문학석사 학위논문

A Research on Lexical Tones of Four Jin Chinese Varieties Spoken in the Former Fenzhou Prefecture

舊汾州府 四縣 晉語의 聲調에 對한 硏究

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舊汾州府 四縣 晉語의 聲調에 對한 硏究

초록(한국어)

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汾州府는 山西省 중부에 위치하며 明淸時代에 한 지방 행정구획 단위이었다. 이 府는 주로 汾陽, 平遙, 介休, 孝義라는 四縣으로 구성되었다. 언어학 상, 이 구역에는 陰平과 陽平이라는 두 성조가 구별되는지 여부에 따라 해당하는 등언선이 바로 경과한다. 기존 연구 중의 晉語에 대한 하위분류법은 이 등언선에 의거하여 山西 중부에서 사용되는 晉語는 상술 두 성조가 구별되지 않는 幷州片과 구별되는 呂梁片으로 나뉠 수 있다(侯精一, 1986; 沈明, 2006). 상술 四縣 중에서는 汾陽 방언은 呂梁片으로 분류되어 있어, 다른 三縣의 방언은 幷州片으로 분류되어 있다. 四縣은 역사, 문화, 지리 등 면에서 밀접한 관계를 맺고, 당지의 주민들이 같은 지역정체성을 공유하고, 방언 사이의 상호이해도도 높다. 그러므로, 四縣에서 사용되는 방언은 근대에 한 조상어 단계로부터 분열하여 나온 것일 가능성이 높다. 그러하나, 기존 분류법에 따른다면 四縣의 방언은 다른 그룹으로 분류되어 있다. 이러한 역사와 방언 분류 사이의 불일치성을 고려하여, 이 구역에서는 陰平과 陽平이 구별되는지 여부를 방언 부류의 기준으로 하는 유효성에 대하여서 궁금히 생각한다. 뿐만 아니라, 많은 晉語 방언에 대한 기술 자료가 부족하고 기존 자료 중에서도 이 구역의 성조 음운사에 관한 가치 있는 정보를 더욱 제공할 수 거의 없을 것 같다. 그러므로, 본 논문은 이 구역 방언의 성조 음운사의 재구에 목표를 두어서 (1)현지 조사, (2)통계학적 분석, (3)재구 등 세 방면에서 연구를 추진하였다.

첫 번째, 필자가 山西省 중부에 가서 여섯 縣의 晉語 방언을 대상으로 현지 조사를 실시하였다. 조사한 데이터를 보면 幷州片에서 陰平과 陽平이 구별되지 않는 현상은 이 두 성조가 합병된 결과일 것 같다. 平遙, 介休, 孝義 방언의 모어 화자들은 陰平과 陽平을 구별하지 못함에도 불구하고 이 두 성조는 음성 실현 면에서 미묘한 피치 차이가 측정되었다. 이러한 차이는 랜덤으로 나타나지 않을 것 같아, 두 성조가 아직 '근사 합류' 단계에 있는 것을 의미한다.

두 번째, 四縣 방언의 성조가 구별되는 차원이 무엇이지를 알아보기 위하여서 본 논문은 다차원척도분석을 실시하였다. 분석한 결과, 평균 피치(F0)와 기점의 높이는 성조 구별하는 기능을 다한다.

세 번째, 분 논문은 변화비교법(朱曉農, 2018)으로써 이 구역의 성조음운사의 재구를 시도하였다. 재구한 결과, 陽平과 去聲의 변화가 가장 일찍 언어 분열을 촉발하였을 것이다. 따라서 陰平과 陽平 사이의 합병은 비교적 늦은 단계에 생기었을 것이다. 이를 기준으로 하여, 汾陽의 방언을 다른 三縣 방언과 나누어 분류하는 것은 합리하지 않다.

본 논문은 구역성 성조음운사를 재구하는 한 시도이었다. 본 논문을 통하여서 晉語를 대상으로 하는 연구에 대한 이 방법의 유효성은 증명되었다.

핵심어: 晉語; 성조 변화; 성조변화비교법; 汾陽, 平遙, 介休, 孝義

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Chapter 1 Introduction

1.1 Overview of Jin group

1.1.1 Definition

The concept of 'Jin Chinese' (晉語), a group of Sinitic languages, was first formally proposed by Li Rong (1985). Li defined Jin group with a phonological feature and a geographic feature which could be summarized as follows[1].

> Jin Chinese refers to a group of varieties spoken in Shanxi Province (山西省) and the adjoining areas with *Ru* tone(s) (入聲) being preserved.
>
> —Li Rong (1985)

1.1.2 Profile

'Jin Chinese' is named after the abbreviation of Shanxi Province 'Jin (晉)', because the Jin-speaking area centers on Shanxi Province. Nevertheless, Jin varieties nowadays are also spoken by residents in the adjoining regions of neighboring provincial administrative divisions brought by several times of migration wave from Shanxi (Qian Zengyi, 2010). Therefore, in 'Jin group', so-called 'Jin' never refers to an administrative division or a historical geographic region. It is employed exclusively for a purpose of dialectal classification. According to the explanatory notes included in *Language Atlas of China, the 2nd Edition* (《中國語言地圖集 第 2 版》) (Institute of Linguistics, CASS, et al, 2012), Jin is spoken in the following areas.

