An Optimality Account of Onset Sensitivity in QI languages

(Preliminary Version)

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Introduction

In standard metrical theory we distinguish between Quantity Sensitive (QS) and Quantity Insensitive (QI) stress systems. The QS ones typically do not have a fixed main stress location. The placement of main stress depends on syllable weight. In most cases the determination of the weight of a syllable is simply a matter of counting the number of segments in the nucleus and/or the coda, the segments in the onset are completely irrelevant (cf. Halle & Vergnaud 1987). In the light of this theory, languages that do seem to count onsets when determining syllable weight would present a problem. It seems that these languages exist. Davis (1985) mentions, among others, Western Aranda and Alyawarra. We could of course alter the theory to accommodate these languages, were it not that the body of languages that do have "onset weight" is so small that it does not justify such a modification of the theory. In Goedemans (1993) some alternative analyses for these languages were presented. These alternatives described the stress patterns of the languages in question within the limits of common metrical theory, no reference to onset weight was needed. However, Optimality Theory (OT) (cf. Prince & Smolensky 1993, henceforth P&S) has come into being since then. It seems rewarding to look at the data once again from an OT point of view. It will appear that in OT we can handle the kind of onset sensitivity that we find in Western Aranda and Alyawarra without some of the weakly motivated assumptions that were needed before. A new constraint, Align-Ft Onset, will play a key role in the solution of the onset sensitivity problem, and a difference in the ranking of the constraints will account for a difference between Aranda and Alyawarra (that otherwise have a similar stress pattern) in the stressing of bisyllabic words. In the next section I will introduce both languages. In section 2, I will briefly present the theoretical framework of OT, after which an alternative analysis for Aranda and Alyawarra is given in section 3.

1 Western Aranda and Alyawarra: Data & Analysis

Two closely related Central Australian languages are Western Aranda and Alyawarra (also called Iliaura). Let us first look at the stress pattern of Western Aranda. Strehlow (1942) notes that words of two syllables are always stressed on the first syllable:

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(1)   gúra 'bandicoot'
      ílba 'ear'
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If a word of more than two syllables begins with a consonant, main stress also falls on the first syllable. When such words begin with a vowel, the second syllable receives main stress. A weak secondary stress is placed two syllables to the right of the main stress, but only if the recipient is non-final. Compare the words in (2).

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(2)   ká:puta        'head'            ibátja        'milk'
      wóratàra       'place name'      arálkama      'to yawn'
      lélantìnama    'to walk along'   ulámbulàmba   'water-fowl'
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Davis (1985) describes Aranda as a Quantity Sensitive system. He claims that Aranda onsets contribute to syllable weight. Thus he describes V(C) syllables as light and CV(C) syllables as heavy. The Aranda stress rule then becomes: stress the first syllable if it is heavy, otherwise the second. Apart from the fact that common metrical theories cannot handle systems in which onsets contribute to syllable weight, such an analysis has some serious drawbacks. Even if we accepted the possibility of onset weight, I fail to see how we could then leave out the contribution of the coda. If Aranda is QS in the sense that not only long vowels but also consonants can attribute to heavyness, then why is the second syllable in *lélantìnama* not heavier than the first? The traditional container for the weight of a syllable is the Rhyme. If we allow onset weight to occur we might just as well (and because of languages such as Aranda, in which onsets contribute and codas do not, we must) have a "flat" syllable structure and project parts of that structure (what parts depending on the language in question) to a plane on which weight can be counted. I doubt whether we should sacrifice the rhyme for the sake of this small group of onset sensitive languages[1]. Moreover, the analysis proposed by Davis misses one crucial observation; second syllables, or for that

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[1] The rhyme has proven its usefulness in many other phonological rules. Besides, the small size of the group of onset sensitive languages is already an argument against the adoption of the possibility of onset weight, let alone abolishment of the rhyme.

matter, any syllable other than the first, are never "light" in Aranda (they always have an onset)[2]. This fact hints upon a QI analysis of Aranda stress. The facts are perhaps more easily explained through misparsing or skipping of the first syllable than through differences in weight.

