A Closer Look at Iterative Foot Optimization and the Case against Parallelism

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December 15, 2009

> "How does she shoot? If you're examining a rifle to see if it killed a man, don't you have to have some idea how it shoots?"
>
> "I can assure you, sir, it has all the hallmarks of a rifle customized for maximum accuracy."
>
> "Yes, but how does it shoot?"
>
> -Stephen Hunter, *Point of Impact*

1 Introduction

The Iterative Foot Optimization proposal of Pruitt (2008) is an important contribution in the debate over serial and parallel derivation in phonology. In IFO, proponents may have found an argument for serialism independent of opacity effects, the area in which serialism is commonly thought to enjoy its greatest advantage. (See Bakovic 2007, 2009 however, for arguments that serialism's grip on this area is not as firm as many suppose.) The IFO-based argument for serialism arises, in fact, in the context of basic quantity-insensitive binary stress patterns, an area that many consider one of the strengths of parallelism. Pruitt's paper compares the predictions of IFO, couched in the framework of Harmonic Serialism (Prince and Smolensky 1993, McCarthy 2007), to those of Generalized Alignment (McCarthy and Prince 1993), the earliest account of metrical stress in Optimality Theory, and claims that the former avoids the difficulties associated with the Odd-Parity Parsing Problem (Hyde 2007, 2008) and related issues, while the latter does not.

The results of the study must be taken seriously. A direct comparison between IFO and GA is an experiment with excellent controls. IFO and GA share the same Weak Layering (Ito and Mester 1992) structural assumptions and the same set of constraints. They differ only in their derivational perspective, IFO adopting the serialism of HS and GA the parallelism of OT. Since derivational perspective is the only difference, it is necessarily the source of any disparity in performance. If IFO avoids the Odd-Parity Parsing Problem and GA does not, as Pruitt concludes, the blame must be laid at the feet of parallelism.

The logic is sound, and the results are clear-cut. Given the significance of their implications, however, another look is certainly warranted and, perhaps, even obligatory. In the discussion that follows, I compare the predictions of GA and IFO in some detail, both in the context of the basic directional parsing patterns of quantity-insensitive systems and in the context of the Odd-Parity Parsing Problem. Since the evidentiary net has been cast a bit wider here than in the original comparison, however, there are additional results to consider, and they lead to a strikingly different conclusion.

2 Basic Directional Parsing Patterns

Iterative Foot Optimization and Generalized Alignment have much in common. To begin, they share the structural assumptions of Weak Layering, giving them the same two options for dealing with the syllable that is leftover in an odd-parity form after disyllabic footing is no longer possible. Weak Layering allows the leftover syllable to remain unfooted, as in (1a), or to be parsed as a monosyllabic foot, as in (1b).

(1) Layering Irregularities under Weak Layering

a. Unparsed Syllable	b. Monosyllabic Foot
(σσ)(σσ)(σσ)σ	(σσ)(σσ)(σσ)(σ)

To determine which option is preferred in a particular language, GA and IFO employ the same parsing and minimality constraints.

(2)
a. PARSE-SYLLABLE: Every syllable is parsed into a foot.
b. FOOT-BINARITY: Every foot is binary (either disyllabic or bimoraic).

PARSE-SYLLABLE requires that every syllable be parsed into a foot, and FOOT-BINARITY requires that feet be at least bimoraic. If Parse-σ is higher-ranked, the leftover syllable will be parsed as a monosyllabic foot. If Ft-Bin is higher-ranked, the leftover syllable will be left unfooted (unless it is heavy and appropriately positioned, as we shall see below).

GA and IFO also employ the same set of alignment constraints to produce directional parsing effects. ALL-FEET-LEFT and ALL-FEET-RIGHT apply to every foot in a prosodic word. They are primarily responsible for establishing general directional orientations for feet.

(3) Alignment Constraints
a. ALL-FEET-LEFT: The left edge of every foot is aligned with the left edge of some prosodic word.
b. ALL-FEET-RIGHT: The right edge of every foot is aligned with the right edge of some prosodic word.
c. PRWD-LEFT: The left edge of every prosodic word is aligned with the left edge of some foot.
d. PRWD-RIGHT: The right edge of every prosodic word is aligned with the right edge of some foot.

PRWD-LEFT and PRWD-RIGHT, apply to just one foot in a prosodic word. Their primary function is to create exceptions to general directional orientations.

In truth, GA and IFO are not even entirely at odds in their derivational perspectives. GA is implemented in the thoroughly parallel OT framework. IFO is implemented in the fundamentally serial HS framework. Rather than reverting to a rule-based format, however, HS assumes, like OT, that simple grammatical requirements interact in the form of ranked constraints, and it retains just enough parallelism to allow constraint ranking to function.

In the discussion that follows, we set aside issues related to the Odd-Parity Parsing Problem – the effects of syllable weight and the possibility of faithfulness violations – and focus for the moment on the basic quantity-insensitive directional parsing patterns that emerge under GA and IFO.

2.1 Directional Parsing Patterns in Generalized Alignment

We begin with the predictions of the more familiar GA approach. Of the twelve basic patterns predicted by GA (when the effects of syllable weight are not considered), two-thirds can be found in attested quantity-insensitive languages.

GA produces the patterns in (4,5) when FEET-L and FEET-R rank highly enough that their ability to establish general directional orientations for feet results in simple unidirectional patterns. The unidirectional patterns in (4) emerge when FT-BIN dominates PARSE-σ, so that the leftover syllable of odd-parity forms is left unfooted. Notice effect that the alignment constraints have on stray syllables, pushing them away from the designated edge of alignment. In drawing feet toward the left edge, FEET-L pushes the unparsed syllable to the right. In drawing feet to the right edge, FEET-R pushes the unparsed syllable to the left.

(4) Unidirectional Underparsing Patterns Predicted by Generalized Alignment[1]

a. FT-BIN >> PARSE-σ >> FEET-L

i. Trochaic: Pintupi-type	ii. Iambic: Araucanian-type
(σ́σ)(σ́σ)(σ́σ)	(σσ́)(σσ́)(σσ́)
(σ́σ)(σ́σ)(σ́σ)σ	(σσ́)(σσ́)(σσ́)σ

b. FT-BIN >> PARSE-σ >> FEET-R

i. Trochaic: Nengone-type	ii. Iambic: *Unattested*
(σ́σ)(σ́σ)(σ́σ)	(σσ́)(σσ́)(σσ́)
σ(σ́σ)(σ́σ)(σ́σ)	σ(σσ́)(σσ́)(σσ́)

The unidirectional patterns in (5) emerge when PARSE-σ dominates FT-BIN, so that the leftover syllable in an odd-parity form is parsed as a monosyllabic foot. Notice that alignment constraints have a different effect on monosyllabic feet than they do on stray syllables, drawing them towards the designated edge of alignment rather that pushing them away (Crowhurst and Hewitt 1995). FEET-L draws monosyllabic feet to the left edge of the prosodic word, and FEET-R draws them to the right edge.

[1] For a description of Pintupi, see Hansen and Hansen 1969. For Araucanian, see Echeverria and Contreras 1965. For Nengone, see Tryon 1967.

(5) Unidirectional Exhaustive Parsing Patterns Predicted by Generalized Alignment[2]

a. PARSE-σ >> FT-BIN >> FEET-L

i. Trochaic: Passamaquoddy-type
(σ́σ)(σ́σ)(σ́σ)
(σ́)(σ́σ)(σ́σ)(σ́σ)

ii. Iambic: Suruwaha-type
(σσ́)(σσ́)(σσ́)
(σ́)(σσ́)(σσ́)(σσ́)

b. PARSE-σ >> FT-BIN >> FEET-R

i. Trochaic: Maranungku-type
(σ́σ)(σ́σ)(σ́σ)
(σ́σ)(σ́σ)(σ́σ)(σ́)

ii. Iambic: *Unattested*
(σσ́)(σσ́)(σσ́)
(σσ́)(σσ́)(σσ́)(σ́)

The reason for alignment's disparate effects on stray syllables and monosyllabic feet is fairly straightforward. As (6) illustrates, when it is feet that are being aligned, a stray syllable does not incur violation marks through its own misalignment. It only helps to produce violation marks through its intervention between a foot and the designated edge of the prosodic word. It is always to a candidate's advantage, then, to position a stray syllable as far from the designated edge as possible, so that it has fewer opportunities to separate a foot from the designated edge. (A leftward pointing hand, "☜", indicates the candidate favored by an individual constraint.)

(6)

	FEET-L	FEET-R
a. (σσ)(σσ)(σσ)σ	☜ ** **** (6)	***** *** * (9)
b. (σσ)(σσ)σ(σσ)	** ***** (7)	***** *** (8)
c. (σσ)σ(σσ)(σσ)	*** ***** (8)	***** ** (7)
d. σ(σσ)(σσ)(σσ)	* *** ***** (9)	☜ **** ** (6)

In contrast, as (7) illustrates, a foot helps to incur violation marks both through its own misalignment and, due to its constituent syllables, through its intervention between another foot and the designated edge. Although a smaller foot and a larger foot both incur the same number of violation marks for the same degree of misalignment, a smaller foot always results in fewer violation marks through intervention than a larger foot. It is always to a candidate's advantage, then, to position larger feet as far as possible from the designated edge, giving their more numerous constituent syllables less opportunity for intervention.

[2] For a description of Passamaquoddy, see LeSourd 1993. For Suruwaha, see Everett 1996. For Maranungku, see Tryon 1970.

(7)

	FEET-L	FEET-R
a. (σσ)(σσ)(σσ)(σ)	** **** ****** (12)	☜ ***** *** * (9)
b. (σσ)(σσ)(σ)(σσ)	** **** ***** (11)	***** *** ** (10)
c. (σσ)(σ)(σσ)(σσ)	** *** ***** (10)	***** **** ** (11)
d. (σ)(σσ)(σσ)(σσ)	☜ * *** ***** (9)	****** **** ** (12)

In addition to the eight unidirectional patterns in (4,5), GA predicts the four bidirectional patterns in (8). When the ranking FT-BIN >> PARSE-σ creates a stray syllable in odd-parity forms, PRWD-L and PRWD-R can create exceptions to the general directional orientations established by FEET-R and FEET-L, respectively. When PRWD-L dominates FEET-R, as in (8a), the former anchors a single foot at the left edge, and the latter draws the remaining feet to the right, stranding the unparsed syllable just to the right of the initial foot. When PRWD-R dominates FEET-L, as in (8b), the former anchors a single foot at the right edge, and the latter draws the remaining feet to the left, stranding the unparsed syllable just to the left of the final foot.

(8) Bidirectional Underparsing Patterns Predicted by Generalized Alignment[3]

a. FT-BIN >> PARSE-σ >> FEET-R; PRWD-L >> FEET-R
   - i. Trochaic: Garawa-type
     (σ́σ)(σ́σ)(σ́σ)
     (σ́σ)σ(σ́σ)(σ́σ)
   - ii. Iambic: *Unattested*
     (σσ́)(σσ́)(σσ́)
     (σσ́)σ(σσ́)(σσ́)

b. FT-BIN >> PARSE-σ >> FEET-L; PRWD-R >> FEET-L
   - i. Trochaic: Piro-type
     (σ́σ)(σ́σ)(σ́σ)
     (σ́σ)(σ́σ)σ(σ́σ)
   - ii. Iambic: *Unattested*
     (σσ́)(σσ́)(σσ́)
     (σσ́)(σσ́)σ(σσ́)

While it might be expected that conflicting alignment would be able to produce bidirectional patterns involving monosyllabic feet, as well, this turns out not to be the case. While it can position unparsed syllables in medial positions, as in (8), it cannot position monosyllabic feet in medial positions. The reason, as (9) illustrates, is simply that PRWD-L and PRWD-R lose their ability to create exceptions to general directional orientations in systems with exhaustive parsing.

[3] For a description of Garawa, see Furby 1974. For Piro, see Matteson 1965.

(9)		PRWD-L	PRWD-R	FEET-L	FEET-R
	a. (σσ)(σσ)(σσ)(σ)			12	☜ 9
	b. (σσ)(σσ)(σ)(σσ)			11	10
	c. (σσ)(σ)(σσ)(σσ)			10	11
	d. (σ)(σσ)(σσ)(σσ)			☜ 9	12

Since there are always feet at the prosodic word edges when parsing is exhaustive, PRWD-L and PRWD-R cannot distinguish between the relevant candidates. The candidates satisfy both constraints, regardless of the position of the monosyllabic foot, so it is left to FEET-L or FEET-R to determine the monosyllabic foot's position. If FEET-L is higher-ranked, the monosyllabic foot occurs at the left edge, as in (9d). If FEET-R is higher-ranked, it occurs at the right edge, as in (9a).

To summarize, then, GA predicts twelve basic quantity-insensitive patterns (when the effects of heavy syllables are not actually considered), eight of which are attested. It is able to produce unidirectional patterns in both underparsing and exhaustive parsing systems, but it is able to produce bidirectional patterns only in underparsing systems.

2.2 Directional Parsing Patterns in Iterative Foot Optimization

Though it adopts the same structural assumptions and employs the same set of constraints, the derivations in IFO are quite different. It should not be surprising, then, there are also important differences in its predictions. IFO produces sixteen basic binary stress patterns (when the effects of syllable weight are not considered), only half of which can be found in attested quantity-insensitive languages. IFO predicts four more basic patterns than GA, then, and each of the additional patterns turns out to be unattested.

