Linguistics 300 | Michael Phillips
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STRESS IN PITTA-PITTA

1. Introduction

Stress is a phonological phenomenon having to do with the length, loudness, and the pitch contour of certain speech sounds. Stress is found in a large amount of languages, one of those languages being Pitta-Pitta, an (unfortunately) extinct Australian Aboriginal language. In this paper, I investigate stress placement in Pitta-Pitta using two different forms of analysis: the Metrical Theory (MT) and Optimality Theory (OT). First, I introduce data from Pitta-Pitta and describe the general stress placement in Pitta-Pitta in order to explain how stress is assigned in this language. Then, I conduct an MT analysis, followed by an OT analysis in order to show how each of these analyses explain stress placement in Pitta-Pitta. Finally, I conduct a short comparison of these two methods of analysis, ultimately concluding that OT is the superior form of analysis with respect to stress in Pitta-Pitta.

2. Analysis

In order to discuss stress in Pitta-Pitta, I introduce data in (1) which shows four examples of Pitta-Pitta words with stress (note that the bolded syllables indicate where the stress is placed, and periods (.) denote syllable boundaries).

(1) Stress in Pitta-Pitta (Blake, 1979: 191)

a.	2	**ká**.ʈi	'yes or ok'
b.		**kíl**.ka	'upper arm'
c.	3	**yá**.pi.ɻi	'father'
d.	4	**pí**.t̪a.**pì**.t̪a	'Pitta-Pitta'

First, let's discuss the placement of primary and secondary stress. This is easily indicated, as primary stress appears on syllables with acute accent marks, and secondary stress appears on syllables with grave accent marks. As can be seen in the data, primary stress consistently appears on the first syllable of each word (from left to right) and secondary stress only appears in (1d) on the third syllable (from the left). One thing you may notice is that (1c) also contains a third syllable, however, there is no secondary stress on it. Before this can be discussed, we must first confirm the direction of the stress (left to right or right to left). This can be discovered by evaluating the numerical patterns that occur when the stress is analyzed from either direction. For example, when we assume the stress is left to right, there is a definite pattern, as every single word from the data shown here consistently has stress on the first syllable. If we evaluate the stress from right to left however, there are numerical inconsistencies. (1a) and (1b) show stress appearing on the second syllable right to left, but (1c) doesn't have stress until the third syllable right to left. Therefore, we can safely assume that the stress assignment is from left to right in this particular language, and that stress is assigned to odd numbered syllables from left to right (1, 3, 5, etc…).

Another thing to consider in this language is whether not the stress is weight-sensitive. This means that the stress would be attracted to CVC syllables. There is only one example of a CVC syllable in these data, which is the first syllable in (1b) (**kíl**.ka). While it is true that this syllable does happen to have stress, it is unlikely that its reasoning for stress has anything to do with the weight of the syllable. This is because this particular syllable happens to be the first syllable of this word. Since we claim that stress is assigned left to right and obeys this pattern, it is more likely that the stress that appears here does so due to the left to right odd syllable stress pattern, and not due to weight sensitivity to CVC syllables. Therefore, weight sensitivity of stress in this language is not relevant, and CVC syllables (heavy syllables) appear in the same consistent manner that CV syllables (light syllables) do with respect to stress.

Now that we have determined the direction of the stress as left to right, let's go back and discuss why there is no stress on the third syllable of (1c), even though it would be consistent with our pattern of stress. There is a condition concerning stress "if they are not final", which prevents the final odd-numbered syllable to be stressed. This only applies to certain words which meet this condition, and the only form out of the four examples here to which this condition, that is (1c) (**yá**.pi.ɻi), this is why there is not stress on the final syllable. If there were a 5-syllable word, we could assume the same thing (that even though it's an odd-numbered syllable, stress would not appear on it because it would be in the word-final position).

