Case Drop and Prosodic Structure in Korean*

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ABSTRACT

The goal of this paper is to examine how Case Drop (the drop of the case markers) correlates with the prosodic structure in Korean. On the assumption that intervocalic Lenis Stop Voicing (LSV) applies within the domain of the Accentual Phrase (AP), voicing analyses are performed on intervocalic lenis stop consonants before and after Case Drop. A statistical analysis reveals that the drop of the nominative and accusative case markers significantly alter the AP structure. Pitch values will then be extracted to verify that such changes in the AP structure conform to the pitch properties proposed for the AP (Jun 1993, 1998). The results show that the AP structure suggested by LSV does not always coincide with that imposed by the pitch properties.

Keywords : Case Drop, case marker, Accentual Phrase, stop voicing, pitch

1. Introduction

In Korean, case markers such as nominative (NOM), accusative (ACC), and genitive (GEN) are often drop in normal speech.1) Some of the representative examples are given below. (Case markers subject to drop are parenthesized.)

(1) a.	yəŋi-(ka) o-ass-ta	'Youngi-(NOM) come-Past-Dec(larative)'
	saram-(i) manh-ta	'people-(NOM) many-Dec'
b.	c^hæk-(ɨl) ilk-nɨn-ta	'book-(ACC) read-Present-Dec'
	tok'i-(lɨl) cap-ass-ta	'rabbit-(ACC) catch-Past-Dec'
c.	əməni-(ɨy) pyənji	'mother-(GEN) letter'

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1) The locative case markers, *-e* and *-lo,* may also drop (e.g. *hakkyo-(e/lo) ka-n-ta* 'school-Locative go-Present-Dec'), but its drop is subject to a peculiar condition on the number of syllables in the word to which they attach. The locative markers drop when the host words have more than two syllables (e.g. *hakkyo-Ø ka-n-ta* 'school go-Present-Dec' *təminal-Ø ka-n-ta* 'terminal go-Present-Dec' vs. **cip-Ø ka-n-ta* 'home go-Present-Dec'). Since the reason for this restriction is not yet clear, the drop of the locative case markers will not be considered here.

d. yəŋi-(ka) əməni-(ɨy) pyənji-(lɨl) ilk-nɨn-ta
'Youngi-(NOM) mother-(GEN) letter-(ACC) read-Present-Dec'

Such elision of case markers, termed here as Case Drop, has been treated in the literature with reference primarily to syntax or semantics. (See H.S. Shin 1982, H.S. Lee & Thompson 1989, and N.S. Lee 1989, 1998 for details.)

In this paper, we will focus rather on the correlation between Case Drop and the prosodic structure. By the prosodic structure here, I refer specifically to the Accentual Phrase (AP) proposed by Jun (1993, 1998), which is roughly defined as the general pitch pattern of Low-High-Low-High (LHLH) and serves as the domain of some phonological or phonetic rules. We will investigate in this paper whether the AP structure may vary depending on Case Drop.

To determine whether the AP structure is affected by Case Drop, I will take the following procedure. First, I will adopt the proposal made by Jun that the AP is the domain of Lenis Stop Voicing (LSV), a postlexical process by which an underlying voiceless lenis stop is realized as voiced when surrounded by voiced sounds as below[2].

(2) a. kɨ c̲ip (→ jip) 'that house'
b. cohɨn k̲irim (→ girim) 'good picture'
c. aju c̲ohɨn (→ joɨn) 'very good'

For a stop consonant to undergo LSV, the stop consonant and its adjacent vowels must be placed within the same AP. If we knew whether a stop consonant undergoes LSV or not, we could decide where the stop consonant is placed in an AP. If there is any significant change in voicing of a stop consonant induced by Case Drop, it means that the stop consonant changes its relative position in an AP, and hence, we can conclude that Case Drop affects the AP structure.

Second, I will investigate the pitch patterns in detail to verify any changes in the AP structure brought about by Case Drop. Jun (1993, 1998) proposes that there be certain pitch properties germane to AP. Centering on such properties, I will examine the changes in the AP structure suggested by the voicing analysis. In particular, I will note that for such changes in the AP structure to be justified, they must exhibit certain pitch patterns as imposed by the pitch properties of the AP. I will analyze the pitch patterns to make sure that the predictions are borne out.

2) There is an argument that voicing of the lenis stop consonant in the intervocalic environment is variable across speakers and also depends on the quality of its neighboring vowels (Han 1995, 2000). In this view, LSV is not a categorical allophonic process but a gradient and purely phonetic process.

2. Experiments

2.1 Subjects

Three male speakers participated in the recording. One speaker is in his late twenties, another in his mid thirties, and the other in his late thirties. They were all born and raised in Seoul, and speak the standard Seoul dialect of Korean. None of the speakers reported any history of speech or hearing disorders.

2.2 Materials

Eight test sentences were used as the primary source of the experiment. The test sentences were designed in the following way. First, they have the basic structure $[[noun_1]_{NP}$-NOM $[[[noun_2]$-GEN $noun_3]_{NP}$-ACC $verb]_{VP}]$, in which the appearance of each case marker is optional. There are three optional case markers to examine, and accordingly, there are eight logically possible cases to consider.

Second, the test sentences were constructed based on the idea that LSV is a cue for an AP. In this view, voicing of an intervocalic lenis stop is critical in determining its position in an AP: if the lenis stop is voiced, it cannot be AP-initial; it can be so only if it is voiceless. To see if Case Drop has any effect on the application of LSV and on the AP structure, all the words in the test sentences are designed to begin with a lenis stop, preceded and followed by a vowel (except the sentence-initial word, which is invariably AP-initial). The format and the complete list of the test sentences used in the experiment are listed below.

