In recent work into the nature of natural language sound systems, much research has been in the area of stress, a sound system phenomenon that occurs above the “letter” level. This paper will examine the distribution patterns of stress in a hitherto unanalyzed language with a rather complicated stress pattern—Tondano—and will offer an explanation of these patterns. This analysis will be within the framework of a newer phonological (sound system) theory called Optimality Theory. Despite Optimality Theory’s initially formidable-looking formal apparatus, it offers a very insightful view of the stress patterns of Tondano, and this paper explains the concepts of the Optimality Theory analysis, yet without much of the mathematical formalisms. However, before charging into the analysis, I first want to give some background on the phenomenon of stress itself, the Tondano language, and Optimality Theory.

**Stress**

The study of stress, as alluded to above, falls in the subfield of linguistics known as phonology, the study of sound systems. In particular, it falls into the study of phenomena above the segment (above the “letter” level) known as prosody. People familiar with the study of meter in poetry will find many similar terms in the study of prosody (including the term prosody itself). This similarity is not accidental; indeed, it stems directly from the insight that poetry involves manipulation of the prosodic qualities of language.

The definition that I will adopt here for stress (modified from Crystal 1997) is that it is the realization of prominence given to particular syllables. It is different from tone in that tone involves solely the manipulation of pitch, whereas stress has tied to some notion of strength or emphasis (which can include pitch or not, see below). This notion of emphasis has traditionally lent itself to the thought that stress involves one or more of the following: increased loudness, higher pitch, and increased duration of the stressed vowel. While subsequent research has shown that these characteristics are not necessarily relevant to all languages and that additional characteristics are involved, these studies have confirmed two results. First, there are phonetic signals to stress. Second, while these signals can vary across languages, prominent stressed syllables are a psychological reality in the minds of speakers, and are an important aspect of the grammar to account for. This paper will be focused on this psychological aspect rather than the phonetic aspects of stress in Tondano.

In addition to the phonetic realization, stress systems also vary in the patterns of where stress is placed. This variation falls into three broad categories. In some languages, stress placement has no discernable pattern, and thus, for each word, the correct stress placement must be learned individually. Such a language might look like the following:

(1) tirésabo
    nádisamu
    luwési
    sadóka
    pinéto

(2) ratú
    méti

There are also languages where the placement of stress is exceedingly regular. In these languages, every word (or nearly every word) has stress on the same syllable position in the word (like the second-to-last syllable). An example, using the same “words” as in (1), would be (2):

(2) nádisamu
    luwési
    sadóka
    pinéto
    ratú
    méti

Finally, there are languages such as Tondano where the placement of stress is ultimately predictable (like in (2)), but on the surface, the patterning seems nearly as irregular as (1).

**Tondano**

Tondano is spoken in the northeastern part of the spider-like island of Sulawesi (formerly known as Celebes), in Indonesia, in and around the town of Tondano. Studies from around 1970 estimated the number of speakers at about seventy thousand (Sneddon 1975: 1). However, more recent estimates (such as SIL International 2000) give the number of speakers at over ninety thousand. Tondano is a part of the vast Austronesian language family, whose members occupy an impressive span of the globe. Tondano is very distantly re-
lated both to Malagasy, the language of the island of Madagascar off the coast of Africa, and Hawaiian, thousands of miles to the east. Tondano is also related to the languages nearby in insular Southeast Asia, including Javanese (of Indonesia), Bahasa Indonesia (the official language of Indonesia) and Tagalog (the official language of the Philippines) (Campbell 1995).

The data in this paper were taken from Sneddon’s (1975) grammar of Tondano, and thus, this paper retains the conventions for writing Tondano contained in that monograph. Most of these symbols follow the International Phonetic Alphabet. The most notable exception is the letter [w], which represents a sound that varies from the w sound in wind to the v sound in very. Stress will be marked, as in (1) and (2) above, with an accent mark over the stressed vowel.

