# Relation between Focus and Accent in Standard Chinese

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*Abstract*—**The present study adopts the acoustic experiment to investigates the corresponding relations between *focus* and *accent* in Standard Chinese (Hereinafter, SC). The research deals with the question from three aspects: (i) focus scope vs. accent domain; (ii) numbers of focus vs. numbers of accents; (iii) focus without accent vs. accent without focus. Results have demonstrated that the focus scope and accent domain shows highly symmetry relation in the way that all the items within the focus scope contribute to the realization of accent. Specifically, the *L* and *H* tonal targets of each syllable are raised significantly. However, the focus and accent exhibits non-symmetry relation from the perspective of *numbers*, i.e., the number of accent is less than the number of focus, and, only the rightmost item can realize accent in multiple focus environment. Further, like English, SC exists the phenomenon that focus is not always signaled by accent and the accent is not always associated with focus.**

*Keywords-focus; accent; relations; Standard Chinese*

## I. INTRODUCTION

It is generally accepted that sentence accentuation reflects in some way the intended *focus* of an utterance[1]. However, there remains a decades-old debate on the corresponding relations between *focus* and *accent*[2]. In previous literatures, Bolinger [3] argued that words in utterences can be 'focused' or 'highlighted' to singal newness, contrast, or some other special informativeness, and that focused words are marked by pitch accents. He maintains the vallidity of the *bidirectional relation* between focus and accent. In this view, if a word is focused, it is accented. His specific ideas on focus and accent were explored and developed in subsequent work on intonation, for example, Ladd [4] and Gussenhoven [5]. However, it is different from Bolinger, Ladd [4] and Gussenhoven [5] follow the 'Focus-to-Accent Theory (FTA)', which deals with the focus phenomenon by distinguishing the distribution of *focus* and the distribution of *accents*. That is, the linguistic description of focus and accent phenomenon involves two complementary but essentially separate aspects: a statement about which parts of an utterance are focused, and a statement about how a

given pattern of focus is conveyed by the location of the accent. They further propose that the speakers' decision about what to focus is subject to all kinds of contextual influences. However, onece the focused part of the utterance is specified, the accent pattern follows more or less automatically by language-specific rules or structural principles such as Gussenhoven's 'Sentence Accent Assignment Rule and 'Minimal Focus Rule'.

Following the path suggested by the FTA theory, the major goal of the present study is to examine the acoustic nature of various focuses conditions in SC with an emphasis on the relation between *focus* and *accent*. In order to approach the research aim, the study investigates the relationship of focus and accent from three aspects: (i) the scope of focus vs. the realization domain of accent, to invetigate the bearing units the accent in different focus environment; (ii) numbers of focuses vs. numbers of accents, to investigate the realizaion number of accent in mutiple focus conditions; (iii) focus without accent vs. accent without focus, to investigate if SC contains these pheonomena. Specifically, the study furhter addresses the following questions: (i) when the focus scope is enlarged, how the accents perform in the surface form? (ii) when the distribution places focuses are varied, how the accent distirbution changes accordingly? (iii) does the focus always signal by the accent? And, does the accent always associate with the focus? It is expected that the examination of focus may provide important evidence for cross-language investigation of focus phenomena, particularly, the relation between *focus* and *accent*.

## II. METHODOLOGH

The research aim of the experiment is to examine the acoustic pattern of accents induced by the various focus conditons. Utterances with the focus conditions, i.e., single focus, multiple focuses and difference kinds of focuses are designed in the experiment.

### A. Materials selection

With regard to the research aim of the experiment, the following factors were considered: word order, tonal combinations, segmental combinations, syntactic structure, and focus categories. Among these factors, segmental compositions and word order of target sentence are controlled to reduce the influences on the results. The means of offsetting the segmental effect is to select syllables with zero and voiced initials to compose the target words. And, these words are merged into the sentence with basic word

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[1] The term *focus* is meant the center of interest during the communication Crystal [1].

