHT, regardless of the position of the monosyllabic foot, it is left to the distance-sensitive ALL-FEET-LEFT and ALL-FEET-RIGHT to determine the monosyllabic foot's position. It emerges at the left edge when ALL-FEET-LEFT is higher-ranked, and it emerges at the right edge when ALL-FEET-RIGHT is higher-ranked.

As the comparative tableaux in (39) and (40) indicate, the two candidates that locate the monosyllabic foot peripherally harmonically bound candidates that locate it medially.

(39)

	FOOT-L	FOOT-R	ALL-FEET-L	ALL-FEET-R
w. [(σσ)(σσ) (σ) (σσ)]	3	3	11	10
a. [(σσ)(σσ)(σσ) (σ)]	3	3	12 W	9 L
b. [(σ) (σσ)(σσ)(σσ)]	3	3	9 L	12 W

(40)

	FOOT-L	FOOT-R	ALL-FEET-L	ALL-FEET-R
w. [(σσ) (σ) (σσ)(σσ)]	3	3	10	11
a. [(σσ)(σσ)(σσ) (σ)]	3	3	12 W	9 L
b. [(σ) (σσ)(σσ)(σσ)]	3	3	9 L	12 W

Like GA constraints, then, RSA constraints cannot produce the bidirectional parsing schemes exhibited by the harmonically bounded candidates (39w) and (40w). If implemented with both iambic and trochaic footing, these schemes would yield the four patterns in (41), the most striking feature of which is the internal clash created by the monosyllabic foot in odd-parity forms.

[16]For Passamaquoddy, see LeSourd (1993); for Suruwaha, Everett (1996); for Maranungku, Tryon (1970).

(41) Bidirectional exhaustive parsing patterns (not predicted under alignment in OT)

a. i. Trochaic: *unattested*
$(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)$
$(\acute{\sigma}\sigma)(\acute{\sigma})(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)$

ii. Iambic: *unattested*
$(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})$
$(\sigma\acute{\sigma})(\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})$

b. i. Trochaic: *unattested*
$(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)$
$(\acute{\sigma}\sigma)(\acute{\sigma}\sigma)(\acute{\sigma})(\acute{\sigma}\sigma)$

ii. Iambic: *unattested*
$(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\sigma\acute{\sigma})$
$(\sigma\acute{\sigma})(\sigma\acute{\sigma})(\acute{\sigma})(\sigma\acute{\sigma})$

Since none of the internal clash patterns are attested, alignment's inability to produce them gives it an important advantage over accounts relying on iterative foot construction, which actually does produce them. The failure to appreciate that the standard OT account represents a substantial improvement over serial accounts in this respect has likely furthered proposals to implement the alignment analysis in the framework of Harmonic Serialism (HS; Prince and Smolensky 1993; McCarthy 2007), where alignment's advantage in this context is effectively relinquished. We pause again to consider this point.

3.4 The importance of parallelism

The Iterative Foot Optimization (IFO) account of Pruitt (2008; see also McCarthy 2008) adopts the same Weak Layering assumptions as the standard OT account and utilizes the same set of constraints. PARSE-σ requires that syllables be parsed into feet, FOOT-BINARITY requires that feet be disyllabic, and alignment constraints orient feet towards one edge or the other of the prosodic word. (Since it makes no difference in this context, I will continue to use RSA constraints.) Because IFO is implemented within Harmonic Serialism, however, the constraints do not evaluate all possible output candidates in a single step, as they would in standard OT. Instead, they perform a series of evaluations on smaller, derivationally-related candidate sets. In the first evaluation, the constraints consider the subset of candidates that differ in at most one respect from the input, selecting an optimal output from among them. The output then becomes the input to the next evaluation. The constraints consider the subsets of candidates with at most a single difference from the new input and arrive at a new output. The new output then becomes the input, and the process is repeated until the optimal output is the faithful candidate. For IFO, this essentially means that feet are added one at a time, and there is an evaluation after each addition to determine the foot's size and position.

Consider in (42) how IFO produces a bidirectional exhaustive parsing pattern simply by combining a ranking that results in exhaustive parsing, PARSE-$\sigma \gg$ FT-BIN $\gg$ ALL-FEET-RIGHT, with a ranking that produces bidirectional parsing schemes, FOOT-LEFT $\gg$ ALL-FEET-RIGHT. In the first step, PARSE-σ and FT-BIN ensure that a disyllabic foot is added to the input form. FOOT-LEFT draws it to the prosodic word's left edge, pushing the unparsed syllables to the right. In the second step, a second disyllabic foot is added. In this case, however, the lower-ranked ALL-FEET-RIGHT draws it to the right edge, pushing the unparsed syllables towards the initial foot. In the third step, a third disyllabic foot is added, and ALL-FEET-RIGHT positions it just to the left of the rightmost foot, leaving only the post-peninitial syllable unparsed. In the final step, the ranking PARSE-$\sigma \gg$ FT-BIN ensures that the post-peninitial syllable is parsed as a monosyllabic foot.

(42)

σσσσσσσ	PARSE-σ	FT-BIN	FOOT-L	ALL-FEET-R
a. σσσσσσσ	******!*			
b. (σ)σσσσσσ	******!	*		******
☞ c. (σσ)σσσσσ	*****			*****
d. σσσσσ(σσ)	*****		*!	

(σσ)σσσσσ	PARSE-σ	FT-BIN	FOOT-L	ALL-FEET-R
a. (σσ)σσσσσ	****!*			*****
b. (σσ)σσσσ(σ)	****!	*	*	*****
☞ c. (σσ)σσσ(σσ)	***		*	*****
d. (σσ)(σσ)σσσ	***		*	***** *!**

(σσ)σσσ(σσ)	PARSE-σ	FT-BIN	FOOT-L	ALL-FEET-R
a. (σσ)σσσ(σσ)	**!*		*	*****
b. (σσ)σσ(σ)(σσ)	**!	*	* *	***** **
☞ c. (σσ)σ(σσ)(σσ)	*		* *	***** **
d. (σσ)(σσ)σ(σσ)	*		* *	***** ***!

(σσ)σ(σσ)(σσ)	PARSE-σ	FT-BIN	FOOT-L	ALL-FEET-R
a. (σσ)σ(σσ)(σσ)	*!		* *	***** **
☞ b. (σσ)(σ)(σσ)(σσ)		*	* * *	***** **** **

Replacing FOOT-LEFT and ALL-FEET-RIGHT in the ranking in (42) with FOOT-RIGHT and ALL-FEET-LEFT, respectively, would produce the mirror image pattern where the antepenult is parsed as a monosyllabic foot. IFO, then, predicts both of the bidirectional exhaustive parsing patterns discussed above. Since these patterns can be implemented with either iambic or trochaic footing, IFO predicts each of the four internal clash patterns in (41), all of which are unattested.

Note that the bidirectional exhaustive parsing patterns that emerge under IFO do not emerge because alignment constraints behave any differently in a serial framework than they do in a parallel framework. They have exactly the same effect on unparsed syllables *in individual evaluations*, and, in principle, they would have exactly the same effect on monosyllabic feet. The difference in IFO is that alignment never actually influences the positions of monosyllabic feet, at least not directly. It only ever influences the position of unparsed syllables. In the first step in (42), for example, FOOT-LEFT draws a disyllabic foot to the left and pushes unparsed syllables to the right. In the second and third steps, ALL-FEET-RIGHT draws a disyllabic foot to the right and pushes unparsed syllables to the left. In the final step, when the position of the leftover syllable has already been determined, alignment has no influence. It is not until this point, however, that the ultimate parsing status of the leftover syllable is decided, the ranking PARSE-$\sigma \gg$ FT-BIN converting it into a monosyllabic foot.