(1) Shanxi Province: 82 cities/counties[2];

(2) Hebei Province (western) (河北省西部/冀西): 35 cities/counties affiliated to Shijiazhuang Prefecture (石家莊地區), Zhangjiakou Prefecture (張家口地區), Handan Prefecture (邯鄲地區), Xingtai Prefecture (邢臺地區);

(3) Henan Province (northern) (河南省北部/豫北): 18 cities/counties affiliated to Jiaozuo Prefecture (焦作地區), Xinxiang Prefecture (新鄉地區), Hebi Prefecture (鶴壁地區), Anyang Prefecture (安陽地區), and

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[1] Li's original statement in Chinese: "晉語指山西省及其毗連地區有入聲的方言".

[2] Jin-speaking areas almost cover all parts of the Shanxi Province. But local dialects of 28 cities/counties in southern Shanxi are classified into Central Plains Mandarin (中原官話), as *Ru* tones have been merged into other tonal categories in these dialects. They are also regarded as Mandarinized Jin varieties.

Jiyuan City (濟源市);

(4) Inner Mongolia Autonomous Region (central) (內蒙古自治區中部): 39 cities/counties/banners affiliated to Hohhot Prefecture (呼和浩特地區), Ordos Prefecture (鄂爾多斯地區), Ulanqab Prefecture (烏蘭察布地區), Baotou Prefecture (包頭地區);

(5) Shaanxi Province (northern) (陝西北部/陝北): 19 cities/counties affiliated to Yulin Prefecture (榆林地區), Yan'an Prefecture (延安地區).

The above-mentioned administrative divisions are populated by around 63.1 million residents, in which the number of Jin speakers is estimated to be 45.7 million.

1.1.3 Internal classification

Although there is basically no remarkable difference in either lexicon or grammar between Jin and Mandarin (官話), Jin varieties are featured by their unique phonology, especially in terms of lexical tones. It is assumed that Jin group has experienced a series of internal differentiation in phonology, which leads to low mutual intelligibility among the speakers inside this group. Primarily referring to the way that the four tones in Middles Chinese (hereafter MC), *Ping* (平聲), *Shang* (上聲), *Qu* (去聲), and *Ru* (入聲), have evolved into their reflexes in the present tonal inventory, Hou Jingyi (1986) proposed an internal classification for Jin group. According to Hou's classification, Jin group could be divided into eight clusters (片)[3]:

(1) Bingzhou cluster (幷州片): represented by Taiyuan (太原, the provincial capital of Shanxi);

(2) Lüliang cluster (呂梁片): represented by Lishi (離石);

(3) Shangdang cluster (上黨片): represented by Changzhi (長治), Jincheng (晉城);

(4) Wutai cluster (五臺片): represented by Xinzhou (忻州), Shuozhou (朔州);

(5) Zhanghu cluster (張呼片): represented by Zhangjiakou (張家口), Hohhot (呼和浩特, the regional capital of Inner Mongolia)

(6) Dabao cluster (大包片): represented by Datong (大同, the second large city in Shanxi), Baotou (包頭);

(7) Hanxin cluster (邯新片): represented by Handan (邯鄲), Xinxiang (新鄉);

(8) Zhiyan cluster (志延片): represented by Zhidan (志丹), Yanchuan (延川).

[3] These clusters are named after: (1) old place name; (2) mountain range name; (3) abbreviation of the representative cities.
(1) Bingzhou, Shangdang (the old name of Taiyuan and Changzhi, the central city of respective regions);
(2) Lüliang, Wutai;
(3) Zhanghu, Dabao, Hanxin, Zhiyan (see respective representative cities listed above).

Since varieties in the regions close to isoglosses usually exhibit transitional features, Hou also added some other shared segmental sound changes as part of the frame of reference, in order to ensure that the boundaries of each cluster could be sufficiently outlined. Hou's classification laid a meaningful foundation for further studies on the phonological history of Jin group. It is believed by the subsequent scholars to be a valid framework that could reflect the general phonological history of Jin group. In a later time, Shen Ming (2006) proposed a revised version which maintains the basic ideas of Hou (1986). Shen's revised version was later accepted in the *Language Atlas of China, the 2nd Edition*.

Table 1 (on the next page) shows the internal classification of Jin group with reference to the correspondence with the four tones in MC. Then, *Map 1* (on the page following that of *Table 1*), a map of Jin group which is included in the *Language Atlas of China, the 2nd Edition* (Institute of Linguistics, CASS, et al, 2012: B1-13), will follow.

From *Table 1* we could see that each cluster could be defined with several tonal mergers or splits. Among the eight clusters, Lüliang cluster and Shangdang cluster could be further divided into two sub-clusters (小片), as each sub-cluster has experienced distinct tonal evolution.