Like GA, IFO predicts the unidirectional patterns in (10,11), but there are slight differences in the crucial rankings involved. When the underparsing ranking FT-BIN >> PARSE-σ creates a stray syllable in odd-parity forms, as in (10), the alignment constraints locate the stray syllable just as they do in GA. FEET-L pushes it to the right edge, and FEET-R pushes it to the left edge.

(10) Unidirectional Underparsing Patterns Predicted by Iterative Foot Optimization

a. FT-BIN >> PARSE-σ >> FEET-L

i. Trochaic: Pintupi-type	ii. Iambic: Araucanian-type
(σ́σ)(σ́σ)(σ́σ)	(σσ́)(σσ́)(σσ́)
(σ́σ)(σ́σ)(σ́σ)σ	(σσ́)(σσ́)(σσ́)σ

b. FT-BIN >> PARSE-σ >> FEET-R

i. Trochaic: Nengone-type	ii. Iambic: *Unattested*
(σ́σ)(σ́σ)(σ́σ)	(σσ́)(σσ́)(σσ́)
σ(σ́σ)(σ́σ)(σ́σ)	σ(σσ́)(σσ́)(σσ́)

When the underparsing ranking PARSE-σ >> FT-BIN creates a monosyllabic foot in odd-parity forms, as in (11), however, the effect of the alignment constraints appears to be different than it is in GA. FEET-R appears to push the monosyllabic foot to the left edge, just as it would a stray syllable, and FEET-L appears to push the monosyllabic foot to the right edge, just as it would a stray syllable

(11) Unidirectional Exhaustive Patterns Predicted by Iterative Foot Optimization

a. PARSE-σ >> FT-BIN >> FEET-R

i. Trochaic: Passamaquoddy-type	ii. Iambic: Suruwaha-type
(σ́σ)(σ́σ)(σ́σ)	(σσ́)(σσ́)(σσ́)
(σ́)(σ́σ)(σ́σ)(σ́σ)	(σ́)(σσ́)(σσ́)(σσ́)

b. PARSE-σ >> FT-BIN >> FEET-L

i. Trochaic: Maranungku-type	ii. Iambic: *Unattested*
(σ́σ)(σ́σ)(σ́σ)	(σσ́)(σσ́)(σσ́)
(σ́σ)(σ́σ)(σ́σ)(σ́)	(σσ́)(σσ́)(σσ́)(σ́)

At first glance, then, alignment seems to have a more uniform effect on unparsed syllables and monosyllabic feet under Harmonic Serialism than it does under Optimality Theory, pushing both away from the designated edge of alignment. A more careful examination, however, reveals that this is not really the case. In HS, constraints do not evaluate all possible output candidates in a single step. Instead, only candidates with at most a single difference from the input are considered. The output then becomes the input to the next evaluation, and candidates with at most a single difference from the new input are evaluated. The output then becomes the new 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. For example, the left-oriented underparsing pattern of (10ai,ii) is the result of the four-step derivation in (12). In the first step, at most a single foot is added to the input form to produce candidates for evaluation. FT-BIN and PARSE-σ ensure that the output contains a foot and that it is disyllabic. FEET-L draws it to the left edge of the prosodic word, pushing any stray syllables to the right. In the second and third steps, FT-BIN and PARSE-σ again ensure that a disyllabic foot is added. FEET-L locates it next to the foot constructed in the previous step, pushing any stray syllables to the right. In the final step, the ranking FT-BIN >> PARSE-σ ensures that leftover syllable – the final syllable, in this case – remains unparsed.

(12)

σσσσσσσ	FT-BIN	PARSE-σ	FEET-L
a. σσσσσσσ		7!	
b. (σ)σσσσσσ	1!	6	
☞ c. (σσ)σσσσσ		5	
d. σσσσσ(σσ)		5	5!

(σσ)σσσσσ	FT-BIN	PARSE-σ	FEET-L
a. (σσ)σσσσσ		5!	
b. (σσ)(σ)σσσσ	1!	4	2
☞ c. (σσ)(σσ)σσσ		3	2
d. (σσ)σσσ(σσ)		3	5!

(σσ)(σσ)σσσ	FT-BIN	PARSE-σ	FEET-L
a. (σσ)(σσ)σσσ		3!	2
b. (σσ)(σσ)(σ)σσ	1!	2	6
☞ c. (σσ)(σσ)(σσ)σ		1	6
d. (σσ)(σσ)σ(σσ)		1	7!

(σσ)(σσ)(σσ)σ	FT-BIN	PARSE-σ	FEET-L
☞ a. (σσ)(σσ)(σσ)σ		1	6
b. (σσ)(σσ)(σσ)(σ)	1!		12

The left-oriented exhaustive parsing pattern of (11ai,ii) arises from the derivation in (13), whose first three steps are identical to those in (12). In each of the first three steps, Parse-σ and Ft-Bin create a disyllabic foot, and Feet-L draws it as close to the left edge as possible, pushing any stray syllables to the right. As in (12), this leaves just the final syllable unparsed at the end of the third step. The difference is in the fourth step. In (13), the ranking Parse-σ >> Ft-Bin ensures that the leftover syllable is parsed as a monosyllabic foot.

(13)

σσσσσσσ	Parse-σ	Ft-Bin	Feet-L
a. σσσσσσσ	7!		
b. (σ)σσσσσσ	6!	1	
☞ c. (σσ)σσσσσ	5		
d. σσσσσ(σσ)	5		5!

(σσ)σσσσσ	Parse-σ	Ft-Bin	Feet-L
a. (σσ)σσσσσ	5!		
b. (σσ)(σ)σσσσ	4!	1	2
☞ c. (σσ)(σσ)σσσ	3		2
d. (σσ)σσσ(σσ)	3		5!

(σσ)(σσ)σσσ	Parse-σ	Ft-Bin	Feet-L
a. (σσ)(σσ)σσσ	3!		2
b. (σσ)(σσ)(σ)σσ	2!	1	6
☞ c. (σσ)(σσ)(σσ)σ	1		6
d. (σσ)(σσ)σ(σσ)	1		7!

(σσ)(σσ)(σσ)σ	Parse-σ	Ft-Bin	Feet-L
a. (σσ)(σσ)(σσ)σ	1!		6
☞ b. (σσ)(σσ)(σσ)(σ)		1	12

In comparing the derivations in (12,13) we can see that alignment's effects on unparsed syllables and monosyllabic feet have not really changed at all from those in GA. The difference in IFO is that alignment never actually influences the positions of monosyllabic feet directly. In the first three steps in both derivations, Feet-L draws a disyllabic foot to the left and pushes the unparsed syllables to the right. In the final step, when the position of the leftover syllable has already been determined – it is final, in this case – alignment has no influence. It is not until this point, however, that the ultimate parsing status of the leftover syllable is decided. In (12), the leftover syllable remains unparsed. In (13), it is parsed as a monosyllabic foot. The unparsed syllable and the monosyllabic foot both end up in the same position, then, but only because alignment is actually positioning unparsed syllables in both cases. It is an important point to keep in mind, because it is also the reason that IFO predicts four additional unattested patterns.

In addition to the eight unidirectional patterns in (10,11), IFO predicts the eight bidirectional patterns in (14,15). Although its bidirectional patterns emerge under rankings similar to those employed in GA, IFO not only produces bidirectional patterns in underparsing systems, it also produces bidirectional patterns in exhaustive parsing systems. Since the exhaustive parsing versions are all unattested, this is not a desirable result.

When the underparsing ranking Ft-Bin >> Parse-σ creates a stray syllable in odd-parity forms, as in (14), PrWd-L and PrWd-R can create exceptions to general directional orientations much as they do in GA. The ranking PrWd-L >> Feet-R positions the stray syllable just to the right of the initial foot, as (14a), and the ranking PrWd-R >> Feet-L positions it just to the left of the final foot, as in (14b).

(14) Bidirectional Underparsing Patterns under Iterative Foot Optimization

a. Ft-Bin >> Parse-σ >> Feet-R; PrWd-L >> Feet-R

i. Trochaic: Garawa-type	ii. Iambic: *Unattested*
(σ́σ)(σ́σ)(σ́σ)	(σσ́)(σσ́)(σσ́)
(σ́σ)σ(σ́σ)(σ́σ)	(σσ́)σ(σσ́)(σσ́)

b. Ft-Bin >> Parse-σ >> Feet-L; PrWd-R >> Feet-L

i. Trochaic: Piro-type	ii. Iambic: *Unattested*
(σ́σ)(σ́σ)(σ́σ)	(σσ́)(σσ́)(σσ́)
(σ́σ)(σ́σ)σ(σ́σ)	(σσ́)(σσ́)σ(σσ́)

Similar patterns emerge, with a monosyllabic foot replacing the stray syllable, under the exhaustive parsing ranking Parse-σ >> Ft-Bin. The ranking PrWd-L >> Feet-R positions the monosyllabic foot just to the right of the initial foot, as (15a), and the ranking PrWd-R >> Feet-L positions it just to the left of the final foot, as in (15b).

(15) Bidirectional Exhaustive Parsing Patterns under Iterative Foot Optimization

a. Parse-σ >> Ft-Bin >> Feet-R; PrWd-L >> Feet-R

i. Trochaic: *Unattested*	ii. Iambic: *Unattested*
(σ́σ)(σ́σ)(σ́σ)	(σσ́)(σσ́)(σσ́)
(σ́σ)(σ́)(σ́σ)(σ́σ)	(σσ́)(σ́)(σσ́)(σσ́)

b. Parse-σ >> Ft-Bin >> Feet-L; PrWd-R >> Feet-L

i. Trochaic: *Unattested*	ii. Iambic: *Unattested*
(σ́σ)(σ́σ)(σ́σ)	(σσ́)(σσ́)(σσ́)
(σ́σ)(σ́σ)(σ́)(σ́σ)	(σσ́)(σσ́)(σ́)(σσ́)

To get a better understanding of why IFO predicts bidirectional parsing patterns in both underparsing and exhaustive parsing systems, we can consider the derivations responsible for the underparsing pattern of (14ai,ii) in (16) and the exhaustive parsing pattern of (15ai,ii) in (17). In the first step in the underparsing derivation in (16), FT-BIN and PARSE-σ ensure that a disyllabic foot is added to the input form. PRWD-L 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, FEET-R draws it to the right edge, pushing the unparsed syllables towards the initial foot. In third step, a final disyllabic foot is added, and FEET-R positions it just to the left of the final foot, leaving only the post-peninitial syllable unparsed. In the final step, the ranking FT-BIN >> PARSE-σ ensures that the post-peninitial syllable remains unfooted.

(16)

σσσσσσσ	FT-BIN	PARSE-σ	PRWD-L	FEET-R
a. σσσσσσσ		7!	1	
b. (σ)σσσσσσ	1!	6		6
☞ c. (σσ)σσσσσ		5		5
d. σσσσσ(σσ)		5	5!	

(σσ)σσσσσ	FT-BIN	PARSE-σ	PRWD-L	FEET-R
a. (σσ)σσσσσ		5!		5
b. (σσ)σσσσ(σ)	1!	4		5
☞ c. (σσ)σσσ(σσ)		3		5
d. (σσ)(σσ)σσσ		3		8!

(σσ)σσσ(σσ)	FT-BIN	PARSE-σ	PRWD-L	FEET-R
a. (σσ)σσσ(σσ)		3!		5
b. (σσ)σσ(σ)(σσ)	1!	2		7
☞ c. (σσ)σ(σσ)(σσ)		1		7
d. (σσ)(σσ)σ(σσ)		1		8!

(σσ)σ(σσ)(σσ)	FT-BIN	PARSE-σ	PRWD-L	FEET-R
☞ a. (σσ)σ(σσ)(σσ)		1		7
b. (σσ)(σ)(σσ)(σσ)	1!			11

Under the exhaustive parsing ranking in (17), the first three steps of the derivation are identical to those under the underparsing ranking in (16). Notice that in each of these steps the alignment constraints are determining the relative positions of disyllabic feet and unparsed syllables. At no point do they influence the position of a monosyllabic foot directly. In the final step, once the position of the leftover syllable has already been determined, the ranking PARSE-σ >> FT-BIN converts the leftover syllable – once again, the post-peninitial syllable – into a monosyllabic foot.

(17)

σσσσσσσ	PARSE-σ	FT-BIN	PRWD-L	FEET-R
a. σσσσσσσ	7!		1	
b. (σ)σσσσσσ	6!	1		6
☞ c. (σσ)σσσσσ	5			5
d. σσσσσ(σσ)	5		5!	

(σσ)σσσσσ	PARSE-σ	FT-BIN	PRWD-L	FEET-R
a. (σσ)σσσσσ	5!			5
b. (σσ)σσσσ(σ)	4!	1		5
☞ c. (σσ)σσσ(σσ)	3			5
d. (σσ)(σσ)σσσ	3			8!

(σσ)σσσ(σσ)	PARSE-σ	FT-BIN	PRWD-L	FEET-R
a. (σσ)σσσ(σσ)	3!			5
b. (σσ)σσ(σ)(σσ)	2!	1		7
☞ c. (σσ)σ(σσ)(σσ)	1			7
d. (σσ)(σσ)σ(σσ)	1			8!

(σσ)σ(σσ)(σσ)	PARSE-σ	FT-BIN	PRWD-L	FEET-R
a. (σσ)σ(σσ)(σσ)	1!			7
☞ b. (σσ)(σ)(σσ)(σσ)		1		11

Since it is the only difference between GA and IFO, the latter's serialism is easily identifiable as the source of the four additional bidirectional patterns. The connection is not difficult to make. In GA, parallel evaluation determines a leftover syllable's position and parsing status *simultaneously*. A leftover syllable that ultimately emerges as an unparsed syllable is positioned as an unparsed syllable, and a leftover syllable that ultimately emerges as a monosyllabic foot is positioned as a monosyllabic foot. Since alignment can locate monosyllabic feet in only a subset of the positions in which it can locate unparsed syllables, GA predicts fewer exhaustive parsing patterns than underparsing patterns. In particular, it predicts both unidirectional and bidirectional underparsing patterns but only unidirectional exhaustive parsing patterns.

