H Tone, Depressors and Downstep in Tsonga

Seunghun J. Lee
Rutgers University

1. Introduction

Tsonga, spoken in South Africa and Mozambique, has consonants that block high tone spreading. This paper proposes that such 'depressor' consonants are tone bearing units (TBU). Consequently, a depressor can block the spreading of a high tone as in (1b), whereas high tone spreads across non-depressor consonant as in (1a).

(1) H tone spreading

a. /í + mùfánà/	→	í mûfánà	it is a boy	***non-depressors***	*H spreading*
H + L H L		H HL H L			
b. /í + m̩àlá/	→	í m̩̀alá	it is an impala	***depressors***	*No H spreading*
H L H		H L H			

The depressor effect in (1b) is explained by the proposal that depressor consonants are TBUs and that they must have L tone. Markedness constraints require tone on depressors (ROOTNODE→T) and ban high tone on depressors (*D-H). Moreover, no faithfulness constraint preserves underlying tone on consonants.

The aim of this paper is two-fold. One is to provide a comprehensive analysis of high tone spreading in Tsonga. The other is to use Tsonga to propose a formal account of depressor consonants in general. The proposal is laid out in section 2. An analysis of H tone spreading in Tsonga is presented in sections 3, 4 and 5. The last section discusses the properties of depressor consonants.

2. Proposal

This proposal addresses the blocking of H tone spreading within Optimality Theory (Prince and Smolensky 1993/2004). I propose that consonants are tone bearing units (TBU) and can therefore host tone, which means that consonants form a binary relationship with a tone. The tone on a depressor is necessarily L(ow). This is achieved formally by the following three elements in (2).

(2) Proposal

a. Markedness constraint: ROOTNODE→T — Root nodes must have a tone. (cf. SPECIFY-T, Yip 2002: 83)

b. Markedness constraint: *D-H — Incur a violation for every depressor consonant with H tone. (cf. Bradshaw 1999)

c. There is no faithfulness constraint that preserves underlying tone on consonants

*I would like to thank Akinbiyi Akinlabi, Paul de Lacy, and Alan Prince for their valuable insights and comments. I would also like to thank Lee Bickmore, Laura Downing, and Mary Paters for their comments at ACAL 38. I also thank Crystal Akers, Will Bennett, James Bruno, Patrick Houghton, Paula Houghton, and Brian McHugh for comments. Any errors or shortcomings are my own. Comments are welcome: juliolee@gmail.com

 Selected Proceedings of the 38th Annual Conference on African Linguistics, ed. Masangu Matondo et al., 26-37. Somerville, MA: Cascadilla Proceedings Project.

The constraint ROOTNODE→T (2a) competes with DEP-T (or DEP-ASSOCIATION) (Myers 1997). When ROOTNODE → T is ranked over DEP-T, depressors may host a tone. If DEP-T dominates ROOTNODE→T, depressors may not be linked with tone. The markedness constraint *D-H (2b) blocks depressors from hosting H tone. Crucial to the proposal is the absence of faithfulness constraints that preserve tone on consonants. Thus, any tone bearing consonant in an optimal candidate will only have L tone.

That depressor consonants are TBUs accounts for the blocking of H(igh) tone spreading in LH nouns (1b). An extension of this proposal to other nouns in Tsonga such as L nouns, H nouns and HL nouns is laid out in section 4 and section 5.

Note that it is necessary to distinguish phonetic depressors from phonological depressors. While phonetic depressors such as voiced consonants always lower the pitch of a following vowel (Hombert 1978), phonological depressors are consonants that are linked with L tone, which consequently affect phonological processes such as H tone spreading. The blocking of H tone spreading in Tsonga is an instance of a phonological depressor at work.

3. H tone spreading in Tsonga

As shown below, all four logically possible combinations of the H and L tones in Tsonga are observed in disyllabic nouns.

(3) Tones (Cuenod 1967)

a. L	^{m}bìlà	xylophone
b. H	^{m}bílá	dassie
c. LH	^{m}pàlá	deep narrow burrow
d. HL	^{m}bílà	rockrabbit

When disyllabic nouns like those in (3) appear after a H tone prefix, different patterns of tone sandhi occur. The table in (4) shows the relationship between the H tone prefix and tones on the following nouns. H tone spreads onto L nouns up to the penultimate syllable (4a). In LH nouns (4b), a contour tone arises from H tone spreading if the noun has a non-depressor onset. However, LH nouns with depressor onsets do not show a change in tones. After a H tone prefix, H tone nouns become downstepped (4c-d).

(4) H tone spreading and depressors (H͡L: falling tone)

			Onsets			
	Prefix	*Root*	non-depressors	depressors		
a.	H-	L	H- HL	--	H tone spreading	Sec. 3.1
b.	H-	LH	H- H͡LH	H- LH	Depressors block spreading	Sec. 3.2, 4
c.	H-	H	H- ꜜH	H- ꜜH	Downstep	Sec. 5
d.	H-	HL	H- ꜜHL	H- ꜜHL	Downstep	

3.1. H-tone spreading to L tone nouns across non-depressor onsets

For L tone nouns, H spreads as right as possible up to the penultimate syllable. H tone in the copulative prefix *í-* spreads to L tone nouns. H tone spreads to the penultimate syllable of L tone nouns both in disyllabic nouns (5a) and in nouns with three syllables (5b). Here and throughout I rely on Baumbach's (1987) description.