Before making any final generalizations about the stress in Pitta-Pitta, I'd like to note something about the assignment of primary and secondary stress. The assignment of each of these kinds of stress occurs in a particular order: secondary stress is assigned first, and primary stress is assigned separately. So secondary stress is really the kind of stress that is being assigned from left to right on odd numbered syllables. Then, primary stress is assigned from left to right, to the leftmost secondary syllable. This explains why primary stress always appears on the first syllable.

Based on the data and this discussion, the following generalizations can be made:

1. Secondary stress in Pitta-Pitta is assigned from left to right, to the odd-numbered syllables.
2. Stress is not assigned to syllables which are word-final, even if it is consistent with the pattern.
3. Primary stress is assigned to the leftmost secondary syllable.

Now that we have discussed the stress placement in Pitta-Pitta, let's now move to the analyses to see how MT and OT explain why and how the stress occurs.

2.1 metrical analysis of stress placement

The primary feature of stress in the metrical analysis utilizes constituents known as feet. A foot is used to parse and account for stress-bearing units, and can be used to explain certain properties of stress, such as their rhythmic tendencies (stress-unstressed). A foot is made up of parenthesis, ( ), which can contain what is called the head (represented by an ‘x’) and the non-head (represented by a ‘•’). The head represents where the stress is, and the non-head marks unstressed syllables. There are different kinds of feet for stress, depending on the stress patterns of a particular language. First of all, a foot is either syllabic (feet indicate syllable stress) or moraic (feet indicate mora stress). Pitta-Pitta, as we discovered before, does not use weight sensitivity to determine stress, and instead only places stress based on the patterns of its syllables, whether that be CV or CVC. Since syllables are what matter, we can conclude that the feet for Pitta-Pitta are syllabic. Feet are also either trochaic (head is on the left) and iambic (head is on the right). Since stress is assigned from left to right in this language, and since the stress appears on the odd-numbered syllables in a consistent pattern, then Pitta-Pitta must use trochees.

In addition to foot construction, a word layer must also be constructed which explains the placement of primary stress. The rules for the construction concerning this particular word constituent is based on what is called End Rules. (27) of Chapter 17 in *Analyzing Sound Patterns* states the rules for word constituent construction clearly. These rules are restated here in (2):

(2) End Rule (Left/Right)

a. Create a new metrical constituent of maximal size at the top of the existing structure.
b. Place the grid mark forming the head of this constituent in the (leftmost/rightmost) available position.

(2b) notes that these constituents can be applied to either the leftmost or rightmost available position(s), but since we know that Pitta-Pitta assigns primary stress to the left most secondary syllable, then the word layer will contain word constituents which assign primary stress to the leftmost available position.

Now that we have explained the foot and word constituent construction, let’s apply this theory to the data in (1). (3) shows a step-by-step derivation illustrating how the metrical structures are constructed for each of the four forms. Note that the metrical analysis can be seen as a derivational approach, since it uses rules to explain the construction of feet and word constituents, and carries out the analysis in a step-by-step way. (3a) shows the underlying representation for each of the four forms, (3b) applies the foot construction of the syllabic trochees, and (3c) applies End Rule Left. (3d) shows the final stressed results.

(3)

a.	Underlying representations			
	ka.ʈi	kil.ka	ya.pi.ɻi	pi.t̪a.pi.t̪a.
b.	Construct syllabic trochees from left to right			
	(x •)	(x •)	(x •)	(x •)(x •)
	ka.ʈi	kil.ka	ya.pi.ɻi	pi.t̪a.pi.t̪a.
c.	End Rule Left			
	(x)	(x)	(x)	(x)
	(x •)	(x •)	(x •)	(x •)(x •)
d.	**ká**.ʈi	**kíl**.ka	**yá**.pi..ɻi	**pí**.t̪a.**pì**.t̪a

As we can see in (3), this analysis is correctly able to account for the stress patterns of Pitta-Pitta using feet (syllabic trochees). Note that the reason that the final syllable in (1c) is unstressed under this analysis is because there are not enough syllables to parse it into a foot. Since it is a single syllable, a head and non-head cannot be constructed. This would result in a degenerate foot, consisting of only one part of the foot.