(3) Format:
yəŋi-(ka) toŋmi-(ɨy) tari-(lɨl) tɨ-ni
Youngi-(NOM) Dongmi-(GEN) leg-(ACC) lift-Int(errogative)

(4) Test sentences:

a.	yəŋi-ka	toŋmi-ɨy	tari-lɨl	tɨ-ni?	(NOM GEN ACC)
b.	yəŋi-ka	toŋmi	tari-lɨl	tɨ-ni?	(NOM Ø ACC)
c.	yəŋi-ka	toŋmi-ɨy	tari	tɨ-ni?	(NOM GEN Ø)
d.	yəŋi-ka	toŋmi	tari	tɨ-ni?	(NOM Ø Ø)
e.	yəŋi	toŋmi-ɨy	tari-lɨl	tɨ-ni?	(Ø GEN ACC)
f.	yəŋi	toŋmi	tari-lɨl	tɨ-ni?	(Ø Ø ACC)
g.	yəŋi	toŋmi-ɨy	tari	tɨ-ni?	(Ø GEN Ø)
h.	yəŋi	toŋmi	tari	tɨ-ni?	(Ø Ø Ø)

The three speakers were asked to read the test sentences five times, arranged in random order, at a natural and comfortable speed. The recordings were made at the SONUS laboratory, located at Seocho-dong, Seoul, using a microphone(Audio-Technica MB4000C) installed on Kay Elemetrics' Computerized Speech Lab (model 4300B). The sampling rate of the recorded data was set at 16,000 Hz.

2.3 Methodology

The recorded data were analyzed using Multi-Speech (model 3700, version 1.2). Waveforms, spectrograms and pitch tracks were created for each token sentence, and then voicing of the word-initial lenis stops and pitch, the two known major acoustic cues for the AP, were examined. In determining whether a given lenis stop is subject to LSV or not, I assumed with Silva (1992, 1998) that the following acoustic parameters are important for judging voicing: (i) the duration of stop closure, (ii) the percentage of closure that is voiced during stop closure, and (iii) the duration of aspiration. Each of these parameters were measured and compared for the word-initial lenis stop *t*, before and after Case Drop.

(5)	<u>before Case Drop</u>		<u>after Case Drop</u>
a. NON vs. Ø	yəŋi-ka [t]oŋmi	vs.	yəŋi [t]oŋmi
b. GEN vs. Ø	toŋmi-ɨy [t]ari	vs.	toŋmi [t]ari
c. ACC vs. Ø	tari-lɨl [t]ɨ-ni	vs.	tari [t]ɨ-ni

The measured values were subject to statistical analysis to see if the values prior to and after Case Drop were significantly different from each other. The longer the duration of closure and aspiration, and the shorter the duration of voicing during closure, the more it is likely to be voiceless. The more it becomes voiceless, the more it is likely to begin a new AP.

Pitch was then measured on the assumption that pitch plays a key role in determining prosodic structure (Jun 1993, 1998). Among the various pitch properties proposed for AP, I adopted in particular the following: (i) the pitch pattern LHLH is superimposed on the AP in the standard Seoul dialect of Korean, (ii) the pitch difference between H and L is greater across an AP boundary than within an AP, and (iii) the first H in an AP is in general lower than the second H[3] (see also Koo 1986). Based on such properties of AP, pitch was measured and compared, before and after Case Drop, to see if there is any significant effect of Case Drop on the pitch patterns.

3) Later, Jun (1998) weakens her position, accommodating Lee & Kim (1997)'s findings, stating that the relative height of the H tones can vary depending on speakers and the length of the AP.

3. Results and Discussion

3.1 Voicing

The results of the voicing analysis are shown in the three tables below. In Table 1, the values for the three acoustic parameters that determine voicing, measured before and after the drop of the nominative marker, *-ka* (yəŋi-ka [t]oŋmi vs. yəŋi [t]oŋmi), are compared. The mean phonetic values and standard deviation for each acoustic feature considered are given. The mean values are calculated for 20 tokens (4 test sentences, each with or without the nominative case, repeated five times), and compared via Student's t-tests performed at the significance level of 0.05. The t-values and the p-values are reported on the last column of each table.

Tables 1. *yəŋi-ka [t]oŋmi* vs. *yəŋi [t]oŋmi*

		yəŋi-ka [t]oŋmi	yəŋi [t]oŋmi	t (p)
		mean±s.d.	mean±s.d.	
Speaker 1	closure (ms)	42.15±7.18	34.03±4.61	3.619 (0.003)
	% voicing	3.87±10.6	20.48±28.8	-2.139 (0.049)
	aspiration (ms)	20.64±5.55	13.94±3.10	4.618 (0)
Speaker 2	closure (ms)	47.03±9.06	28.11±8.65	6.772 (0)
	% voicing	9.03±19.9	1.81±7.4	1.468 (0.159)
	aspiration (ms)	41.65±7.42	36.21±6.42	2.522 (0.021)
Speaker 3	closure (ms)	51.52±11.00	39.05±7.53	3.897 (0.001)
	% voicing	32.82±31.7	58.86±27.8	-3.474 (0.002)
	aspiration (ms)	30.54±8.91	25.32±9.17	1.957 (0.065)
1,2,3 Pooled*	closure (ms)	47.24±9.92	33.70±8.54	7.735 (0)
	% voicing	16.05±25.05	27.52±33.53	-2.021 (0.046)
	aspiration (ms)	31.68±11.27	25.96±11.24	2.690 (0.008)

* '1, 2, 3 Pooled' includes the combined data for speakers 1, 2, and 3.