In standard OT, the (b) candidate in the final step of (42) would compete to be the ultimate output with candidates where the monosyllabic foot occurs in various different positions, and ALL-FEET-RIGHT would ensure that the candidate where it occurs at the right edge emerged as the winner. In IFO, however, there is no such competition, so alignment effectively has no influence over the position of the monosyllabic foot. It has already been determined by the results of previous iterations—where the monosyllabic foot was still a stray syllable—and it emerges just to the right of the initial foot. (See Hyde 2009 for additional discussion.)

3.5 Alignment requirements and parsing requirements

Before concluding the discussion of directional parsing effects, it is important to notice that the RSA approach to creating exceptions to directional orientations differs from the GA approach. Where RSA employs distance-insensitive evaluation, GA employs existential quantification. The divergence is significant enough that it necessitates a revised analysis for dual stress systems, as discussed below, but it also has certain theoretical advantages.

As we saw in Sect. 1, ALIGN (F, L) and ALIGN (F, R) are the GA constraints that establish general directional orientations for feet within prosodic words. Since they have universal quantification over the *foot* category, their alignment requirements apply to all feet. ALIGN (F, L) draws them towards the left edge of the prosodic word, and ALIGN (F, R) draws them towards the right edge. The GA constraints that create exceptions to general directional orientations are ALIGN (ω, L, F, L, σ) and ALIGN (ω, R, F, R, σ), given in (43). Since they have existential quantification over the *foot* category, their alignment requirements need only apply to the single foot which can best satisfy them: the foot that is actually alignable.

(43) a. ALIGN (ω, L, F, L, σ): The left edge of every prosodic word coincides with the left edge of some foot. Assess a violation mark for each syllable intervening between misaligned edges.

b. ALIGN (ω, R, F, R, σ): The right edge of every prosodic word coincides with the right edge of some foot. Assess a violation mark for each syllable intervening between misaligned edges.

While the existential quantifier allows GA to create exceptions to general directional orientations, it also makes alignment constraints unnecessarily complex and violation assessment less straightforward. GA constraints are more complex because they not only require alignment, but they also often require parsing. Because *ACat2* is existentially quantified in the general definition, an instance of *ACat2* must be present in the output if an instance of *ACat1* is present. A GA constraint, then, can actually be violated in two ways: misalignment of category instances that are present in the output or the absence of an instance of the existentially quantified category.

Compare the demands of ALIGN (ω, L) with those of its RSA counterpart, FOOT-LEFT. In (44), the two constraints evaluate a form with a single misaligned foot and a form with no feet. Both constraints assess violation marks for the misaligned foot. Although the distance-sensitive ALIGN (ω, L) assesses multiple violation marks where the distance-insensitive FOOT-LEFT assesses only one, the important point in this context is simply that misalignment of existing categories runs afoul of both constraints. This is not the situation for the candidate where feet are absent. ALIGN (ω, L)—which requires some foot to be present, given the presence of the prosodic word—assesses a single violation mark. FOOT-LEFT, which does not require a foot to be present, is vacuously satisfied.

(44)

	ALIGN (ω, L)	FOOT-LEFT
a. [σσσσσσσ]	*	
b. [σσσσ(σσ)σ]	****	*

Where RSA constraints are simple prohibitions against misalignment, then, GA constraints require both alignment and parsing. The greater complexity is undesirable for two reasons. The first is that it is simply unnecessary. Consider the case of dual stress patterns, the case that is typically cited to demonstrate the usefulness of GA's parsing requirement. The usual situation in dual stress patterns is that found in Chimalapa Zoque (Knudson 1975), where one stress appears on the initial syllable and another on the penultimate, suggesting the presence of two trochaic feet.

(45) Chimalapa Zoque

a. wɨ̀ti hukútɨ 'big fire'
b. mìnsukkéʔtpa 'they are coming again'
c. wìtuʔpaynɨ́ksɨ 'he is coming and going'
d. mìnsukkeʔtpaʔɨ́ttɨ 'they were going to come again'

To produce such a pattern, the standard alignment account allows a constraint like ALIGN (F, L), which establishes a general leftward orientation for feet, to be dominated by a constraint like ALIGN (ω, R), which creates an exception for the rightmost. It then ranks both above PARSE-σ. The result, as (46) illustrates, is similar to the bidirectional patterns discussed above, but it lacks medial feet. Notice that ALIGN (ω, R) plays two distinct roles in this situation. First, in excluding a completely unparsed candidate, (46e), ALIGN (ω, R)'s parsing requirement insists that the output form contain at least one foot. Second, in excluding candidates where the final foot is misaligned, as in (46d), ALIGN (ω, R)'s alignment requirement anchors a single foot at the right edge. The decision between the remaining candidates falls to ALIGN (F, L) and PARSE-σ. ALIGN (F, L) excludes candidates with medial feet, such as (46c), but the lower-ranked PARSE-σ can still insist that a single foot occur at the left edge. It excludes the unary stress pattern, (46b), in favor of the dual pattern, (46a).

(46)

	ALIGN (ω, R)	ALIGN (F, L)	PARSE-σ
☞a. [(όσ)σσσ(όσ)]		*****	***
b. [σσσσσ(όσ)]		*****	****!*
c. [(όσ)(όσ)σ(όσ)]		** ****!*	*
d. [(όσ)σσσσσ]	*!****		*****
e. [σσσσσσσ]	*!		*******

At first glance, it might seem as if RSA is unable to reproduce these results. The RSA constraints corresponding to ALIGN (ω, R) and ALIGN (F, L) are FOOT-RIGHT and ALL-FEET-LEFT respectively. Without the alignment-internal parsing requirement, the high-ranked FOOT-RIGHT and ALL-FEET-LEFT would conspire to prevent any foot at all from appearing in the output. As Birgit Alber (personal communication) points out, however, the key is to recognize that one of the feet in a dual stress pattern is necessarily the head foot. A head foot can be required independently of feet in general, and it can be positioned independently. (See footnote 8.) To produce the Chimalapa Zoque pattern, we require the presence of a head foot with the HEAD-FOOT constraint, (47a), and we use the RSA constraint HEAD-FOOT-RIGHT, (47b), to align it with the right edge.

(47) a. HEAD-FOOT: Every prosodic word has a head foot.

b. HEAD-FOOT-RIGHT: $*\langle \omega, F_{Hd}, \sigma \rangle / [\ldots F_{Hd} \ldots \sigma \ldots]_{\omega}$
'Assess a violation mark for every $\langle \omega, F_{Hd}, \sigma \rangle$ such that F_{Hd} precedes σ within ω.'

As (48) illustrates, the combination of HEAD-FOOT and HEAD-FOOT-RIGHT has the same effect as GA's ALIGN (ω, R). HEAD-FOOT excludes the footless candidate (48e), and HEAD-FOOT-RIGHT excludes the candidate where the head foot fails to position itself at the right edge, (48d). With the head foot in final position, ALL-FEET-LEFT excludes candidates with medial feet, such as (48c), but PARSE-σ is able to insist that an initial foot appear, excluding (48b) in favor of (48a).