(5) L tone nouns: *H tone spreads* (Baumbach 1987: 46-47)

a. H + LL → H + HL	rìbjè	→	í ríbjè	it is a stone
	^{m}bìlà	→	í ^{m}bílà	it is a xylophone
b. H + LLL → H + HHL	ʃìkòsà	→	í ʃíkósà	it is an old woman
	mìlètì	→	í mílétì	it is naughtiness

In Bantu languages, H tone spreading to the penultimate syllable is not uncommon. The H tone spreading in Tsonga is shown below as a result of competition between the ALIGN-R constraint and NON-FINALITY. The latter constraint blocks the final syllable from being assigned H tone (an analysis related to Downing's 1990).

The ranking with respect to the H tone spreading to L tone nouns is given in (6).[1] The definitions of the constraints are given in (7). The faithful candidate (6b) violates ALIGN-R, which motivates the H tone spreading as right as possible. A candidate that spreads the H tone to the rightmost edge, however, violates NON-FINALITY (6c). If possible, the contour tone in the output is deferred by the *CONTOUR constraint, which dominates MAX-ASSOCIATION as in (6d).

(6) **L nouns**: NON-FINALITY >> ALIGN-R >> DEP-ASSOCIATION; *CONTOUR >> MAX-ASSOCIATION

	H L | ⋀ V V V	NON-FINALITY	ALIGN-R	DEP-ASSOCIATION	*CONTOUR	MAX-ASSOCIATION
a.☞	H L ⋀ | V V V		*[2]	*		*
b.	H L | ⋀ V V V		W**	L		L
c.	H L ⋀ | V V V	W*	L	W**	W*	L
d.	H L ⋀ | V V V		*	*	W*	L

(7) Constraints

a. **NON-FINALITY** (Prince and Smolensky 1993/2004)
Do not associate the final syllable of a prosodic domain with a H tone

b. **ALIGN(H, R, PRWD, R)** [ALIGN-R] (Yip 2002: 83)
Align the right edge of the association line of a H tone with the right edge of a prosodic word

c. **DEP-ASSOCIATION** (Myers 1997)
An output association line must have a correspondent association in the input

d. ***CONTOUR** (Yip 2002: 83)
Do not have a contour tone

e. **MAX-ASSOCIATION** (Myers 1997)
An input association line must have a correspondent association in the output

In L nouns with three syllables, the same constraints explain H tone spreading. H tone in the prefix spreads to the penultimate syllable because of the ranking between NON-FINALITY and ALIGN-R.

3.2. H-tone spreading to LH nouns across non-depressor onsets

In LH nouns, H tone spreads to the first L and forms a contour tone. LH nouns with depressor onsets, however, do not have this contour formation, which is analyzed as blocking of the H tone spreading by the depressor consonant (see section 4). H tone spreading to LH nouns with non-

[1] In each comparative tableau, asterisks indicate violation profiles. 'W' means that the optimal candidate is the winner under a constraint. 'L' means that the optimal candidate loses against other candidates under a constraint. In each row of the tableau, all L's should be dominated by at least one W. See Prince (2002).

[2] The constraint ALIGN-R assigns violations based on the number of TBUs between a H tone and the right edge of a word. Since depressors are TBUs, they also add violation marks.

depressors results in a contour tone. The examples in (8) show falling contour tone in the first syllable of a noun after a H tone prefix. The initial consonants of these LH nouns are non-depressor consonants, which include fricatives, voiceless stops, prenasalized stops, and other sonorants (nasals, liquids, glides).

(8) LH tone nouns (Baumbach 1987: 50)

a. *fricatives*	βòná	→	ñí **β**ôná	it is they
b. *voiceless stops*	kòmbé	→	í **k**ômbé	it is an ousted impala
c. *nasals*	mìná	→	ñí **m**îná	it is me
d. *prenasalized stops*	mbìtá	→	ñí ^{m}**b**îtá	with a pot

As discussed in section 3.1., H tone spreads due to the ALIGN-R constraint. In the following tableau in (9), ALIGN-R dominates *CONTOUR, and thereby allows word-medial contour tones. Thus, the optimal candidate (9a) is chosen over the faithful candidate (9b), in which there is no H tone spreading. A candidate that deletes the final H in order to satisfy NON-FINALITY (9c) is not desirable because it violates MAX-T, which does not prefer deletion of underlying tones. The definition of MAX-T is given in (10).[3]