The results reveal that within these speakers, all the values for the duration of stop closure and the duration of aspiration differ significantly depending on the presence or absence of the nominative case marker ($p < 0.05$) (except the values for the duration of aspiration for speaker 3, which is meaningful at a slightly lower significance level). That the values for these two parameters differ significantly is confirmed by the statistical analysis of the pooled data from speakers 1, 2, and 3, which suggests that the difference is meaningful at a high significance level.

The values for the percentage of voicing during stop closure, however, do not seem consistent across speakers. For speakers 1 and 3, the difference is judged to be significant

($p < 0.05$), and it thus appears that *t* in *yəŋi [t]oŋmi* becomes more voiced than *t* in *yəŋi-ka [t]oŋmi*; but for speaker 2, the difference is not significant ($p = 0.159$). The statistical analysis performed on the pooled data might be suggestive on this matter, which shows that the difference between the values is significant ($p = 0.046$). In all, then, *t* in *yəŋi-ka [t]oŋmi* seems to be longer in the duration of stop closure and aspiration, and smaller in the percentage of voicing during closure, and hence less likely to be voiced than *t* in *yəŋi [t]oŋmi*.

(6) less voiced   more voiced
    yəŋi-ka [t]oŋmi < yəŋi [t]oŋmi

Unlike Case Drop that applies to the nominative marker, the drop of the genitive case marker, *-ɨy*, does not seem to affect voicing of the following stop consonant in any meaningful way. Table 2 below, from which such a conclusion is drawn, shows the statistical comparison between two [t]'s in *toŋmi-ɨy [t]ari* vs. *toŋmi [t]ari*. Both within and across speakers, and also in the pooled data, we do not find any significant differences between voicing of the two [t]'s, measured before and after the drop of the genitive marker.

Table 2. *toŋmi-ɨy [t]ari* vs. *toŋmi [t]ari*

		toŋmi-ɨy [t]ari	toŋmi [t]ari	t (p)
		mean±s.d.	mean±s.d.	
Speaker 1	closure (ms)	36.67±8.75	35.92±7.27	0.259 (0.799)
	% voicing	11.45±21.9	3.60±10.0	1.345 (0.199)
	aspiration (ms)	17.66±5.34	21.27±6.13	-1.948 (0.07)
Speaker 2	closure (ms)	35.27±6.39	33.94±8.95	0.465 (0.647)
	% voicing	12.63±21.5	10.65±20.0	0.288 (0.777)
	aspiration (ms)	40.39±10.19	42.42±6.25	-0.792 (0.491)
Speaker 3	closure (ms)	41.37±6.68	38.31±8.16	1.233 (0.233)
	% voicing	26.28±23.7	46.05±29.0	-2.668 (0.015)
	aspiration (ms)	30.67±9.45	23.97±8.02	3.341 (0.003)
1,2,3 Pooled	closure (ms)	37.85±7.60	36.07±8.28	1.186 (0.238)
	% voicing	17.17±23.07	21.28±28.47	-0.839 (0.403)
	aspiration (ms)	30.42±12.6	29.79±11.72	0.275 (0.784)

Finally, Table 3 below shows how voicing is affected by the drop of the accusative marker, *-lɨl*. The values for the duration of closure and aspiration for each of the speakers are significantly different between two [t]'s in *tari-lɨl [t]i-ni* and *tari [t]i-ni* (p

< 0.05) (except for the duration of aspiration for speaker 1). With speakers 1, 2, and 3 pooled together, all the values including the percentage of voicing during closure seem to differ significantly. Specifically, [t] in *tari [t]ɨ-ni*, the one that undergoes the drop of the accusative marker, is longer in the duration of closure and aspiration, and smaller in the percentage of voicing than [t] in *tari-lɨl [t]ɨ-ni*. The former [t] in *tari [t]ɨ-ni*, therefore, is less likely to be voiced than the latter [t] in *tari-lɨl [t]ɨ-ni*.

Table 3. *tari-lɨl [t]ɨ-ni* vs. *tari [t]ɨ-ni*

		tari-lɨl [t]ɨ-ni	tari [t]ɨ-ni	t (p)
		mean±s.d.	mean±s.d.	
Speaker 1	closure (ms)	39.71±9.07	46.59±6.11	-2.538 (0.023)
	% voicing	25.98±35.1	29.25±36.0	-0.265 (0.795)
	aspiration (ms)	18.66±5.55	18.80±3.92	-0.100 (0.921)
Speaker 2	closure (ms)	35.83±8.20	41.90±9.63	-2.322 (0.031)
	% voicing	37.52±39.3	6.71±13.1	3.241 (0.004)
	aspiration (ms)	22.66±8.63	36.55±13.19	-4.110 (0)
Speaker 3	closure (ms)	37.24±8.14	44.51±10.65	-2.951 (0.008)
	% voicing	74.05±19.0	63.33±30.2	1.192 (0.248)
	aspiration (ms)	10.21±2.32	18.79±6.20	-5.995 (0)
1,2,3 Pooled	closure (ms)	37.44±8.43	44.17±9.22	-4.032 (0)
	% voicing	47.27±37.70	33.37±36.31	1.987 (0.049)
	aspiration (ms)	17.07±8.08	25.13±12.30	-4.101 (0)

(7) <u>more voiced</u> <u>less voiced</u>
tari-lɨl [t]ɨ-ni > tari [t]ɨ-ni

Since it is assumed that LSV applies within an AP, but not across an AP boundary, voiced stops in the intervocalic environment are expected to appear in an AP-internal position. To put it in a gradient setting, the more voiced a given lenis stop is, the more likely it appears in an AP-internal position; the less voiced it is, the more likely it appears at the edge (i.e. the initial position) of an AP. Therefore, it is possible to interpret the above results to suggest that rephrasing occurs in the following patterns concomitant with the drop of the nominative and accusative case markers.[4)] (AP's are

4) This may have a significant bearing on the view that the prosodic structure is dependent on the syntactic structure (Cho 1987, 1990, Silva 1991, 1998, Kang 1992. among others). In this view, any changes in the prosodic structure presupposes changes in the syntactic structure; hence, if Case Drop induces changes in the prosodic structure, it would mean that Case Drop also brings about changes in the syntactic structure.

represented within braces.)