In IFO, serial evaluation determines a leftover syllable's position and its parsing status at different stages of the derivation. During the stages of the derivation in which alignment constraints determine its position, the leftover syllable is always unparsed. It is only *after* its position has been fixed that the ranking between PARSE-σ and FT-BIN determines whether it will remain unparsed or be parsed as a monosyllabic foot. Since alignment never influences monosyllabic feet directly, its more stringent restrictions on the positions of monosyllabic feet are never felt, and they can occur in every position in which unparsed syllables occur. Not only do unidirectional patterns with unparsed syllables have corresponding patterns with monosyllabic feet in the same position, then, but bidirectional patterns with unparsed syllables also have corresponding patterns with monosyllabic feet in the same position.[4]

3 The Odd Heavy Problem

The Odd-Parity Parsing Problem arises from the combined effects of two well-motivated requirements: the requirement that syllables be parsed into feet and the requirement that feet be at least bimoraic. The former is captured in both GA and IFO using the PARSE-σ constraint. The latter is captured using the FT-BIN constraint. (See the appendix for additional discussion of the formulation of FT-BIN.) Together, the two constraints require that all forms be exhaustively parsed into binary feet, unproblematic in even-parity forms but a source of pathological predictions in odd-parity forms.

The Odd-Parity Parsing Problem can be usefully divided into two subproblems, the Odd Heavy Problem and the Even Output Problem. We consider the OHP in this section and the EOP in Section 4.

3.1 An Unattested Type of Quantity-Sensitivity

Odd-parity forms can achieve exhaustive binary footing, satisfying PARSE-σ and FT-BIN simultaneously, by parsing a single odd-numbered heavy syllable as a monosyllabic foot. As (18) illustrates, the heavy monosyllabic foot divides any remaining syllables into even-parity strings, which can then be subdivided evenly into disyllabic feet. Since the heavy monosyllabic foot and the disyllabic feet are all binary, the form achieves exhaustive binary parsing.

(18) Parsing Odd-Numbered Heavy Syllables as Monosyllabic Feet

(σσ)(σσ)(σσ)(H)	(σσ)(σσ)(H)(σσ)
(σσ)(H)(σσ)(σσ)	(H)(σσ)(σσ)(σσ)

[4] Another way to see the connection between serialism and the bidirectional exhaustive parsing patterns is through the lens of opacity. The rankings involved in the production of bidirectional exhaustive parsing patterns are opaque. They would select some other form than the surface form if presented with a larger set of candidates to choose from. Since ranking opacity (as opposed to the opacity of individual constraints, which is quite common in OT) is roughly equivalent to "stuff that OT can't do", it is clear that serialism's ability to produce opacity effects is at fault here.

The ability to achieve exhaustive binary parsing in this fashion results in the Odd Heavy Problem, a peculiar and unattested type of quantity-sensitivity where stress is sensitive to syllable weight but only to the weight of odd-numbered syllables in odd-parity forms.

(19) The Odd Heavy Problem
A heavy syllable *H* is parsed as a monosyllabic foot *iff*
a. *H* occurs in an odd-parity form; and
b. *H* is odd-numbered; and
c. (*additional restrictions*)

Approaches suffering from the OHP all exhibit a type of quantity-sensitivity that conforms to the unusual restrictions in (19a,b), but individual approaches may have additional restrictions, as indicated in (19c). The possibility of variation in these additional restrictions allows for variation in the different versions of the OHP found in different accounts.

In general, the OHP is most conspicuous when it has one of two effects. In the first, the weight of an odd-numbered syllable corresponds to an alternation between underparsing and exhaustive parsing. Consider the ranking FT-BIN >> PARSE-σ, for example, the ranking responsible for underparsing patterns. In odd-parity forms without odd-numbered heavy syllables, the ranking results in a single syllable being left unparsed, like the antepenult in (20a). In forms that do contain an odd-numbered heavy syllable, as in (20b), however, the same ranking would parse it as a monosyllabic foot.

(20) Alternation between Underparsing and Exhaustive Parsing

a. Light Unparsed Syllable	b. Heavy Monosyllabic Foot
(σσ)(σσ)L(σσ)	(σσ)(σσ)(H)(σσ)

Alternations between underparsing and exhaustive parsing based on the presence or absence of odd-numbered heavy syllables are unattested.[5]

The second effect is a perturbation of expected parsing directionality. Consider the ranking PARSE-σ >> FT-BIN, for example, the ranking responsible for exhaustive parsing. In odd-parity forms without odd-numbered heavy syllables, like (21a), the position of the monosyllabic foot indicates parsing directionality. If the form contained an odd-numbered heavy syllable in a different position, however, as in (21b), the monosyllabic foot would be constructed on the heavy syllable instead.

(21) Perturbation of Parsing Directionality

a. Light Unparsed Syllable	b. Heavy Monosyllabic Foot
(L)(LL)(LL)(LL)	(LL)(LL)(H)(LL)

Languages where heavy syllables can perturb basic directional parsing patterns only if they are odd-numbered appear to be unattested.

[5] The exception is languages like Wergaia (Hercus 1986) where quantity-sensitivity is limited to the final syllable. The fact that it limited to final syllables, however, indicates that it is a nonfinality effect, rather than a general minimality effect. See Hyde 2007 for discussion.

As we shall see next, GA and IFO both exhibit quantity-sensitivity consistent with (19a,b), indicating that neither parallelism nor serialism is actually the source of the OHP. The additional restrictions imposed by IFO and GA are quite different, however, indicating that derivational perspective does play a role in how the OHP is manifested in different accounts.

3.2 The Odd Heavy Problem under Generalized Alignment

GA exhibits the version of the Odd Heavy Problem described in (22). In GA, as in other accounts that exhibit the effects of the OHP, parsing patterns are sensitive to the weight of odd-numbered syllables in odd-parity forms. The part of the description that is unique to GA is (22c).

(22) The Odd Heavy Problem in Generalized Alignment

A heavy syllable *H* is parsed as a monosyllabic foot *iff*

a. *H* occurs in an odd-parity form; and
b. *H* is odd-numbered; and
c. *H* is the heavy syllable conforming to (a,b) that is closest to the preferred edge of general foot alignment.

In the GA version of the OHP, a heavy syllable can be parsed as a monosyllabic foot in *any* odd-numbered position, but the alignment constraints, FEET-L and FEET-R, decide among them when multiple options are available. When FEET-L is higher-ranked, the leftmost odd-numbered heavy syllable is parsed as a monosyllabic foot. When FEET-R is higher-ranked, the rightmost is parsed as a monosyllabic foot.

(23) OHP Varieties under Generalized Alignment

a. FEET-L >> FEET-R
The leftmost odd-numbered heavy syllable is parsed as a monosyllabic foot.
b. FEET-R >> FEET-L
The rightmost odd-numbered heavy syllable is parsed as a monosyllabic foot.

The reason that FEET-L and FEET-R alone are responsible for determining the position of the heavy monosyllabic foot is that a monosyllabic foot always results in exhaustive parsing. As the reader will recall, the other two alignment constraints, PRWD-L and PRWD-R, lose their influence when parsing is exhaustive.

To illustrate how the GA version of the OHP emerges, consider first the unidirectional underparsing ranking FT-BIN >> PARSE-σ >> FEET-L. In odd-parity forms containing only light syllables, it produces the basic odd-parity parsing pattern in (24), where the final syllable is left unparsed.

(24) FT-BIN >> PARSE-σ >> FEET-L

(LL)(LL)(LL)L

In forms containing odd-numbered heavy syllables, however, as indicated in (25-28), the ranking FT-BIN >> PARSE-σ >> FEET-L parses one as monosyllabic foot, giving preference to the leftmost when more than one is available.

(25)

LLLLLLH	FT-BIN	PARSE-σ	FEET-L
a. (LL)(LL)(LL)H		1!	6
☞ b. (LL)(LL)(LL)(H)			12
c. (L)(LL)(LL)(LH)	1!		9

(26)

LLLLHLH	FT-BIN	PARSE-σ	FEET-L
a. (LL)(LL)(HL)H		1!	6
b. (LL)(LL)(HL)(H)			12!
☞ c. (LL)(LL)(H)(LH)			11
d. (L)(LL)(LH)(LH)	1!		9

(27)

LLHLLLH	FT-BIN	PARSE-σ	FEET-L
a. (LL)(HL)(HL)H		1!	6
b. (LL)(HL)(LL)(H)			12!
☞ c. (LL)(H)(LL)(LH)			10
d. (L)(LH)(LL)(LH)	1!		9

(28)

HLLLHLL	FT-BIN	PARSE-σ	FEET-L
a. (HL)(LL)(HL)L		1!	6
b. (HL)(LL)(H)(LL)			11!
☞ c. (H)(LL)(LH)(LL)			9
d. (HL)(L)(LH)(LL)	1!		10

The first thing to notice in (25-28) is that underparsing rankings like FT-BIN >> PARSE-σ >> FEET-L produce an alternation between underparsing and exhaustive parsing based on the weight of odd numbered syllables. If the odd-numbered syllables are all light, as in (24), an underparsing pattern emerges. When one or more of the odd-numbered syllables is heavy, as in (25-28), an exhaustive parsing pattern emerges. The second thing to notice is that the monosyllabic foot in (25-28) may or may not appear in the same position as the unparsed syllable in (24). It is constructed on the leftmost odd-numbered heavy syllable, and any odd-numbered heavy syllable might end up being the leftmost, depending on the position of the others. The result, then, is a perturbation of the basic directional parsing pattern.

Now consider the exhaustive parsing ranking FT-BIN >> PARSE-σ >> FEET-R. In odd-parity forms containing only light syllables, it produces the basic odd-parity parsing pattern in (29), where the final syllable is parsed as a monosyllabic foot.

(29) PARSE-σ >> FT-BIN >> FEET-R

(LL)(LL)(LL)(L)

In forms containing odd-numbered heavy syllables, however, as indicated in (30-33), the ranking PARSE-σ >> FT-BIN >> FEET-R parses one as monosyllabic foot, giving preference to the rightmost when more than one is available.

(30)

HLLLLLL	PARSE-σ	FT-BIN	FEET-R
a. H(LL)(LL)(LL)	1!		6
☞ b. (H)(LL)(LL)(LL)			12
c. (HL)(LL)(LL)(L)		1!	9

(31)

HLHLLLL	PARSE-σ	FT-BIN	FEET-R
a. H(LH)(LL)(LL)	1!		6
b. (H)(LH)(LL)(LL)			12!
☞ c. (HL)(H)(LL)(LL)			11
d. (HL)(HL)(LL)(L)		1!	9

(32)

HLLLHLL	PARSE-σ	FT-BIN	FEET-R
a. H(LL)(LH)(LL)	1!		6
b. (H)(LH)(LL)(LL)			12!
☞ c. (HL)(LL)(H)(LL)			10
d. (HL)(LL)(HL)(L)		1!	9

(33)

HLHLLLL	PARSE-σ	FT-BIN	FEET-R
a. L(LH)(LL)(LH)	1!		6
b. (LL)(H)(LL)(LH)			11!
☞ c. (LL)(HL)(LL)(H)			9
d. (LL)(HL)(L)(LH)		1!	10

Although there is no alternation between underparsing and exhaustive parsing in exhaustive parsing ranking like PARSE-σ >> FT-BIN >> FEET-R, the perturbations of the basic directional parsing pattern reveal the influence of the OHP. Any odd-numbered heavy syllable may be parsed as monosyllabic foot. It need not be final, the position of the monosyllabic foot in (29). It only needs to be the rightmost of the odd-numbered heavy syllables present in the form.

Similar results emerge when odd-numbered heavy syllables are present under each of GA rankings discussed above. Underparsing rankings, whether unidirectional or bidirectional, alternate between underparsing and exhaustive parsing in odd-parity forms based on the weight of odd-numbered syllables. They also show perturbations in directional parsing based on the same consideration. Exhaustive parsing rankings always produce exhaustive parsing patterns. They do not alternate between exhaustive parsing and underparsing. They do, however, exhibit perturbations in directional parsing consistent with the OHP. I omit the additional tableaux.

When we consider the potential effects of heavy syllables, then, we can see that each of the binary parsing patterns predicted by GA, all twelve, actually exhibit the unattested quantity-sensitivity associated with the OHP. In the summaries in (34-36), the first form given with each ranking is an odd-parity form with all light syllables. This form illustrates the basic pattern that the ranking produces when odd-numbered heavy syllables are absent. The second form contains two odd-numbered heavy syllables. It illustrates the particular OHP effects that the ranking produces when odd-numbered heavy syllables are present. It indicates that parsing is exhaustive, under both exhaustive parsing and underparsing rankings, and it indicates whether the leftmost or the rightmost odd-numbered heavy syllable is parsed as a monosyllabic foot.