(9) LH nouns: MAX-T >> NON-FINALITY; ALIGN-R >> *CONTOUR

	H L H | | | V V V	MAX-T	NON-FINALITY	ALIGN-R	*CONTOUR
a. ☞	H L H ◿| | V V V		*	*	*
b.	H L H | | | V V V		*	W**	L
c.	H L ◿ | V V V	W*	L	*	L

(10) **MAX-T** (Yip 2002: 83)
An input tone must have a correspondent tone in the output

In the tableau (9), tones are assumed to be underlyingly present. So, deletion of underlying tone is not tolerated because it violates MAX-T (9c). Under Richness of the Base in OT, there can be roots with no underlying tone in input, whose optimum will emerge with some sort of tonal pattern. Under the current ranking, as the tableau in (11) shows, H tone will spread as right as possible but not to the final syllable because NON-FINALITY dominates ALIGN-R. A faithful candidate violates TBU→T as well as ALIGN-R, which dominates DEP-T. The selected optimum of a toneless input demonstrates the same pattern observed in H tone spreading to L tone nouns as discussed in section 3.1.

[3] A reviewer suggested an alternative analysis, in which the contour formation in LH nouns results from the Obligatory Contour Principle (OCP) constraint rather than *CONTOUR because H + LL does not surface with contour tones as in H + HL L. This analysis can extend to LH nouns if we assume an input without L tone. The spreading of H from the prefix H surfaces with two adjacent H tones in the output, which would violate the OCP. The contour tone is formed as a result of avoiding an OCP violation and thereby inserting a L tone.

Note that the role of the OCP would only be significant if an input does not have an underlying L tone. A candidate with an underlying L tone (in this case the first tone in LH nouns) would not violate the OCP as a result of H tone spreading. Thus, the contour formation should be motivated by a lower ranked constraint such as *CONTOUR. This constraint can be violated in order to satisfy the ALIGN-R constraint. While acknowledging that the OCP constraint would be necessary, I argue that *CONTOUR motivates contour formation in LH nouns. Contour tones are not formed in L nouns due to other constraints as shown in (6d) in section 3.1.

(11) LH nouns

	H | V V V	NON-FINALITY	TBU→T	ALIGN-R	DEP-T	*CONTOUR
a. ☞	H L ∧ | V V V			*	*	
b.	H L | ∧ V V V			W**	*	
c.	H L H ∧| | V V V	W*		*	W**	W*
d.	H | V V V		W**	W**	L	

A question arises whether H tone on the final syllable in LH nouns violates NON-FINALITY. H tone on the final syllable does violate NON-FINALITY. Even so, the higher ranked MAX-T constraint does not tolerate deletion of an underlying tone, which prevents the final H from being deleted.

In the following sections, H tone spreading to other nouns -LH with depressors, HL, and H nouns- will be examined and analyzed. It will be shown that the proposal not only accounts for the blocking of H tone spreading to LH nouns, but also explains downstep in H tone nouns. The types of depressor consonants in Tsonga will be discussed further in section 6.

4. Depressor consonants block H tone spreading

4.1. H-tone spreading to LH nouns across depressor onsets

When a H tone prefix comes before an LH noun with an initial depressor consonant (marked with capital 'D'), the tones on the noun remains the same. The data below shows that breathy voice onsets (12a), voiced onsets (12b), and aspirated onsets (12c) behave as depressors in Tsonga.

(12) LH nouns with depressors: H + **DLH** → H + **DLH** (Baumbach 1987: 53-5)

a. *Breathy voice*

n̤àŋgá	→	í **n̤**àŋgá	it is a hut for unmarried girls
r̤òβá	→	í **r̤**òβá	it is a flat cake

b. *Voiced*

bùʃá	→	í **b**ùʃá	it is a hen which eats its own eggs
ɦòmú	→	í **ɦ**òmú	it is a beast

c. *Aspirated*

tsʰùrí	→	í **tsʰ**ùrí	it is a mortar
kʰòswá	→	í **kʰ**òswá	it is a half portion

As outlined in the proposal in section 2, the blocking of H tone spreading in LH nouns with depressor onsets is the result of two markedness constraints. Depressors require a tone and the tone cannot be high. Thus, depressor consonants must have a low tone in the output.

The constraint ROOTNODE→T (2a) is violated if a depressor TBU in the output is toneless. The second constraint *D-H (2b) requires L tone on depressor in the output. Because there is no faithfulness constraint that preserves an underlying tone on consonants, an input with high tone on depressors will never be faithful in the output in Tsonga, and in general.

Before proceeding on to an analysis, I will clarify how violations of ROOTNODE→T can be avoided. An association line can link depressor consonants with a preceding or following L tone (which predicts that L tone can spread regardless of the presence of depressors). If the depressor does

not have a neighboring L tone, ROOTNODE→T can be satisfied by inserting a L tone associated with a depressor. This explains the blocking effect of depressors.