In Goedemans (1993) an analysis of these data is proposed in which an empty vowel, that is assumed to occur before consonant initial words, plays a key role. If this vowel is taken to be extrametrical, like all other initial vowels in Aranda, we can derive the correct stress pattern. We need to build trochees from left to right, and assume that degenerate feet are forbidden. The end rule promotes the leftmost "*" to main stress.

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(3)       *                               *
         (* .)(* .)                      (*  .)(*  .)
     <V>lélantìnama                  <u>lā́mbu lā̀mba
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There is some evidence for this empty vowel but it is rather diachronic in nature (cf. among other arguments, note 2). The OT account given below is not based on such an assumption, and therefore to be preferred. We could also derive the correct patterns if we adopted a proposal made by Archangeli (1986), who stated that all first segments of Aranda words are extrametrical (except in two syllable words where the revoking of extrametricality relieves the unstressable word syndrome[3]). If we then assign trochees from left to right and assume

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[2] This probably has got something to do with a historical development called Initial Dropping. This process changed the initial syllables of the Lamalamic languages of Cape York, but it has been claimed (Dixon 1970) to have occurred elsewhere on the Australian mainland. In the process word initial consonants were dropped, sometimes taking with them the following vowel. In the cases where the vowel remained V(C) syllables suddenly occurred in languages that otherwise had a CV(C) template. This could easily have affected the placement of stress in these languages, which was on the first syllable as in most Australian languages. A more detailed account of this phenomenon is given in Goedemans (1994).

[3] The unstressable word syndrome describes a situation in which a word receives no metrical structure at all, and as a consequence would not receive stress if the rules were applied rigorously. Here the initial syllable is extrametrical and the second syllable may not have a foot of its own because that foot would be degenerate. The unstressable word syndrome must be relieved, which can be done in two ways. First the extrametricality rule might not apply, leaving the word open for the building of a trochee (results in initial stress, the option chosen in Aranda), or secondly, the ban on degenerate feet might be temporarily lifted (results in stress on the second syllable, the option chosen in Alyawarra, see below).

that degenerate feet are prohibited, we arrive at the correct surface patterns. The representations belonging to this solution would only differ from those in (3) in one respect: The <V> in front of *lélantìnama* would disappear and the extrametricality brackets would embrace the first /l/. This solution is adequate and intuitively attractive, but it cannot handle the data of the related language Alyawarra, which is only different in two minor details. The Alyawarra data are presented below.