**Optimality Theory**

As noted above, this analysis is drawn within the framework of Optimality Theory (abbreviated OT). OT was first introduced in Prince & Smolensky (1993), but it has been further developed by a large body of literature in the past ten years. OT is a generative theory in that it generates surface forms from abstract mental entities, known as underlying representations. However, it departs in several respects from its predecessors. First, OT is a constraint-based framework, instead of rule-based framework. The difference between rules and constraints is subtle, but one can think of it in terms of a difference in orientation. Rules are process-based (they are more focused on the path to the result), while constraints are target-based (they are more focused on the result) (Crosswhite 2000). Having constraints then feeds a second important feature of OT—the constraints can be violated. If one has the constraint DON’T EAT CHOCOLATE and the constraint DON’T EAT ICE CREAM, and the only choices are to eat chocolate ice cream, eat vanilla ice cream, or eat nothing, one of these constraints may be violated. Yet, the constraints can still characterize the decision to eat vanilla ice cream or the decision to eat nothing at all. The capability for violation is the source of the term optimality in Optimality Theory. The generative part of the theory creates an infinite number of possible choices then using the constraints narrows them down to one optimal choice—the one that has the fewest violations of the constraints. However, this system is not one where one can apply any constraint at any time. Instead, the constraints can be ranked so that some apply before others, although the constraints do not necessarily have to be ranked. Thus, it is the job of the analyst to determine both which constraints are involved in a particular phenomenon and how they are ranked with respect to other constraints. Finally, the constraints themselves are thought to be universal (i.e. available to every natural language), but their ranking is language-specific.

**Assumptions**

For this analysis of Tondano stress, I make several assumptions about the nature of the Tondano phonological system. First, I assume (following McCarthy & Prince 1993) that Tondano has metrical structures, where the segments are dominated by morae nodes (µ), morae are dominated by syllable nodes (σ), and syllables by feet (Ft). These structural units are hierarchically arranged like the following:

\[\text{PrWd} \rightarrow \text{Ft} \rightarrow \sigma \rightarrow \mu \rightarrow \text{segments}\]

The remainder of my assumptions rest on this idea of prosodic structure, and the next few specifically focused on the level of the mora, which will prove to be the most important level of Tondano stress. The mora is a unit of metrical time or size (Crystal 1997). Vowels are generally assumed to have a mora. I assume that long vowels in Tondano have two morae. Additionally, I assume that syllable-final consonants carry a mora, so that (CV) syllables, like (CVV) syllables, have two morae (C stands for consonant and V for vowel). This assumption is based upon the common (but, by no means necessary) equivalence of CV and CVV syllables in many languages. However, the analysis given in section V will make it clear that this must be the correct analysis. Fourth, I assume that the vowel “uh” (called schwa, written as ə) does not project a mora (following Crosswhite 2001). The intuition behind this assumption is that schwa is a very weak vowel and as such it just is not strong enough to project a mora. While I make this assumption outright here, over the course of the analysis it will become clear that this assumption must be correct, at least for Tondano. However, what then is the number of morae when a schwa (zero µ) is followed by a coda consonant (1 µ)? In these instances, I assume the coda consonant and the schwa share the single mora. Thus, a (C)VC syllable will count as a syllable with one mora (that is importantly vocalic), but with a nonmoraic vowel.

Finally, I assume that only one foot is formed for the purposes of stress. This foot will be graphically placed in parentheses in examples. I make this final assumption because Sneddon (1975) describes only primary stress and no secondary stress.