Depressors can have a tonal specification because depressors are TBUs. For depressors, I will assume that the root node itself bears a tone. This is clearly a contentious claim as TBUs have standardly been argued to be mora or syllable nodes (Yip 2002: 72-4). Whereas studies have shown that coda consonants can be contextually moraic (Zec 1995 among others, Morén 1999, Elias-Ulloa 2006), onsets are often considered not to bear a mora (though Topintzi 2006 argues for the existence of moraic onsets). While acknowledging this important issue, I will defer further discussion to other work (Lee in prep.).

So, depressors are associated with tones without having an intermediate prosodic unit. It is possible that this extraordinary property of depressor TBUs is related to the proposal that no faithfulness constraints preserve underlying tone on consonants. It is possible that only tone-prosodeme relationships can be preserved, a point discussed further in Lee (in prep.).

The ranking argument for depressor-tone interaction is presented in (13). The spreading of H in candidate (13b), favored by the constraint ALIGN-R, cannot be performed because the candidate violates *D-H, which does not allow depressor consonants to be assigned a H tone. A depressor consonant that is a TBU should have a tone because of ROOTNODE→T constraint, even though DEP-ASSOCIATION constraint prefers a faithful candidate with toneless depressors (13c).

(13) LH nouns with depressors: *D-H >> ALIGN-R ; ROOTNODE→T >> DEP-ASSOCIATION

	H L H | | | V DV V	*D-H	ROOTNODE→T	ALIGN-R	DEP-ASSOCIATION
a. ☞	H L H | ⟋| | V DV V			***	*
b.	H L H ⟋⟍| | V D V V	W*		L*	W**
c.	H L H | | | V DV V		W*	***	L

A hypothetical input with H tone on a depressor (assuming Richness of the Base) should emerge with the optimal output that has L tone on the depressor. Recall that this paper proposes that there is no faithfulness constraint that preserves tone on consonants. Because there is no faithfulness constraint for consonantal tone, the faithful candidate could only emerge as the winner if markedness constraints happened to favor it over all other options - i.e. preservation of underlying tone would be incidental, never directly forced for preservation reasons. Under the current ranking, the markedness constraint *D-H prevents the faithful candidate (14b) from being the winner.

(14) An input with H tone on depressor

	H L H ⟍| | V DV V	*D-H	DEP-ASSOCIATION
a. ☞	H L H | ⟋| | V DV V		*
b.	H L H ⟍| | V DV V	W*	L

This proposal is different from the seminal work on consonant-tone interaction by Bradshaw (1999). Whereas she proposes the multi-planar theory with feature [voice/L] that sets a mediating

feature between a segmental plane and a tonal plane, the current proposal is based on depressor consonants being TBUs. In a constraint-based theory as laid out in this paper, Bradshaw's proposal would have the shortcoming of having a restriction on inputs. The consonant-tone interaction in her work crucially relies on an input in which a depressor consonant is specified with the [voice/L] feature. This restriction on inputs makes the multi-planar theory less desirable not only because the class of consonants that behave as depressors differs from one language to another (also summarized in Bradshaw), but also because it requires an unacceptable modification in the basic assumption of the constraint-based framework.[4]

4.2. H-tone spreading to L tone nouns across depressor onsets

The proposal in this paper predicts that H tone spreading to L nouns should be blocked by depressors. H+**DL**L should become H+**DL**L, but not *H+**DH**L. This predicted result, however, needs further confirmation because of the gap in the presentation in Baumbach (1987).

5. Downstep and H tone spreading

5.1. H tone spreading across non-depressor onsets

This section presents and analyzes H tone spreading to H tone nouns. Irrespective of the presence of depressors, downstep occurs when a H tone prefix precedes H tone nouns. Examples in (15) and (16) show the downstep in HL nouns and H nouns respectively. Downstep is marked with a superscript downward arrow (ꜜ) before downstepped syllables.

(15) HL tone nouns (Baumbach 1987: 50)

a. H+**H**L	→ H+ꜜ**H**L	nsóŋgà	→	í **ꜜnsó**ŋgà	it is a bend of the river
b. H+**H**HL	→ H+ꜜ**H**HL	púláŋgì	→	í **ꜜpú**láŋgì	it is a plank

(16) H tone nouns (Baumbach 1987: 49)

H+**H**H	→ H+ꜜ**H**H	ŋwáná	→	í **ꜜŋwá**ná	it is a child
		léró	→	ɲí **ꜜlé**ró	it is that one

Downstep in Tsonga is analyzed following Bickmore's (2000) proposal on Namwanga. He convincingly argues that downstep in Namwanga results when adjacent H tones cannot be fused with each other in the output. In Namwanga, H tone spreads from left to right. However, when the H tone from the left encounters a H tone that is underlyingly present, further spreading is blocked. As a result, the second H tone becomes a downstep. His proposal shows that downstep is not necessarily caused by L tones that are not linked with a TBU (a floating L tone).

Two adjacent H tones in the output are phonetically realized with a downstep of the second H tone. In other words, a violation of Obligatory Contour Principle (OCP) is not fixed by phonological repairs such as fusion of the two H tones, insertion of a floating L tone, deletion of one of the H's, or change of tonal property of one of the H to L. In section 5.4, I will discuss and refute an analysis that involves insertion of a floating L tone.