Yallop (1977) describes the Alyawarra stress system as follows: bisyllabic words can have main stress on the second syllable if they begin with a vowel or glide. (Compare the examples in (4) and (5) to the corresponding Aranda words).

```
(4)  athá      'I (erg.)'     kwíya    'girl'
     iylpá     'ear'          wáka     'hut'[4]
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Otherwise stress is like in Aranda (cf. 5a), except that words of more than two syllables beginning with a glide also have main stress on the second syllable (cf. 5b). Yallop furthermore notes that words with an initial consonant are far less common than in Aranda.

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(5)  a.   ilípa           'axe'
          párriyka        'fence'
          mpúla           'you'
          apmpírnitjìka   'will cook'
     b.   walíymparra     'pelican'
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We can easily devise accounts for Alyawarra stress rules that are similar to those I presented for W. Aranda. Of these analyses, the one proposed by Archangeli was the only one without serious drawbacks. However, while it did seem to work for Aranda, it fails here. If we apply it to words with an initial glide, we predict main stress to fall on the first syllable, which is not what we observe. We could just treat Alyawarra differently in this small respect, but a model that deals with both languages in one go is to be preferred. I will return to this problem during the presentation of the OT alternative. First I will introduce Optimality Theory.

[4] This word is obviously an exception, see below for discussion. Readers that are familiar with the facts of Davis (1985) may notice that he represents this word as *waká*. Yallop, however, explicitly states that this word is an exception and has initial main stress (Yallop 1977:28).

2. Optimality Theory

OT is a theory that allows us to view phonological problems from a constraint based angle instead of a rule based, or derivational one. The most important claim made by OT is that these constraints are ordered with respect to each other and operate on a set of possible output candidates. The constraints themselves make up UG but the ordering of the constraints is language specific. For every given input the function GEN(erator) provides an set of possible candidates which are then evaluated on the basis of the ranked constraints. Output forms may violate constraints, but, the higher the ranking of the constraint, the worse the violation, and the higher the number of offenses to a certain constraint, the worse the violation. The candidate that violates the constraints minimally is the optimal output. We might say that the constraints filter the candidate set until only one candidate remains. This candidate is selected as the output. Below I give the main assumptions of OT.

1. Violability: The constraints are violable, but violation is minimal.

2. Ranking: Constraints are ranked on a language-particular basis; the notion of minimal violation (or best satisfaction) is defined in terms of this ranking.

3. Inclusiveness: The candidate analyses, which are evaluated by the constraint hierarchy, are admitted by very general considerations of structural well formedness; there are no specific rules or repair strategies with specific structural descriptions or structural changes or with connection to specific constraints.

4. Parallelism: Best satisfaction of the constraint hierarchy is computed over the whole hierarchy and the whole candidate set.

The constraints mentioned above are statements about the well-formedness of surface patterns, they are not surface truths, since constraints may be violated. Best satisfaction is computed along the lines scetched out in example (6). A,B, and C are the candidates, while X, Y, and Z are constraints. Suppose that A violates X, that B and C both violate Y, and that C violates

Z. This is expressed in a tableau as follows:

6.	X	Y	Z
A	*!		
☞ B		*	
C		*	*!

The tableaus are used to visualise the evaluation of some candidates that are likely to form the output. These candidates are tabulated in the leftmost column. In the first row the constraints are given in their ranking order. Whenever a candidate violates a constraint a "*" is put in the box corresponding to the candidate and the relevant constraint. The "!" indicates that a certain violation is crucial, it means that this particular violation causes the candidate to lose from the other(s). Candidate B violates the constraints minimally, and is, therefore, the optimal output. The winner is indicated by "☞".

From the whole package of constraints that make up UG we will only look at the ones that contain statements about stress patterns. To deal with the phenomena we find in metrical phonology we need some constraints that make sure a string of syllables has a certain metrical structure in the output. In principle we want every syllable in the string to be incorporated in the metrical structure. The constraint Parse-syllable should take care of that.

• Parse-Syllable (PARSE): All syllables must be parsed by feet.

This constraint can only work if we know what feet are and what they look like. Since I am only dealing with languages that have trochaic feet I use the following constraint to define the foot.

• FootForm(Trochaic): A foot is a metrical element expressing rhythm type. It has the following shape:

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*
(σ σ)
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Prince & Smolensky adopt a constraint called Ft-Bin to ensure that all feet are binary (encompass two syllables or moras).

• Ft-Bin: Feet are binary at some level of analysis (μ, σ)

They claim that this constraint is never violated. From the stress systems of many languages we know, however, that monosyllabic feet must occur. In (7) for example feet are assigned from left to right. In words with an odd number of syllables this leads to a "leftover" syllable.

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(7)                         Catalexis             Degenerate Feet
        (* .)(* .)->     (* .)(* .)(* .)        (* .)(* .)(*)
         σ σ  σ σ σ       σ σ  σ σ  σ            σ σ  σ σ  σ
```

If this syllable happens to bear secondary stress it must be parsed. Prince & Smolensky choose the option to "overparse" here. They use a device called catalexis (Kiparsky 1992) to assign a bisyllabic trochee to the last syllable. Catalexis is more or less the opposite of extrametricality, a piece of metrical structure is built over the space to the right of the word. This is only allowed if it is the dependent, or weak, part of the foot that does not dominate a syllable. This move saves their claim that Ft-Bin cannot be violated, but the they must adopt a new principle (Catalexis). I opt not to enter this discussion here but assume that Ft-Bin can be violated[5]. This constraint then prohibits the occurrence of monosyllabic feet (which we call degenerate feet). When it is ranked higher than PARSE degenerate feet will indeed not occur, but when PARSE is ranked higher than Ft-Bin it is more important to parse the leftover syllable than to avoid degenerate feet. Hence the leftover syllable is parsed into a monosyllabic foot.