2.2 optimal-theoretic analysis of stress placement

Now let's move to OT to see how it handles stress placement. As we know, OT uses constraints instead of rules, so I start here by introducing the relevant constraints with respect to Pitta-Pitta and metrical structures. Then, I rank the constraints using a method of pairwise comparisons. Finally, I provide full tableaux with respect to the four words from the data in (1).

2.2.1 introducing the relevant constraints

ALL-FT-LEFT (and ALL-FT-RIGHT)

I introduce these two constraints together because they ultimately are used to show whether or not stress is assigned from left to right or right to left (this uses the same insights that the metrical theory uses in terms of stress assignment direction). ALL-FT-LEFT prefers syllables be parsed into corresponding to the leftmost edge of a prosodic word, and ALL-FT-RIGHT prefers syllables be parsed with respect to the right edge of a prosodic word. A language which assigns stress from left to right will rank ALL-FT-L higher, and a language which assigns stress from right to left will rank ALL-FT-R higher. This explains why you might see *(**yá**.pi)..ɻi* in a language that wants to parse syllables from the left edge as opposed to *ya.(**pí**..ɻi)* which wants to parse syllables as closed to the right edge as possible.

PAR-SY

This constraint states that syllables must be parsed into feet. This again shows how OT draws from the insights of MT with respect to stress assignment. It is a relevant constraint because it shows how OT organizes and accounts for stressed syllables. If every single syllable was unparsed, how would you be able to account for stress placement, or properties such as the rhythmic property? You would need some kind of completely new proposal, but OT still uses foot-parsing for stress. Therefore, anytime an unfooted syllable appears in a word, it incurs one violation. Another reason we know this constraint is relevant is because if ALL-FT-L and ALL-FT-R prefer that parsed feet appear on either edge of a word, then instead of getting forms like ***(pí**.t̪a.)(**pì**.t̪a)* (which is attested), you'd get ***pí**.t̪a.(**pì**.t̪a)* or *(**pí**.t̪a).pi.t̪a* where the parsing only occurs on one side or the other, which would incur multiple violations and be inconsistent with how the words are parsed in this particular language.

GrWd=PrWd (GW=PW)

This constraint states that a grammatical word must be a prosodic word. With respect to stress and OT, this simply means that a word must has at least one foot in its output (in order to be considered a well-formed prosodic word). This is relevant to this language because all of the attested optimal candidates have at least one foot.

NON-F

This constraint states that no foot is final in the prosodic word. This means that a foot cannot appear in the word-final position of a word. This constraint is relevant because just like PAR-SY, it applies to any languages which use foot structures to explain stress patterns.

FT-BIN

This constraint states that feet are binary under moraic or syllabic analysis. This means that feet, just like in the metrical analysis, have two parts. According to this constraint, feet cannot contain any random number of syllables, but must contain a specific amount (two). This constraint is relevant because it explains why you can expect to see forms such as *(**yá**.pi.).ɻi* but not *(**yá**.piɻi)* or *(**yá**.)piɻi*.

RHTHYM TYPE=TROCHAIC (RHTY=T) (and RHTHYM TYPE=IAMBIC)

This is the constraint that determines the type of foot that is being used in the analysis. In the metrical theory, we decide that a foot is either a trochee or an iamb, depending on whether or not the head of a foot is on the left (left-headed) or on the right (right-headed). In our discussion of Pitta-Pitta stress, we determined that (secondary) stress is assigned from left to right on the odd-numbered syllables. In the metrical analysis, we concluded that Pitta-Pitta uses syllabic trochees, which are left-headed. Therefore, this constraint must be relevant in order to determine the direction (left to right or right to left) of the head with respect to the feet. RHTHYM TYPE=IAMBIC would be ranked high if this language used iambs, but is ranked low in languages (like Pitta-Pitta) which use trochees. Both of these constraints are relevant, as their respective ranking help support the case that Pitta-Pitta uses trochees, and not iambs.