(8) <u>before Case Drop</u> <u>after Case Drop</u>

a. {yəŋi-ka} {[t]oŋmi} ⇨ {yəŋi [t]oŋmi}

b. {tari-lɨl [t]ɨ-ni} ⇨ {tari} {[t]ɨ-ni}

Let us now consider how we interpret the AP structure and rephrasing above. It has been reported that AP's depend on the number of syllables, and AP's with the size of three to four syllables are more common than those with two or five syllables (Chung, *et al.* 1996, Jun 1998). The AP's in (8b), then, all resulting in two or five syllable AP, do not seem to be natural, unlike those in (8a), which conform quite well to these findings on the size of the AP's. We can understand at least why the AP *{tari-lɨl [t]ɨ-ni}* in (8b) is permitted as it is, considering the semantic role of the accusative marker *-lɨl* and its effect on prosody. It has been often noted that the accusative marker is realized to serve a special semantic function: the accusative marker conveys the information that the speakers and the listeners do not share, and by doing so, it topicalizes or brings into focus the word to which it attaches (H.S. Shin 1982, H.S. Lee & Thompson 1989, K.-H. Kim *et al.* 1999). The focused element then has a significant effect on the prosodic structure, according to Jun (1993), in such a way that the focused element is grouped with all following material up to the Intonational Phrase boundary into a single AP. In the present case, therefore, *tari-lɨl*, in which the accusative marker is realized, is grouped with the following word, *tɨ-ni*, to form a single AP.

So far, we have seen, based on the voicing analysis, that the prosodic structure is significantly affected by dropping the nominative and the accusative markers. In the next section, we will examine whether the AP structure and rephrasing in (8) follow the pitch-based definition of AP.

3.2 Pitch

In the previous section, we saw that the drop of the nominative and accusative markers significantly affects the application of LSV to the plain stop consonant that follows the deleted case marker. Since the AP is supposed to serve as the domain of LSV, it was then concluded that Case Drop in these cases induces changes in the AP structure (cf. (8)). We will henceforth examine whether such structural changes can also be justified by the pitch-based definition of AP.

According to Jun (1993, 1998), an AP is supposed to have the following pitch- related properties.

(9) Properties of AP

a. The underlying tonal pattern of AP is LHLH.

b. When an AP is composed of fewer than four syllables, the initial LH, or just the first H, or just the medial L can be undershot.

c. When there are more than four syllables in an AP, the first H tone and the medial L tone are fixed on the second and the penult syllables, respectively, and the intervening syllables are interpolated.

d. When an AP begins with either an aspirated or a tense consonant, the initial tone is realized as H, rather than L.

e. The medial L lowers as the number of syllables within an AP increases.

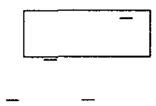
f. The falling slope from H to L is negatively correlated with the number of syllables within an AP.

g. The initial H, when realized, is in general not as high as the final H.[5]

h. The falling slope from H to L across an AP boundary is steeper than that within an AP.

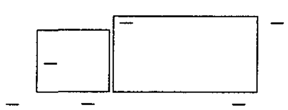
Among these, we focus on (9a), (9g) and (9h), of which the latter two properties are schematized below in (10) and (11), respectively. In (11), in particular, it is shown that H falls to L more radically across an AP boundary than within an AP.

(10) { σ1 σ2 σ3 σ4 }



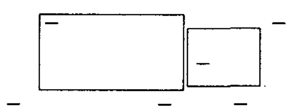
L H L H

(11) a. { σ1 σ2 σ3 σ4 } { σ5 σ6 }



L H L H L H

b. { σ1 σ2 } { σ3 σ4 σ5 σ6 }



L H L H L H

5) Lee & Kim (1997), based on the observation that the initial H tones in five syllable AP's are often higher than the second H tones, argue that the relative height of the H tones varies depending on the length. Such findings are not so well confirmed by the results of the present experiment: as we will see in figures 9 through 12, the initial H tones in {*yəŋi toŋmiɨy*} are higher than the second H tones. The matter does not seem to be conclusive, however, since they deal with the AP's that are composed of one phonological word but here we concern the AP's that consist of two phonological words.

These properties of AP predict that the AP structures in (8) must show certain pitch patterns. First of all, the AP's, whether they undergo restructuring or not, must all exhibit the general pitch patterns of LHLH, as stipulated in (9a). This seems to be supported by the pitch analyses of *yəŋi-(ka) toŋmi-(ɨy)* and *tari-(lɨl) tɨ-ni*. In *yəŋi-(ka) toŋmi-(ɨy)*, the first H tone is realized on *-ka* of *yəŋi-ka* when the nominative marker is realized, or *i* of *yəŋi* when the nominative marker drops; and the second H tone on the genitive marker *-ɨy* of *toŋmi-ɨy* when the genitive marker remains, or *i* of *toŋmi* when the genitive marker drops. The realization of LHLH on *yəŋi-(ka) toŋmi-(ɨy)* is well exhibited in the following figures. In each figure, the upper two lines represent the pitch values measured on the vowels of *yəŋi toŋmi-ɨy* (solid lines) and *yəŋi toŋmi* (dotted lines), and the lower two lines show the pitch values for *yəŋi-ka toŋmi-ɨy* (solid lines) and *yəŋi-ka toŋmi* (dotted lines).