(48)

	HD-FOOT	HD-FOOT-R	ALL-FEET-L	PARSE-σ
☞ a. [(σ̀σ)σσσ(σ́σ)]			*****	***
b. [σσσσσ(σ́σ)]			*****	****!*
c. [(σ̀σ)(σ̀σ)σ(σ́σ)]			** ****!*	*
d. [(σ́σ)σσσσσ]		*!****		*****
e. [σσσσσσσ]	*!			*******

Parsing requirements and alignment requirements work just as well, then, when separate and related by ranking as they do when combined into single complex constraint.

The second reason to avoid combining an alignment requirement with a parsing requirement in the same constraint is that it undermines the very strong position that OT takes on the way that linguistic principles interact with each other. One of the most interesting aspects of OT is its assertion that linguistic principles are implemented as simple constraints and that each principle/constraint relates to every other principle/constraint in one way and one way only: ranking. By including both in a single constraint, GA stipulates a non-ranking interaction between an alignment requirement and a parsing requirement, weakening the framework's theoretical position. In decoupling the alignment requirement from the parsing requirement, RSA helps to maintain the stronger position.

3.6 Interim summary

We have seen that RSA constraints successfully reproduce GA's essential directionality effects by exploiting the different types of influence that distance-sensitive and distance-insensitive constraints have over the position of category instances. Because they can influence the positions of both alignable instances and instances that are necessarily misaligned, distance-sensitive constraints can establish general directional orientations. Because they influence the position of alignable instances only, distance-insensitive constraints can only create exceptions to general directional orientations.

Comparing the standard alignment analysis of bidirectional underparsing schemes to the Rhythmic Licensing analysis, we saw that the theory must include distance-sensitive alignment constraints in order to produce a sufficiently wide range of bidirectional patterns. They cannot be replaced by constraints that license rhythmic irregularities near prominent structures. Languages with foot extrametricality and similar effects also support distance-sensitivity.

Comparing the predictions of alignment constraints in standard OT to those of the same constraints under Harmonic Serialism, we saw that alignment's ability to avoid bidirectional exhaustive parsing patterns depends on parallel evaluation. The ability is lost under the serial approach, primarily because alignment never actually has a chance to influence the position of monosyllabic feet directly.

Finally, we saw that there is an important difference in how GA and RSA create exceptions to general directional orientations. Where GA relies on existential quantification, RSA relies on distance-insensitive assessment. The disadvantage of the GA approach is that it combines alignment and parsing requirements into a single constraint, making them unnecessarily complex and undermining OT's position that the only relationship between such basic requirements is that established by ranking. The RSA approach keeps alignment and parsing requirements separate, allowing the theory to maintain the stronger position.

4 Avoiding the midpoint pathology

In Sect. 3, we saw that RSA successfully replicates GA's essential directionality effects despite its different approach to violation assessment. This section focuses on the consequences of RSA's approach to defining prohibited configurations of misalignment. The range of misalignment configurations that any one constraint prohibits is much narrower under RSA than it is under GA. This is a point of divergence with significant empirical advantages. As we shall see below, it allows RSA constraints to avoid Eisner's (1997) Midpoint Pathology and to provide a general account of trisyllabic stress windows.

4.1 Same-edge alignment

We saw in Sect. 1 that alignment must have two properties to be susceptible to the Midpoint Pathology: it must be distance-sensitive, and it must be relation-general. Since GA constraints have both of these properties, they often produce

Midpoint Pathology effects. In contrast, RSA constraints do not have both properties. Although they can be distance-sensitive, they are always relation-specific. It is their relation-specificity that makes them immune to the Midpoint Pathology.

Recall from Sect. 1 the effects of the GA constraint ALIGN (σ, L, F, L, σ), which aligns the left edge of every syllable with the left edge of a foot. In forms with just a single foot, ALIGN (σ, L)'s combination of distance-sensitivity and relation-generality draws the left edge of the foot to the left edge of the medial syllable. As the tableau in (7), repeated in (49), illustrates, medial position is optimal because it minimizes the overall distance between the left foot edge and the left edges of *all* misaligned syllables. In (49) and (51) below, *p* denotes a violation mark derived from a misaligned syllable that precedes the foot, *f* a violation mark from a misaligned syllable that follows the foot, and *c* a violation mark from a misaligned syllable contained within the foot.

(49)

	ALIGN (σ, L)
a. [(σσ)σσσσσ]	c ff fff ffff fff!ff ffffff
b. [σ(σσ)σσσσ]	p c ff fff ffff ff!fff
c. [σσ(σσ)σσσ]	pp p c ff fff ffff!
☞ d. [σσσ(σσ)σσ]	ppp pp p c ff fff
e. [σσσσ(σσ)σ]	pppp ppp pp p c ff!
f. [σσσσσ(σσ)]	ppppp pppp ppp p!p p c

Now consider how a left-edge alignment constraint like ALIGN (σ, L) would have to be formulated under RSA. The prohibited configuration in RSA's left-edge alignment schema, (18a), is one where the separator category precedes one aligned category within the other aligned category. To require left-edge alignment between syllables and feet, then, the prohibited configuration would be one where a syllable (the separator category) precedes another syllable (one aligned category) within a foot (the other aligned category). Including the separator category, *syllable*, in the definition of an LV makes the constraint distance-sensitive. The result is given in (50).

(50) ALL-SYLLABLES-LEFT: $*\langle F, \sigma, \sigma\rangle/[\ldots\sigma\ldots\sigma\ldots]_F$
'Assess a violation mark for every $\langle F, \sigma, \sigma\rangle$ such that σ precedes σ within F.'

Though it is like ALIGN (σ, L) in its distance-sensitivity and its promotion of alignment between the left edges of syllables and feet, ALL-SYLLABLES-LEFT cannot draw a foot to medial position. The difference is the crucial containment relationship specified in its PCM. ALL-SYLLABLES-LEFT prohibits left-edge misalignment only when the syllable is contained within the foot, not when it either precedes or follows it. As (51) illustrates, since it only assesses violations for misaligned syllables contained within the foot, ALL-SYLLABLES-LEFT assesses the same number of violation marks regardless of the foot's location. It has no influence at all over where the foot will ultimately appear.

(51)

	ALL-SYLLABLES-LEFT
☞a. [(σσ)σσσσσ]	c
☞b. [σ(σσ)σσσσ]	c
☞c. [σσ(σσ)σσσ]	c
☞d. [σσσ(σσ)σσ]	c
☞e. [σσσσ(σσ)σ]	c
☞f. [σσσσσ(σσ)]	c

While the outcome leaves the position of the foot undecided, leaving the question to be settled by other constraints, an individual constraint's failure to arrive at a unique output is hardly pathological, or even problematic. In fact, this possibility is a necessary aspect of the OT framework.

4.2 Consistency in directional parsing

While it is crucial that the theory avoid pathological predictions, the Midpoint Pathology is not merely a peripheral phenomenon manufacturing curiosities of overgeneration like the one illustrated in (7) and (49). The Midpoint Pathology is so pervasive under GA that it actually prevents it from producing its essential directionality effects consistently, resulting in significant cases of undergeneration. Consider again ALIGN (F, L) and ALIGN (F, R), the GA constraints responsible in the standard OT account for establishing general directional orientations for feet within prosodic words. In exemplifying analyses in the literature, ALIGN (F, L) and ALIGN (F, R) are most often shown evaluating forms that contain a single prosodic word. In such forms, the two constraints establish the general directional orientations necessary for producing an appropriate range of directional parsing schemes. ALIGN (F, L) establishes a general leftward orientation and ALIGN (F, R) a general rightward orientation. The difficulty arises when the constraints evaluate forms that contain multiple prosodic words.