1.2 Research object, motivation, and goal

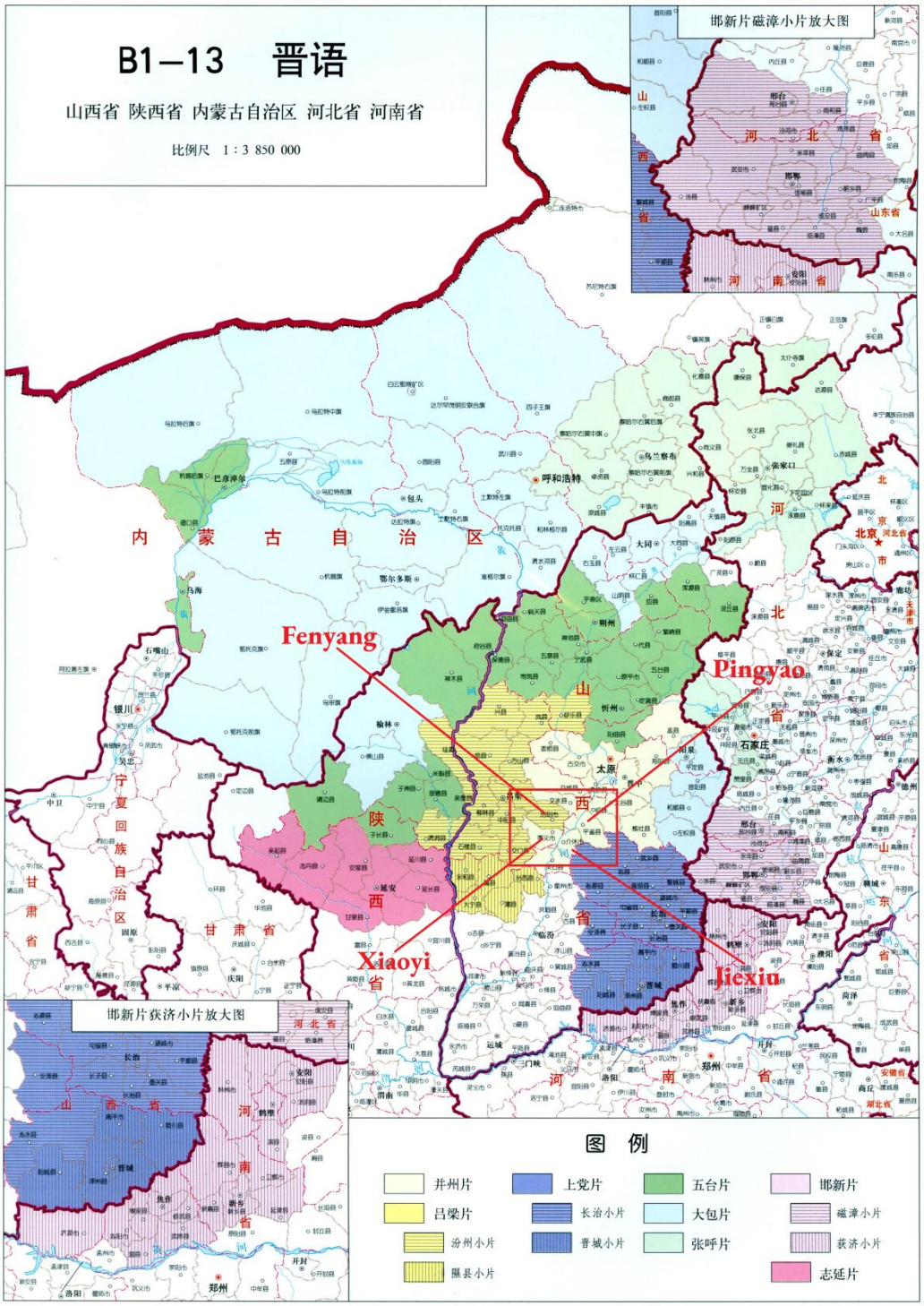
1.2.1 Research object

In this thesis, we will investigate the tonal systems of four Jin varieties: Fenyang (汾陽), Pingyao (平遙), Jiexiu (介休), and Xiaoyi (孝義). This research will be unfolded based on the assumption that these four Jin varieties share a common recent origin, and we will attempt to reconstruct the tonal evolution history of this region.

In Ming and Qing dynasties, these four counties were affiliated to Fenzhou Prefecture (汾州府), with Fenyang being the prefectural capital. As a local administrative division in Ming and Qing dynasties, Fenzhou was first established as an independent department (直隸州) in 1368, and it was promoted to a prefecture (府) in 1595. With this adjustment, some other counties located in Lüliang mountainous area (呂梁山區) were separated from their original prefectures to which they had been affiliated and incorporated within the newly upgraded Fenzhou Prefecture. However, these counties were geographically separated from Fenyang, the prefectural capital, by a great distance. The core area