[2] The term *accent* is meant sentence accent, which is also referred to by some authors as stress (Crystal [1], Ladd [2]). The present study adopts the term *accent* to express the accentuation in the surface form.

order as 'SVO' in order to conterbalence the influence from various word orders. In this regard, the following segments, which fall into four sets: Subject =[Liu2 Min2(Liumin)]; Adverb=[Ling2 Chen2(early moring)]; Verb=[Ti2Ba2(elevate)]; Object=[Mao2 Lan2(Maolan)], were selected as the target constituents. The reasons that the tonal combinations of "tone2+tone2" were employed in each syntactic constituent is that it facilitates the observation of the entire range of $F_0$ change for one tonal feature and the pitch performance of the 'H-L' tone permutation in one sentence type. All the above components were merged into the following syntactic patterns of sentences that are classified into three types, i.e., SOV sentence, S(Ad)OV sentence, *lian…dou* structure[3], all of which are taken, in one way or another, as the classical structures to represent focus environment in SC (refer to, among others, Xu [6] and Fang [7]). The sample sentence is presented in (i)-(iii):

(i) Liu2 Min2 Ti2 Ba2 Mao2 Lan2 Le0.

   *liu min elevate mao lan le*

   (Liumin elvated Maolan)

(ii) Liu Min2 Ling2 Chen2 Ti2 Ba2 Mao2 Lan2 Le0.

   *liu min early morning elevate mao lan le*

   (Liumin elevated Maolan in the early morning)

(iii) Liu2 Min2 Lian2 Mao2 Lan2 dou1 Ti2 Ba2 Le0.

   *liu min even mao lan elevate le*

   (Liumin even elevated Maolan)

Various kinds and different numbers af focus conditions are approached through the adotation of *wh*-operaters. The *wh*-quesiton and focus conditons are listed in (a)-(k):

(a) Fa1 Sheng1 Le0 Shen2 Me0 Shi4?

   *happen le what case*

   (What happened?)

   Liu2 Min2 Ti2 Ba2 Mao2 Lan2 Le0[BF]4 .

(b) Shei Ti2 Ba2 Mao2 Lan2 Le0?

   *who elevate mao lan*

   (Who elevated Maolan?)

   Liu2 Min2[NF] Ti2 Ba2 Mao2 Lan2 Le0.

(c) Liu2 Min2 Ti2 Ba2 Shei2 Le0?

   *liu min elevate who le*

   (Liumin elevated whom?)

   Liu2 Min2 Ti2 Ba2 Mao2 Lan2[NF] Le0.

(d) Shei2 Zen3 Me0 Mao2 Lan2 Le0?

   *who do what mao lan le*

   Liu2 Min2 [NF]Ti2 Ba2 [NF]Mao2 Lan2 Le0.

(e) Liu2 Min2 Zen3 Me0 Shei2 Le0?

   *liu min do what whom*

   (Liumin do what to whom?)

(f) Fa1 Sheng1 Le0 Shen2 Me0 Shi?

   *happen le what case*

   (What happened?)

Liu Min2 Ling2 Chen2 Ti2 Ba2 Mao2 Lan2 Le0[+BF] .

(g) Shei2 Ling2 Chen2 Zen3 Me0 Shei2 Le0?

   *who early morning do what whom*

   (Who do what to whom in the early morning?)

Liu2Min2[+NF]Ling2Chen2 Ti2 Ba2[+NF] Mao2 Lan2[+NF] Le0.

(h) Liu2 Min2 Shen2 Me0 Shi2 Hou0 Zen3 Me0 Shei2 Le0?

   *liu min when do what whom*

   (When and where Liumin do what to whom?)

Liu2Min2 Ling2Chen2[+NF] Ti2 Ba2[+NF] Mao2 Lan2 [+NF] Le0.

(i) Shei2 Shen2 Me0 Shi2 Hou0 Zen3 Me0 Mao2 Lan2 Le0?