(34) Unidirectional Underparsing Patterns under Generalized Alignment

a. Ft-Bin >> Parse-σ >> AllFeetL

i. Trochaic: *Unattested*	ii. Iambic: *Unattested*
(ĹL)(ĹL)(ĹL)L	(LĹ)(LĹ)(LĹ)L
(ĹL)(H́)(ĹH)(ĹL)	(LĹ)(H́)(LH́)(LĹ)

b. Ft-Bin >> Parse-σ >> AllFeetR

i. Trochaic: *Unattested*	ii. Iambic: *Unattested*
L(ĹL)(ĹL)(ĹL)	L(LĹ)(LĹ)(LĹ)
(ĹL)(H́L)(H́)(ĹL)	(LĹ)(HĹ)(H́)(LĹ)

(35) Unidirectional Exhaustive Parsing Patterns under Generalized Alignment

a. Parse-σ >> Ft-Bin >> Feet-L

i. Trochaic: *Unattested*	ii. Iambic: *Unattested*
(Ĺ)(ĹL)(ĹL)(ĹL)	(Ĺ)(LĹ)(LĹ)(LĹ)
(ĹL)(H́)(ĹH)(ĹL)	(LĹ)(H́)(LH́)(LĹ)

b. Parse-σ >> Ft-Bin >> Feet-R

i. Trochaic: *Unattested*	ii. Iambic: *Unattested*
(ĹL)(ĹL)(ĹL)(Ĺ)	(LĹ)(LĹ)(LĹ)(Ĺ)
(ĹL)(H́L)(H́)(ĹL)	(LĹ)(HĹ)(H́)(LĹ)

(36) Bidirectional Underparsing Patterns under Generalized Alignment

a. FT-BIN >> PARSE-σ >> FEET-R; PRWD-L >> FEET-R

i. Trochaic: *Unattested*
(ĹL)L(ĹL)(ĹL)
(ĹL)(H́L)(H́)(ĹL)

ii. Iambic: *Unattested*
(LĹ)L(LĹ)(LĹ)
(LĹ)(HĹ)(H́)(LĹ)

b. FT-BIN >> PARSE-σ >> FEET-L; PRWD-R>> FEET-L

i. Trochaic: *Unattested*
(ĹL)(ĹL)L(ĹL)
(ĹL)(H́)(ĹH)(ĹL)

ii. Iambic: *Unattested*
(LĹ)(LĹ)L(LĹ)
(LĹ)(H́)(LH́)(LĹ)

When we consider the potential effects of heavy syllables, then, GA has significant problems of both undergeneration and overgeneration. It fails to produce a single attested quantity-insensitive pattern, but it produces twelve unattested quantity-sensitive patterns.

3.3 The Odd Heavy Problem under Iterative Foot Optimization

The proposition that IFO avoids the OHP turns out not to be true. IFO exhibits the characteristic quantity-sensitivity described in (37a,b) but with the additional restriction given in (37c). To be parsed as a monosyllabic foot, a heavy syllable must be the last syllable in the course of the derivation to have its parsing status settled.

(37) The Odd Heavy Problem in Iterative Foot Optimization

A heavy syllable *H* is parsed as a monosyllabic foot *iff*

a. *H* occurs in an odd-parity form; and
b. *H* is odd-numbered; and
c. *H* is the last syllable in the derivation to have its parsing status settled.

In the derivation of an odd-parity form, there are four syllables which might be the last to have their parsing status addressed – the initial, the post-peninitial, the antepenult, and the ultima – depending on the preferences of the alignment constraints. This means that the OHP has four distinct types under IFO, rather than the two distinct types that it has under GA.

As indicated in (38), when FEET-L is the highest-ranked alignment constraint, the ultima is the last addressed, so only the ultima can be parsed as a monosyllabic foot. When FEET-R is the highest-ranked, the initial syllable is the last addressed, so only the initial syllable can be parsed as a monosyllabic foot. The post-peninitial syllable is the last to be disposed of when PRWD-L dominates FEET-R, so only the post-peninitial syllable can form a monosyllabic foot. Finally, the antepenultimate is the last addressed when PRWD-R dominates FEET-L, so only the antepenult can form a monosyllabic foot.

(38) OHP Varieties under Iterative Foot Optimization

a. FEET-L
If the ultima is heavy, it is parsed as a monosyllabic foot.

b. FEET-R
If the initial syllable is heavy, it is parsed as a monosyllabic foot.

c. PRWD-R >> FEET-L
If the antepenult is heavy, it is parsed as a monosyllabic foot.

d. PRWD-L >> FEET-R
If the post-peninitial syllable is heavy, it is parsed as a monosyllabic foot.

To illustrate, consider underparsing rankings, the rankings where FT-BIN dominates PARSE-σ. In odd-parity forms with a light final syllable, the ranking FT-BIN >> PARSE-σ >> FEET-L produces the parsing pattern in (39), where the final syllable remains unparsed.

(39) PARSE-σ >> FT-BIN >> FEET-L
(LL)(LL)(LL)L

As (40) illustrates, however, in odd-parity forms with a heavy final syllable, the final syllable is parsed as a monosyllabic foot. In examining the different steps of the derivation in (40), and in those that follow, notice that is never advantageous to parse a heavy syllable as monosyllabic foot unless the heavy syllable is the only syllable left unparsed.

In the first step in (40), there is the choice of creating a disyllabic foot or a heavy monosyllabic foot, but there is no advantage to constructing the latter *at this point*. Both satisfy FT-BIN and FEET-L. Because a disyllabic foot allows one more syllable to be parsed, reducing the number of PARSE-σ violations, a disyllabic foot is selected. Only in the last step, where the rightmost syllable alone remains unparsed and a disyllabic foot cannot be constructed, does it become advantageous to parse a heavy syllable as a monosyllabic foot. It is only here, then, where we see the OHP's quantity-sensitivity emerge. If the final syllable had been light, as in (39), it would not have been advantageous to parse it as a monosyllabic foot.

(40)

HLLLLLH	FT-BIN	PARSE-σ	FEET-L
a. HLLLLLH		7!	
b. (H)LLLLLH		6!	
☞ c. (HL)LLLLH		5	
d. HLLLL(LH)		5	5!

(HL)LLLLH	FT-BIN	PARSE-σ	FEET-L
a. (HL)LLLLH		5!	
b. (HL)(L)LLLH	1!	4	2
☞ c. (HL)(LL)LLH		3	2
d. (HL)LLL(LH)		3	5!

(HL)(LL)LLH	FT-BIN	PARSE-σ	FEET-L
a. (HL)(LL)LLH		3!	2
b. (HL)(LL)(L)LH	1!	2	6
☞ c. (HL)(LL)(LL)H		1	6
d. (HL)(LL)L(LH)		1	7!

(HL)(LL)(LL)H	FT-BIN	PARSE-σ	FEET-L
a. (HL)(LL)(LL)H		1!	6
☞ b. (HL)(LL)(LL)(H)			12

Though both exhibit the effects of OHP, the output for the input and underparsing ranking in (40) is different in IFO than it is in GA. In GA, we would see both an alternation between underparsing and exhaustive parsing and a perturbation of the basic directional parsing pattern. In GA, the leftmost heavy syllable – the initial syllable, given the input in (40) – would be parsed as a monosyllabic foot, rather than the final syllable. In IFO, we see only the alternation between underparsing and exhaustive parsing. There is no perturbation of the basic directional parsing pattern. The monosyllabic foot in (40) occurs in the same position – final position – as the unparsed syllable in (39).

The difference arises due to the different derivational perspectives of the two approaches. The ability of odd-numbered heavy syllables to perturb parsing directionality in GA can be traced to the equal consideration given to *all* odd-numbered heavy syllables for parsing as a monosyllabic foot. The equal consideration is a direct consequence of GA's parallelism. GA evaluations simultaneously consider *all* output candidates with monosyllabic feet constructed on heavy syllables, not just candidates with monosyllabic feet in the position where the leftover syllable normally occurs in the basic pattern. While this allows appropriately positioned odd-numbered heavy syllables to perturb the basic pattern, it also limits the specific OHP types under GA to two: one where the leftmost odd-numbered heavy syllable is parsed as a monosyllabic foot, and one where the rightmost is parsed as a monosyllabic foot.

In contrast, the serial IFO does not compare all possible surface forms to see whether or not it would be advantageous to construct a heavy monosyllabic foot in a position other than the one in which the leftover syllable occurs in the basic pattern. It *first* determines where the leftover syllable will appear, and *then* it decides whether or not it would be advantageous to construct monosyllabic foot *in that position*. While this prevents heavy syllables from perturbing basic directional parsing patterns, it also has the effect of doubling the specific OHP types under IFO to four: one for each position where the leftover syllable might appear in the basic pattern of an odd-parity form.

In the next several examples, we see the effects of the OHP under the remaining underparsing rankings. The results are similar to those in (39,40). In odd-parity forms with a light final syllable, the ranking FT-BIN >> PARSE-σ >> FEET-R produces the parsing pattern in (41), where the initial syllable is left unparsed.

(41) PARSE-σ >> FT-BIN >> FEET-R

L(LL)(LL)(LL)

As (42) illustrates, however, in odd-parity forms with a heavy initial syllable, the initial syllable is parsed as a monosyllabic foot.

(42)

HLLLHLL	FT-BIN	PARSE-σ	FEET-R
a. HLLLHLL		7!	
b. HLLLHL(L)	1!	6!	
☞ c. HLLLH(LL)		5	
d. (HL)LLHLL		5	5!

HLLLH(LL)	FT-BIN	PARSE-σ	FEET-R
a. HLLLH(LL)		5!	
b. HLLL(H)(LL)		4!	2
☞ c. HLL(LH)(LL)		3	2
d. (HL)LLH(LL)		3	5!

HLL(LH)(LL)	FT-BIN	PARSE-σ	FEET-R
a. HLL(LH)(LL)		3!	2
b. HL(L)(LH)(LL)	1!	2	6
☞ c. H(LL)(LH)(LL)		1	6
d. (HL)L(LH)(LL)		1	7!

H(LL)(LH)(LL)	FT-BIN	PARSE-σ	FEET-R
a. H(LL)(LH)(LL)		1!	6
☞ b. (H)(LL)(LH)(LL)			12

The rankings Ft-Bin >> Parse-σ >> Feet-L and PrWd-R >> Feet-L produce the odd-parity pattern in (43) leaving a light antepenult unparsed.

(43) Parse-σ >> Ft-Bin >> Feet-L; PrWd-R >> Feet-L

(LL)(LL)L(LL)

When the antepenult is heavy, however, the same rankings parse it as a monosyllabic foot, as in (44).

(44)

HLLLHLH	Ft-Bin	Parse-σ	PrWd-R	Feet-L
a. HLLLHLH		7!	1	
b. HLLLHL(H)		6!		6
☞ c. HLLLH(LH)		5		5
d. (HL)LLHLH		5	5!	

HLLLH(LH)	Ft-Bin	Parse-σ	PrWd-R	Feet-L
a. HLLLH(LH)		5!		5
b. (H)LLLH(LH)		4!		5
☞ c. (HL)LLH(LH)		3		5
d. HLL(LH)(LH)		3		8!

(HL)LLH(LH)	Ft-Bin	Parse-σ	PrWd-R	Feet-L
a. (HL)LLH(LH)		3!		5
b. (HL)(L)LH(LH)	1!	2		7
☞ c. (HL)(LL)H(LH)		1		7
d. (HL)L(LH)(LH)		1		8!

(HL)(LL)H(LH)	Ft-Bin	Parse-σ	PrWd-R	Feet-L
a. (HL)(LL)H(LH)		1!		7
☞ b. (HL)(LL)(H)(LH)				11

Finally, in odd-parity forms with a light post-peninitial syllable, the rankings FT-BIN >> PARSE-σ >> FEET-R and PRWD-L >> FEET-R leave the post-peninitial syllable unparsed, as is (45).

(45) PARSE-σ >> FT-BIN >> FEET-R; PRWD-L >> FEET-R
(LL)L(LL)(LL)

When the post-peninitial syllable is heavy, however, it is parsed as a monosyllabic foot, as in (46).

(46)

LLHLHLH	FT-BIN	PARSE-σ	PRWD-L	FEET-R
a. LLHLHLH		7!	1	
b. (L)LHLHLH	1!	6		6
☞ c. (LL)HLHLH		5		5
d. LLHLH(LH)		5	5!	

(LL)HLHLH	FT-BIN	PARSE-σ	PRWD-L	FEET-R
a. (LL)HLHLH		5!		5
b. (LL)HLHL(H)		4!		5
☞ c. (LL)HLH(LH)		3		5
d. (LL)(HL)HLH		3		8!

(LL)HLH(LH)	FT-BIN	PARSE-σ	PRWD-L	FEET-R
a. (LL)HLH(LH)		3!		5
b. (LL)HL(H)(LH)		2!		7
☞ c. (LL)H(LH)(LH)		1		7
d. (LL)(HL)H(LH)		1		8!

(LL)H(LH)(LH)	FT-BIN	PARSE-σ	PRWD-L	FEET-R
a. (LL)H(LH)(LH)		1!		7
☞ b. (LL)(H)(LH)(LH)				11

When we consider the effects of heavy syllables, then, we see that the OHP also emerges under IFO. In each of the sixteen binary patterns that IFO predicts, an odd-numbered heavy syllable will be parsed as a monosyllabic foot if it is the last syllable in the derivation to have its parsing status settled. In the summaries in (47-50), the first odd-parity form illustrates the basic pattern produced by each ranking. The second form illustrates the effects of the OHP. It indicates the position of the last syllable addressed by the derivation, the syllable that, if heavy, will be parsed as a monosyllabic foot.

As a result of the OHP, IFO fails to predict a single quantity-insensitive underparsing parsing pattern. In their place, IFO predicts the eight quantity-sensitive patterns in (47, 48). Only one of these patterns is actually attested: quantity-sensitivity limited to final syllables can be found in Wergaia (Hercus 1986). (The fact that this type of quantity-sensitivity is attested only in final syllables indicates that it is a nonfinality effect rather than a more general minimality effect. See Hyde 2007, for discussion.)