中古調類 MC tonal category		平聲 *Ping*			上聲 *Shang*			去聲 *Qu*			入聲 *Ru*		
中古聲母 MC initial		次濁 *Sonorant*	全濁 *Voiced*	清 *Voiceless*	清 *Voiceless*	次濁 *Sonorant*	全濁 *Voiced*	次濁 *Sonorant*	全濁 *Voiced*	清 *Voiceless*	清 *Voiceless*	次濁 *Sonorant*	全濁 *Voiced*
幷州片 Bingzhou		平聲 *Ping*			上聲 *Shang*			去聲 *Qu*			陰入 *Yin-Ru*		陽入 *Yang-Ru*
呂梁片 Lüliang	汾州 Fenzhou	陽平 *Yang-Ping*		陰平 *Yin-Ping*	上聲 *Shang*			去聲 *Qu*			陰入 *Yin-Ru*	陽入 *Yang-Ru*	
	隰縣 Xixian	陽平 *Yang-Ping*		陰平 *Yin-Ping*	上聲 *Shang*			去聲 *Qu*			陰入 *Yin-Ru*		陽入 *Yang-Ru*
上黨片 Shangdang	長治 Changzhi	陽平 *Yang-Ping*		陰平 *Yin-Ping*	上聲 *Shang*			陽去 *Yang-Qu*		陰去 *Yin-Qu*	陰入 *Yin-Ru*	陽入 *Yang-Ru*	
	晉城 Jincheng	陽平 *Yang-Ping*		陰平 *Yin-Ping*	上聲 *Shang*			去聲 *Qu*			入聲 *Ru*		
五臺片 Wutai		陽平 *Yang-Ping*		陰平上 *Yin-Ping-Shang*				去聲 *Qu*			入聲 *Ru*		
張呼片 Zhanghu		平聲 *Ping*			上聲 *Shang*			去聲 *Qu*			入聲 *Ru*		
大包片 Dabao		陽平 *Yang-Ping*		陰平 *Yin-Ping*	上聲 *Shang*			去聲 *Qu*			入聲 *Ru*		
邯新片 Hanxin		陽平 *Yang-Ping*		陰平 *Yin-Ping*	上聲 *Shang*			去聲 *Qu*			入聲 *Ru*		陽平 *Yang-Ping*
志延片 Zhiyan		陽平 *Yang-Ping*		陰平 *Yin-Ping*	上聲 *Shang*			去聲 *Qu*			陰平 *Yin-Ping*		入聲 *Ru*

Table 1: Internal classification of Jin group (Hou Jingyi, 1986; Shen Ming, 2006)



Map 1: Distribution and scope of each cluster of Jin group (Institute of Linguistics, CASS et al, 2012: B1-13)

(continued from Page 3) of Fenzhou remained unchanged in the four counties in question. *Map 2* and *3*[4] (on the next two pages) demonstrate the administrative boundaries and scope of Fenzhou in Shanxi in Ming and Qing dynasties.

Because of the geographic contiguity and shared socio-historical context, residents in the four counties had long developed relatively higher mutual intelligibility among their accents as well as a common sense of identification. However, if according to the current internal classification of Jin group proposed by Hou Jingyi (1986)/Shen Ming (2006), we will find a kind of incoordination between linguistic classification and the geographic contiguity/socio-historical context that Fenyang Jin is classified into Fenzhou sub-cluster of Lüliang cluster while the other three are classified into Bingzhou cluster, since Fenyang Jin maintains a tonal contrast between *Yin-Ping* and *Yang-Ping* while the other three not.

1.2.2 Motivation

This research is primarily motivated by the incoordination between the linguistic classification and the geographic contiguity/socio-historical context of this region. We assume that the four Jin varieties share a recent common parental stage, and if it is the case, the validity of taking (in)distinguishability between *Yin-Ping* and *Yang-Ping* to separate Fenyang Jin from Pingyao, Jiexiu, and Xiaoyi Jin will be challenged. Furthermore, there are two phenomena that solidate our assumption.

First, context-dependent distinguishability between *Yin-Ping* and *Yang-Ping* has been reported in some Bingzhou Jin varieties including: Qingxu (清徐), Loufan (婁煩), Wenshui (文水), Qixian (祁縣), Pingyao (平遙), Jiexiu (介休), and Xiaoyi (孝義). This phenomenon refers to the case that these two tonal categories are not distinguishable in citation form while in some certain sandhi forms they are[5]. The context-dependent distinguishability between *Yin-Ping* and *Yang-Ping*, if we interpret