Figures 1-4. Pitch values of *yəŋi-(ka) toŋmi-(ɨy)*

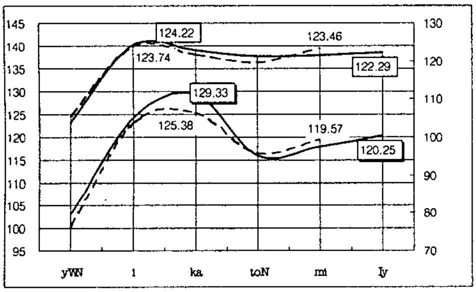


Figure 6. Speaker 1

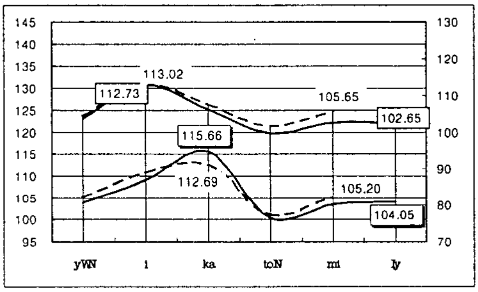


Figure 7. Speaker 2

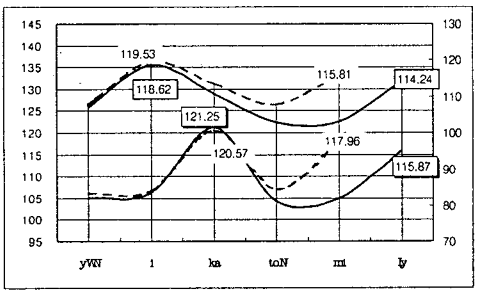


Figure 8. Speaker 3

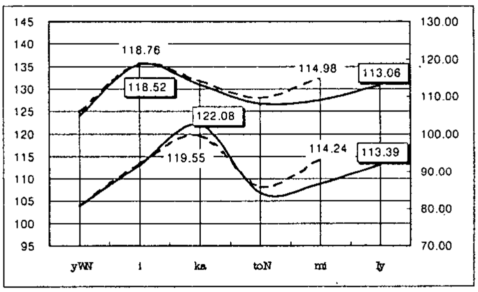


Figure 9. Speakers 1, 2, 3 Pooled

We can also observe that the pitch pattern LHLH realizes on *tari-(lɨl) tɨ-ni*: it appears that the first H tone is placed on the accusative marker *-lɨl* in *tari-lɨl tɨ-ni* when the accusative marker realizes, or on *ri* in *tari tɨ-ni* when the accusative marker drops; the second H tone is on the interrogative marker *-ni* across the board, well beyond the expected range probably due to the boundary tone H%. Such pitch patterns are shown in the following figures, where the pitch values for *tari-lɨl tɨ-ni* (solid lines) and *tari tɨ-ni* (dotted lines) are compared.