   *who when do what mao lan*

   (Who and when do what to Maolan?)

Liu2Min2[+NF]Ling2Chen2[+NF] Ti2 Ba2[+NF] Mao2 Lan2 Le0.

(j) Fa1 Sheng1 Le0 Shen2 Me0 Shi?

   *happen le what case*

   (What happened?)

   Liu2 Min2 Lian2 Mao2 Lan2 [Lian-Focus]dou1 Ti2 Ba2 Le0.

(k) Shei2 Lian2 Mao2 Lan2 Dou1 Ti2 Ba2 Le0?

   *who even mao lan all elevate le*

   Liu2 Min2[NF] Lian2 Mao2 Lan2 [Lian-F]dou1 Ti2 Ba2 Le0.

*B.  Recording procedure*

All the above-mentioned sentences were contained in the recording schema with two repetitions for each sentence. Eight SC speakers, four females and four males, aged 20-45, were recruited as the participants. These participants were divided into four groups, each containing two women or two men. The advantage of collecting sound samples from more than one person and more than one time is that the individual differences among speakers and the contingency of the data can be reduced to a minimum. The recording was conducted in a sound-proof booth at the Institute of Linguistics, Chinese Academy of Social Sciences. During the recording procedure, each *wh*-question and target sentence pair appeared on a computer screen in a random order. Within each group, one participant was asked to read the *wh*-questions and the other was inquired to read the target sentences as the answer to the questions. The participants were instructed to read the sentences as naturally as possible according to the context given, and were free to repeat them in case they considered their reading to be unnatural or not fluent. Each target sentence was typed on a separate sheet to avoid a list-reading effect and was read twice. After the presentation of the materials, the participants were asked to change their *asking-answering* roles. The analysis was performed on the tokens produced by all eight participants. Finally, we got 32 sampels for one target sentence for further statistical analyisis.

*C.  Data labeling and extraction*

All the sound files were annotated. The annotation is based on the following two steps: 1) All 'wav' files were segmented by automatic segmentation software, and then the syllable boundaries of each syllable were modified by hand; 2) the focus condition of each target sentence was labeled.

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3 In Chinese literatures, the '*lian…dou*' is considered to be the typical structures to mark focus (refer to Fang [7]). The selection of this formula is to observe the interaction of syntax-marked focus and the *wh*-question induced focus through which to explore the 'focus without accent' phenomenon.

4 The symbol of [BF] is taken to stand for the broad focus condition, and [NF] means the narrow focus and [Lian-F] indicates the *lian*-marked focus.

Research data was extracted and analyzed. The following steps were utilized: 1) the "PitchTier" file for each target sentence was modified automatically by praat script; 2) the extraction of $F_0$ data was based on PitchTier with the range of 10 points being assigned to each syllable; 3) the SPSS software program was adopted for obtaining the $F_0$ means from the eight participants; and 4) One-Way ANOVA was adopted to obtain the means of the data, and the Bonfrroni post hoc test was conducted to compare the significance of the data in different focus conditions.

### D. Measurement of $F_0$ data

$F_0$ was measured from $F_0$ contours plotted using the pitch tracker feature of the PitchTier files. $F_0$ values for the following set of points in the contour were obtained for each test-sentence: (i) $F_0$ contour (the overall $F_0$ movements), (ii) onset (the minimum and maximum pitch values), (iii) maximum (the highest $F_0$ point in the sentence), and (iv) final low (the lowest $F_0$ point in the last vowel). Additionally, the following points were also measured: (i) the H and L targets of the prominent element and (ii) the H or L target of the post-prominent and pre-prominent element. In every case, the H target was measured at the highest $F_0$ point. If an L target also existed, it was measured at the lowest $F_0$ point.