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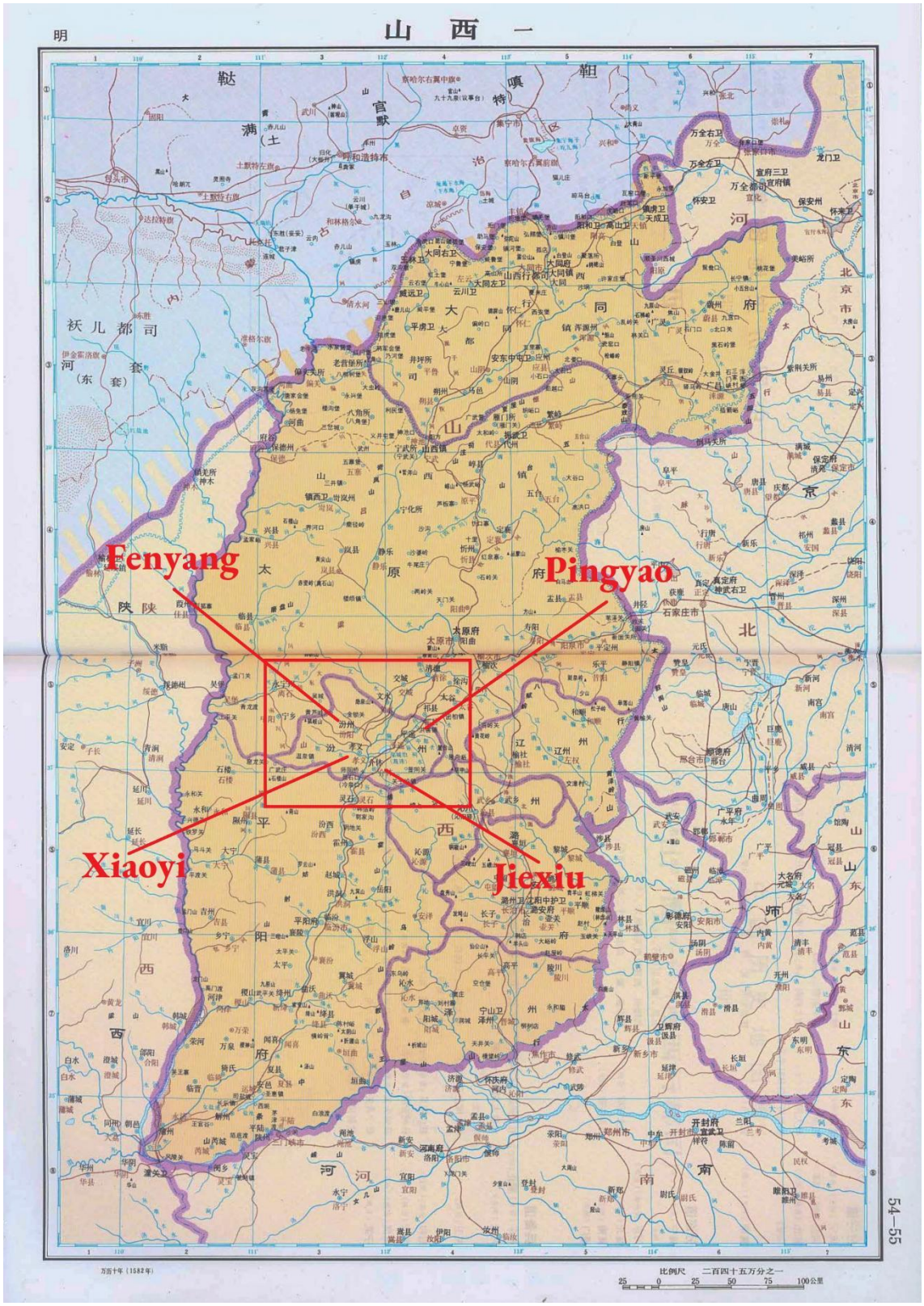
[4] The two maps are included in *Historical Atlas of China* (《中國歷史地圖集》) (Tan Qixiang, 1982) (*Map 2* in Vol.7: 54-55; *Map 3* in Vol.8: 20-21).

[5] This context-dependent distinguishability between *Yin-Ping* and *Yang-Ping* is realized in different fashions variety by variety. But it could be roughly summarized as two kinds:

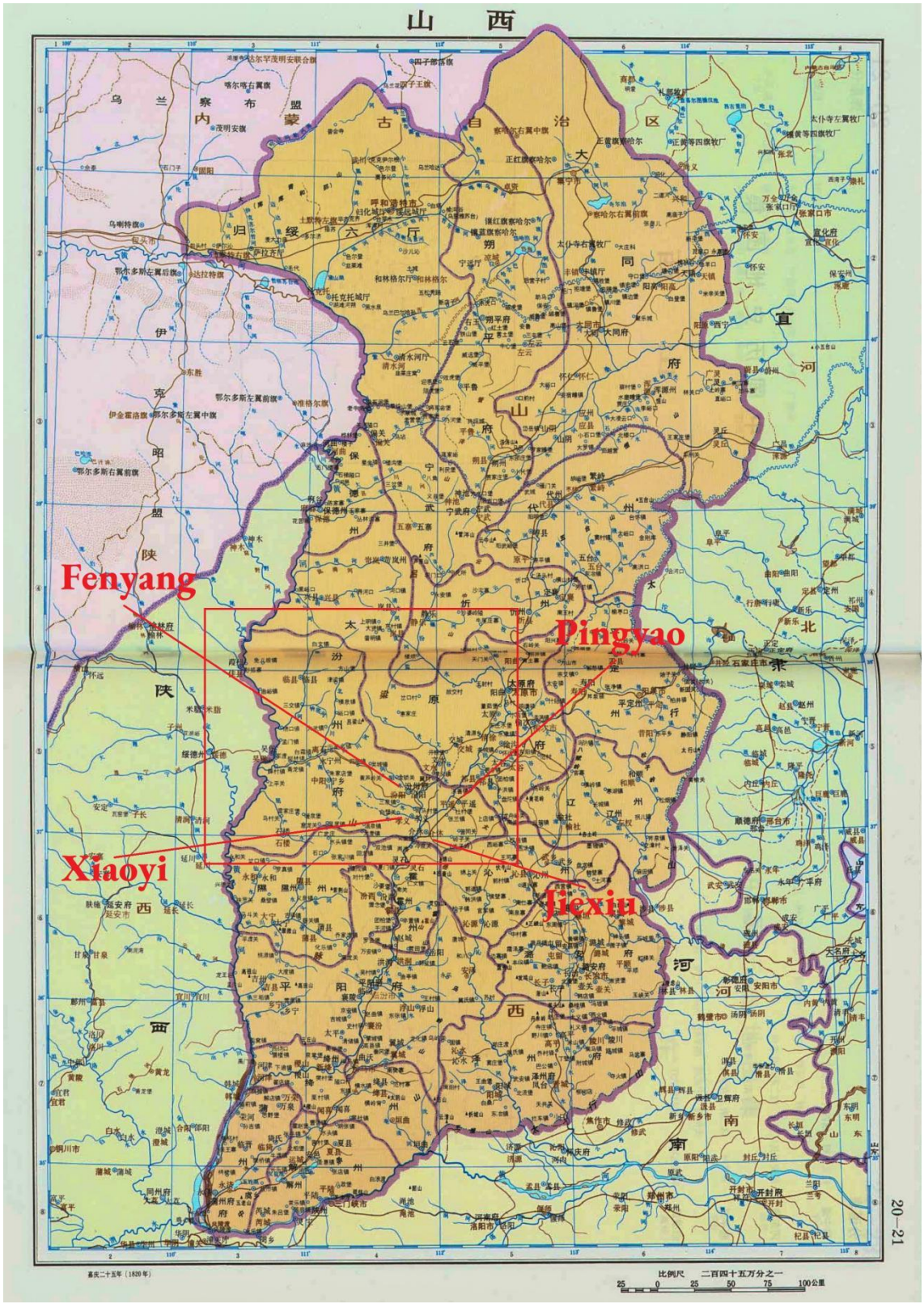
(1) The surface tonal representations of '*Yin-Ping*+T' and '*Yang-Ping*+T', or of 'T+*Yin-Ping*' and 'T+*Yang-Ping*' are different with each other ('T' refers to a certain tonal category);