(47) Unidirectional Underparsing Patterns Predicted by Iterative Foot Optimization

a. Ft-Bin >> Parse-σ >> Feet-L

i. Trochaic: Wergaia-type
(σ́σ)(σ́σ)(σ́σ)L
(σ́σ)(σ́σ)(σ́σ)(H́)

ii. Iambic: *Unattested*
(σσ́)(σσ́)(σσ́)L
(σσ́)(σσ́)(σσ́)(H́)

b. Ft-Bin >> Parse-σ >> Feet-R

i. Trochaic: *Unattested*
L(σ́σ)(σ́σ)(σ́σ)
(H́)(σ́σ)(σ́σ)(σ́σ)

ii. Iambic: *Unattested*
L(σσ́)(σσ́)(σσ́)
(H́)(σσ́)(σσ́)(σσ́)

(48) Bidirectional Underparsing Patterns under Iterative Foot Optimization

a. Ft-Bin >> Parse-σ >> Feet-R; PrWd-L >> Feet-R

i. Trochaic: *Unattested*
(σ́σ)L(σ́σ)(σ́σ)
(σ́σ)(H́)(σ́σ)(σ́σ)

ii. Iambic: *Unattested*
(σσ́)L(σσ́)(σσ́)
(σσ́)(H́)(σσ́)(σσ́)

b. Ft-Bin >> Parse-σ >> Feet-L; PrWd-R >> Feet-L

i. Trochaic: *Unattested*
(σ́σ)(σ́σ)L(σ́σ)
(σ́σ)(σ́σ)(H́)(σ́σ)

ii. Iambic: *Unattested*
(σσ́)(σσ́)L(σσ́)
(σσ́)(σσ́)(H́)(σσ́)

As indicated in (49,50), the quantity-sensitivity of the OHP is obscured in exhaustive parsing patterns. The same syllable will be parsed as a monosyllabic foot whether it is heavy or light. This being the case, IFO is able to produce three attested quantity-insensitive patterns: (49ai), (49aii), and (49bi). The remaining five patterns are unattested.

(49) Unidirectional Exhaustive Patterns Predicted by Iterative Foot Optimization

a. Parse-σ >> Ft-Bin >> Feet-R

i. Trochaic: Passamaquoddy-type
(Ĺ)(σ́σ)(σ́σ)(σ́σ)
(H́)(σ́σ)(σ́σ)(σ́σ)

ii. Iambic: Suruwaha-type
(Ĺ)(σσ́)(σσ́)(σσ́)
(H́)(σσ́)(σσ́)(σσ́)

b. Parse-σ >> Ft-Bin >> Feet-L

i. Trochaic: Maranungku-type
(σ́σ)(σ́σ)(σ́σ)(Ĺ)
(σ́σ)(σ́σ)(σ́σ)(H́)

ii. Iambic: *Unattested*
(σσ́)(σσ́)(σσ́)(Ĺ)
(σσ́)(σσ́)(σσ́)(H́)

(50) Bidirectional Exhaustive Parsing Patterns under Iterative Foot Optimization

a. Parse-σ >> Ft-Bin >> Feet-R; PrWd-L >> Feet-R

i. Trochaic: *Unattested*

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

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

ii. Iambic: *Unattested*

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

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

b. Parse-σ >> Ft-Bin >> Feet-L; PrWd-R >> Feet-L

i. Trochaic: *Unattested*

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

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

ii. Iambic: *Unattested*

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

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

The OHP, then, contributes to the deterioration of IFO's predictions in two ways. The first is that it exacerbates IFO's overgeneration problem. Overgeneration in IFO was already substantial, given the predicted, but unattested, bidirectional exhaustive parsing patterns, and the prediction of twelve unattested quantity-sensitive patterns only makes matters worse. The second is that the OHP gives IFO a substantial undergeneration problem. It cannot produce a single quantity-insensitive underparsing system.

Since it emerges under both parallelism and serialism, neither derivational perspective can be the source of the OHP. Since IFO and GA place different additional restrictions on the position of heavy monosyllabic feet in their particular versions of the OHP, however, their derivational perspectives clearly do play a role in how the OHP is manifested. As a result, its proponents can rightly claim that serialism allows IFO to predict (a grand total of) four attested patterns despite the effects of the OHP.

4 The Even Output Problem

Although it is well known that faithfulness violations can arise as the result of concerns related to parsing and minimality – lengthening to comply with the canonical shape of iambic feet or to comply with minimal word restrictions, for example – they do not appear to arise simply to ensure exhaustive binary footing in longer forms. In both GA and IFO, however, faithfulness constraints can interact with parsing and minimality constraints in ways that produce just this result. When parsing and minimality constraints dominate faithfulness constraints, they can require that a syllable be added to or subtracted from an odd-parity input, making it even-parity on the surface, so that it can be exhaustively parsed into binary feet.

4.1 The Even Output Problem under Generalized Alignment

The Even Output Problem is more limited, in a sense, than the Odd Heavy Problem in that it depends on a particular ranking of the faithfulness constraints. In GA, the OHP emerges under any ranking that produces binary stress patterns, but the EOP only emerges when both Parse-σ and Ft-Bin dominate either Max or Dep.

(51) Faithfulness constraints

a. Max: Every syllable in the input is present in the output.

b. Dep: Every syllable in the output is present in the input.

When PARSE-σ, FT-BIN, and DEP all dominate MAX, MAX will be violated and a single syllable subtracted from an odd-parity input to achieve exhaustive binary parsing. When PARSE-σ, FT-BIN, and MAX all dominate DEP, DEP will be violated and a single syllable added to an odd-parity input.

Under those rankings where the EOP does arise, it only affects odd-parity forms that escape the OHP. The OHP affects odd-parity forms with odd-numbered heavy syllables, and the OHP affects all other odd-parity forms. This is illustrated for the deletion ranking in (52,53) and the insertion ranking in (54,55).

(52)

LLLLHLL	PARSE-σ	FT-BIN	DEP	MAX
☞ a. (LL)(LL)(H)(LL)				
b. (LL)(LL)(HL)				1!
c. (LL)(LL)(HL)(LL)			1!	
d. (LL)(LL)(HL)(L)		1!		
e. (LL)(LL)(HL)L	1!			

(53)

LLLLLLL	PARSE-σ	FT-BIN	DEP	MAX
☞ a. (LL)(LL)(LL)				1
b. (LL)(LL)(LL)(LL)			1!	
c. (LL)(LL)(LL)(L)		1!		
d. (LL)(LL)(LL)L	1!			

In (52), since the odd-parity input contains an odd-numbered heavy syllable, the heavy syllable can be parsed as a monosyllabic foot, and there is no need to violate faithfulness to achieve exhaustive binary footing. The results are different in (53), however, which does not contain an odd-numbered heavy syllable. In this case, PARSE-σ and FT-BIN exclude the faithful candidates because they must either leave a syllable unparsed or parse a light syllable as monosyllabic foot. Since the higher-ranked DEP excludes the candidate where a single syllable has been added to the odd-parity input, the optimal candidate is the one that achieves exhaustive binary parsing by deleting a single syllable at the expense of the low-ranked MAX.

The results are similar under the insertion ranking in (54,55).

(54)

LLLLHLL	PARSE-σ	FT-BIN	MAX	DEP
☞ a. (LL)(LL)(H)(LL)				
b. (LL)(LL)(HL)			1!	
c. (LL)(LL)(HL)(LL)				1!
d. (LL)(LL)(HL)(L)		1!		
e. (LL)(LL)(HL)L	1!			

(55)

LLLLHLL	PARSE-σ	FT-BIN	MAX	DEP
a. (LL)(LL)(LL)			1!	
☞ b. (LL)(LL)(LL)(LL)				1
c. (LL)(LL)(LL)(L)		1!		
d. (LL)(LL)(LL)L	1!			

The faithful candidate is optimal when the input contains an odd-numbered heavy syllable, as in (54). When there is no odd-numbered heavy syllable, as in (55), however, an unfaithful candidate is optimal. Under the insertion ranking, the higher-ranked MAX excludes the candidate where a single syllable has been deleted. The candidate that violates the low-ranked DEP by inserting a single syllable emerges as the winner.

In addition to the twelve patterns, summarized in (34-36), that exhibit the OHP only, GA predicts eight patterns where the EOP emerges alongside. The combined OHP + EOP patterns makes sensitivity to the weight of odd-numbered heavy syllables conspicuous in a new way. This time, it is conspicuous in an alternation between odd- and even-parity outputs. When an odd-numbered heavy syllable is present, the output for an odd-parity input is still odd-parity. When no odd-numbered heavy syllable is present, however, the output is even-parity.

To summarize, then, OHP-only patterns emerge when both faithfulness constraints dominate either PARSE-σ or FT-BIN.

(56) Odd Heavy Problem Only: DEP, MAX >> PARSE-σ or DEP, MAX >> FT-BIN

Summarized in (34-36) above.

Languages that exhibit the EOP in addition to the OHP emerge in GA when PARSE-σ and FT-BIN both dominate one of the faithfulness constraints. For each language in the tables in (57,58), there are two example outputs for odd-parity inputs. The first indicates which odd-numbered heavy syllable, the leftmost or the rightmost, is parsed as a monosyllabic foot when one or more is available. The second indicates whether a syllable is added or subtracted when no odd-numbered heavy syllable is available.

(57) Odd Heavy Problem + Even Output Problem (Deletion Version)

a. PARSE-σ, FT-BIN, DEP >> MAX >> ALLFEETL

i. Trochaic: *Unattested*	ii. Iambic: *Unattested*
LLHLHLL → (ĹL)(H́)(ĹH)(ĹL)	LLHLHLL → (LĹ)(H́)(LH́)(LĹ)
LLLLLLL → (ĹL)(ĹL)(ĹL)	LLLLLLL → (LĹ)(LĹ)(LĹ)

b. PARSE-σ, FT-BIN, DEP >> MAX >> ALLFEETR

i. Trochaic: *Unattested*	ii. Iambic: *Unattested*
LLHLHLL → (ĹL)(H́L)(H́)(ĹL)	LLHLHLL → (LĹ)(HĹ)(H́)(LĹ)
LLLLLLL → (ĹL)(ĹL)(ĹL)	LLLLLLL → (LĹ)(LĹ)(LĹ)

(58) Odd Heavy Problem + Even Output Problem (Insertion Version)

a. PARSE-σ, FT-BIN, MAX >> DEP >> ALLFEETL

i. Trochaic: *Unattested*

LLHLHLL → (ĹL)(H́)(ĹH)(ĹL)

LLLLLLL → (ĹL)(ĹL)(ĹL)(ĹL)

ii. Iambic: *Unattested*

LLHLHLL → (LĹ)(H́)(LH́)(LĹ)

LLLLLLL → (LĹ)(LĹ)(LĹ)(LĹ)

b. PARSE-σ, FT-BIN, MAX >> DEP >> ALLFEETR

i. Trochaic: *Unattested*

LLHLHLL → (ĹL)(H́L)(H́)(ĹL)

LLLLLLL → (ĹL)(ĹL)(ĹL)(ĹL)

ii. Iambic: *Unattested*

LLHLHLL → (LĹ)(HĹ)(H́)(LĹ)

LLLLLLL → (LĹ)(LĹ)(LĹ)(LĹ)

When MAX is the lower-ranked faithfulness constraint, as in (57), the two OHP types specific to GA – rightmost odd-numbered heavy syllable parsed as a monosyllabic foot or leftmost – are accompanied by the deletion version of the EOP. Combined with both iambic footing and trochaic footing, the result is four patterns, each of which is unattested. When DEP is lower-ranked, as in (58), the two OHP types are accompanied by the insertion version of the EOP. Combined with both iambic and trochaic footing, the result is four additional patterns, each of which is unattested.

4.2 The Even Output Problem under Iterative Foot Construction

As in GA, the Even Output Problem in IFO only applies to odd-parity forms that escape the Odd Heavy Problem. Under IFO, however, the EOP results in twice as many unattested patterns. The reason is simply that the EOP can accompany twice as many specific manifestations of the OHP. In GA, the OHP has only two types: one that selects the leftmost odd-numbered heavy syllable for parsing as a monosyllabic foot and one that selects the rightmost. In IFO, the OHP has four types: one that selects a heavy initial syllable, one that selects a heavy post-peninitial syllable, one that selects a heavy antepenult, and one that selects a heavy ultima. Each of these four types can be combined with both the insertion and deletion varieties of the EOP.

IFO's deletion version of the EOP arises in rankings where PARSE-σ and FT-BIN both dominate MAX (the ranking of DEP is not crucial). To illustrate, consider the effects of the ranking (with rightward alignment) in (59) and (60). The derivation in (59) illustrates that the OHP, rather than the EOP, emerges in forms with an appropriately positioned heavy syllable – in this case, the final syllable.

(59)

HLLLLLL	PARSE-σ	FT-BIN	MAX
a. HLLLLLL	7!		
b. HLLLLL(L)	6!	1!	
☞ c. HLLLL(LL)	5		
d. HLLLLL	6!		1

HLLLL(LL)	PARSE-σ	FT-BIN	MAX
a. HLLLL(LL)	5!		
b. HLLL(L)(LL)	4!	1!	
☞ c. HLL(LL)(LL)	3		
d. HLLL(LL)	4!		1

HLL(LL)(LL)	PARSE-σ	FT-BIN	MAX
a. HLL(LL)(LL)	3!		
b. HL(L)(LL)(LL)	2!	1!	
☞ c. H(LL)(LL)(LL)	1		
d. HL(LL)(LL)	2!		1

H(LL)(LL)(LL)	PARSE-σ	FT-BIN	MAX
a. H(LL)(LL)(LL)	1!		
☞ b. (H)(LL)(LL)(LL)			
c. (LL)(LL)(LL)			1!