Finally we need to make sure that the feet are properly mounted to the prosodic word and the string of syllables. For this we use McCarthy & Prince's (1993b) Align-Ft constraint. It says:

• Align(Ft,L/R,PrWd,L/R)

[5] This move simplifies the OT accounts of Aranda and Alyawarra. It must be noted, however, that accounts with normal Ft-Bin and catalexis can be just as easily given. The choice for violable Ft-Bin does not affect the crucial parts of the analysis, it is just meant to simplify the presentation somewhat.

This constraint aligns the left or right edges of all feet to the left or right edge of a prosodic word, thus it expresses directionality. In our case we will need the left variant of this constraint. Note that it is impossible to align all feet in the word to one edge of a PrWd. Only the first foot can fully satisfy the constraint, all others will violate it. Violation must be minimal, which means that the number of syllables between the edge and the foot must be minimal. This does not involve counting. In the evaluation the syllables that constitute the violations of the candidates are compared in pairs. Pairs are "crossed out" until there are no pairs left. If then one of the candidates has a leftover syllable, while the other has not, this syllable is the one that makes its candidate owner violate the constraint worse than the other candidate. (Later, in section 3 we will find an example of this in tableau 8b, where the choice between two candidates is determined in this way.) Because of this the feet are neatly concatenated behind (or before) the first. There are no intervening gaps since these would take a successive foot further from the edge and thus constitute a worse violation of Align-Ft.

We have not yet said anything about the ranking of the constraints. It is without question that Foot-Type will never be violated in the languages discussed here. I will even leave this constraint out of the analyses and assume that it is the highest ranked constraint. Furthermore, we observe that words with an odd number of syllables in W. Aranda and Alyawarra do not have final secondary stress (cf. *ká:puta*). This indicates that degenerate feet are forbidden, which means that Ft-Bin must be ranked higher than PARSE. We must also assume that PARSE is ranked higher than Align-Ft. Then it is allowed to build feet further from the edge, and violate the Align-Ft constraint, in order not to violate PARSE. Were it to be the other way around, however, a minimal violation of Align-Ft (even of only one σ) would outweigh a violation of PARSE. This would result in words surfacing with only one foot on the right or left edge, violating PARSE but not Align-Ft. In our case we can see that the words have more than one foot (there are more stresses), so we will have to rank PARSE above Align-Ft. This results in the following ranking:

- Foot-Type(Trochaic)
- Ft-Bin
- PARSE
- Align(Ft,L,PrWd,L)

Were we to exhaustively describe the stress systems of Aranda and Alyawarra we would need another constraint telling us where the main stress is located. However, this paper only deals with the effects of onset sensitivity on the location of stress. Since for this discussion it is not important whether the first stressed position of Aranda and Alyawarra words is a main or secondary stress, we will abstract from it. In the following section we will apply the constraints in the ranking above to the Aranda and Alyawarra facts. We will see that they are not sufficient. Two more constraints are needed, one that has already been proposed by P&S and one that could have been.

3 Application

Now that we have introduced the theoretical machinery of OT we can try to apply it to Aranda and Alyawarra. Let us begin with the simple Aranda cases that have a first syllable beginning with a consonant. Cases like *wóratàra* and *lélantìnama*. If we cast these in the kind of tableau P&S use to visualize optimality we get (8). As was the case in (6) the first row reflects the ranking order of the constraints. Note that in the last column violation is given in terms of "x syllables from the edge", hence the deviant symbol. The boxes that are not needed to determine which of the candidates will be the output candidate are shaded.

8a. Candidates	Ft-Bin	PARSE	Align-Ft
(* .) wóratara		*!	
☞ (* .)(* .) wóra tàra			σσ
(* .) worátara		*!	σ

8b. Candidates	Ft-Bin	PARSE	Align-Ft
(* .)(* .)(*) lélantìnamà	*!		σσ/σσσσ
☞ (* .)(* .) lélantìnama		*	σσ
(* .) (* .) lélantinàma		*	σσσ!