(2) *Yin-Ping* and *Yang-Ping* are different in reduplicated word (also known as *Dieci* in *Pinyin*, 疊詞) or in *Erhua* form (r-coloring rhyme, 兒化韻) and *Er*-suffixed form (兒尾詞).

Refer to specific researches of each variety which shows context-dependent distinguishability: Qingxu (Pan Yaowu, 1990); Loufan (Zhai Yingyi, 1989); Wenshui (Hu Shuangbao, 1988); Qixian (Yang Shuzu & Wang Ailu, 1984); Pingyao (Hou Jingyi, 1980, 1982); Jiexiu (Zhang Yimei, 1991); Xiaoyi (Guo Jianrong, 1989). Generally, the northern four counties (Qingxu, Loufan, Wenshui, Qixian, affiliated to the former Taiyuan Prefecture in Ming and Qing dynasties) are the (1) pattern while the southern three counties (Pingyao, Jiexiu, Xiaoyi, affiliated to the former Fenzhou Prefecture) are the (2) pattern.



Map 2: Scope of Fenzhou (in 1582, Ming dynasty) (Tan Qixiang, 1982: Vol.7 54-55)



Map 3: Scope of Fenzhou (in 1820, Qing dynasty) (Tan Qixiang, 1982: Vol.8 20-21)

(continued from Page 6) it as a result of a tonal merger of these two categories (a controversial issue, see Chapter 2 for detailed discussions), indicates that the tonal merger itself is likely to be a near merger[6]. If it is the case of near merger, we will have direct evidence to suggest that Pingyao, Jiexiu, and Xiaoyi Jin had ever preserved the tonal contrast between *Yin-Ping* and *Yang-Ping*, and in turn to support a common parental stage shared by Fenyang, Pingyao, Jiexiu, and Xiaoyi Jin.

Second, Fenyang Jin also seems unique among the varieties in Fenzhou sub-cluster of Lüliang cluster, as it shows a high-level *Qu* tone while the others consistently show a high-falling one (Shen Ming & Akitani Hiroyuki, 2018). As far as we know, the contour of Fenyang Jin's *Qu* tone is more similar to that of Pingyao, Jiexiu, and Xiaoyi Jin. Thus, the contour of *Qu* tone provides another clue for the comparability between the four Jin varieties.

As far, we have not seen any research where whether the tonal merger between *Yin-Ping* and *Yang-Ping* is a near merger example in some Bingzhou Jin varieties has been examined. If this could be certified, we will have a base for the further study on reconstructing the tonal evolution history of this region, as we could hereby rule out the validity of the (in)distinguishability between these two tonal categories, which is taken to separate Fenyang Jin from Pingyao, Jiexiu, and Xiaoyi Jin, and in turn, reconstruct the tonotype of each tonal category in the common parental stage[7].

Besides, the tone value in most available previous works on these Jin varieties was transcribed with an impressionistic style in 1980~1990s. This method of transcription would inevitably result in some problems of inaccuracy, due to the subjective judgment made by each fieldworker. Therefore, renewing the data is also a necessary work that functions as a foundation for further discussions on the above-mentioned issues.

1.2.3 Goal

In order to reconstruct the tonal evolution history in the region of the former Fenzhou Prefecture, this thesis aims to reach the following three goals.

First, we will employ instrumental-based methods to record each tonal category of the four Jin varieties, and transcribe them with a more reasonable system.