It is often the case that the left or right word edge nearest a foot does not belong to the prosodic word that actually contains that foot. Given this situation and the fact that ALIGN (F, L) and ALIGN (F, R) do not restrict their alignment requirements to feet and prosodic words that occur in a containment relationship, a candidate can often perform better by positioning a foot closer to the relevant edge of an *adjacent* prosodic word. As a result, optimal candidates are often those that seem to draw feet in both directions away from a central position, producing a different kind of Midpoint Pathology effect.

In (52), ALIGN (F, L) draws the feet of the first prosodic word in two different directions. Rather than drawing all three feet towards the left edge of the first prosodic word, as in (52a), it draws the first two feet towards the left edge of the first prosodic word and the third foot towards the left edge of the second, as in (52b). The third foot actually incurs fewer violations when evaluated with respect to the left edge of the second prosodic word. In (52), (54), and (55), *c* denotes a violation mark arising from evaluation of a foot with respect to the prosodic word that contains it and *f* a violation mark arising from evaluation with respect to a prosodic word that follows it.

(52)

	ALIGN (F, L)
a. [(σσ)(σσ)(σσ) σ] [(σσ)(σσ)(σσ) σ]	[cc ccc!c][cc cccc]
☞ b. [(σσ)(σσ) σ (σσ)] [(σσ)(σσ)(σσ) σ]	[cc ff][cc cccc]

In general, ALIGN (F, L) produces the expected left-oriented unidirectional pattern in final prosodic words, but it produces an unusual type of bidirectional pattern in non-final prosodic words. The effect varies, however, depending on the number of syllables that the non-final prosodic word contains. In non-final three-syllable prosodic words, the effect fails to emerge. In larger non-final prosodic words, the effect emerges in slightly different ways. In those that have an odd number of feet (those with $4n + 3$ syllables), all feet to the right of the medial foot orient themselves towards the left edge of the following prosodic word. In those that have an even number of feet (those with $4n + 5$ syllables), the final half orient themselves toward the left edge of the following prosodic word, but the leftmost of these does so only optionally.

(53) Effects of ALIGN (F, L) in non-final prosodic words

a. 3 syllables
$[\sigma\sigma\sigma][\sigma\sigma\ldots \rightarrow [(\sigma\sigma)\ \sigma][(\sigma\sigma)\ldots$

b. $4n + 3$ syllables ($n \geq 1$)
$[\sigma\sigma\sigma\sigma\sigma\sigma\sigma][\sigma\sigma\ldots \rightarrow [(\sigma\sigma)(\sigma\sigma)\ \sigma\ (\sigma\sigma)][(\sigma\sigma)\ldots$
$[\sigma\sigma\sigma\sigma\sigma\sigma\sigma\sigma\sigma\sigma\sigma][\sigma\sigma\ldots \rightarrow [(\sigma\sigma)(\sigma\sigma)(\sigma\sigma)\ \sigma\ (\sigma\sigma)(\sigma\sigma)][(\sigma\sigma)\ldots$

c. $4n + 5$ syllables
$[\sigma\sigma\sigma\sigma\sigma][\sigma\sigma\ldots \rightarrow [(\sigma\sigma)(\sigma\sigma)\ \sigma][(\sigma\sigma)\ldots$ *or* $[(\sigma\sigma)\ \sigma\ (\sigma\sigma)][(\sigma\sigma)\ldots$
$[\sigma\sigma\sigma\sigma\sigma\sigma\sigma\sigma\sigma][\sigma\sigma\ldots \rightarrow [(\sigma\sigma)(\sigma\sigma)(\sigma\sigma)\ \sigma\ (\sigma\sigma)][(\sigma\sigma)\ldots$
or $[(\sigma\sigma)(\sigma\sigma)\ \sigma\ (\sigma\sigma)(\sigma\sigma)][(\sigma\sigma)\ldots$

The tableau in (54) illustrates the reason for the optionality using a non-final nine-syllable prosodic word. Since the third foot is equally well-aligned whether it is drawn towards the left edge of its own prosodic word, as in (54a), or the left edge of the prosodic word that follows, as in (54b), ALIGN (F, L) cannot distinguish between the two positions. It allows either option.[17]

(54)

	ALIGN (F, L)
☞ a. [(σσ)(σσ)(σσ) σ (σσ)][(σσ) …	[cc cccc ff][…
☞ b. [(σσ)(σσ) σ (σσ)(σσ)][(σσ) …	[cc ffff ff][…

The corresponding RSA constraints are not susceptible to this problem. Since ALL-FEET-LEFT and ALL-FEET-RIGHT only prohibit misalignment between feet and the prosodic words that contain them, a candidate can never improve its performance by orienting one or more of its feet towards the relevant edge of an adjacent prosodic word. Consider in (55) the effects of ALL-FEET-LEFT when evaluating multiple prosodic words. All three feet in the first prosodic word orient themselves towards the left edge of the first prosodic word, and all three feet in the second prosodic word orient themselves towards the left edge of the second. ALL-FEET-LEFT produces the expected unidirectional pattern, and no Midpoint Pathology effect emerges.

[17] ALIGN (F, R) would produce a right-oriented unidirectional pattern in initial prosodic words and an unattested type of bidirectional pattern in non-initial prosodic words. I omit the additional tableaux.

(55)

		ALL-FEET-LEFT
☞ a.	[(σσ)(σσ)(σσ) σ][(σσ)(σσ)(σσ) σ]	[cc cccc][cc cccc]
b.	[(σσ)(σσ) σ (σσ)][(σσ)(σσ)(σσ) σ]	[cc ccccc!][cc cccc]

By avoiding Midpoint Pathology effects, RSA constraints establish the desired general directional orientations for feet, even in forms containing multiple prosodic words. As a result, they establish general directional orientations more reliably than GA itself.

4.3 Opposite-edge alignment

Like its same-edge constraints, GA's opposite-edge constraints produce Midpoint Pathology effects because they are both distance-sensitive and relation general. Consider, for example, the opposite-edge GA constraint ALIGN (F, L, x_ω, R, σ), a constraint that requires alignment between the left edges of feet and the right edge of a primary stress. ('x_ω' denotes a prosodic word-level gridmark, or primary stress.)

(56) ALIGN (F, L, x_ω, R, σ): The left edge of every foot coincides with the right edge of some primary stress. Assess a violation mark for each syllable intervening between misaligned edges.

As (57) illustrates, ALIGN (F, L, x_ω, R, σ) draws the right stress edge to the left edge of the medial foot, minimizing the overall distance between the right stress edge and the left edges of *all* misaligned feet. In (57) and (59), *p* denotes a violation mark derived from a misaligned foot that precedes the stress, *f* a violation mark from a misaligned foot that follows the stress, and *c* a violation mark from a misaligned foot that contains the stress.