### III. ACCENT PATTERNS IN VARIOUS FOCUS CONDITIONS

This part mainly examines the corresponding relation between *focus* and *accent* in SC. The acoustic evidence is searched from three steps: (i) scope of focus vs. domain of accent, specifically, it mainly investigates the realization domain of accent when the focus scope is enlarged; (ii) numbers of focus vs. numbers of accents, it mainly discuses the acoustic pattern of accents induced by different numbers of focuses; (iii) focus without accent vs. accents without focus, it mainly examines if SC exists the fact that when focus is not signaled by accent and accent is not associated with focus.

### A. scope of focus vs. domain of accent

In this part, the study investigates the corresponding relations between *focus* and *accent* through the examination of acoustic performances of accents triggered by focuses with various scopes. The following Figure 1 illustrates the $F_0$ means of three focus conditions, i.e., broad focus, narrow focus on subject and narrow focus on object. This condition is described in the bottom part of the figure where BF stands for broad focus, NF-S means the focus is distributing on the subject item and NF-O is on the object. The top part of the X-Axis describes the content of each syllable in the sentence. The Y-Axis is the $F_0$ range (Unit: Hz) which is fixed from 110Hz-260Hz according to all the speakers' range. The target sentence here is always selected as "Liu2 Min2 Ti2 Ba2 Mao2 Lan2 Le0 (Liumin elevated Maolan)". The *wh*-operaters adopted here is in (a)-(c) as listed in part II. They are represented here: (a) Fa1 Sheng1 Le0 Shen2 Me0 Shi4? (b) Shei Ti2 Ba2 Mao2 Lan2 Le0? (c) Liu2 Min2 Ti2 Ba2 Shei2 Le0? Through the effect of question sentences of (b) and (c), the target sentence has a narrow focus on the two syllables of subject or object items, accordingly. Thus, the narrow focus

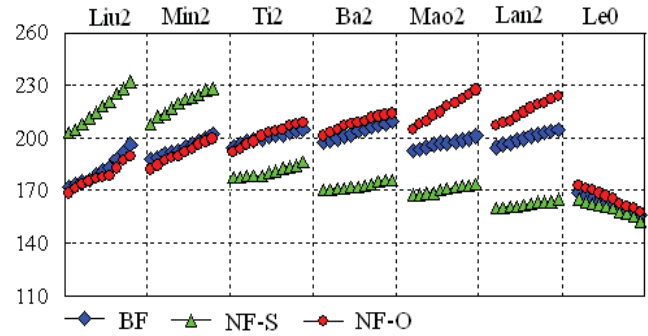scopes of these two sentences are two syllables or a syntactic item.



Figure 1. $F_0$ Menas of sentent with S and O as narrow focus items

With regard to the contour 'BF', there is no obvious $F_0$ prominence in the sentence. A clear difference exists in the contour 'NF-S', as it has a $F_0$ prominece on the subject item which is also the narrow focus bearing unit. As it is pointed out previously, the narrow focus bearing unit contains two syllables, and it can be obtained obviously that the two syllables contribute to the $F_0$ prominnce. Specifically, the *L* and *H* tones of each syllable are raised signifcantly. Further, the constituents reside after the subject constituent are lowered in the way that all the *L* and *H* tones are compressed sucessively. And, a closer examination of the post-focus constitents, they even lose their L-H tonal feature due to the compressive effect from the subject. One-Way ANOVA is conducted to test the significance of the above observations. Results of the Bonferroni post hoc text show that the maximu andminimum values of the subject in contour 'NF-S' are significantly different from 'BF' [$P_{max}$=0.00; $P_{min}$=0.01]. As for the constituents locating after subject, they are different from those ones in conour 'BF' with all the $P_{max}$<0; $P_{min}$<0. Similar case can be seen from contour 'NF-O', the narrow focus bearing unit, i.e., object, bears the $F_0$ prominece, specifically, the two syllables in the narrow focus scope contribute to the $F_0$ raising, and both *L* tones and the *H* tones are raised obviously. Bonferroni post hoc supports the observation in the way that $P_{max}$ and $P_{min}$ are different from those in the coutour 'BF'.