Second, in order to explore the distinguishability between tonal categories, we will attempt to

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[6] 'Near merger' refers to a kind of asymmetry of production and perception. In cases of near merger, a repeatable difference can be found between the acoustic realizations of the two categories that are being merged with each other, while the native speakers always deny the existence of this difference, as this difference has been imperceivable to them. We will detailedly discuss this issue in Chapter 3.

[7] Many thanks to Prof. Shen Ruiqing (National University of Singapore) for reminding me of the possibility of near merger. Any remaining errors are of course solely my responsibility.

identify what perceptual dimensions may be relevant to the tonal contrasts in these four Jin varieties. Since any tonal change such as mergers and differentiation is controlled by perceptual dimensions, this information will help us to explain potential tonal changes in history.

Third, based on the instrumental-based materials, transcriptions, and the relevant perceptual dimensions, we will attempt to reconstruct the tonotype of each tonal category in the parental stage, and outline how they have evolved into their reflexes in present-day Fenyang, Pingyao, Jiexiu, and Xiaoyi Jin.

1.3 Methodology

In this research, we mainly employed three specific methods to meet specific demands of different goals we have discussed above in Subsection 1.2.3.

First, we carried out two times of fieldwork in central Shanxi Province and recorded relatively sufficient materials of six Jin varieties (the four counties in question plus Wenshui and Qixian as a reference group). The fieldwork data indicate that the tonal merger between *Yin-Ping* and *Yang-Ping* in Pingyao, Jiexiu, and Xiaoyi Jin is indeed a near merger, because we measured a repeatable subtle difference in pitch value (F0) between the tokens of *Yin-Ping* and *Yang-Ping*.

Second, we employed the multidimensional scaling analysis, a statistical tool realized with R, to visualize the dispersion of each tonal category of the four Jin varieties within a two-dimensional space. The analyzed results indicate that the two dimensions are likely to correlate with the average F0 and the onset of the tokens. Thus, it should be these two perceptual dimensions that are relevant to the tonal contrasts in the four Jin varieties in question.

Third, we employed evolutionary comparative method (Zhu Xiaonong, 2018) to reconstruct the tonotype of each tonal category in the parental stage as well as their evolution paths leading to the present-day forms. With unnatural patterns (those discontiguous in geographic space, or reverse in generation) being ruled out, our reconstructions indicate that the earliest internal split in the common parental stage might have been triggered by changes in the contour of *Yang-Ping* and *Qu*, while the tonal merger between *Yin-Ping* and *Yang-Ping* seems to have occurred in a more recent stage.

1.4 Organization of chapters

Besides this Chapter 1 which serves as an introduction, the succeeding five chapters are organized as follows.

In Chapter 2, we first introduce the general tonal evolution inside Jin group and then discuss two relevant historical linguistic controversies over Jin group: (1) the relationship between Jin group and Mandarin group; (2) the evolution of *Yin-Ping* in Bingzhou cluster.

In Chapter 3, we demonstrate the fieldwork data that have been collected and then transcribe the pitch value of each tonal category for the four Jin varieties. Based on these works, we will conduct further examinations of whether the tonal merger between *Yin-Ping* and *Yang-Ping* in relevant Jin varieties is actually a near merger by contrasting them with the data of Wenshui and Qixian Jin in this chapter.

In Chapter 4, we introduce the analysis results of multidimensional scaling and identify what perceptual dimensions are relevant to the tonal contrasts in the four Jin varieties in question. In turn, we will interpret the results in terms of the correlation between the perceptual dimensions and the tonal evolution.

In Chapter 5, we demonstrate the procedure of how we reconstruct the tonotype of each tonal type in the common parental stage based on present-day materials and how we establish the tonal evolution history of this region.

Finally, in Chapter 6 we summarize this research and discuss the future direction of studies on the tonal evolution history in central Shanxi.

Chapter 2 Relevant Linguistic Controversies over Jin Group

This chapter is comprised of three sections. In Section 2.1, we introduce the general tonal evolution inside Jin group, with tonal categories in Middle Chinese (hereafter MC) being the frame of reference. In Section 2.2, we discuss the controversial issue of the relationship between Jin group and Mandarin group. In Section 2.3, we discuss another controversial issue of whether the indistinguishability between *Yin-Ping* and *Yang-Ping* is the result of a 'splitting-then-merging' evolution procedure, or directly reflects the MC *Ping* tonal category which has not experienced any split at all in history.

2.1 General tonal evolution inside Jin group

For convenience, discussions in this section follow the sequence of *Ru*→*Shang*/*Qu*→*Ping*.

2.1.1 *Ru* tone (入聲調)

Concerning the *Ru* tones, we assume that in the period of proto-Jin, from which all present-day Jin varieties are descended, the *Ru* tonal category of Middle Chinese (hereafter MC *Ru*) had already split into three contrastive tonal categories according to the voicing value of MC initials (中古聲母). This assumption could be supported by a certain Shangdang Jin variety which is spoken in a small town called Shuzhang Town (樹掌鎮) in Huguan County (壺關縣) affiliated to Changzhi Prefecture (長治地區). It is believed that Shuzhang Jin is the only one currently existing Jin variety in which there are three contrastive *Ru* tonal categories preserved. These three *Ru* tonal categories are *Yin-Ru* (陰入), *Second Yang-Ru* (次陽入), and *Yang-Ru* (陽入) which regularly corresponds to MC Voiceless *Ru* (中古清入), Sonorant *Ru* (中古次濁入) and Voiced *Ru* (中古全濁入) respectively (Li Xi, 2013).