LEFTMOST (and RIGHTMOST)

This constraint states that the left edge of the head foot must correspond with the left or right edge of the prosodic word. This constraint captures what the word constituent in the metrical analysis captures with respect to the assignment of primary stress. This constraint is relevant to this language because as we learned via the metrical analysis and our discussion concerning Pitta-Pitta stress, primary stress is assigned to the leftmost secondary syllable, meaning that this constraint must be how this is explained in OT. If primary stress were assigned from the right, then the constraint RIGHTMOST would apply. This is the constraint that predicts forms like *(**pí**.̪ta.)(**pì**.̪ta)* to occur, rather than sub-optimal candidates such as *(**pì**.̪ta)(**pí**.̪ta.)*.

2.2.2 ranking the constraints

Now that the relevant constraints have been introduced and discussed, we must rank them before constructing the final tableaux. Let's start with ALL-FT-LEFT and ALL-FT-RIGHT. As we said earlier, these constraints are OT's way of determining the direction of stress assignment, and since our previous discussions reveal that Pitta-Pitta assigns stress from left to right, we could postulate that ALL-FT-L is a higher ranked constraint than ALL-FT-R. But in order to prove this, let's compare the optimal candidate with the suboptimal candidate . These two candidates in (4) differ in the direction of their respective foot parsing.

(4) Pairwise comparisons for *(**yá**.pi.)ɻi*

i.	/yapi.ɻi/	ALL-FT-L	ALL-FT-R
☞	(**yá**.pi)..ɻi		*
	ya.(**pí**..ɻi)	*!	

ii.	/yapi.ɻi/	ALL-FT-R	ALL-FT-L
	(**yá**.pi)..ɻi	*!	
👎	ya.(**pí**..ɻi)		*

As (4i) shows, it is optimal to rank ALL-FT-L higher than ALL-FT-R, in order to predict *(**yá**.pi.)ɻi* as the optimal candidate. This so far provides us with the following constraint ranking:

ALL-FT-L >> ALL-FT-R

Now, let's consider the candidates *(**pí**.̪ta.)(**pì**.̪ta)* and *(**pí**.̪ta.)pi.̪ta*. The second candidate would be preferred with respect to ALL-FT-L, but we know that it is not the optimal form in this language. Therefore, the following pairwise comparisons in (5) show these candidates ranked using the ALL-FT-L and PAR-SY constraints.

(5) Pairwise comparisons for *(**pí**.t̪a.)(**pì**.t̪a)*

i.	/pit̪apit̪a/	PAR-SY	ALL-FT-L
☞	(**pí**.t̪a.)(**pì**.t̪a)		**
	(**pí**.t̪a).pi.t̪a	*!*	

ii.	/pit̪apit̪a/	ALL-FT-L	PAR-SY
	(**pí**.t̪a.)(**pì**.t̪a)	*!*	
👎	(**pí**.t̪a).pi.t̪a		**

As (5) shows, in order to predict the optimal form, it must be more important in this language to parse as many syllables as possible, rather than to keep parse syllables on the leftmost edge of the word. This results in the following ranking:

PAR-SY >> ALL-FT-L >> ALL-FT-R

Let's return to the candidate *(**yá**.pi)..ɻi*, and compare it in (6) with *(**yá**.pi).(**ɻì**)*. This second candidate makes sense, considering the PAR-SY constraint that prefers syllables to be parsed into feet.