Figures 5-8. Pitch values of *tari-(lɨl) tɨ-ni*

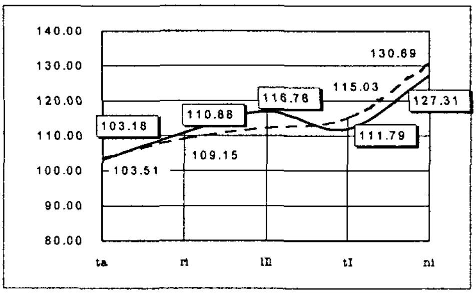


Figure 10. Speaker 1

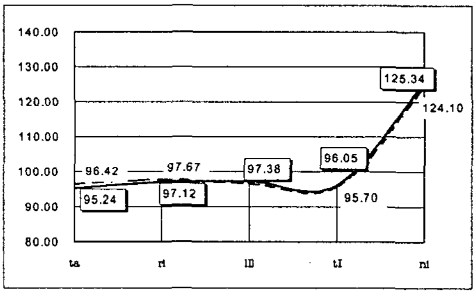


Figure 11. Speaker 2

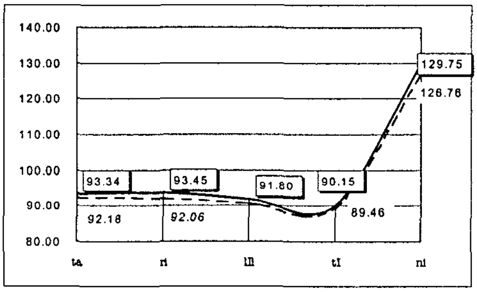


Figure 12. Speaker 3

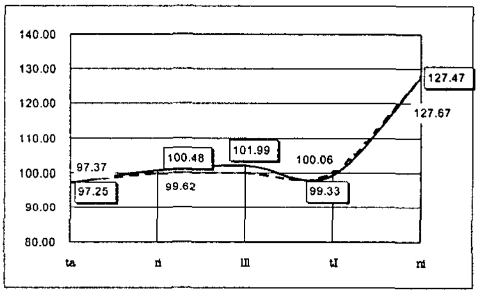


Figure 13. Speaker 1, 2, 3 Pooled

Another type of pitch pattern is predicted by the structural changes in (8) based on (9g). In (8a), it was suggested that two separate AP's are rephrased into one AP by dropping the nominative marker *-ka.*, i.e. *{yəŋi toŋmi-(ɨy)}*. According to (9g), the first H tone in an AP is lower than the second H tone; thus, it is predicted that in *{yəŋi toŋmi-(ɨy)}*, the H tone on *i* of *yəŋi* is lower than that on *mi* or *-ɨy* of *toŋmi-(ɨy)* (see (12a)). Further, if we extend (9g), it could be interpreted to mean that in the cases where two separate AP's do not coalesce, the last H tone of the first AP is *not* lower than the first H tone of the second AP. In the present case, it is possible to say that in *{yəŋi-ka} {toŋmi-(ɨy)}*, the H tone on *-ka* of the first AP is higher than the H tone on *-ɨy* or *mi* of the second AP (see (12b)), and similarly, (ii) in *...toŋmi-(ɨy)} {tari-(lɨl)...*, the H tone on *-ɨy* or *mi* of the first AP is higher than the H tone on *-lɨl* or *ri* of the second AP[6] (see (13)). (Below the syllables on which the H tones are realized are represented in the brackets.)

6) For the form prior to the case drop of the accusative marker, we have seen that the voicing analysis suggests the AP structure of *{tari-lɨl tɨ-ni}*. Here we cannot attribute the lower H tone on *-lɨl* to the AP property on the relative height of the H tones, because the boundary tone H% is assigned on the interrogative marker *-ni*.

(12) {yəŋi-ka} {toŋmi-(ɨy)} {tari... ⇨ {yəŋi toŋmi-(ɨy)} {tari... (8a)....

a. *i* is lower than *mi* in *{yəŋ[i] toŋ[mi]}*.

i is lower than *ɨy* in *{yəŋ[i] toŋmi-[ɨy]}*.

b. *ka* is higher than *mi* in *{yəŋi-[ka]} {toŋ[mi]}*.

ka is higher than *ɨy* in *{yəŋi-[ka]} {toŋmi-[ɨy]}*.

(13) ...toŋmi-(ɨy)} {tari-lɨl tɨ-ni} ⇨ ...toŋmi-(ɨy)} {tari} {tɨ-ni} (8b)

a. *ɨy* is higher than *lɨl* in *...toŋmi-[ɨy]} {tari-[lɨl]....*

mi is higher than *lɨl* in *...toŋ[mi]} {tari-[lɨl]....*

b. *ɨy* is not lower than *ri* in *toŋmi-[ɨy]} {ta[ri]}*.

mi is not lower than *ri* in *toŋ[mi]} {ta[ri]}*.

The results of the pitch analysis, however, indicate that not all the predictions above are borne out. As we see in the following figures 9 through 16, the results are quite compatible with (12b) and (13ab), but not with (12a). Contrary to the prediction, the H tone on *i* of *yəŋi* is rather higher than the H tone on *-ɨy* or *mi* of *toŋmi-(ɨy)*.

Figures 9-12. Pitch values of *-ka*, *i* in *yəŋi-(ka)* vs. *-ɨy*, *mi* in *toŋmi-(ɨy)*

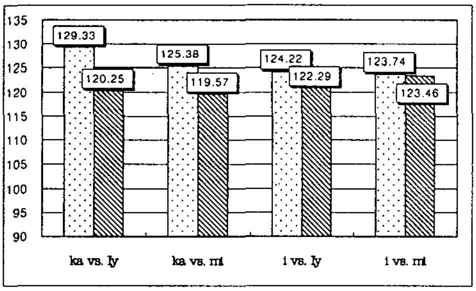


Figure 14. Speaker 1

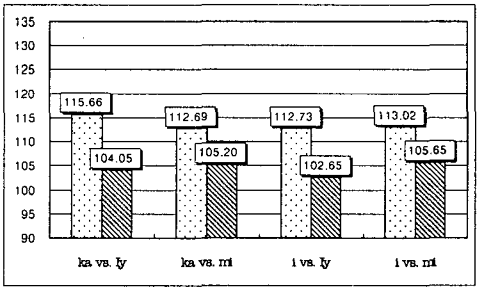


Figure 15. Speaker 2

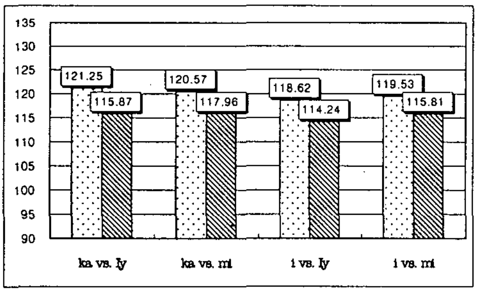


Figure 16. Speaker 3

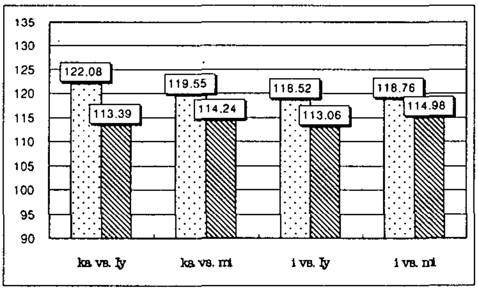


Figure 17. Speakers 1, 2, 3 Pooled

Figures 13-16. Pitch values of *-ɨy*, *mi* in *toŋmi-(ɨy)* vs. *-lɨl*, *ri* in *tari-(lɨl)*