The derivation in (60) illustrates how a syllable is deleted in forms that lack an appropriately positioned heavy syllable. The key step in (60) is the last, where the input has a single light syllable left unfooted. If the syllable is left unparsed, it violates the high-ranked PARSE-σ. If the syllable is parsed a monosyllabic foot, it violates the high-ranked FT-BIN. In the end, deleting the syllable is the best option, as it satisfies FT-BIN and PARSE-σ simultaneously.

(60)

LLLLLLL	PARSE-σ	FT-BIN	MAX
a. LLLLLLL	7!		
b. LLLLLL(L)	6!	1!	
☞ c. LLLLL(LL)	5		
d. LLLLLL	6!		1

LLLLL(LL)	PARSE-σ	FT-BIN	MAX
a. LLLLL(LL)	5!		
b. LLLL(L)(LL)	4!	1!	
☞ c. LLL(LL)(LL)	3		
d. LLLL(LL)	4!		1

LLL(LL)(LL)	PARSE-σ	FT-BIN	MAX
a. LLL(LL)(LL)	3!		
b. LL(L)(LL)(LL)	2!	1!	
☞ c. L(LL)(LL)(LL)	1		
d. LL(LL)(LL)	2!		1

L(LL)(LL)(LL)	PARSE-σ	FT-BIN	MAX
a. L(LL)(LL)(LL)	1!		
b. (L)(LL)(LL)(LL)		1!	
☞ c. (LL)(LL)(LL)			1

The reason that the ranking of DEP is not crucial in (60) is that the high-ranking PARSE-σ and FT-BIN both discourage syllable insertion in the final step. Adding another stray syllable would increase the violations of the high-ranked PARSE-σ. Adding a syllable to an existing disyllabic foot (making the foot ternary) would create a violation of FT-BIN. It is impossible to create a new foot to accommodate the inserted syllable, as in (61), because a candidate can have only one difference from the input. A new syllable and a new foot represent two differences. There is simply no advantage to be gained, then, from a DEP violation.

(61) Impossible Mapping

L(LL)(LL)(LL) → (LL)(LL)(LL)(LL)

It is only advantageous to insert a syllable when it can be added to an existing monosyllabic foot, and this circumstance helps to determine the rankings under which the insertion version of the EOP emerges. The last unparsed syllable of an odd-parity form will only be parsed as a monosyllabic foot when Parse-σ and Max both dominate Ft-Bin. A syllable will then be added to the monosyllabic foot when all three constraints dominate Dep. The derivations in (62,63) illustrate the effects of the ranking Parse-σ, Max >> Ft-Bin >> Dep (with rightward alignment).

The derivation in (62) illustrates that the OHP, rather than the EOP, emerges in forms with an appropriately positioned heavy syllable – once again, the final syllable.

(62)

HLLLLLL	Parse-σ	Max	Ft-Bin	Dep
a. HLLLLLL	7!			
b. HLLLLL(L)	6!		1	
☞ c. HLLLL(LL)	5			
d. HLLLLLLL	8!			1
e. HLLLLL	6!	1!		

HLLLL(LL)	Parse-σ	Max	Ft-Bin	Dep
a. HLLLL(LL)	5!			
b. HLLL(L)(LL)	4!		1	
☞ c. HLL(LL)(LL)	3			
d. HLLLLL(LL)	6!			1
e. HLLL(LL)	4!	1!		

HLL(LL)(LL)	Parse-σ	Max	Ft-Bin	Dep
a. HLL(LL)(LL)	3!			
b. HL(L)(LL)(LL)	2!		1	
☞ c. H(LL)(LL)(LL)	1			
d. HLLL(LL)(LL)	4!			1
e. HL(LL)(LL)	2!	1!		

H(LL)(LL)(LL)	Parse-σ	Max	Ft-Bin	Dep
a. H(LL)(LL)(LL)	1!			
☞ b. (H)(LL)(LL)(LL)				
c. HL(LL)(LL)(LL)	2!			1
d. (LL)(LL)(LL)		1!		

The derivation in (63) illustrates how a syllable is inserted in forms that lack an appropriately positioned heavy syllable. The key steps in (63) are the fourth and fifth. In the fourth, the input has a single light syllable left unfooted. The syllable cannot be left unparsed in the output without violating the high-ranked PARSE-σ, and it cannot be deleted without violating the high-ranked MAX. To satisfy both, it is parsed as a monosyllabic foot at the expense of FT-BIN. In the fifth step, the ranking FT-BIN >> DEP ensures that a single syllable is added to the monosyllabic foot, making the foot disyllabic and the overall form even-parity.

(63)

LLLLLLL	PARSE-σ	MAX	FT-BIN	DEP
a. LLLLLLL	7!			
b. LLLLLL(L)	6!		1	
☞ c. LLLLL(LL)	5			
d. LLLLLLLL	8!			1
e. LLLLLL	6!	1!		

LLLLL(LL)	PARSE-σ	MAX	FT-BIN	DEP
a. LLLLL(LL)	5!			
b. LLLL(L)(LL)	4!		1	
☞ c. LLL(LL)(LL)	3			
d. LLLLLL(LL)	6!			1
e. LLLL(LL)	4!	1!		

LLL(LL)(LL)	PARSE-σ	MAX	FT-BIN	DEP
a. LLL(LL)(LL)	3!			
b. LL(L)(LL)(LL)	2!		1	
☞ c. L(LL)(LL)(LL)	1			
d. LLLL(LL)(LL)	4!			1
e. LL(LL)(LL)	2!	1!		

L(LL)(LL)(LL)	PARSE-σ	MAX	FT-BIN	DEP
a. L(LL)(LL)(LL)	1!			
☞ b. (L)(LL)(LL)(LL)			1	
c. LL(LL)(LL)(LL)	2!			
d. (LL)(LL)(LL)		1!		1

(L)(LL)(LL)(LL)	PARSE-σ	MAX	FT-BIN	DEP
a. (L)(LL)(LL)(LL)			1!	
☞ b. (LL)(LL)(LL)(LL)				1

In addition to the patterns summarized in (47-50), then, IFO predicts eight OHP + EOP deletion languages, and eight OHP + EOP insertion languages. As indicated in (64), the patterns in (47-50) emerge under the rankings Ft-Bin, Max >> Parse-σ or Max, Dep >> Ft-Bin.

(64) OHP Only: Ft-Bin, Max >> Parse-σ or Max, Dep >> Ft-Bin

Summarized in (44-47) above.

The predicted OHP + EOP languages are summarized in (65-66). For each language predicted, there are two example mappings. The first indicates the type of OHP pattern that emerges from odd-parity inputs with an appropriately positioned odd-numbered heavy syllable, and the second example illustrates the type of EOP pattern that emerges from odd-parity inputs that lack such a heavy syllable.

(65) Odd Heavy Problem + Even Output Problem (Deletion Version)

a. Parse-σ, Ft-Bin >> Max >> Feet-R

i. Trochaic: *Unattested*
Hσσσσσσ → (H́)(σ́σ)(σ́σ)(σ́σ)
Lσσσσσσ → (σ́σ)(σ́σ)(σ́σ)

ii. Iambic: *Unattested*
Hσσσσσσ → (H́)(σσ́)(σσ́)(σσ́)
Lσσσσσσ → (σσ́)(σσ́)(σσ́)

b. Parse-σ, Ft-Bin >> Max >> Feet-L

i. Trochaic: *Unattested*
σσσσσσH → (σ́σ)(σ́σ)(σ́σ)(H́)
σσσσσσL → (σ́σ)(σ́σ)(σ́σ)

ii. Iambic: *Unattested*
σσσσσσH → (σσ́)(σσ́)(σσ́)(H́)
σσσσσσL → (σσ́)(σσ́)(σσ́)

c. Parse-σ, Ft-Bin >> Max >> Feet-R; PrWd-L >> Feet-R

i. Trochaic: *Unattested*
σσHσσσσ → (σ́σ)(H́)(σ́σ)(σ́σ)
σσLσσσσ → (σ́σ)(σ́σ)(σ́σ)

ii. Iambic: *Unattested*
σσHσσσσ → (σσ́)(H́)(σσ́)(σσ́)
σσLσσσσ → (σσ́)(σσ́)(σσ́)

d. Parse-σ, Ft-Bin >> Max >> Feet-L; PrWd-R >> Feet-L

i. Trochaic: *Unattested*
σσσσHσσ → (σ́σ)(σ́σ)(H́)(σ́σ)
σσσσLσσ → (σ́σ)(σ́σ)(σ́σ)

ii. Iambic: *Unattested*
σσσσHσσ → (σσ́)(σσ́)(H́)(σσ́)
σσσσLσσ → (σσ́)(σσ́)(σσ́)

(66) Odd Heavy Problem + Even Output Problem (Insertion Version)

a. PARSE-σ, MAX >> FT-BIN >> DEP, FEET-R

i. Trochaic: *Unattested*

Hσσσσσσ → (H́)(σ́σ)(σ́σ)(σ́σ)

Lσσσσσσ → (Ĺσ)(σ́σ)(σ́σ)(σ́σ)

ii. Iambic: *Unattested*

Hσσσσσσ → (H́)(σσ́)(σσ́)(σσ́)

Lσσσσσσ → (σĹ)(σσ́)(σσ́)(σσ́)

b. PARSE-σ, MAX >> FT-BIN >> DEP, FEET-L

i. Trochaic: *Unattested*

σσσσσσH → (σ́σ)(σ́σ)(σ́σ)(H́)

σσσσσσL → (σ́σ)(σ́σ)(σ́σ)(Ĺσ)

ii. Iambic: *Unattested*

σσσσσσH → (σσ́)(σσ́)(σσ́)(H́)

σσσσσσL → (σσ́)(σσ́)(σσ́)(σĹ)

c. PARSE-σ, MAX >> FT-BIN >> DEP, FEET-R; PRWD-L >> FEET-R

i. Trochaic: *Unattested*

σσHσσσσ → (σ́σ)(H́)(σ́σ)(σ́σ)

σσLσσσσ → (σ́σ)(Ĺσ)(σ́σ)(σ́σ)

ii. Iambic: *Unattested*

σσHσσσσ → (σσ́)(H́)(σσ́)(σσ́)

σσLσσσσ → (σσ́)(σĹ)(σσ́)(σσ́)

d. PARSE-σ, MAX >> FT-BIN >> DEP, FEET-L; PRWD-R >> FEET-L

i. Trochaic: *Unattested*

σσσσHσσ → (σ́σ)(σ́σ)(H́)(σ́σ)

σσσσLσσ → (σ́σ)(σ́σ)(Ĺσ)(σ́σ)

ii. Iambic: *Unattested*

σσσσHσσ → (σσ́)(σσ́)(H́)(σσ́)

σσσσLσσ → (σσ́)(σσ́)(σĹ)(σσ́)

Notice that the quantity-sensitivity of the OHP can be observed with exhaustive parsing rankings (PARSE-σ >> FT-BIN) in the context of EOP patterns, where they were obscured by the basic exhaustive parsing patterns in the predictions summarized in (49,50). As in GA, sensitivity to the weight of odd-numbered syllables in odd-parity forms results in an alternation between odd-parity outputs and even-parity outputs. In the context of EOP patterns, then, it is no longer the case that the last syllable addressed will be parsed as monosyllabic foot whether it is heavy or light. If it is heavy, it will be parsed as a monosyllabic foot. If it is light, it will be deleted or parsed into a disyllabic foot with an epenthetic syllable.

5 Weak Bracketing

As we have seen in the preceding section, neither serialism nor parallelism is the source of the Odd-Parity Parsing Problem. To find the source, it is necessary to look elsewhere, making comparisons between theories that allow other factors, such as structural assumptions or constraint formulation, to be isolated. As it happens, comparisons of this type have already been made. In particular, Hyde 2008 compared GA, a Weak Layering account, to the account of binary stress patterns proposed in Hyde 2002, a Weak Bracketing account. It found that the former but not the latter exhibited the effects of the Odd-Parity Parsing Problem. While the experiment was not as perfectly controlled as the one pursued above – the accounts both adopt a parallel derivational perspective but they employ similar, not identical, constraints – it strongly suggests that Weak Layering is the source of the Odd-Parity Parsing Problem. In this section, I show how the Weak Bracketing account avoids the Odd-Parity Parsing Problem and summarize its predictions.

5.1 Avoiding the Odd-Parity Parsing Problem

The Odd-Parity Parsing Problem arises in both GA and IFO due the their structural assumptions. Both are Weak Layering approaches, so both require that the leftover syllable of an odd-parity form remain unparsed or be parsed as a monosyllabic foot. Given these options, parsing and minimality requirements can only be satisfied simultaneously for an odd-parity input by parsing an odd-numbered heavy syllable as a monosyllabic foot or violating a faithfulness constraint (making the form even-parity). If we are willing to make changes in our basic assumptions about prosodic layering, however, the options for achieving exhaustive binary parsing in odd-parity forms also change.

Weak Bracketing takes a different approach to the layering irregularities that the grammar uses to deal with the leftover syllable of an odd-parity form. Under Weak Bracketing, a leftover syllable can be parsed as a monosyllabic foot, as in (67a), or it can be parsed into a disyllabic foot that overlaps another disyllabic foot, as in (67b).