From the above aoustic analysis we can obtain that both coutour 'NF-S' and 'NF-O' have an accent corresponding with the narrow focus. From the examination of the bi-syllabic narrow focus constiuents, we find that all the syllabes in the narrow focus scope are servering as the accent bearing anchor. Therefore, the whole word is the accent bearing unit which is quite different from English (refer to, Pierrehumbert [8]). And, in English, although the whole word is focus, only the stressed syllabe serves as the accent bearing unit.

In the follwing part, the scope of narrow focus is enlarged to two syntactic items (that is four syllables) in order to investigate weather all the syllabes can participate in the realization of the accent. The resluts are presented in Figure 2. Within the figure, the Y-Axis and the top part of the X-Axis

share the idential content with Figure 1. And, at the bottom part of the graph, it also describes the focus conditions of the sentences. Specifcially, 'BF' is also to mark broad focus; 'NF-S-V' means the narrow focus bearing unit are two adjacent syntactic items, i.e., subject and verb. Also, the narrow focus constituents in contour 'NF-V-O' are verb and object items. The focus conditons are approached through *wh*-quesiotion as listed in (d)-(e) in II. A: (d) Shei2 Zen3 Me0 Mao2 Lan2 Le0? (e) Liu2 Min2 Zen3 Me0 Shei2 Le0?. Therefore, the narrow focus scope is enlarged to two syntactic constituents.
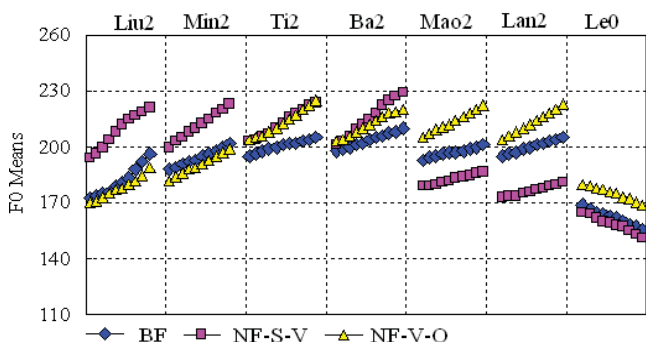


Figure 2.   $F_0$ Menas of sentent with S Vand VO as narrow focus items

It can be seen clearly that when the narrow focus scope is enlarged, all the syllable in the focus scope also contribute to the $F_0$ prominence. Specifically, in regard with contour 'NF-S-V', in comparison with 'BF', the $F_0$ prominence in 'NF-S-V' is locating on the adjacent constituents, i.e., subject and verb constituents. The *L* and *H* tones of the four syllables are all raised obviously. The $F_0$ of the other constituents such as object item is lowered by the compressive effect of narrow focus. One-Way ANOVA is conducted to text the significance of the above claims. And, Bonferroni post hoc text shows that the maximum and minimum values of the subject and verb items in contour 'NF-S-V' are significantly different from those in 'BF', with $P_{max}<0$ and $P_{min}<0$. As for contour 'NF-V-O', the narrow focus is designed on verb and object items. It can be obtained from the above figure that the $F_0$ prominence spreads from the very first syllabe to the last syllable in the focus scope. Also, all the *L* and *H* tones contribute to the prominence. And, the Bonferroni post hoc text supports this claim.

In this part the narrow focus scope is enlarged to two words (four syllalbes), and the above analysis exhibits that accent domain also corresponds with narrow focus scope. In previous study, Jia et. al [9] investigated the five-syllable focus cosntiuents in SC, and they prsoposed that the narrow focus scope is identical with the accent domain in the surface form. Therefore, the focus corresponds with the accents on the aspect of *scope* or *domain*.

*B.   numbers of focus vs. numbers of accents*

This part mainly deals with the relation between *focus* and *accent* from the aspect of *numbers*, that is, when the sentence has more than two foci, if the sentence can realize more than one accent.