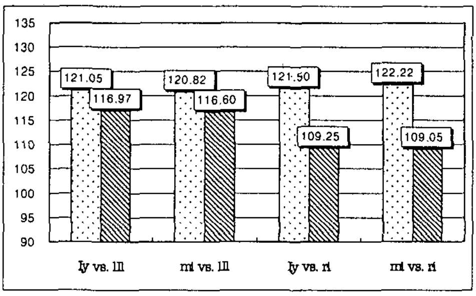


Figure 18. Speaker 1

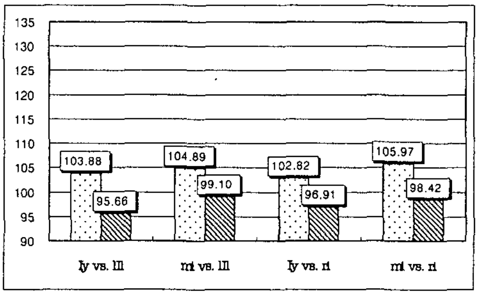


Figure 19. Speaker 2

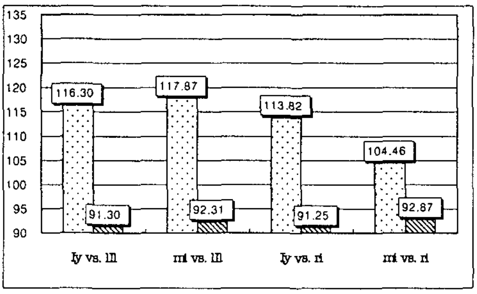


Figure 20. Speaker 3

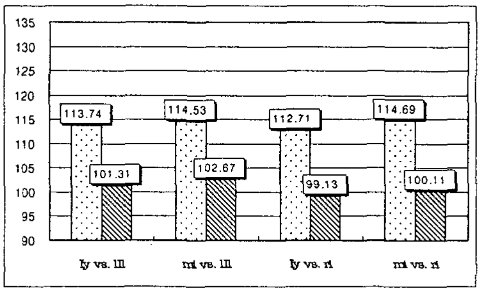


Figure 21. Speakers 1, 2, 3 Pooled

The last pitch patterns that we will examine are those which are predicted by the property (9h) on the degree or the depth of the falling slope from H to L. According to (9h), the falling slope from H to L across an AP boundary is steeper than that within an AP. Given a balanced time interval between each tone, this means that the pitch difference from H to L across an AP boundary is greater than that within an AP. Thus, in *{yəŋi toŋmi-(ɨy)} {tari...*, which results from the drop of the nominative marker, the tonal difference between the H tone on *mi* or *-ɨy* of *toŋmi-(ɨy)* and the L tone on *ta* of *tari* (across an AP boundary) is greater than that between the H tone on *i* of *yəŋi* and the L tone on *t* of *toŋmi-(ɨy)* (within an AP) (see (14)). And similarly, in *...toŋmi-(ɨy)} {tari-lɨl tɨ-ni}*, which corresponds to the form prior to the drop of the accusative marker, the pitch difference between *mi* or *-ɨy* of *toŋmi-(ɨy)* and *ta* of *tari* (across an AP boundary) is greater than that between *-lɨl* of *tari-lɨl* and *tɨ* of *tɨ-ni* (within an AP) (see (15)).

(14) <u>{yəŋi-ka} {toŋmi-(ɨy)}</u> {tari... ⇨ <u>{yəŋi toŋmi-(ɨy)}</u> {tari... (8a)

a. *[i toŋ]* differs less than *[mi ta]* in *{yəŋ[i toŋ][mi} {ta]ri....*

b. *[i toŋ]* differs less than *[ɨy ta]* in *{yəŋ[i toŋ]mi-[ɨy} {ta]ri....*

(15) ...toŋmi-(ɨy)} {tari-lɨl tɨ-ni} ⇨ ...toŋmi-(ɨy)} {tari} {tɨ-ni} (8b)

a. *[mi ta]* differs more than *[lɨl tɨ]* in *...toŋ[mi} {ta]ri-[lɨl tɨ]-ni}.*

b. *[ɨy ta]* differs more than *[lɨl tɨ]* in *...toŋmi-[ɨy} {ta]ri-[lɨl tɨ]-ni}.*

The following tables, Tables 4 and 5, show how the results of the pitch analysis would support the predictions. In Table 4, the mean pitch differences between *i* and *toŋ* in *{yəŋ[i toŋ]mi}* are compared with those between *mi* and *ta* in *toŋ[mi} {ta]ri*, and between *-ɨy* and *ta* in *toŋmi-[ɨy} {ta]ri*. In Table 5, the mean pitch differences between *mi* and *ta* in *toŋ[mi} {ta]ri*, and between *-ɨy* and *ta* in *toŋmi-[ɨy} {ta]ri*, are compared with those between *-lɨl* and *tɨ* in *{tari-[lɨl tɨ]-ni}*. The pitch differences are calculated by the subtraction of the preceding H value from the following L value. The mean pitch differences are compared via Student's t-tests performed at the significance level of 0.05. The t-values and the p-values are reported on the last column of each table.

Table 4. HL difference: *{yəŋ[i toŋ][mi} {ta]ri...* and *{yəŋ[i toŋ]mi-[ɨy} {ta]ri...*

	mean±s.d.	mean±s.d.	t (p)
	{yəŋ[i toŋ]mi}	toŋ[mi} {ta]ri	
Speaker 1	-3.61±3.44	-17.90±4.89	9.562 (0)
Speaker 2	-11.65±4.59	-8.08±4.15	-2.574 (0.014)
Speaker 3	-13.88±5.62	-23.17±4.97	5.536 (0)
1,2,3 Pooled	-10.15±6.31	-16.28±7.97	4.513 (0)
	{yəŋ[i toŋ]mi}	toŋmi-[ɨy} {ta]ri	
Speaker 1	-3.61±3.44	-18.21±2.63	13.495 (0)
Speaker 2	-11.65±4.59	-8.56±3.34	-2.432 (0.020)
Speaker 3	-13.88±5.62	-23.25±3.69	6.230 (0)
1,2,3 Pooled	-10.15±6.31	-16.56±7.12	5.046 (0)