(6) Pairwise comparisons for *(**yá**.pi)..ɻi*

i.	/yapiɻi/	FT-BIN	PAR-SY
☞	(**yá**.pi)..ɻi		*
	(**yá**.pi).(**ɻì**)	*!	

ii.	/yapiɻi/	PAR-SY	FT-BIN
	(**yá**.pi)..ɻi	*!	
👎	(**yá**.pi).(**ɻì**)		*

As is shown in (6), it must be more important in this particular language that feet are binary (FT-BIN) rather than have every syllable parsed. This results in the following constraint ranking so far:

FT-BIN >> PAR-SY >> ALL-FT-L >> ALL-FT-R

Now consider the constraints GW=PW, LEFTMOST, and RHTY=T. These constraints can be said to always be ranked at the very top, as they are always obeyed. There are certain facts to suggest that constraints like these (in this language) are always undominated. GW=PW is always undominated because every one of the words from the data in (1) have at least one foot. LEFTMOST is always undominated because it is the constraint that tells us the directionality of primary stress assignment which we know in Pitta-Pitta needs to be from left to right. Also, RHTY=T is never violated because all the attested feet are left-headed in this language. These constraints may not be able to be ranked with respect to each other, but we can add these constraints to the top along with FT-BIN in order to result in the following constraint ranking:

GW=PW, LEFTMOST, RHTY=T, FT-BIN >> PAR-SY >> ALL-FT-L >> ALL-FT-R

Finally, let's consider the constraints RHTY=I, NON-F, and RIGHTMOST. These constraints can be said to always be ranked at the very bottom, as they are always violated. There are certain facts to suggest that constraints like these (in this language) are always dominated. RHTY=I must always be violated since this language does not use iambs, and is instead uses trochees due to its stress patterns. NON-F is violated by three of the four attested candidates, and (1c) can be explained with respect to FT-BIN in this language (explained again later). And lastly, RIGHTMOST is always violated because primary stress in this language, as we've discovered, does not fall on the head of the rightmost foot. When we add these final three constraints, we get the complete proposed constraint ranking for stress in Pitta-Pitta:

GW=PW, LEFTMOST, RHTY=T, FT-BIN >> PAR-SY >> ALL-FT-L >> ALL-FT-R, RHTY=I, NON-F, RIGHTMOST

2.2.3 tableaux illustrations

Now that the relevant OT constraints with respect to stress in Pitta-Pitta have been introduced, discussed, and ranked, we can finally put the Pitta-Pitta data from (1) into complete OT tableaux in (7). (Note that the constraints RHTY=I and RIGHTMOST have been omitted from the tableaux. This is not because they are not relevant, but because they can be considered non-essential, and for space reasons considering there are ten constraints.)

(7)

i. Tableau for ***(ká**.ʈi)*

	/kaʈi/	GW=PW	LEFTMOST	RHTY=T	FT-BIN	PAR-SY	ALL-FT-L	ALL-FT-R	NON-F
☞	a. (**ká**.ʈi)								*
	b. (**ká**).ʈi				*!	*		*	
	c. (ka.**ʈí**)		*!	*					*
	d. ka.ʈi	*!				**			

ii. Tableau for ***(kíl**.ka)*

	/kilka/	GW=PW	LEFTMOST	RHTY=T	FT-BIN	PAR-SY	ALL-FT-L	ALL-FT-R	NON-F
☞	a. (**kíl**.ka)								*
	b. (**kíl**).ka				*!	*		*	
	c. (kil.**ká**)		*!	*					*
	d. kil.ka	*!				**			

iii. Tableau for *(**yá**.pi)..ɻi*

	/yapi.ɻi/	GW=PW	LEFTMOST	RHTY=T	FT-BIN	PAR-SY	ALL-FT-L	ALL-FT-R	NON-F
☞	a. (**yá**.pi)..ɻi					*		*	*
	b. ya.(**pí**..ɻi)					*	*!		
	c. (**yá**.pi)..ɻi				*!			*	
	d. (ya.**pí**)..ɻi			*!				*	
	e. ya.pi..ɻi	*!							