(67) Weak Bracketing

a. Monosyllabic Foot

σ σ σ σ σ σ σ
\/ \/ \/ |

b. Overlapping Feet

σ σ σ σ σ σ σ
\/ \/ \/\/

As in the GA and IFO accounts, the ability of a monosyllabic foot to achieve exhaustive binary parsing depends on the weight of odd-numbered syllables. The ability of overlapping feet, however, does not. Overlapping feet result in exhaustive binary parsing regardless of the weight of the syllables involved.

As indicated in (68, 69), the addition of the overlapping feet option makes both the existence and position of heavy syllables irrelevant to a form's ability to achieve exhaustive binary parsing, a result sufficient to eliminate the Odd Heavy Problem.

(68)

LLLLLLL	FT-BIN	PARSE-σ
☞ a. L L L L L L L \/ \/ \/\/		
☞ b. L L L L L L L \/ \/\/ \/		
☞ c. L L L L L L L \/\/ \/ \/		
d. L L L L L L L \/ \/ \/ |	1!	
e. L L L L L L L \/ \/ \/		1!

As (68) illustrates, even when an odd-parity form consists of all light syllables, overlapping feet allow it to achieve exhaustive binary parsing. An overlapping configuration parses three syllables into two disyllabic feet. With an even number of syllables remaining, it is a simple matter to parse the rest of the string into disyllabic feet, as well. As a result Ft-Bin and Parse-σ are satisfied simultaneously. As we shall see below, alignment constraints are primarily responsible for determining the ultimate position of overlapping feet, for distinguishing between (68a-c), for example.

(69)

LLHLLLL	Ft-Bin	Parse-σ
☞ a. L L H L L L L		
☞ b. L L H L L L L		
☞ c. L L H L L L L		
☞ d. L L H L L L L		
e. L L H L L L L	1!	
f. L L H L L L L		1!

As (69) illustrates, parsing an odd-numbered heavy syllable as a monosyllabic foot, when one is available, does not present a better alternative. Parse-σ and Ft-Bin can be satisfied simultaneously by parsing an odd-numbed heavy syllable as a monosyllabic foot, as in (69d), but they can also be satisfied simultaneously by parsing three syllables of any weight into two overlapping feet, as in (69a-c). Since the overlapping feet can be freely positioned by alignment and other relevant constraints without the interference of weight-based restrictions, and will be preferred to forms with a heavy monosyllabic foot as a result, syllable weight affects neither parsability nor parsing directionality. When odd-numbered heavy syllables are present, then, exactly the same pattern emerges as when they are absent.

Similar considerations allow the Weak Bracketing approach to avoid the Even Only Problem. As (70) indicates, since overlapping feet can achieve exhaustive binary parsing for any odd-parity form, even those containing only light syllables, there is no advantage to be gained by converting an odd-parity input to an even-parity output, either through deletion or insertion.

(70)

LLLLLLL	Ft-Bin	Parse-σ	Max	Dep
☞ a. L L L L L L L				
b. L L L L L L L L				1!
c. L L L L L L			1!	

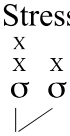
In (70), overlapping feet allow Parse-σ and Ft-Bin to be satisfied simultaneously while remaining faithful to the odd-parity input. Inserting a syllable simply creates a gratuitous Dep violation without improving performance on the parsing and minimality requirements, and deleting a syllable simply creates a gratuitous Max violation.

Under Weak Bracketing, then, overlapping feet provide a way to achieve exhaustive binary footing for any odd-parity input without making parsing sensitive to syllable weight or converting the odd-parity input into an even-parity output. This allows the theory to avoid both aspects of the Odd-Parity Parsing Problem – the Odd Heavy Problem and the Even Output Problem – altogether. The accomplishment, of course, means very little if the set of patterns that Weak Bracketing does predict are not a reasonably close match to the set of attested patterns. As it happens, the Weak Bracketing approach does predict a reasonably close match, being particularly strong in the area of iambic-trochaic asymmetries. Since these predictions have been discussed elsewhere at some length (see Hyde 2002), I will discuss them only briefly here.

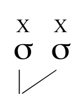
5.2 Basic Predictions of the Weak Bracketing Approach

Following Selkirk (1980), the traditional view of the relationship between prosodic categories that project to the metrical grid and the grid entries projected is that they stand in a one-to-one correspondence. Though there is still a fundamental relationship between prosodic structure and grid entries in the Weak Bracketing approach, the relationship is somewhat looser than it is in traditional approaches. The account departs from the traditional view in two ways. The first is that a prosodic category can fail to correspond to a grid entry. A foot, for example, may be stressed or stressless, as illustrated in (68). (In the examples that follow, a vertical association line indicates the head syllable of the foot. Though a foot need not be stressed in every context, it must always have a head syllable.)

(71) a. Stressed Trochee

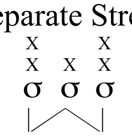


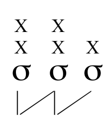
b. Stressless Trochee

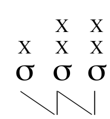


The second departure is that overlapping prosodic categories may be stressed separately but they may also share a stress.

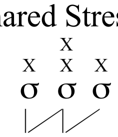
(72) a. Separate Stresses

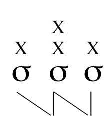
i. 

ii. 

iii. 

b. Shared Stress

i. 

ii. 

In (72a), there is a foot-level gridmark for each foot in the overlapping configurations. In (72b), however, the two feet share a foot-level gridmark.

The mappings where feet and stress stand in the traditional one-to-one correspondence and the mappings where they do not are all made possible by the formulation of the constraints that require prosodic categories to map to the metrical grid. Since the constraints are violable, it is possible to have stressless prosodic categories when they are appropriately low-ranked. Since the constraints only require that each instance of a prosodic category be associated with a grid entry, without the additional requirement that the association be unique, it is possible for two instances of a prosodic category to share an entry, if the categories overlap. The constraint that requires feet to correspond to foot-level gridmarks is given in (73).

(73) MAPGRIDMARK: Each foot has a foot-level gridmark within its domain.

When MAPGRIDMARK is satisfied, each foot will be stressed. When the constraint must be violated, however, a foot may emerge without a stress. In regular layering configurations, where feet do not overlap, the requirement that each foot have a foot-level gridmark within its domain means that there must be a unique gridmark associated with each individual foot. In configurations where feet do overlap, however, each foot can satisfy the requirement simply by positioning a gridmark over the shared syllable, as in (72b). While the constraint can also be satisfied by associating a unique gridmark with each foot, as in (72a), a unique gridmark is not strictly necessary.

To provide a basic picture of the patterns predicted by the Weak Bracketing account, the account includes four constraints that require alignment between the heads of feet and prosodic words.

(74) Foot-Head Alignment

a. ALLHEADSL: The left edge of every foot-head is aligned with the left edge of some prosodic word.

b. ALLHEADSR: The right edge of every foot-head is aligned with the right edge of some prosodic word.

c. HEADL: The left edge of every prosodic word is aligned with the left edge of some foot-head.

d. HEADR: The right edge of every prosodic word is aligned with the right edge of some foot-head.

ALLHEADSL and ALLHEADSR influence the position of every head syllable, drawing each towards the designated edge of the prosodic word. HEADL and HEADR influence the position of a single head syllable, insisting that one occur at the designated edge of the prosodic word.

As indicated in (75a), drawing foot-heads towards the left edge of the prosodic word creates a trochaic pattern with overlapping feet at the left edge in odd-parity forms. Similarly, in (75b), drawing foot-heads towards the right edge creates an iambic pattern with overlapping feet at the right edge in odd-parity forms. The *CLASH constraint ensures that the overlapping feet in both cases are mapped to the metrical grid in a gridmark-sharing configuration.

(75) a. Nengone-type (Trochaic)
ALLHEADSL, *CLASH, MAPGM

x		x		x	
x	x	x	x	x	x
σ	σ	σ	σ	σ	σ

	x		x		x	
x	x	x	x	x	x	x
σ	σ	σ	σ	σ	σ	σ

b. Araucanian-type (Iambic)
ALLHEADSR, *CLASH, MAPGM

	x		x		x
x	x	x	x	x	x
σ	σ	σ	σ	σ	σ

	x		x		x	
x	x	x	x	x	x	x
σ	σ	σ	σ	σ	σ	σ

The result is a pair of patterns that exhibit neither clash nor lapse. Both are quantity-insensitive, and both are attested.

Ranking HEADL above ALLHEADSR positions a single head syllable at the left edge while drawing all others the right. As indicated in (76a), the result is a trochaic pattern with overlapping feet at the right edge in odd-parity forms. The overlapping feet map to the grid with a separated gridmark configuration. Ranking HEADR above ALLHEADSL positions a single head syllable at the right edge while drawing all others to the left. The result, illustrated in (76b), is an iambic pattern with overlapping feet at the left in odd-parity forms, also mapped with a separated gridmark configuration.

(76) a. Maranungku-type (Trochaic)
HEADL >> ALLHEADSR; MAPGM

x		x		x	
x	x	x	x	x	x
σ	σ	σ	σ	σ	σ

x		x		x		x
x	x	x	x	x	x	x
σ	σ	σ	σ	σ	σ	σ

b. Suruwaha-type (Iambic)
HEADR >> ALLHEADSL; MAPGM

	x		x		x
x	x	x	x	x	x
σ	σ	σ	σ	σ	σ

x		x		x		x
x	x	x	x	x	x	x
σ	σ	σ	σ	σ	σ	σ

Conflicting alignment, then, results in two additional patterns that exhibit neither clash nor lapse. Both of the patterns are quantity-insensitive, and both are attested.

To this point, then, the patterns predicted by the Weak Bracketing account all exhibit perfect binary alternation. To introduce clash and lapse in appropriate positions, the account also includes the asymmetrical INITIAL GRIDMARK and NONFINALITY constraints.

(77) Constraints Promoting Clash and Lapse

a. INITIAL GRIDMARK: The initial syllable of a prosodic word is stressed.

b. NONFINALITY: The final syllable of a prosodic word is stressless.

INITIAL GRIDMARK (Prince 1983) requires that the initial syllable of a prosodic word be stressed, and NONFINALITY (Prince and Smolensky 1993) requires that the final syllable of a prosodic word be stressless.

The inclusion of INITIAL GRIDMARK in the constraint set allows the account to produce trochaic patterns with clash and lapse as variations on the trochaic pattern in (75a). When INITIAL GRIDMARK and MAPGRIDMARK both dominate *CLASH, the result is a trochaic pattern with clash at the left edge in odd-parity forms, as in (78a). When INITIAL

GRIDMARK and *CLASH both dominate MAPGRIDMARK, the result is that the second foot is stressless in odd-parity forms, as in (78b), creating a lapse configuration after the initial stress. Both of these patterns are quantity-insensitive, and both are attested.

(78) a. Passamaquoddy-type (Trochaic)
ALLHEADSL, INITIALGM, MAPGM >> *CLASH

```
x   x   x
x x x x x x
σ σ σ σ σ σ

x x   x   x
x x x x x x x
σ σ σ σ σ σ σ
```

b. Garawa-type (Trochaic)
ALLHEADSL, INITIALGM, *CLASH >> MAPGM

```
x   x   x
x x x x x x
σ σ σ σ σ σ

x     x   x
x x x x x x x
σ σ σ σ σ σ σ
```

Since INITIAL GRIDMARK is asymmetric, affecting only the left edge of the prosodic word, it cannot be used to produce mirror image iambic versions of the patterns in (78). Since the iambic mirror images are unattested, this is the desired result.

NONFINALITY allows the account to produce variations on the trochaic pattern in (76a) where a lapse occurs at or near the right edge in odd-parity forms. As (79a) indicates, ranking NONFINALITY and ALLHEADSR above MAPGRIDMARK produces a final stressless foot in odd-parity forms, resulting in a final lapse. As (79b) indicates, ranking NONFINALITY and MAPGRIDMARK above ALLHEADSR moves the final foot-head one syllable to left in odd-parity forms. This creates a final gridmark-sharing configuration with a lapse preceding the rightmost stress. The result is again a pair of attested quantity-insensitive patterns.

(79) a. Pintupi-type (Trochaic)
HEADL >> ALLHEADSR;
ALLHEADSR, NONFIN >> MAPGM

```
x   x   x
x x x x x x
σ σ σ σ σ σ

x   x   x
x x x x x x x
σ σ σ σ σ σ σ
```

b. Piro-type (Trochaic)
HEADL >> ALLHEADSR;
MAPGM, NONFIN >> ALLHEADSR

```
x   x   x
x x x x x x
σ σ σ σ σ σ

x   x     x
x x x x x x x
σ σ σ σ σ σ σ
```

Since NONFINALITY's asymmetrical formulation prevents it from creating similar lapse configurations at the left edge of the prosodic word, so it cannot be used to produce iambic mirror images of the patterns in (79). Since the iambic mirror images are unattested, this is the desired result.

From the examples above, we can see that the differences between individual stress patterns are not completely determined by the positions of overlapping feet in the Weak Bracketing approach. Instead, they are determined both by the positions of overlapping feet, as determined by alignment constraints, and by the way in which the overlapping feet map to the metrical grid. The positions of the properly and improperly bracketed feet in (75a, 78a,b) are the same, but the stress patterns are different, the differences being due to interactions between requirements that all feet be stressed, that the initial syllable be stressed, and that clash be avoided. Similarly, properly and improperly bracketed feet are positioned in the same way in (76a, 79a,b), but different stress patterns emerge. In this case, the differences are due to interactions between alignment, the requirement that all feet be stressed, and the requirement that the final syllable be stressless.