After Bickmore's proposal, downstep in Tsonga is seen as the phonetic realization of adjacent H tones. A H tone from the prefix spreads, but it cannot spread if it is followed by an underlying H tone. As shown in tableau (17), the fusion of two H tones is blocked because UNIFORMITY-T dominates ALIGN-R. Deletion of an underlying H tone is not allowed because it violates higher ranked constraint MAX-T.

[4] Another line of research on consonant-tone interaction is the Optimal Domain Theory (ODT) proposed by Kisseberth (1984) and Cassimjee & Kisseberth (1998). In Downing (2007), for example, a depressor domain is proposed to account for the depressor effect on H tones.

(17) HL nouns

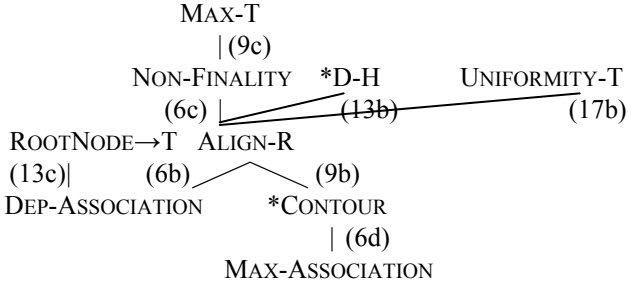
	H_1 H_2 L | | | V V V	UNIFORMITY-T	ALIGN-R
a. ☞	H_1 H_2 L | | | V V V		**
b.	$H_{1,2}$ L ◿ | V V V	W*	L*

(18) Constraints

Uniformity-T Separate underlying tones must stay separate (Yip 2002: 83)

The ranking of the constraints in Tsonga is presented in (19). High ranked MAX-T does not allow deletion of underlying tones in input. The constraint ALIGN-R prefers candidates in which H tone is realized as right as possible, but NON-FINALITY would not allow the final syllable to host H tone unless there is an underlying H tone such as in LH nouns. Satisfaction of ALIGN-R cannot be at the expense of a violation of *D-H, which bans H tone on depressors. Neither can it be satisfied by violating UNIFORMITY-T, which bans fusion of tones. Depressors require tone in the output due to the ranking of ROOTNODE→T over DEP-ASSOCIATION.

(19) Ranking



5.2. H tone spreading across depressor onsets

When a H noun with depressors follows a H tone prefix, the first H on the noun becomes downstepped as well. If lack of L tone between adjacent H tones in the output causes downstep as above in section 5.1., the depressor's L tone should be able to block the downstep because two H tones are not adjacent due to the intervening L tone on a depressor. The data in (20), however, shows that downstep still occurs in H nouns with depressors.

(20) Depressor consonant between two H tones (Baumbach 1987: 49)

H+D**H**HH → H+D**ꜜH**HH ɲóŋgónjí→ í ꜜɲóŋgónjí it is a gnu

Various possibilities can account for this downstep. Downstep in (20) can be the result of a phonetic realization of a phonological L tone on depressors. The downstep is articulatory undershoot. The phonological L of a depressor is a phonetic target that lowers the F0. After the depressor, the F0 does not recover fast enough to reach the H's usual level, which results in as downstep.[5]

[5] A reviewer has suggested that the downstep might result from OCP effect by adjacent H tones, and not from the phonetic undershoot of Low tone of depressors. Given that the markedness constraint related to depressors only ban an association to a high tone, the OCP analysis is possible to account for the downstep. However, the conditions for downstep require more phonetic study in the future. Collaboration with a native speaker of Tsonga will corroborate the facts and contribute to the better understanding of this phenomenon.

In a multi-planar theory as in Bradshaw (1999), consonantal tone may belong to a different plane from other tones. If planes do not interfere, two H tones are adjacent in the output that results in downstep as discussed in section 4.1.

In this paper, the former account will be preferred to the latter because the multi-planar theory has assumptions that make different predictions than the constraint-based theory defended in this paper.

5.3. The role of OCP

After Meeussen's rule, tone languages are reported to observe the Obligatory Contour Principle (OCP). In an autosegmental theory, the OCP is a rule that does not allow two identical autosegments to be adjacent in the representation. In a constraint-based theory like OT, the OCP can be a constraint, only if it is violable. Originally, the OCP was claimed to be an inviolable principle. However, some subsequent studies have disputed the inviolability of the OCP (Odden 1986). In the discussion above, the violation of the OCP is satisfied by a phonetic repair strategy.

In Tsonga, the OCP constraint must be ranked lower than UNIFORMITY-T and MAX-T as in (21). UNIFORMITY-T dominates OCP. This ranking bans the fusion of two adjacent H tones, even though the candidate in (21b) satisfies OCP. MAX-T also dominates OCP. Thus, the candidate in (21c), which satisfies the OCP constraint by deleting one of the adjacent H tones in the output cannot be the optimum.