(57)

	ALIGN (F, L, x_ω, R, σ)
a. (σ́σ)(σσ)(σσ)(σσ)(σσ)	c f fff fffff fff!ffff
b. (σσ́)(σσ)(σσ)(σσ)(σσ)	cc ff ffff fffff!f
c. (σσ)(σ́σ)(σσ)(σσ)(σσ)	ppp c f fff fffff!
☞ d. (σσ)(σσ́)(σσ)(σσ)(σσ)	pppp cc ff ffff
e. (σσ)(σσ)(σ́σ)(σσ)(σσ)	ppppp ppp c f fff!
f. (σσ)(σσ)(σσ́)(σσ)(σσ)	pppppp pppp cc f!f
g. (σσ)(σσ)(σσ)(σ́σ)(σσ)	ppppppp ppppp p!pp c f
h. (σσ)(σσ)(σσ)(σσ́)(σσ)	pppppppp ppppp!p pppp cc
i. (σσ)(σσ)(σσ)(σσ)(σ́σ)	ppppppppp pppp!ppp ppppp ppp c
j. (σσ)(σσ)(σσ)(σσ)(σσ́)	pppppppppp ppp!ppppp pppppp pppp cc

Like its same-edge counterparts, RSA's opposite-edge constraints avoid Midpoint Pathology effects due to their relation-specificity. In the opposite-edge case, however, the remedy has some surprising consequences. Opposite-edge constraints have the effect of confining instances of one of the aligned categories to a 'window' at an edge of a form established by an instance of the other aligned category. Consider how an opposite-edge constraint like ALIGN (F, L, x_ω, R, σ) would have to be formulated under RSA. The prohibited configuration in RSA's opposite-edge alignment schema, (18c), is one where one aligned category precedes the other with the separator category intervening. To require alignment between the right edge of a primary stress and the left edge of a foot, then, the prohibited configuration would have to be one where a primary stress precedes a foot with a syllable intervening. Including the separator category, *syllable*, in the definition of an LV makes the constraint distance-sensitive. The result is the FINAL-WINDOW constraint, (58a). Along with its sister constraint INITIAL-WINDOW, (58b), FINAL-WINDOW will play an important role in the analysis of trisyllabic stress windows further below.

(58) a. FINAL-WINDOW: $*\langle x_\omega, F, \sigma\rangle / x_\omega \ldots \sigma \ldots F$
'Assess a violation mark for every $\langle x_\omega, F, \sigma\rangle$ such that x_ω precedes F with σ intervening.'

b. INITIAL-WINDOW: $*\langle F, x_\omega, \sigma\rangle / F \ldots \sigma \ldots x_\omega$
'Assess a violation mark for every $\langle F, x_\omega, \sigma\rangle$ such that F precedes x_ω with σ intervening.'

Though FINAL-WINDOW is like ALIGN (F, L, x_ω, R, σ) in that it is distance-sensitive and promotes alignment between the left edges of feet and the right edge of the primary stress, it differs from its GA counterpart in being relation-specific. Where ALIGN (F, L, x_ω, R, σ) prohibits misalignment whether the misaligned foot precedes, follows, or contains the primary stress, FINAL-WINDOW prohibits misalignment only when the misaligned foot follows the stress. As (59) illustrates, FINAL-WINDOW draws the primary stress, not to the center of the form, but to the syllable adjacent to the final foot, as in (59h), or to one of the two syllables that make up the final foot, as in (59i, j). The constraint is satisfied when the stress occurs in these positions because any misaligned foot either precedes the stress or contains it and, therefore, fails to produce violation marks. The result is that FINAL-WINDOW confines the primary stress to a three-syllable window at the right edge.

(59)

	FINAL-WINDOW
a. (σ́σ)(σσ)(σσ)(σσ)(σσ)	f! fff fffff ffffff
b. (σσ́)(σσ)(σσ)(σσ)(σσ)	f!f ffff fffff
c. (σσ)(σ́σ)(σσ)(σσ)(σσ)	f! fff fffff
d. (σσ)(σσ́)(σσ)(σσ)(σσ)	f!f ffff
e. (σσ)(σσ)(σ́σ)(σσ)(σσ)	f! fff
f. (σσ)(σσ)(σσ́)(σσ)(σσ)	f!f
g. (σσ)(σσ)(σσ)(σ́σ)(σσ)	f!
☞h. (σσ)(σσ)(σσ)(σσ́)(σσ)	
☞i. (σσ)(σσ)(σσ)(σσ)(σ́σ)	
☞j. (σσ)(σσ)(σσ)(σσ)(σσ́)	

In a similar fashion, INITIAL-WINDOW confines primary stress to a three-syllable window at the left edge. INITIAL-WINDOW is satisfied when the primary stress occurs either on the syllable immediately following the initial foot or on one of the two syllables within the initial foot. I omit the additional tableau.

4.3.1 A general approach to trisyllabic stress windows

Though the window effect is unexpected, it is not unwelcome. It is often the case that some type of phonological structure finds itself confined to a certain space at the edge of a form. The window effect provides a simple, general account in such situations. Perhaps the most familiar examples are found in languages with trisyllabic stress windows, languages that confine primary stress to a form's first three syllables or a form's final three syllables.

Languages that confine primary stress to the first three syllables include Azkoitia Basque (Hualde 1998) and Kashaya (Buckley 1992, 1994). The example forms in (60) are from Azkoitia Basque, where stress occurs on the rightmost of the first three syllables that is not also the word-final syllable.

(60) Initial stress window in Azkoitia Basque

a.	óna	'good'
b.	gizóna	'man'
c.	katedrála	'cathedral'
d.	melokótoye	'peach'
e.	telebísixue	'television'

Languages that confine primary stress to the final three syllables include Latin, Macedonian (Comrie 1976), Maithili (Jha 1940–1944, 1958; Hayes 1995), and Pirahã (Everett and Everett 1984; Everett 1988). The example forms in (61) and (62) are from Macedonian. In the regular Macedonian pattern, stress occupies the leftmost of the final three syllables.

(61) Macedonian regular pattern

a.	zbór	'word'	b.	vodéničar	'miller'
	zbórot			vodeníčarot	
	zbórovi			vodeníčari	
	zboróvite			vodeničárite	

In the irregular pattern, stress occurs on a lexically specified syllable as long as it is one of the final three. If suffixation pushes the lexically specified syllable further to the left, stress returns to the antepenult by default.

(62) Macedonian irregular pattern

a.	citát	'quotation'	b.	romántik	'romantic'
	citátot			romántikot	
	citáti			romántici	
	citátite			romantícite	

The RSA constraints Initial-Window and Final-Window provide a simple, general account of the most difficult aspect of trisyllabic stress windows: their size. In theories that exclude ternary feet, as most contemporary theories of metrical stress do, there is no prosodic category that regularly consists of three syllables and that could, therefore, be used to establish a trisyllabic domain directly. Initial-Window and Final-Window allow the theory to focus on the gap between the stress and the relevant edge of the form rather than on the three-syllable domain itself. Since the maximum gap is two syllables, the standard disyllabic foot is the obvious choice to establish it. A language with a trisyllabic window at the left edge is one where INITIAL-WINDOW confines primary stress to the two syllables within the initial foot or the syllable immediately following the initial foot. A language with a trisyllabic window at the right edge is one where FINAL-WINDOW confines primary stress to the two syllables within the final foot or the syllable immediately preceding the final foot.

Given space limitations, I will not attempt to illustrate how INITIAL-WINDOW and FINAL-WINDOW help to account for each of the different cases of trisyllabic stress windows individually. It should be reasonably clear that they confine primary stress to the appropriate domains. Instead, I will examine two crucial examples, Macedonian and Maithili, to indicate the possibility of a general account under the RSA approach and the impossibility of a general account under alternative approaches.