**Analysis of Tondano**

First, let us look at simple words, given in (3) below.

\[(\text{3}) (\text{wâ.le}) \text{ ‘house’} \quad \text{wa. (nû.a) ‘village’}\]

Taking Sneddon’s (1975: 9) claim that “[s]tress usually falls on the penultimate syllable of the word,” and examples like the data set in (3), I analyze Tondano as having a stress pattern where the stress is on the first part of the metrical foot. This pattern can be captured with the following TROCHEE constraint (akin to Cohn & McCarthy’s 1994 FT-Form (TROCHAIC)):

\[(\text{4}) \text{TROCHEE}\]

The stressed part of the foot must be on the left

However, words like wana illustrate that TROCHEE alone is not sufficient to characterize the stress, even in these basic cases. Wana has two possible footings that satisfy TROCHEE: wa(nda) and (wâ’nà). To rule this latter candidate out, we also must add a type of constraint known as an alignment constraint. The intuition behind alignment constraints is that languages prefer that the boundaries of two units (such as Prosodic Word and Foot or Stem and Foot) to line
up or align on one side or the other (right or left). From wa(núa) and *(wánu)a, the correct alignment constraint looks to be ALIGN-FT-R, which is formulated in (5) below.

(5)ALIGN-FT-R (McCarthy & Prince 1993, Cohn & McCarthy 1994)
“The right edge of every foot coincides with the right edge of some prosodic word.”

Finally, a third constraint must be added to the above two, since there is nothing to eliminate single syllable, single mora stresses, like *wanu(á) and *wa(lé). In these words, the stressed part is on the left because there is only one part. These, however, can be eliminated through a constraint on the size of feet, FT-MIN-2 µ, which is formulated below in (6).

(6)FT-MIN-2 µ
The foot must not have less than two morae.

This constraint predicts that Tondano stress is sensitive to vowel length—a prediction that will shortly be shown as correct. We will also see, as this analysis unfolds, that the level of the morae is very central to the Tondano stress system.

With these three constraints, we now can account for the data in (3) as every attested form in (3) is optimal in that none violate any constraints whereas other possible forms do. Thus far, it seems that all the constraints are non-ranked, since there has not been any data to suggest otherwise.

Turning now to another set of words, those with the vowel schwa (9), we see that the above three constraints alone are not sufficient. In the data set in (7), we see that the presence of ə in the penultimate syllable produces words with final-syllable stress.

(7) sə.(rá)? ‘fish’
ma.ə.ə.(déy) ‘intends to stand’
ra.ə.ə.(déy) ‘is standing’
ə.(sá) ‘one’

To deal with this pattern, we add the constraint *P/NONMORAIC (along the same lines as NON-HEAD(ə) in Cohn & McCarthy [1994] and *P/ə in Kenstowicz [1994]), given in (8).

(8)*P/NONMORAIC
Nonmoraic vowels may not bear stress.

Note that the proposed foot structures in (7) (marked with parentheses) include feet that are in violation of FT-MIN-2 µ. This sort of interaction suggests that FT-MIN 2 µ and *P/Nonmoraic might be ranked with respect to each other. However, nothing in (7) offers a test case for the ranking of FT-MIN-2 µ vs. *P/Nonmoraic. Instead, all the possible feet either have zero morae (with ə lacking a mora) or they have one mora, so all of them violate FT-MIN-2 µ, and no ranking can be ascertained from this data.

Thus far, we have examined a subset of words of Tondano, all of them without long vowels and with stress either on the penultimate syllable or, in the case of a penultimate schwa, on the final syllable. However, Tondano also includes words with long vowels and with stress on the third-to-last syllable (the antepenultimate). Some examples are given in (9) below.

(9)ka.ri.(máŋ,ka)? ‘spider’
(ki.ŋáŋ).ku ‘has been eaten by me’
(káŋ).na ‘will be eaten by him’
wiŋ.(kó.ə)na ‘will be asked by him’
ti.(kó) ‘throat’
(wé:.nu) ‘will be given by you’

To account for the words in (9), I propose using the constraint, *LAPSE (following Elenbaas & Kager 1999, ultimately from Selkirk 1984). Elenbaas & Kager’s (1999) formulation of *LAPSE was in an account of a particular kind of secondary stress pattern not found in Tondano (but found in Cayuvava, Chugach Alutiiq, and Estonian, inter alia). However, as we will see below, *LAPSE helps to determine primary stress in Tondano, even without this secondary stress pattern.