Though the brief sketch presented above provides only an incomplete picture of the Weak Bracketing approach, it does indicate that overlapping feet can be mapped to the metrical grid in way that produces an appropriate range of stress patterns. (For a more detailed presentation of the assumptions and constraints involved in the Weak Bracketing account, and the typology of stress patterns predicted, see Hyde 2002.) Most importantly, we have seen that the Weak Bracketing approach avoids both aspects of the Odd-Parity Parsing Problem – the Odd Heavy Problem and the Even Output Problem – altogether. The reason is simply that overlapping feet allow all odd-parity forms to achieve exhaustive binary footing regardless of the weight of the syllables involved. As a result there is never a need to parse an odd-numbered heavy syllable as a monosyllabic foot or to violate faithfulness constraints to make the form even parity. We have also seen that the Weak Bracketing account seems to predict an appropriate range of quantity-insensitive binary stress patterns.

6 Conclusions and Summary

Although Pruitt's (2008) Iterative Foot Optimization proposal is an important contribution in the debate over serial and parallel derivation in phonology, it is important primarily because it helps to demonstrate as clearly as possible that neither serialism nor parallelism is the source of the Odd-Parity Parsing Problem. IFO and Generalized Alignment share the same structural assumptions and the same set of constraints. They differ only in their derivational perspective, IFO being implemented in the serial framework of Harmonic Serialism and GA being implemented in the parallel framework of Optimality Theory. If the Odd-Parity Parsing Problem could be shown to arise in one but not the other, then the derivational perspective of the offending account would be identified as its source.

When we actually compared IFO to GA, however, we saw that the Odd-Parity Parsing Problem arises in both accounts and that it contributes significantly to the inadequacy of both. The source of the problem, then, had to be something that IFO and GA have in common, either their Weak Layering structural assumptions or their shared set of constraints. When we compared the predictions of IFO and GA to those of the parallel account of Hyde (2002), we saw that the Odd-Parity Parsing Problem does not arise under the structural assumptions of Weak Bracketing. Given this result, we could identify Weak Layering as the source of the Odd-Parity Parsing Problem in IFO and GA.

It turns out, then, that there is no argument for serialism based on IFO's ability to avoid the Odd-Parity Parsing Problem. Though it suffers differently, it suffers its effects just like GA. There is a strong argument, however, for the Weak Bracketing account, which does manage to avoid the problem.

We began in Section 2 by setting aside the potential effects of heavy syllables and the possibility of faithfulness violations and examining how GA and IFO produce basic directional parsing effects. There is one important difference in their predictions. IFO's serialism results in an extra set of four bidirectional exhaustive parsing patterns, each of which is unattested.

In Section 3, we examined the different versions of the Odd Heavy Problem that arise under GA and IFO. There are two effects that make the peculiar quantity-sensitivity of the OHP conspicuous. In the first, the presence or absence of odd-numbered heavy syllables is the basis for an alternation between underparsing and exhaustive parsing. In the second, the presence of an odd-numbered heavy syllable perturbs basic directional parsing effects. GA exhibits both effects. IFO exhibits only the former, a circumstance that allows it to produce a couple of attested quantity-insensitive patterns under exhaustive parsing rankings.

The OHP occurs in two distinct types under GA, one where the leftmost odd-numbered heavy syllable is parsed as a monosyllabic foot and one where the rightmost is parsed as a monosyllabic foot. It occurs in four distinct types under IFO, one where an initial heavy syllable is parsed as a monosyllabic foot, one where a post-peninitial heavy syllable parsed as a monosyllabic foot, one where a heavy antepenult is parsed as a monosyllabic foot, and one where a heavy ultima is parsed as a monosyllabic foot.

In Section 4 we examined the different versions of the Even Only Problem that arise under the GA and IFO. Under both accounts, the EOP only emerges in conjunction with the OHP, the former affecting just those odd-parity inputs that escape the latter. The quantity-sensitivity of the combined OHP + EOP languages is conspicuous in the alternation between odd-parity output and even-parity outputs. When an appropriately positioned odd-numbered heavy syllable is present, the result for an odd-parity input is an odd-parity output. When no such odd-numbered heavy syllable is available, the result is an even-parity output.

Finally, in Section 5, we saw that a Weak Bracketing approach avoids both the OHP and EOP making it possible to identify the Weak Layering common to GA and IFO as the source of the Odd-Parity Parsing Problem. We also saw that, unlike GA and IFO, the Weak Bracketing approach is actually able to produce a reasonably accurate range of quantity-insensitive binary stress patterns.

Appendix

> Mr. Woody, seeming almost of sound mind but wet-eyed drunk, hooked onto the word "codicil" from somewhere in his past life, telling Donnell that's what it was, a codicil, like an addendum. You didn't scribble a codicil, it was a legal document and ought to be typewritten.
>
> -Elmore Leonard, *Freaky Deaky*

What might seem like an obvious solution to the Odd Heavy Problem – that the minimal foot requirement in quantity-insensitive systems always insists on two syllables rather than two moras – is really no solution at all. There are several reasons, the first being that a disyllabic minimal foot requirement could not simply replace the well-motivated bimoraic minimal foot requirement. The bimoraic minimal foot requirement would still be present in the set of constraints, potentially influencing the outcome even when it is low-ranked.

Consider separate syllabic and moraic minimality restrictions along the lines proposed by Hewitt (1994).[6]

(80) a. FT-MIN-σ: A foot contains at least two syllables.
b. FT-MIN-μ: A foot contains at least two moras.

As indicated in (81) for GA and (82) for IFO, when FT-MIN-σ dominates PARSE-σ, it is never helpful to parse a heavy syllable as a monosyllabic foot and the types of foot patterns expected in quantity-insensitive systems can emerge. Rightward alignment is used to illustrate in both examples.

(81) Quantity-Insensitivity in GA

HLLLLLL	FT-MIN-σ	PARSE-σ	FEET-R
☞ a. H(LL)(LL)(LL)		1	6
b. (H)(LL)(LL)(LL)	1!		12
c. (HL)(LL)(LL)(L)	1!		9

[6] For the sake of simplicity, I ignore the syllabic and moraic constraints on maximum foot size and simply assume that the maximum size is universally disyllabic.

(82) Quantity-Insensitivity in IFO

HLLLLLL	Ft-Min-σ	Parse-σ	Feet-R
a. HLLLLLL		7!	
b. HLLLLL(L)	1!	6	
☞ c. HLLLL(LL)		5	
d. (HL)LLLLL		5	5!

HLLLL(LL)	Ft-Min-σ	Parse-σ	Feet-R
a. HLLLL(LL)		5!	
b. HLLL(L)(LL)	1!	4	2
☞ c. HLL(LL)(LL)		3	2
d. (HL)LLL(LL)		3	5!

HLL(LL)(LL)	Ft-Min-σ	Parse-σ	Feet-R
a. HLL(LL)(LL)		3!	2
b. HL(L)(LL)(LL)	1!	2	6
☞ c. H(LL)(LL)(LL)		1	6
d. (HL)L(LL)(LL)		1	7!

H(LL)(LL)(LL)	Ft-Min-σ	Parse-σ	Feet-R
☞ a. H(LL)(LL)(LL)		1	6
b. (H)(LL)(LL)(LL)	1!		12

As indicated in (83) for GA and (84) for IFO, however, when Parse-σ dominates Ft-Min-σ, it again becomes desirable to parse an odd-numbered heavy syllable as a monosyllabic foot, and the peculiar quantity-sensitivity of the OHP emerges. In GA, this is true as long Ft-Min-μ dominates alignment – its ranking relative to Parse-σ and Ft-Min-σ is not crucial. In IFO, it is true regardless of the ranking of Ft-Min-μ. Ft-Min-μ dominates Parse-σ in the examples below, so that an underparsing pattern would have emerged if the relevant odd-numbered heavy syllables were all light.

(83) OHP in GA

HLLLLLL	Ft-Min-μ	Parse-σ	Ft-Min-σ	Feet-R
a. H(LL)(LL)(LL)		1!		6
☞ b. (H)(LL)(LL)(LL)			1	12
c. (HL)(LL)(LL)(L)	1!			9

(84) OHP in IFO

HLLLLLL	FT-MIN-μ	PARSE-σ	FT-MIN-σ	FEET-R
a. HLLLLLL		7!		
b. HLLLLL(L)	1!	6	1	
☞ c. HLLLL(LL)		5		
d. (HL)LLLLL		5		5!

HLLLL(LL)	FT-MIN-μ	PARSE-σ	FT-MIN-σ	FEET-R
a. HLLLL(LL)		5!		
b. HLLL(L)(LL)	1!	4	1	2
☞ c. HLL(LL)(LL)		3		2
d. (HL)LLL(LL)		3		5!

HLL(LL)(LL)	FT-MIN-μ	PARSE-σ	FT-MIN-σ	FEET-R
a. HLL(LL)(LL)		3!		2
b. HL(L)(LL)(LL)	1!	2	1	6
☞ c. H(LL)(LL)(LL)		1		6
d. (HL)L(LL)(LL)		1		7!

H(LL)(LL)(LL)	FT-MIN-μ	PARSE-σ	FT-MIN-σ	FEET-R
a. H(LL)(LL)(LL)		1!		6
☞ b. (H)(LL)(LL)(LL)			1	11

In (83) and in the final step in (84), a monosyllabic foot is built on an odd-numbered heavy syllable to satisfy FT-MIN-μ and PARSE-σ simultaneously. Since PARSE-σ dominates FT-MIN-σ, the latter cannot prevent the heavy monosyllabic foot from being constructed.

Overall, then, a separate disyllabic foot minimality requirement would allow both GA and IFO to produce truly quantity-insensitive systems, addressing the undergeneration aspect of the OHP, but it would still allow the theory to produce otherwise quantity-insensitive patterns that are sensitive just to the weight of odd numbered heavy syllables in odd-parity forms, leaving the overgeneration aspect of the problem unaddressed.

A second reason that a separate disyllabic minimality requirement is not a viable solution is that it is not particularly well motivated. In Hewitt's account, for example, FT-MIN-σ is conspicuous for standing around with nothing to do. This should not be surprising. As Hayes (1995) notes, quantity-insensitive languages that allow bimoraic syllables seem never to categorically prohibit heavy monosyllabic feet. Even in those cases where the minimal word is disyllabic, rather than bimoraic, it can be accounted for with a bimoraic minimal foot, an extrametricality/nonfinality effect, or a combination of the two.

The final reason that a separate syllabic minimal foot requirement is undesirable is that it actually exacerbates the second sub-problem of the Odd-Parity Parsing Problem: the Even Output Problem. In the version of the EOP discussed above, only those odd-parity inputs that escaped the OHP were converted to even-parity outputs. When FT-MIN-σ is added to the constraint set, however, a new version of the EOP is predicted, one where odd-parity inputs are converted into even-parity outputs even when odd-numbered heavy syllables are available. The result is the prediction of languages with only even-parity surface forms.

In GA, even-only languages would emerge whenever PARSE-σ and FT-MIN-σ both dominate one of the faithfulness constraints, MAX or DEP. The deletion ranking PARSE-σ, FT-MIN-σ >> DEP is used to illustrate.

(85) Even Only Language in GA (Deletion Version)

LLLLHLL	PARSE-σ	FT-MIN-σ	MAX
a. (LL)(LL)(H)(LL)		1!	
☞ b. (LL)(LL)(HL)			1
c. (LL)(LL)(HL)(L)		1!	
d. (LL)(LL)(HL)L	1!		

As indicated in (85), despite the presence of an odd-numbered heavy syllable, it is necessary to delete a syllable to satisfy PARSE-σ and FT-MIN-σ simultaneously. The result is a language that only allows even-parity outputs.

In IFO, even-only languages would emerge under the ranking PARSE-σ, FT-MIN-σ >> MAX or the ranking PARSE-σ, MAX >> FT-MIN-σ >> DEP. The result for the former ranking is illustrated in (86).

(86) Even Only Language in IFO (Deletion Version)

HLLLLLL	PARSE-σ	FT-MIN-σ	MAX
a. HLLLLLL	7!		
b. HLLLLL(L)	6	1!	
☞ c. HLLLL(LL)	5		
d. HLLLLL	6!		1

HLLLL(LL)	PARSE-σ	FT-MIN-σ	MAX
a. HLLLL(LL)	5!		
b. HLLL(L)(LL)	4!	1!	
☞ c. HLL(LL)(LL)	3		
d. HLLL(LL)	4!		1

HLL(LL)(LL)	PARSE-σ	FT-MIN-σ	MAX
a. HLL(LL)(LL)	3!		
b. HL(L)(LL)(LL)	2!	1!	
☞ c. H(LL)(LL)(LL)	1		
d. HL(LL)(LL)	2!		1

H(LL)(LL)(LL)	PARSE-σ	FT-MIN-σ	MAX
a. H(LL)(LL)(LL)	1!		
b. (H)(LL)(LL)(LL)		1!	
☞ c. (LL)(LL)(LL)			1!

As indicated in the final step of (86), rather the parsing the heavy syllable as a monosyllabic foot, the heavy syllable is deleted to achieve exhaustive disyllabic parsing. The result is, again, a language that only allows even-parity outputs.

While separate moraic and syllabic minimality requirements do make significant improvements with respect to undergeneration, then, they also make things significantly worse with respect to overgeneration. To the prediction of languages that exhibit the OHP only and the prediction of languages that exhibit the OHP and EOP in combination, they would add the prediction of languages that only allow even-parity forms on the surface.

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