(21) HL nouns

	H_1 H_2 L | | | V V V	MAX-T	UNIFORMITY-T	ALIGN-R	OCP
a. ☞	H_1 H_2 L | | | V V V			**	*
b.	$H_{1,2}$ L ◠ | V V V		W*	L*	L
c.	H_1 L | ◠ V V V	W*		**	L

5.4. Downstep with floating L tone

As addressed in section 5.1, alternative analyses for downstep in Tsonga are possible. In this section, I will discuss an analysis that posits a floating L tone for downstep. Previous studies have shown that downstep can arise from a floating L tone by delinking an underlying L tone from its TBU (Schachter and Fromkin 1968). The floating tone analysis, however, has some shortfalls in explaining the Tsonga cases.

Whereas the floating tone analysis usually relies on the delinking of an underlying L tone, the data above would necessitate an analysis that requires the insertion of a L tone that is not linked to any TBU (H+H → H+L̶H; L̶ denotes a floating L). To motivate the insertion, the floating tone analysis inevitably needs the OCP constraint. The insertion of a L tone incurs a violation of DEP→T, which in turn competes with the OCP constraint.

While a floating L tone analysis would explain downstep by the ranking between DEP→T and OCP in non-depressor cases, H nouns with depressors need further examination. Under the current proposal, L tone on depressors will be sufficient to avoid OCP violation because the two H tones are not adjacent. This, however, predicts that there should be no downstep, which is counterexemplified by the data in (20).

In a multi-planar theory, the OCP constraint will be violated because the consonantal L tone would not belong to the same plane as two H tones, and the H tones are adjacent. The insertion of a

floating L tone will avoid the OCP violation. If we retain the current proposal, the optimal candidate needs insertion of two L tones: a floating L tone and a consonantal L tone.

In sum, a floating tone analysis requires the insertion of a L tone in H nouns with non-depressors to avoid an OCP violation. For downstep in H nouns with depressors, the analysis also requires insertion of a floating L tone, in addition to the assumption about multiple tonal planes.

On the contrary, the analysis with phonetic undershoot of a phonological consonantal L tone defended in this proposal accounts for the downstep uniformly without importing further assumptions on multiple planes. While acknowledging floating L tone as a cause of downstep, further research is needed to develop a precise understanding of floating tones.

6. Depressors and breathy voice

Tsonga depressors are voiced stops (but not voiced fricatives), breathy voice, and aspirated consonants. These are phonological depressors due to the blocking of H tone spreading. The blocking cannot be a phonetic effect caused by voicing because the set of consonants excludes voiced fricatives and, moreover it includes voiceless aspirated consonants.

Tsonga consonants are laid out in (22), in which depressors are placed in heavy-lined boxes. Voiced stops, breathy voice and aspirated stops are depressors that block H tone spreading.

(22) Consonants (Baumbach 1987: 3-16)

	bilabial		dental		alveolar		palatal		velar		glottal
Stops	p	b			t	d			k	g	
aspirated/breathy	p^h	$^{(m)}b̤$			t^h	$^{(n)}d̤$			k^h	$^{(ŋ)}g̈$	
prenasalized		^{m}b				^{n}d				^{ŋ}g	
Fricatives	ɸ	β	f	v	s	z	ʃ	ʒ	x		ɦ
Affricates	pf	bv			ts	ʣ	ʧ	ʤ			
aspirated/breathy	pf^h	bv̤			ts^h	ʣ̤	$ʧ^h$	ʤ̤			
Nasals		m				n		ɲ		ŋ	
breathy		m̤				n̤				ŋ̈	
Lateral						l					
aspirated/breathy					l^h	l̤					
Rhotic						r					
breathy						r̤					
Glides		w						j			
breathy		w̤						j̈			

The effect of consonants on tone is observed as early as Beach (1924) and Lanham (1958) in many Nguni languages such as Zulu, Ndebele, and Xhosa. In Tsonga, voiced stops, breathy voice, and aspirated consonants are depressors. Whereas voiced stops and breathy voice consonants are reported to be depressors in other languages, aspirated consonants are unusual depressors. In (23)-(25), examples of H tone spreading in depressors are presented.

(23) (Prenasalized) breathy voice (Baumbach 1987: 53)

m̤	m̤àlá	→	í **m̤à**lá	it is an impala
n̤	n̤àŋgá	→	í **n̤à**ŋgá	it is a hut for unmarried girls
ŋ̈w	ŋ̈wàrí	→	í **ŋ̈w**àrí	it is a partridge

$^{(m)}$ḇ	^{m}ḇìmbí	→	í **^{mm}ḇ**ìmbí	it is a mangosteen tree
$^{(n)}$ḍ	^{n}ḍ^{ɦ}àmbá	→	í **^{n}ḍ**àmbá	it is a cooking pot
ʤ	^{n}ʤèŋgá	→	í **^{n}ʤ**èŋgá	it is afternoon
ǧ	^{n}ǧòŋǧwé	→	í **^{n}ǧ**òŋǧwé	it is an old ousted vervet monkey
ḍl	^{n}ḍlàzí	→	í **^{n}ḍl**àzí	it is a mousebird
ṛ	ṛòβá	→	í **ṛ**òβá	it is a flat cake