Figure 3 contains three $F_0$ contours that have identical syllabic compositions: "Liu2 Min2 Ling2 Chen2 Ti2 Ba2 Mao2 Lan2 Le0" as described in (ii) in part II.A. The symbols 'Ad+V+O' and 'S+Ad+V' denote the narrow focus distributing on the adverb, verb, and object; and, subject, adverb, and verb components, respectively. 'BF' also stands for broad focus. The other content of X-Axis and Y-Axis are identical with Figure 1 and Figure 2. The focus environment is approached through three *wh*-operaters, that is, (f) Fa1 Sheng1 Le0 Shen2 Me0 Shi? (g) Shei2 Ling2 Chen2 Zen3 Me0 Shei2 Le0? (h) Liu2 Min2 Shen2 Me0 Shi2 Hou0 Zen3 Me0 Shei2 Le0?
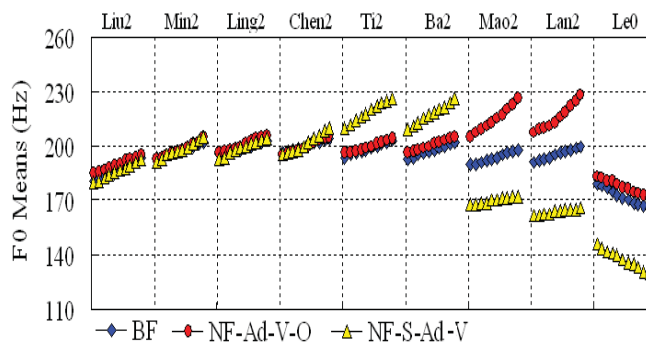


Figure 3.   $F_0$ Menas of sentent with AdVoand SAdV as narrow focus items

As for contour 'NF-Ad-V-O', although three focuses are distributing onto the adverb, verb and object constituents, the prominence only locates on the object item, specifically, it distributes on the rightmost focus bearing unit. The specific phonetic realization of the prominence is due to the raising of the *L* tones and *H* tones of the two syllables. In comparison with the 'BF' contour, the lowest and highest points of the object in 'NF-Ad-V-O' is significantly different from those in 'BF' contour. Results of Bonfrroni post hoc test support this observation, with $P_{max}<0$ and $P_{min}<0$. In regard with contour 'NF-S-Ad-V', it illustrates in the above figure that the verb constituent "ti2ba2" shows higher pitch register than the subject, adverb and the object constituents in the same sentence, concretely, both the *L* tones and the *H* tones of the verb constituents are raised by the narrow focus. However, the focus bearing units of the subject and adverb constituents show no obvious effect upon the pitch raising. In contrast to the former constituents, the object item gets pitch register lowering. Results of Bonfrroni post hoc test have shown that the pitch values of the verb constituent is significantly different from the one in 'BF' condition, with $P_{max}<0$ and $P_{min}<0$.

The realization of the prominence of multiple focuses is lead by the rightmost focus which indicates that only the right most items realizes accent in the surface form. Hence, the evidences suggest that the number of focus and the number of accent is *non-symmetry*. The number of accent is less than the number of narrow focus.

IV.   FOCUS WITHOUT ACCENT VS. ACCENTS WITHOUT FOCUS

Previous part III.B has demonstrated that multiple numbers of foci can not realize the same numbers of accents. This is an evidence for the argument of 'focus-without accent'.