Before proceeding, it should be noted that the proposed account is not compatible with all approaches to metrical stress. Crucial to the analysis is the assumption that the grammar allows stressless feet. To establish a stress window, there must be a foot to carry the primary stress and there must be a foot to establish the maximal gap between the primary stress and the relevant edge. When the primary stress occurs on a window's innermost syllable (the post-peninitial syllable for initial windows and the antepenultimate syllable for final windows) the two feet are necessarily distinct. To accommodate languages where no stress occurs in the gap, a typical but not a universal circumstance, it must be possible for the foot that establishes the gap to be stressless.[18]

4.3.2 Macedonian

In Macedonian, many forms exhibit a regular, predictable stress pattern, but there are also numerous cases of irregular, lexical stress. In the regular pattern, as we saw in (61), primary stress occurs on the antepenult. There appears to be no evidence of secondary stress. In the irregular pattern, as we saw in (62), primary stress occurs on a lexically specified syllable as long as it is one of the final three. If suffixation pushes the stress beyond the three-syllable window, it returns to the antepenult by default.

To produce the antepenultimate stress of the regular pattern, FINAL-WINDOW creates a three-syllable window at the right edge of the word and MAIN-STRESS-LEFT, given in (63), aligns the primary stress as far to the left within the window as possible.

(63) MAIN-STRESS-LEFT: $*\langle \omega, x_\omega, \sigma \rangle / [\ldots \sigma \ldots x_\omega \ldots]_\omega$
'Assess a violation mark for every $\langle \omega, x_\omega, \sigma \rangle$ such that σ precedes x_ω within ω.'

As (64) illustrates, the ranking FINAL-WINDOW $\gg$ MAIN-STRESS-LEFT locates the primary stress just to the left of a final stressless foot. FINAL-WINDOW excludes

[18] Accounts that allow stressless feet include those of Hayes (1987), Tyhurst (1987), Hung (1993, 1994), Selkirk (1995), Crowhurst (1996), Hyde (2001, 2002), and Buckley (2009).

(64c, d), where the primary stress fails to occur either within the final foot or adjacent to the final foot. As for the remaining competitors, MAIN-STRESS-LEFT excludes (64a, b), because the stress occurs further to the left in (64w).

(64)

	FINAL-WINDOW	MAIN-STRESS-LEFT
→ w. σσσ́(σσ)	0	2
a. σσσ(σσ́)	0	4 W
b. σσσ(σ́σ)	0	3 W
c. σσ́σ(σσ)	1 W	1 L
d. σ́σσ(σσ)	1 W	0 L

When we insert the constraint that requires faithfulness to a lexically stressed syllable into the ranking between FINAL-WINDOW and MAIN-STRESS-LEFT, the analysis also establishes the appropriate restrictions on irregular stress. (See Pater 2000; Alderete 2001a, 2001b; and Revithiadou 2006, among others, for discussion of lexical stress in OT.)

(65) FAITH-STRESS: A stress in the input occurs on the same syllable in the output.

As (66) illustrates, FINAL-WINDOW must dominate FAITH-STRESS to prevent stress from following the lexically specified syllable beyond the three-syllable window. FINAL-WINDOW excludes the faithful candidate in such cases and, in conjunction with the low-ranked MAIN-STRESS-LEFT (omitted from the tableau), returns stress to its default position over the antepenult.

(66)

σσ́σσσ	FINAL-WINDOW	FAITH-STRESS
→ w. σσσ́(σσ)	0	1
l. σσ́σ(σσ)	1 W	0 L

As (67) illustrates, FAITH-STRESS must dominate MAIN-STRESS-LEFT to allow the lexically specified syllable to retain stress when it is penultimate or final. In such cases, FAITH-STRESS prevents MAIN-STRESS-LEFT from pushing the stress to the left edge of the window.

(67)

σσσσ́σ	FAITH-STRESS	MAIN-STRESS-LEFT
→ w. σσσ(σ́σ)	0	3
l. σσσ́(σσ)	1 W	2 L

To summarize, then, the RSA approach to opposite-edge alignment helps to establish the type of stress window appropriate for both the regular and irregular stress patterns of Macedonian. A stress window arises when no syllable can separate the stress from the final (or, in some languages, the initial) foot. Hence, stress is free to occupy any of the final (or initial) three syllables, but it is limited to just these three. The ranking FINAL-WINDOW ≫ FAITH-STRESS ≫ MAIN-STRESS-LEFT establishes the antepenultimate stress of the regular Macedonian pattern and confines lexical stress to a three-syllable window in the irregular pattern.

4.3.3 Maithili

The trochaic language Maithili (Jha 1940–1944, 1958; Hayes 1995) offers one of the clearest examples of a trisyllabic window for primary stress being accompanied by a pattern of secondary stresses.[19] The basic pattern locates stress on the initial syllable and every even-numbered syllable counting from the right with the rightmost stress being primary. This basic pattern can be altered, however, by the preference of primary stress to occur on a heavy syllable. As (68c, d) illustrate, if the penult is heavy, it carries the primary stress, and the overall pattern is the same as if both the penult and the antepenult were light. As (68e) illustrates, however, if the penult is light and the antepenult heavy, primary stress shifts to the antepenult, leaving the penult with secondary stress. Any secondary stress between the antepenult and the initial syllable shifts one syllable to the left.

(68) Maithili pattern

a.	L̀ĹL	bíndúlə̆	‘a fabulous horse’
b.	H̀LĹL	bɑ̀ːǰĭtɒ́tʰĭ	‘speak-3 FUT.’
c.	L̀L̀LH́L	dɑ̀hìnə̆bɑ́ːrĭ	‘the right one’
d.	H̀H́L	dèːkʰɑ́ːrə̆	‘seen’
e.	L̀L̀LH́L̀L	ǰìmùtə̆bɑ́ːhɒ̀nə̆	(proper name)

To focus on the implementation of the stress window, I will take the pattern of secondary stresses as given and consider only the most relevant possible variations in the position of primary stress. Given the pattern of secondary stresses, we can see that primary stress prefers to fall on the rightmost non-final heavy syllable, as long as it is one of the final three. If there is no non-final heavy syllable among the final three, then primary stress occurs on the rightmost non-final syllable. (The avoidance of final stress is due to a high-ranked non-finality constraint, which need not concern us here.)

As in Macedonian, FINAL-WINDOW creates the three-syllable window in Maithili. The rightward orientation of the primary stress can be captured with the alignment constraint, MAIN-STRESS-RIGHT (69a), and the preference of primary stress to fall on a heavy syllable can be captured with STRESS-TO-WEIGHT (69b).[20]

(69) a. MAIN-STRESS-RIGHT: $*\langle\omega, x_\omega, \sigma\rangle/[\ldots x_\omega \ldots \sigma \ldots]_\omega$

‘Assess a violation mark for every $\langle\omega, x_\omega, \sigma\rangle$ such that x_ω precedes σ within ω.’

[19] Norwegian appears to be another case where a secondary stress pattern accompanies a stress window. See Rice (2006) and Lunden (2006) for a description of primary stress and Lorentz (1996) for a description of secondary stress. A secondary stress pattern also accompanies the Kashaya stress window.