In (8a) we see that none of the candidates violate Ft-Bin. The first and the third candidate violate PARSE, so they get a *. Since violation of a high ranked constraint carries more weight than violation of one ore more lower ones, we can immediately see that the second candidate must win, whatever happens in the Align-Ft column (both *'s in the third column have an !). Since the generator produces every possible option, there are more candidates that could be compared to the ones in (8a). For obvious reasons of space it is accepted practice to only compare the most likely candidates in the tableau. In (8b) the situation is only slightly more complicated. The first candidate violates Ft-Bin, which is crucial because the others do not. Both other candidates violate PARSE, so we must look at Align-Ft to choose between them. For both candidates the first foot does not violate Align-Ft. The second foot of the second candidate is two syllables from the left edge, hence two σ's in the box. The second foot of the third candidate is three syllables from the edge of which the third constitutes the crucial violation. We see here that constraints can be violated gradually, and that the worst violation loses.

It may be clear that, if we adopt these constraints in this order, the evaluation of candidates of words beginning with a vowel will go wrong because the stress pattern is shifted in these cases. These candidates may not violate PARSE and Align-Ft, so a trochee will be built over the first two syllables as in (8), resulting in initial stress, while these words must have stress on the second syllable. We can only solve this dilemma if we somehow allow candidates to violate PARSE and Align-Ft. It may very well be that in Aranda and Alyawarra, for some reason, a previously lower ranked constraint has climbed up to interfere with stress assignment. A likely candidate is formed by a constraint that has not yet been proposed in OT, but I presume it has been assumed to be present since the beginning. It is a member of the Alignment family which I will call Align-FtO, and is defined as follows:

• Align(Ft,L,Onset): The left edge of a foot must always be aligned to the onset of the first syllable in the foot.

This constraint makes sure that the foot is properly aligned to the onset of a syllable, if the syllable has an onset. Thus it is designed to protect syllable integrity. Obviously this constraint must be ranked quite low in numerous languages that allow feet to be built on top of syllables that have no onset. But see what happens if we allow this constraint to climb in the ranking and end up above parse. Then it is more important to align the left edge of the foot to an onset than to parse a syllable. This will result in a system in which onsetless syllables are skipped rather than be parsed as the *first* syllable of a foot; exactly what we need for Aranda and Alyawarra. We further note that the new constraint must be ranked under Ft-Bin, otherwise words of two syllables of which the first has no onset would be given stress on the second syllable, which is not what we observe. It must be more important to have bisyllabic feet than to align the left edge of a foot to an onset. An evaluation tableau for a vowel initial word is given in (9).

9. Candidates	Ft-Bin	Align-FtO	PARSE	Align-Ft
(* .) (* .) úlambùlamba		*!	*	σσ
☞ (* .)(* .) <u>lámbulàmba			*	σ/σσσ

So far we have not given an evaluation tableau for bisyllabic words with initial vowels. The problem with these has already been hinted upon when we discussed the ordering of Ft-Bin and Align-FtO. This ordering does not save us completely because there is an option for bisyllabic words to avoid violations of both Ft-Bin and Align-FtO. The word could remain completely unparsed. Since PARSE is the lowest ranked constraint of the relevant three, an unparsed, and therefore unstressed, string would form the optimal output. Several phonologists have noted this problem in the past with respect to other languages and they have formulated rules to avoid it. For OT, P&S have proposed the constraint Lx≈Pr which is defined as:

• Lx≈Pr (*Mcat*): A member of the morphological category *Mcat* correspond to a PrWd.

In other words we may not leave the entire string unparsed. It will be clear that Lx≈Pr must be the highest ranked constraint. A bisyllabic word like *ílba* can then be derived as in (10).