The intuition behind *LAPSE is that languages do not like to have long stretches of syllables unstressed. As we saw in (9), the stress shifts from the default penultimate syllable to the left when there are long stretches of syllables to left. This intuition might shed light on why the words discussed earlier in this paper do not show any effects from *LAPSE—they are not long enough. Only words that are long enough to have a “long stretch” show the effects of *LAPSE.
However, to make *Lapse work, we must determine what exactly a “long stretch” is in Tondano. Because the prosodic structure (feet, syllables, and morae) includes units that can easily be counted by the grammar, it seems like the best candidate for judging what a “long stretch” is. However, the question remains which level of prosodic structure is relevant, because *Lapse has been applied to a number of levels within this structure, including both syllables and morae (as noted for Cayuvava and Chugach Alutiiq, respectively, in Elenbaas & Kager 1999). Initially, it would seem that Tondano would be like Chugach, and be sensitive to morae. The form (ka;ñóna) seems to support this, since stress is placed on the first syllable to avoid leaving the two mora at; unstressed. However, a word like wíñ̄(kot̠̣̄n̄a) throws that analysis into doubt (and supports a syllabic analysis), since it has two unstressed morae in a row (the moraic vowel i and the syllable-final consonant ŋ). How should we resolve this puzzle? I propose that, instead of having *Lapse tied up with solely syllables or morae, *Lapse is relevant to moraic vowels (all those vowels except a). This thinking also makes sense from another angle: moraic vowels would seem to be the best candidates to receive stress, since moraic consonants cannot be stressed, and there is already a constraint in Tondano to not stress nonmoraic a. Thus, we formalize this idea of *Lapse in (10):

(10)*Lapse  
PrWd must not have two adjacent nonprominent vocalic morae

This formulation of *Lapse with vocalic morae also adds evidence for the nonmoraicity of a. Though syllable-final consonants such as ŋ in wíñ̄kot̠̣̄n̄a motivated the formulation of *Lapse, the optimal candidate, wíñ̄(kot̠̣̄n̄a), has no violations of *Lapse, with the nonmoraicity of a. If a was moraic, wíñ̄(kot̠̣̄n̄a) would have one violation of *Lapse, enough to eliminate it as a candidate. This analysis would, predict the correct form to be unattested wíñ̄(kot̠̣̄n̄a). However, if a is nonmoraic, *wíñ̄(kot̠̣̄n̄a) is ruled out by its one violation of *Lapse—the lack of stress on either syllable of wíñ̄kot̠̣̄—thus allowing for the correct prediction.

The presence of *Lapse also helps to explain the seemingly unusual stress placement in the word ka:.(ñóŋ.ku), ‘will be eaten by me.’ Initially, one might think that the ka: syllable would be stressed to avoid violating *Lapse. However, recall that a syllable with the sequence ac projects a single mora. Because of this, possible forms that do not stress the schwa are also in violation of *Lapse (since ñóŋ.ku part of the word also counts as two morae) and eliminated.

However, *Lapse alone does not do all the work in this form. First, FT-MIN-2 µ eliminates ka:(ñóŋ.ku), since there is only mora in the stressed foot. Second, the two remaining forms of ka:(ñóŋ.ku) and ka:(ñóŋ.ku), determine the critical ranking of ALIGN-FT-R over *P/Nonmoraic. Only when ALIGN-FT-R is ranked over *P/Nonmoraic is the right prediction of the stressed schwa made. Otherwise, the analysis would predict that no schwa would be stressed.