Something to note: The “if they are not final” condition which prevents the stressing of the third syllable in (1c) shown again in (7iiic) is explained in OT by the claim that it was unable to be parsed into a foot, because feet must be binary due to the high ranking FT-BIN constraint.

iv. Tableau for *(**pí**.t̪a).(**pì**.t̪a)*

	/pit̪apit̪a/	GW=PW	LEFTMOST	RHTY=T	FT-BIN	PAR-SY	ALL-FT-L	ALL-FT-R	NON-F
☞	a. (**pí**.t̪a).(**pì**.t̪a)						**	**	*
	b. (**pí**.t̪a).pi.ta					*!*		**	
	c. (**pí**.t̪a).(**pì**).t̪a				*!	*	**	***	
	d.(pi.**t̪á**).(pi.**t̪à**)			*!			**	**	*
	e.(**pì**.t̪a).(**pí**.t̪a)		*!				**	**	*
	f. pi.t̪a.pi.t̪a	*!				****			

These tableaux in (7) show that OT is able to correctly predict the correct surface outcomes for the stress of these Pitta-Pitta data. These sub-optimal candidates have helped to support the relevance and ranking of our constraints under this analysis.

2.3 comparison of the analysis

Now that the Metrical Theory (MT) analysis and the Optimality Theory (OT) analysis have been illustrated, let’s look at one similarity and one difference concerning these analyses, and see if we can determine whether or not one analysis is superior to the other.

One major similarity between these two analyses is how much OT draws from the insights of MT concerning the usage of foot structures in the analyses. Constraints like GW=PW, FT-BIN, and PAR-SY make sure that there is foot parsing, and that the feet contain two inner components (in this case syllables) just like MT. Constraints like ALL-FT-L and ALL-FT-R are used to determine the directionality of the foot parsing (just like in MT), the constraint RHTY=T and RHTY=I are used to determine whether or not the language uses trochaic (left-headed) or moraic (right-headed) feet in the outputs (just like the trochaic and moraic feet in MT). Also, the constraints LEFTMOST/RIGHTMOST aim at determining the directionality of primary stress assignment, just as the word constituents in the word layer in MT do.

One major difference between these two analyses is that MT is a derivational approach which primarily uses rules, and OT uses constraints in this analysis. This alone is obvious, but it results in some further differences. Since MT uses rules, these rules cannot be violated. However in OT, since it uses constraints and constraint ranking, the constraints can be violated. Different constraint rankings of the same constraints in different languages capture similarities among those languages not shown in a rule-based approach. For example, we know that in this language the final syllable of *(**yá**.pi).ɻi* is not parsed due to the constraint ranking FT-BIN >> PAR-SY. MT captures this by obeying the condition that a light syllable cannot be footed (so as to prevent making a degenerate foot). However, this only applies to this language. What if another language with stress did allow such a thing to occur? MT would need to propose an entirely new rule (exception), while OT could simply rank the constraints (like FT-BIN) differently, thus displaying connections between “seemingly” exceptional patterns.

Based on this difference, I conclude OT as a superior form of analysis. It’s ability to capture functional unity (connections concerning the patterns of cross-linguistic stress) using violable constraints due to constraint ranking is a serious advantage to MT here, which would have to create exceptions and new rules to explain these ultimately connected phenomenon.

3. Conclusion

In this paper, I have evaluated the stress patterns of a language called Pitta-Pitta. In the beginning, we discovered a number of patterns in the data, which led to the generalizations in section 2 concerning these stress patterns. We found that secondary stress is assigned from left to right on the odd numbered syllables, and that primary stress appears on the left most syllables. Then, we looked at how MT and OT explain and illustrate these stress patterns. The MT analysis used syllabic trochees to parse syllables into feet which showed how stress is assigned, and shows the rhythmic property (stress-unstressed) that the words have. OT then introduced a number of metrical constraints, which when ranked in the correct way, showed why the attested candidates are optimal when compared to sub-optimal candidates.

We find that even though MT and OT are able to account for the stress assignment and placement in this particular language, there is a difference between the two analyses which causes us to prefer the OT analysis to the MT analysis. This has to do with the inviolable rules of MT versus the violable constraints of OT. The constraint ranking of the constraints of OT are ultimately able to capture and display connected and unified patterns (functional unity) concerning stress that MT cannot using rules.