10. Candidates	Lx≈Pr	Ft-Bin	Align-FtO	PARSE	Align-Ft
<ilba>	*!			*	
(*) <il>bá		*!		*	σ
☞ (* .) ílba			*		

With these constraints in this order we can correctly derive all Aranda surface patterns. We do not have to adopt an empty vowel in front of consonant initial words and we do not have to make the first segment extrametrical[6]. We can derive the Alyawarra surface patterns in exactly the same way. Remember, however, that Alyawarra was different from Aranda in two respects. Firstly there was the matter of the glide initial words which bear stress on the second syllable. The solution to this problem lies hidden in some remarks that Strehlow and Yallop make with respect to the nature of the glides in both languages. Strehlow notes that the Aranda [w] is like the [w] in *water* and that [j] is like the [j] in *you*. This explains why they pattern with the consonants. The situation in Alyawarra is rather different: "word initial *u*- and

[6] Another OT analysis has been proposed to me by Ruben van de Vijver (p.c.). In fact it has also occurred to me that we could try to analyze the Aranda and Alyawarra facts through creative usage of the Onset constraint that is already present in OT. Although I have some reservations about the usage of this and other syllabification constraints in the metrical picture, and suspect that such an analysis will lead to deletion of the first vowel altogether (which is not what we want), I think the idea has some merit and is worth exploring. Anyhow, the alignment constraint I propose is needed anyway, and the analysis presented here is probably just as acceptable as any analysis using Onset will be.

i- are pronounced *wu*- and *yi*- but the semivowels are in this case part of the phonetic realisation of the vowels" (Yallop 1977:19). So it is justified to treat the sequences [wu] and [ji] as complex vowels which are, like all other initial vowels, skipped. This is probably the case for all initial glides except the ones in words like *wáka*, which may be more like the Aranda [w]. Notice that our OT misalignment alternative can make crucial usage of Yallop's observation, while Archangeli's solution, presented in section 1, cannot. We can describe the Aranda and Alyawarra facts with one set of constraints, and do not have to refer to the glide initial words as exceptions.

The second difference between Aranda and Alyawarra had to do with the position of stress in bisyllabic words. Alyawarra stresses the bisyllabic words on the second syllable, while in Aranda stress is on the first. From this we may conclude that the ordering of the constraints that are relevant to these bisyllabic words is different. In Alyawarra it seems more important to Align the left edge of a foot to an onset than to avoid degenerate feet. This means that the constraints Ft-Bin and Align-FtO have to trade places. Let us see what happens if they do.

11. Candidates	Lx≈Pr	Align-FtO	Ft-Bin	PARSE	Align-Ft
<iylpa>	*!			*	
☞ (*) <iyl>pá			*	*	σ
(* .) íylpa		*!			

It appears that we are able to derive all Alyawarra surface forms with a slightly different ordering of the constraints. Because Align-FtO is now higher ranked than Ft-Bin the foot binarity constraint may be violated, hence the degenerate foot on the second syllable of the selected candidate in (11). This different ordering of the constraints does not affect the analyses of the other words, only in bisyllabic words are Ft-Bin and Align-FtO in direct relationship. In longer words Align-FtO is always the only constraint that determines the placement of the first stress. Remember also that the stress placement in Aranda bisyllabic words formed the reason to rank Align-FtO under Ft-Bin in the first place.

Conclusion

We have been able to handle the problem of onset sensitivity in OT with the assumption of only one new constraint. The new constraint Align-FtO is crucial in these cases, but it is also of importance to other languages, since it aligns the foot to the onset and thus prevents the occurrence of "loose" onsets where the foot might have been wrongly aligned to the nucleus. The constraint on the non-parsing of strings, Lx≈Pr, was already present in OT. We have shown that onset sensitivity does not have anything to do with weight, as was assumed in earlier accounts of the Aranda and Alyawarra data. It rather seems to be a matter of an alignment constraint that interferes with the assignment of stress, where in most other languages it does not. Thus the weightlessness hypothesis of the onset is saved. There are some other languages for which onset sensitivity is claimed. The Lamalamic languages of Cape York have stress patterns that are similar to those of Aranda and Alyawarra. They can be analyzed in the same way. Other languages like Madimadi and Pirahã are more difficult to fit in. In these languages the onset sensitivity is complicated by normal weight considerations.

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