In this part, further evidence is searched from the interaction of *Lian*-marked focus and the *wh*-question induced focus. The results are illustrated in Figure 4. Within the figure, the top part of X-Axis and the Y-Axis describe identical content with the previous figures. And, the symbols listed at the bottom part of the X-Axis are the focus conditions of the sentences in the figure, specifically, 'Lian-F' stands for the situation that the *Lian*-marked focus distributing on the verb item; 'NF-Lian-F' means the *wh*-question induced focus is located at subject item while the *Lian*-marked focus is also at the verb item. The intended focus environment is approach from the adoption of (j) Fa1 Sheng1 Le0 Shen2 Me0 Shi4? and (k) Shei2 Lian2 Mao2 Lan2 Dou1 Ti2 Ba2 Le0? The target sentence is always from 'Liu2 Min2 Lian2 Mao2 Lan2 [*Lian*-Focus] dou1 Ti2 Ba2 Le0'.
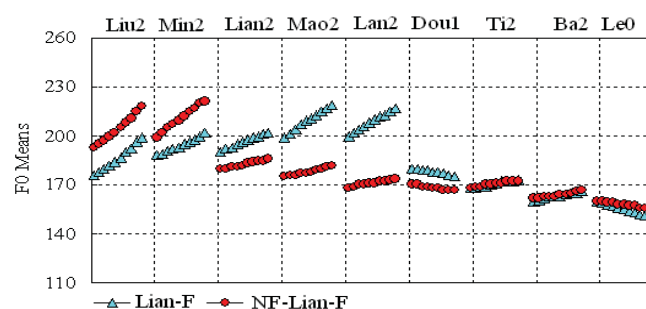


Figure 4.    $F_0$ Menas of sentent with V and SV as narrow focus items

In grammatical study of focus-marking structure, the *lian…dou* formula is considered to be the typical structure to mark focus, the focus constituent locates immediately after the marker *Lian* (refer to, Fang [7]). Examination of the above contour 'Lian-F', it contains an $F_0$ prominence corresponding with the focused item, which is the verb constituent 'Mao2Lan2 (Maolan)'. The domain of prominence also shows identical with the scope of focus. Specifically, within the focus scope, each syllable contributes to the realization of $F_0$ prominence, and the all the *L* and *H* tones are lifted significantly. The study further conducts One-Way ANOVA to compare the differences of the maximum and minimum pitch values within the contour. Results of Bonfrroni post hoc test demonstrates that the pitch values of the focus bearing unit 'Maoo2Lan2' is significantly different from other constituents, with $P_{max}<0$ and $P_{min}<0$. As for the contour 'NF-Lian-F', it contains double focus in the sentence, i.e., *Lian*-marked focus: distributing on 'Mao2Lan2', *wh*-induced focus: locating on 'Liu2Min2'. However, there is only one $F_0$ prominence associating with 'Liu2Min2', with all the *L* and *H* tones in the domain of prominence being raised clearly. Therefore, the focused item on the word 'Mao2Lan2' is *de-accented*. This result is further supported by the One-Way ANOVA analysis.

Therefore, the interaction of *Lian*-marked focus and *wh*-question triggered focus further demonstrate that focus is not always marked by accent in the surface form in SC. As for the phenomenon of 'accent-without-focus', Jia et. al [10] provide evidences from the sentences with multiple foci (especially, *shi…de* construction)and they proposed that accent is not always generated from focus in SC.

## V.    CONCLUDING REMARKS AND CROSS-LANGUAGE IMPLICATIONS

The present study systematically investigates the corresponding relations between *focus* and *accent* in SC. The research is conducted from three aspects: (i) the corresponding relation from the *scope* and *domain*, and results demonstrate that the focus scope is the accent realization domain; (ii) the corresponding relations of focus numbers and accent numbers, acoustic analysis shows that the numbers of focus and accent exhibit *non-symmetry* relations, and they do not equal to each other. The number of accent is less than the number of focus; (iii) in SC, there exists the phenomenon that focus is not always expressed by accent, and accent is not always associated with focus. The non-symmetry relations between focus and accent have provided important evidences from SC for the cross-language discussion on focus phenomenon. As for the case 'focus-without-accent', Ladd [2] proposed that focus is not always signaled by accent, other acoustic cues, such as, vowel quality may serve as the anchor to express focus in the surface form. In regard with 'accent-without-focus', Selkirk [11] deals with this situation from the discussion of single word utterance like 'California' and she found when the whole word is focused, the word has two accents. Hence, she proposed that the second accent can not be explained from focus.

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