**Residual Issues**

While the above constraints of Trochee, *Lapse, FT-MIN-2 µ, ALIGN-FT-R, and *P/Nonmoraic can account for a large number of Tondano words, there remain a few loose ends to tie up. First is the form maŋãmán, ‘is continually eating.’ The above five constraints eliminate all candidates except maŋã(ñá)n and maŋã(ñá)n. The problem remains how to rule out this last form with a four-mora foot. To do so, I propose the following constraint, analogous to, but the opposite of FT-MIN-2 µ:

(11)FT-MAX-2 µ  
Feet should not be more than two morae

This constraint is ranked in the “second tier” of constraints because no form critically dependent on FT-MAX-2 µ critically violates any of the “first tier” constraints: Trochee, *Lapse, FT-MIN-2 µ, and ALIGN-FT-R.

The inclusion of this last constraint may seem unparsimonious, since one constraint already references foot size (FT-MIN-2 µ) and another (*Lapse) indirectly limits the size of the foot (i.e. most of the possible forms that have a foot that is “too large” will be eliminated by *Lapse). Yet, fixing the problem with maŋãmán appears to have two solutions: either add the FT-MAX-2µ constraint, to rule out the unattested *maŋãmán or stipulate this as part of the set of lexical exceptions. I choose the former on the intuition that this word acts as if it were governed by the same set of rules as the other words. However, regardless of how one goes about dealing with the problem, this troublesome part of the Tondano data suggests further investigation.

One final set of data, given below in (12), also requires explanation:

(12)(tampo)k ‘tip, end’  
(tâpɔ) ‘fast’  
(wâŋɔ) ‘stupid’

Like maŋãmán above, the data in (12) evade the existing set of constraints. None of the vowels projects a mora; thus all the syllables are in violation of FT-MIN-2 µ, and all the vowels are a, so all syllables violate *P/Nonmoraic. Without these constraints, there is no mechanism to distinguish between pairs like (tâpɔ) and *tɔ(pɔ). Thus, I add another constraint, given below in (13).

(13)FT-MIN-2 a  
Feet should have a minimum of two syllables

The presence of this constraint shows that Tondano assesses foot-minimality at both the level of the mora and at the level of the syllable. A critique may be raised that FT-MIN-2 a, too, is not parsimonious; a language should not evaluate foot-minimality on two levels. However, there is evidence for FT-MIN-2 µ across languages (certainly in Tondano, but in other languages as well) and FT-MIN-2 a (cf. FT-BIN for Indonesian in Cohn & McCarthy 1994), so they both should be part of the universal constraint set. As such, they could conceivably interact
within a given language, as they appear to do in Tondano.

FT-MIN-2 σ should obviously be ranked below *P/Nonmoraic, since all critical examples (as noted above in (13)) occur in words where all the vowels violate *P/Nonmoraic.

So to conclude this section on the analysis of the stress system in Tondano, given here in (14) is a summary of the constraints and their respective rankings:

(14) TROCHEE *P/Nonmoraic
*LAPSE » FT-MAX-2 µ » FT-MIN 2 σ
FT-MIN-2 µ
ALIGN-FT-R

CONCLUSIONS

From this study of the Tondano stress system, we can reach several conclusions. First, we can see the elegance of the Optimality Theory system. This framework can account for the rather complicated stress system with only seven small constraints. We have also seen that the elegance depends on the system of violable constraints, which provide evidence that perhaps the language would be best characterized not by invariable rules, but by complex web of constraints working with and against each other.

Second, from the analysis itself we can see that even a complex stress system such as Tondano’s can be understood in a principled way. Specifically, we see that Tondano is a language that prefers penultimate stress. However, this preference is tempered by other tendencies: not leaving “large stretches” of the word unstressed, not stressing weak vowels, and havingmetrical feet that are just the right size—not too big or too small.

Finally, I hope to have shown that language can be very intricate, even in the area of phonology, an area of language that we are constantly in contact with whenever we speak ourselves or listen to someone else. It is these intricacies that make one realize how truly remarkable our ability to speak actually is and that motivate linguists such as myself to try to figure out how languages work. □