(24) Voiced stops & voiced glottal (Baumbach 1987: 54)

b	bùʃá	→	í **b**ùʃá	it is a hen which eats its own eggs
d	dòɲé	→	í **d**òɲé	it is an undersized peanut
g	gùdá	→	í **g**ùdá	it is a small verandah
bj	bjàŋgá	→	í **bj**àŋgá	it is a beer
dj	djòná	→	í **dj**òná	it is it
ɦ	ɦòmú	→	í **ɦ**òmú	it is a beast

(25) Aspirated consonants (Baumbach 1987: 54)

tl^{h}	^{n}tl^{h}àmú	→	í **^{n}tl^{h}**àmú	it is a trap
ts^{h}	ts^{h}ùrí	→	í **ts^{h}**ùrí	it is a mortar
ʧ^{h}	ʧ^{h}ìpá	→	í **ʧ^{h}**ìpá	it is a pensioner
t^{h}	t^{h}ònsí	→	í **t^{h}**ònsí	it is a drop
k^{h}	k^{h}òswá	→	í **k^{h}**òswá	it is a half portion

There are two points to be emphasized in discussing Tsonga depressors. First, the status of aspirated depressors needs explanation because aspirated sounds do not commonly lower the F0. The second point has to do with how speakers of Tsonga group depressors as a natural class. Whereas this paper does not provide a conclusive answer for these two contentious issues, this section presents some directions for future research.

Phonetic studies on voiced consonants and breathy voice consonants show that these types of consonants lower the pitch of the beginning of the following vowel. Traill and Jackson (1988), for example, reports that breathy nasals in Tsonga have lower F0 perturbations than the normal voice consonants.

The fact that aspirated sounds behave on par with other depressors is intriguing because aspirated consonants do not share physical properties with voiced consonants or breathiness. A study on Korean aspirated sounds (Jun 1998) convincingly argues for the change of intonation pattern from LHLH to HHLH, if a phonological phrase begins with an aspirated consonant. Pitch raising by aspirated consonants is also observed in Thai (Gandour 1974). If the phonetic property of aspirated sounds in Tsonga were the same as in Korean or Thai, phonetics would not be criteria for determining depressors.

A phonetic-phonological definition on [voice] is proposed in Bradshaw (1999: 147) in connection with consonant-tone interaction. She suggests that the feature [voice] could be defined as "a laryngeal setting … that results in lowered fundamental frequency on a vowel". The definition of feature [voice] would not easily extend to sounds such as aspirated sounds that do not seem to lower the F0.[6]

The inclusion of aspirated sounds suggests that lowering of the F0 might not be the only correlate for depression, which in turn supports an idea about phonological depressors (versus phonetic depressors).

7. Conclusion

This paper discusses and analyzes depressor consonants and tone in Tsonga. In Tsonga, depressor consonants block H tone spreading from a H tone prefix. The proposal has two parts: depressor

[6] A recent phonetic study on Shanghai Chinese by Chen (2007) suggests that F0 of aspirated consonants can be lower than that of voiceless stops. This shows that aspirated consonants may not always be pitch raisers. More phonetic study would be required to understand the exact nature of these aspirated consonants in Tsonga.

consonants are TBUs that require L tone and there are no faithfulness constraints sensitive to consonantal tone. The L tone on depressors blocks H tone spreading. For H nouns, the consonantal L tone is analyzed as the reason for downstep after depressors.

The current proposal is following Bradshaw (1999, 2000), in that depressors must have L tone. The result of the proposal is that depressors block H tone spreading, but they allow L tone spreading. The analysis is based on the proposal as follows.

(26) Proposal
a. Markedness constraint: ROOTNODE→T Root nodes must have a tone.
b. Markedness constraint: *D-H
Incur a violation for every depressor consonant with H tone.
c. There is no faithfulness constraint that preserves underlying tone on consonants

I have also discussed types of depressor consonants. Depressor consonants in Tsonga are voiced stops, breathy voice and aspirated consonants.

References

Baumbach, Ernst J.M. 1987. *Analytical Tsonga Grammar*, Pretoria: University of South Africa.

Beach, Douglas M. 1924. The science of tonetics and its application to Bantu languages. *Bantu Studies* 2:75-106.

Bickmore, Lee. 2000. Downstep and fusion in Namwanga. *Phonology* 17:297-331.

Bradshaw, Mary. 1999. A Crosslinguistic Study of Consonant-Tone Interaction, Ph. D., Ohio State University.

Bradshaw, Mary. 2000. Consonant-Tone Interaction in African Languages. In: *Advances in African Linguistics*, eds. V. Carstens & F. Parkinson, Trenton, N.J. & Asmara, Eritrea: Africa World Press, 151-164.