[20] STRESS-TO-WEIGHT is formulated here as a non-finality constraint. If primary stress cannot occur on the final mora of a syllable, then a syllable must have at least two moras to support a primary stress. See Hyde (2007) for arguments supporting this approach.

b. Stress-to-Weight: No prosodic word-level gridmark occurs over a syllable-final mora.

The Maithili pattern emerges when Final-Window dominates Stress-to-Weight and Stress-to-Weight dominates Main-Stress-Right.

Ranking Final-Window above Stress-to-Weight prevents the weight of syllables that occur outside the trisyllabic window from affecting the position of primary stress. It prevents primary stress from moving to the left of the antepenult in order to satisfy the lower-ranked Stress-to-Weight.

(70)

HLLL	Final-Window	Stress-to-Weight
→ w. (H̀L)(ĹL)	0	1
l. (H́L)(L̀L)	1 W	0 L

Ranking Stress-to-Weight above Main-Stress-Right allows the preference for primary stress to occupy a heavy syllable to overcome its rightward orientation. As (71) demonstrates, Stress-to-Weight prevents Main-Stress-Right from positioning the primary stress on a light penult when a heavy antepenult is available.

(71)

LLLHLL	Stress-to-Weight	Main-Stress-Right
→ w. (L̀)(L̀L)(H́)(L̀L)	0	2
l. (L̀)(L̀L)(H̀)(ĹL)	1 W	1 L

As (72) and (73) demonstrate, however, the lower-ranked Main-Stress-Right can still draw primary stress onto the penult when the penult and the antepenult are the same weight.

(72)

HHL	Stress-to-Weight	Main-Stress-Right
→ w. (H̀)(H́L)	0	1
l. (H́)(H̀L)	0	2 W

(73)

LLL	Stress-to-Weight	Main-Stress-Right
→ w. (L̀)(ĹL)	1	1
l. (Ĺ)(L̀L)	1	2 W

In summary, the RSA approach to opposite-edge alignment also establishes the type of stress window appropriate for Maithili. The ranking Final-Window ≫ Stress-to-Weight Main-Stress-Right confines the primary stress to one of the final three syllables and ensures that it occurs on a heavy syllable when one is present within the window.

4.3.4 Alternative methods for establishing stress windows

Alternative proposals cannot provide a general approach to stress windows because they fail to account for one of the examples discussed above. A non-finality approach, used by Prince and Smolensky (1993) to produce the stress window of Latin, fails to account for the restrictions on irregular stress in Macedonian. Extended lapse avoidance (Gordon 2002; Kager 2005) and weak local parsing (Kager 1994; Green 1995; Green and Kenstowicz 1995) fail to account for the restrictions on primary stress in Maithili.

First, consider the role that NONFINALITY, given in (74), might play in establishing regular antepenultimate stress.

(74) NONFINALITY: The head foot is not final in the prosodic word.

When NONFINALITY dominates HEAD-FOOT-RIGHT, given in (47b), it prevents the head foot from including the final syllable, as in (75b). Assuming that the head foot is trochaic, then, the primary stress can occur no closer to the right edge than the antepenult. By insisting that the head foot occur as close to the right edge as possible, HEAD-FOOT-RIGHT excludes candidates like (75a), where the primary stress occurs to the left of the antepenult. The result is the regular antepenultimate stress of Macedonian.

(75)

	NONFINALITY	HEAD-FOOT-RIGHT
→ w. σσσ(σ́σ)σ	0	1
a. σσ(σ́σ)σσ	0	2 W
b. σσσσ(σ́σ)	1 W	0 L

The problem arises in accounting for the irregular Macedonian pattern: attempting to use NONFINALITY to restrict lexical stress to a three-syllable window results in a ranking conflict. As (76) illustrates, FAITH-STRESS must dominate NONFINALITY in order to allow irregular stress on the penult or the ultima.

(76)

σσσσσ́σ	FAITH-STRESS	NONFINALITY
→ w. σσσσ(σ́σ)	0	1
l. σσσ(σ́σ)σ	1 W	0 L

As (77) indicates, however, when the lexically specified syllable has drifted further to the left, it is necessary to rank NONFINALITY above HEAD-FOOT-RIGHT and to rank HEAD-FOOT-RIGHT above Faith-Stress in order to return the primary stress to its default position over the antepenult.

(77)

σσσ́σσσ	NONFINALITY	HEAD-FOOT-RIGHT	FAITH-STRESS
→ w. σσσ(σ́σ)σ	0	1	1
a. σσ(σ́σ)σσ	0	2 W	0 L
b. σσσσ(σ́σ)	1 W	0 L	1

FAITH-STRESS must dominate NONFINALITY, then, so that a lexically specified stress is retained when it occurs on any of the final three syllables, but NONFINALITY must dominate FAITH-STRESS in order to return stress to its default location when the lexically specified syllable drifts outside the window. These conflicting ranking requirements make it impossible to implement the analysis, demonstrating that non-finality is inadequate as a general approach to stress windows.

The demonstration that extended lapse avoidance and weak local parsing are also inadequate is even more straightforward. Some stress windows are accompanied by a pattern of secondary stresses with binary alternation. In the case of Maithili, there can even be a secondary stress within the stress window intervening between the primary stress and the right edge of the prosodic word. Since the distance between stresses and the distance between peripheral stresses and word edges is actually smaller than that allowed by extended lapse avoidance or weak local parsing, neither can be used to establish the stress window.

The extended lapse avoidance approach is the more direct of the two. *EXTENDED-LAPSE-RIGHT simply prohibits configurations where the final three syllables of a form are all stressless.[21]

(78) *EXTENDED-LAPSE-RIGHT: A maximum of two unstressed syllables separates the rightmost stress from the right edge of the stress domain.

As (79) illustrates, assuming that the primary stress is the only stress, *EXTENDED-LAPSE-RIGHT is only satisfied when the primary stress occurs over one of the final three syllables, effectively establishing a trisyllabic window.

(79)

	*EXTENDED-LAPSE-RIGHT
☞ a. σσσσσσ́	
☞ b. σσσσσ́σ	
☞ c. σσσσ́σσ	
d. σσσ́σσσ	*
e. σσ́σσσσ	*

The weak local parsing approach is less direct. WEAK-LOCAL-PARSING prohibits a form from containing adjacent stray syllables.[22]

(80) WEAK-LOCAL-PARSING: For every two adjacent syllables, one must be parsed into a foot.

As (81) illustrates, assuming that the primary stress is the only stress, the constraint can be satisfied only when the final foot occurs no more than one syllable away from the right edge. If the final foot is the head foot, WEAK-LOCAL-PARSING effectively establishes a trisyllabic window for the primary stress.

[21] The constraint is *EXTENDED-LAPSE-RIGHT in Gordon (2002) and *FINAL-LONG-LAPSE in Kager (2005).

[22] WEAK-LOCAL-PARSING represents the LAPSE constraint of Green (1995) and Green and Kenstowicz (1995) and the PARSE-2 constraint of Kager (1994). Though there is a slight difference between the two constraints, both essentially insist on weak local parsing. (See Hayes 1995 for discussion.)

(81)

	WEAK-LOCAL-PARSING
☞ a. σ(σσ)σ(σ́σ)	
☞ b. (σσ)σ(σ́σ)σ	
c. (σσ)(σ́σ)σσ	*

The problem for such approaches arises when other considerations impose more severe restrictions on stresses or feet than those imposed by *EXTENDED-LAPSE-RIGHT or WEAK-LOCAL-PARSING. If *EXTENDED-LAPSE-RIGHT and WEAK-LOCAL-PARSING do not actually play a role in establishing the maximum distance allowed between the rightmost stress and the right edge of the word, they cannot establish a stress window.