Table 5. HL difference: *...toŋ[mi} {ta]ri-[lɨl tɨ]-ni}* and *...toŋmi-[ɨy} {ta]ri-[lɨl tɨ]-ni}*

	mean±s.d.	mean±s.d.	t (p)
	toŋ[mi} {ta]ri	{tari-[lɨl tɨ]ni}	
Speaker 1	-17.90±4.89	-4.99±4.65	-7.652 (0)
Speaker 2	-8.08±4.15	-1.20±3.34	-6.047 (0)
Speaker 3	-23.17±4.97	-1.65±2.33	-17.528 (0)
1,2,3 Pooled	-16.28±7.97	-2.45±3.67	-11.802 (0)
	toŋmi-[ɨy} {ta]ri	{tari-[lɨl tɨ]ni}	
Speaker 1	-18.21±2.63	-4.99±4.65	-9.903 (0)
Speaker 2	-8.56±3.34	-1.20±2.95	-7.394 (0)
Speaker 3	-23.25±3.69	-1.65±2.33	-22.126 (0)
1,2,3 Pooled	-16.56±7.12	-2.45±3.67	-13.185 (0)

The statistical analysis in Table 5 shows that prediction (15) is borne out throughout the speakers: the HL differences across an AP boundary (i.e. between *mi* and *ta* in *toŋ[mi ta]ri*, and between *-ɨy* and *ta* in *toŋmi-[ɨy ta]ri*) are significantly greater than the HL differences within an AP (i.e. between *-lɨl* and *tɨ* in *tari-[lɨl tɨ]ni*) ($p < 0.001$). Table 4 shows, however, that the prediction (14) is subject to speaker variation. For speaker 1 and speaker 3, it is true that the HL difference across an AP boundary (i.e. between *mi* or *-ɨy* and *ta* in *toŋmi-(ɨy) tari*) is significantly greater than the HL difference within an AP (i.e. *i* and *toŋ* in *yəŋ[i toŋ]mi*) ($p < 0.001$); but for speaker 2, the opposite seems to hold true.

To summarize, since the AP's are supposed to have certain properties related to pitch, the changes in AP structure induced by Case Drop (8) make certain predictions. We have examined in this section how such predictions are borne out, centering on various pitch analyses performed on the test sentence *yəŋi-(ka) toŋmi-(ɨy) tari-(lɨl) tɨ-ni*. The predictions and the results we have obtained are summarized below.

(16)	Predicted	Actual
a.	*i* is lower than *mi* in *{yəŋi toŋmi}*.	no
	i is lower than *ɨy* in *{yəŋi toŋmi-ɨy}*.	no
b.	*ka* is higher than *mi* in *{yəŋi-[ka]} {toŋ[mi]}*.	yes
	ka is higher than *ɨy* in *{yəŋi-[ka]} {toŋmi-[ɨy]}*.	yes
c.	*ɨy* is higher than *lɨl* in *...toŋmi-ɨy} {tari-lɨl....*	yes
	mi is higher than *lɨl* in *...toŋmi} {tari-lɨl....*	yes
d.	*ɨy* is higher than *ri* in *...toŋmi-ɨy} {tari}*.	yes
	mi is higher than *ri* in *...toŋmi} {tari}*.	yes
e.	*[i toŋ]* differs less than *[mi ta]* in *{yəŋi toŋmi} {tari....*	speaker variation
	[i toŋ] differs less than *[ɨy ta]* in *{yəŋi toŋmi-ɨy} {tari....*	speaker variation
f.	*[mi ta]* differs more than *[lɨl tɨ]* in *...toŋmi} {tari-lɨl tɨ-ni}*.	yes
	[ɨy ta] differs more than *[lɨl tɨ]* in *...toŋmi-ɨy} {tari-lɨl tɨ-ni}*.	yes

In all, the pitch properties of AP that we have considered are not exactly as predicted by the AP structure and rephrasing in (8). Other than the general pitch pattern of AP's being LHLH, we could not draw any consistent conclusion from the examination of the relative height of the H tones (cf. (9g)), or from the comparison of the HL differences across an AP boundary and within an AP (cf. (9h)). Faced with these results, we could speculate that this is either because the two pitch properties of AP that we have examined, (9g) and (9h), are not decisive enough to hold for all data and speakers, or because the idea that the application of LSV hinges on the AP structure, on which the AP structure and rephrasing in (8) is based, is not correct to begin with. Touching on this matter, however, is beyond the scope of this paper and I will leave the study of this issue for future research.

4. Conclusion

In this paper we have investigated how Case Drop correlates with the prosodic structure. Adopting the idea that LSV applies within the domain of an AP, we have performed a voicing analysis on the intervocalic lenis stop consonants before and after Case Drop. The statistical analysis reveals that among the three case markers considered (i.e. the nominative, accusative, and genitive markers), the drop of the nominative and accusative markers significantly alters voicing of the lenis stops that follow the case markers, and accordingly, changes the AP structure. By dropping the nominative marker, the lenis stop is more likely to be voiced, and hence more likely to be AP-internal. By dropping the accusative marker, on the other hand, the opposite seems to hold: the following lenis stop is more likely to be voiceless, and accordingly more like to be AP-initial. Then, assuming the pitch properties of AP proposed by Jun (1993, 1998), we have carried out a pitch analysis to verify the AP structure and rephrasing suggested by the voicing analysis. We have found that the AP structure enforced by LSV does not always coincide with the AP structure imposed by the pitch analysis.

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