Cassimjee, Farida, & Kisseberth, Charles W. 1998. Optimal domains theory and Bantu tonology: a case study from Isixhosa and Shingazidja. In: *Theoretical aspects of Bantu tone*, eds. L. Hyman & C.W. Kisseberth, CSLI, 33-132. [ROA-176]

Chen, Yiya. 2007. F0 and segment interaction in Shanghai Chinese. Paper presented at *Workshop on Segments and Tone*, Amsterdam, the Netherlands.

Cuenod, R. 1967. *Tsonga-English Dictionary*, Braamfontein: Sasavona Publishers.

Downing, Laura J. 1990. Local and metrical tone shift in Nguni. *Studies in African Linguistics* 21:261-317.

Downing, Laura J. 2007. On pitch lowering not linked to voicing: the case of Southern Bantu depressors. Paper presented at *Workshop on Segments and Tone*, Amsterdam, the Netherlands.

Elías-Ulloa, José. 2006. Theoretical Aspects of Panoan Metrical Phonology: Disyllabic Footing and Contextual Syllable Weight, Ph. D., Rutgers University. [ROA-804]

Gandour, Jack. 1974. Consonants types and tones in Siamese. *Journal of Phonetics* 2.4:337-350.

Hombert, Jean-Marie. 1978. Consonant types, vowel quality, and tone. In: *Tone: A Linguistic Survey*, ed. Victoria Fromkin, New York: Academic Press, 77-111.

Jun, Sun-Ah. 1998. The Accentual Phrase in the Korean prosodic hierarchy. *Phonology* 15:189-226.

Kisseberth, Charles. 1984. Digo Tonology. In: *Autosegmental Studies in Bantu Tone*, eds. G. N. Clements & J. Goldsmith, Dordrecht: Foris, 105-182.

Lanham, L. W. 1958. The tonemes of Xhosa. *African Studies* 17.2:65-81.

Lee, Seunghun J. in prep. The interaction of tone and laryngeal features, Ph. D., Rutgers University.

Morén, Bruce. 1999. Distinctiveness, Coercion and Sonority: A Unified Theory of Weight, Ph. D., University of Maryland. [ROA-346]

Myers, Scott. 1997. OCP effects in Optimality Theory. *Natural Language and Linguistic Theory* 15.4:847-892.

Odden, David. 1986. On the role of the Obligatory Contour Principle in phonological theory. *Language* 62:353-383.

Prince, Alan, and Smolensky, Paul. 1993/2004. *Optimality Theory: Constraint interaction in generative grammar*, Oxford: Basil Blackwell. [ROA-537]

Prince, Alan. 2002. Arguing Optimality. In: *Papers in Optimality Theory II*, eds. A. Coetzee, A. Carpenter & P. de Lacy, GLSA, University of Massachusetts, Amherst. [ROA-536]

Schachter, Paul, and Fromkin, Victoria. 1968. A phonology of Akan; Akuapem, Asante, and Fante. In: *UCLA Working Papers in Phonetics 9* Los Angeles, CA: University of California.

Topintzi, Nina. 2006. Moraic Onsets, Ph.D., University College London.

Traill, Anthony, and Jackson, Michel. 1988. Speaker variation and phonation type in Tsonga nasals. *Journal of Phonetics* 16:385-400.

Yip, Moira. 2002. *Tone*, Cambridge: Cambridge University Press.

Zec, Draga. 1995. Sonority constraints on syllable structure. *Phonology* 12:85-129.

Selected Proceedings of the 38th Annual Conference on African Linguistics: Linguistic Theory and African Language Documentation

edited by Masangu Matondo, Fiona Mc Laughlin, and Eric Potsdam

Cascadilla Proceedings Project Somerville, MA 2009

Copyright information

ISBN 978-1-57473-429-4 library binding

Ordering information

Orders for the library binding edition are handled by Cascadilla Press.
To place an order, go to www.lingref.com or contact:

Cascadilla Press, P.O. Box 440355, Somerville, MA 02144, USA
phone: 1-617-776-2370, fax: 1-617-776-2271, e-mail: sales@cascadilla.com

Web access and citation information

This entire proceedings can also be viewed on the web at www.lingref.com. Each paper has a unique document # which can be added to citations to facilitate access. The document # should not replace the full citation.

This paper can be cited as:

Lee, Seunghun J. 2009. H Tone, Depressors and Downstep in Tsonga. In *Selected Proceedings of the 38th Annual Conference on African Linguistics*, ed. Masangu Matondo, Fiona Mc Laughlin, and Eric Potsdam, 26-37. Somerville, MA: Cascadilla Proceedings Project.

or:

Lee, Seunghun J. 2009. H Tone, Depressors and Downstep in Tsonga. In *Selected Proceedings of the 38th Annual Conference on African Linguistics*, ed. Masangu Matondo, Fiona Mc Laughlin, and Eric Potsdam, 26-37. Somerville, MA: Cascadilla Proceedings Project. www.lingref.com, document #2133.