In the case of Maithili, for example, neither *EXTENDED-LAPSE-RIGHT nor WEAK-LOCAL-PARSING can restrict the primary stress's position. Since no more than one syllable ever occurs between the rightmost stress and the end of the word, *EXTENDED-LAPSE-RIGHT has no influence over the position of the primary stress. It is satisfied regardless of which stress is primary. Similarly, since parsing is exhaustive, WEAK-LOCAL-PARSING has no influence over the position of the primary stress.

(82)

LLLHLL	*EXTENDED-LAPSE-RIGHT	WEAK-LOCAL-PARSING
☞ a. (L̀)(L̀L)(H̀)(ĹL)		
☞ b. (L̀)(L̀L)(H́)(L̀L)		
☞ c. (L̀)(ĹL)(H̀)(L̀L)		
☞ d. (Ĺ)(L̀L)(H̀)(L̀L)		

Since *EXTENDED-LAPSE-RIGHT and WEAK-LOCAL-PARSING cannot effectively restrict the position of primary stress in languages that have a binary pattern of secondary stresses, neither offers a general approach to stress windows.

4.4 Interim summary and remarks

Two advantages emerge from RSA's relation-specificity. The first is that RSA avoids Midpoint Pathology effects without abandoning distance-sensitivity and losing the ability to produce essential directionality effects. In fact, in avoiding Midpoint Pathology effects, RSA not only escapes the Midpoint Pathology's characteristic curiosities of overgeneration, it is also able to produce essential directionality effects more consistently than GA itself. The second advantage is that relation-specificity allows for a general account of trisyllabic stress windows (and other types of windows). While alternatives such as non-finality, extended lapse avoidance, and weak local parsing can all establish trisyllabic windows in certain contexts, none of them offers the same level of generality as that provided by RSA's opposite-edge alignment constraints.

Before moving on, an anonymous reviewer asks about the prediction of window effects arising from opposite-edge alignment in other domains; for example, opposite-edge alignment of morphological or syntactic categories. Though same-edge alignment is typically employed to position affixes relative to stems—in other words, to position them as prefixes or suffixes (McCarthy and Prince 1993b;

Orgun and Sprouse 1999)—opposite-edge alignment is often employed to prevent epenthesis between stems and affixes (McCarthy and Prince 1993a, 1993b, 1994). As the reviewer points out, under the RSA approach to opposite-edge alignment, we might expect an affix to attach to the innermost edge of a peripheral stem in a complex base, much like primary stress positions itself adjacent to the innermost edge of a peripheral foot in the regular Macedonian stress pattern.

(83)	a.	Initial window [stem+aff stem stem ...]	b.	Final window [... stem stem aff+stem]

While I do not know of an example that matches this hypothetical case exactly, there are some well-known phenomena that are parallel in a reasonably straightforward way. In verb-second languages, for example, the verb must appear just to the right of the leftmost constituent. In Wackernagel phenomena, much the same restriction is placed on clitics. The clitic must occur just to the right of the leftmost base. In infixing languages, restrictions on the depth of infixation are also suggestive of window effects. In the interest of space, I will not explore these examples in detail here.

5 Concluding remarks and directions for future research

This article has presented a new approach to alignment constraints: Relation-Specific Alignment. RSA maintains Generalized Alignment's ability to produce the essential directionality effects, but it avoids GA's susceptibility to the Midpoint Pathology. In Sect. 1, we saw that two characteristics are necessary for Midpoint Pathology effects to emerge: alignment constraints must be distance-sensitive, but they must also be relation-general. GA is susceptible to the Midpoint Pathology because it has both characteristics. RSA is immune because it does not. While RSA constraints can be distance-sensitive, they are always relation-specific.

In Sect. 2, we saw that RSA achieves relation-specificity by prohibiting misalignment directly and by insisting that a particular relation of containment or precedence between the aligned categories be specified in the prohibited configuration. We also saw that RSA accommodates both distance-insensitive and distance-sensitive assessment without resorting to gradient evaluation. Employing only categorical evaluation, the type of assessment depends on whether or not the definition of a locus of violation includes the separator category. If the separator category is omitted, assessment is distance-insensitive. If it is included, assessment is distance-sensitive.

In Sect. 3, we saw that distance-sensitive assessment is crucial to alignment's ability to establish general directional orientations and that RSA's distance-sensitivity allows it to duplicate GA's essential directionality effects. We also saw that a non-alignment alternative like Rhythmic Licensing is an inadequate replacement in crucial contexts: bidirectional stress patterns in underparsing systems, left-oriented moraic trochee systems, and systems with foot extrametricality and similar effects. We also saw that parallelism is necessary for alignment's characteristic directionality effects to emerge on the surface. Under Harmonic Serialism, alignment loses one of its most important advantages: its inability to produce bidirectional patterns in systems with exhaustive parsing.

In Sect. 4, we examined the consequences of RSA's relation-specificity. Relation-specificity not only allows RSA to avoid Midpoint Pathology effects, but it also allows it to produce the essential directionality effects more reliably than GA and to offer a general account of trisyllabic stress windows.

While the article has addressed several fundamental issues, many questions remain. The first, not necessarily specific to RSA, is how to establish, in a principled way, appropriate restrictions on the inventory of alignment constraints that the theory allows. I do not take the position that any constraint that can be formulated under a general definition is necessarily a part of the grammar, but there must be a principle or set of principles telling us which to include and which to omit. These, of course, will likely depend on the characteristics of the particular approach under consideration. In Hyde's (2001, 2002) Weak Bracketing approach to metrical stress, for example, it is crucial that head syllables of feet be aligned rather than feet themselves. In Alber's (2005) Asymmetrical Alignment approach it is crucial that feet be aligned only to the left and never to the right. Accounts employing alignment constraints should make as clear as possible the principle that divides the constraints that are adopted from those that are crucially excluded.

An anonymous reviewer points to a potentially similar situation. In cases where alignment constraints have been employed to prevent epenthesis between affixes and their bases, it seems always to be crucial that assessment is distance-insensitive. (See McCarthy 2003 for discussion.)[23] Given the cases where distance-sensitivity is crucial, however, several of which were examined in Sect. 3, the option of simply abandoning distance-sensitive assessment is unavailable. One task for future work on the crucially distance-insensitive cases, then, is how to ensure, in a principled way, that the analyses only employ distance-insensitive assessment.

A second question that should be mentioned here concerns the new uses for alignment constraints that the proposed approach makes possible. For example, though it is clear that the RSA analysis captures the basic characteristics of stress windows, it remains to be seen exactly how the typologies predicted by the various compatible frameworks will be affected by accommodating the constraints necessary to execute it. The introduction of a new formulation will necessarily have unanticipated consequences, both positive and negative. Since these potential consequences cannot all be adequately explored in a single article, however, they are necessarily the objects of future research.

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[23] McCarthy (2003) appeals to the need for distance-insensitivity as his reason for supplanting alignment constraints in such cases with anchoring constraints (McCarthy and Prince 1995). Since McCarthy's alignment constraints are supposed to be distance-insensitive, however, this cannot be the whole story. The fact that his alignment formulation does not provide for opposite-edge constraints also seems to be a factor.

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