In turn, these three contrastive *Ru* tonal categories merged into two or one in other Jin varieties. In the clusters wherein there are two *Ru* tonal categories (*Yin-Ru* and *Yang-Ru*) preserved in the tonal inventory, there might have occurred a tonal merger in which *Second Yang-Ru* had eventually merged into either *Yin-Ru* or *Yang-Ru*. Specifically, the varieties of Bingzhou cluster and Xixian sub-cluster of Lüliang cluster reflect the former pattern, while those of Fenzhou sub-cluster of Lüliang cluster and Changzhi sub-cluster of Shangdang cluster reflect the latter pattern. Additionally, Hanxin and Zhiyan Jin varieties might have also experienced the former pattern of tonal merger (*Second Yang-Ru* into *Yin-Ru*), although superficially there is only one *Ru* tonal category preserved in the present-day tonal inventory. Note that all of the Jin varieties in these two clusters are spoken

beyond the scope of Shanxi Province, which means that their speakers are much more likely to maintain fewer connections with those of Shanxi while receive more political, economic, or cultural radiation from the powerful metropolises inside the provinces where they are located. Since Hanxin Jin varieties are spoken in Henan and Hebei, inside which oral communications among local people are mainly dominated by local varieties of Central Plains Mandarin (中原官話) and Jilu Mandarin (冀魯官話), Hanxin Jin speakers should have more frequent contact with these Mandarin speakers. In both the two Mandarin sub-groups, *Yang-Ru* (MC Voiced *Ru* 中古全濁入) and *Yin-Ru* (MC Voiceless/Sonorant *Ru* 中古清/次濁入) had been merged into *Yang-Ping* and *Yin-Ping* respectively. Accordingly, Hanxin Jin varieties also share the former tonal merger with these Mandarin varieties. Similarly, Zhiyan Jin varieties are spoken in Shaanxi (陝西), where most of the residents are native to local varieties of Central Plains Mandarin. Under the influence from the local Mandarin, Zhiyan Jin is in accord with Central Plains Mandarin in the way that *Yin-Ru* (MC Voiceless and Sonorant *Ru* 中古清/次濁入) had been lengthened and in turn been merged into *Yin-Ping*.

In Jin varieties of Wutai, Zhanghu, and Dabao clusters, there is only one *Ru* tonal category preserved in the tonal inventory. This pattern is assumed to be the most progressive type since multi *Ru* tonal categories had probably been merged into one certain category. According to Shen Ming (1999), the hypothesis that this pattern reflects the most progressive evolution rather than the most conservative one could be supported by some examples of Wutai Jin varieties[8]. Shen pointed out that unlike other clusters in Jin group, the contour of the *Ru* tone varies among Wutai Jin varieties. Specifically, the contour could be realized as a level-like tone, a falling-like tone, or a dipping-like tone. If it is the case of a level-like tone, it is similar to *Yang-Ping* in the adjacent Bingzhou and Lüliang cluster, while if it is the case of a falling- or dipping-like tone, it is similar to *Shang* in the adjacent clusters. Shen also summarized two correspondence rules that in Shanxi Jin varieties *Yin-Ru* and *Yang-Ru* are similar to *Yang-Ping* and *Shang* respectively in terms of both pitch value and general contour type. According to the correspondence rules, Shen argues that the varied contours of *Ru* in Wutai Jin varieties may reflect the difference of which target tonal category the other one was eventually merged into. More specifically, if it is the case that the *Ru* tone is realized as a level contour, it may indicate the merger that *Yang-Ru* was merged into *Yin-Ru*, while if it is the case of a falling or dipping contour, it should be the merger of reverse pattern (*Yin-Ru* into *Yang-Ru*) that might have occurred.

[8] In the latter case (conservative), the single *Ru* tone in these three clusters is assumed to directly reflect the MC *Ru* without experiencing any tonal merger or split in history.

2.1.2 *Shang* tone (上聲) and *Qu* tone (去聲)

We put *Shang* and *Qu* together to discuss. All Jin varieties seem to have undergone the same merger as Mandarin has. That is, MC Voiced *Shang* (中古全濁上) has been merged into *Qu*. Hence, at present *Shang* only reflects MC Voiceless/Sonorant *Shang* (中古清上/次濁上). This tonal merger could separate Mandarin from most southern Sinitic groups, as the latter did not undergo this merger in history. In this sense, it is more reasonable to incorporate Jin varieties into Mandarin group.

A further tonal split occurred in Changzhi sub-cluster of Shangdang cluster. In the Jin varieties of this sub-cluster, *Qu* is further split into two: *Yin-Qu* (reflecting MC Voiced *Shang* 中古全濁上 and Voiceless/Sonorant *Qu* 中古清/次濁去) and *Yang-Qu* (reflecting MC Voiced *Qu* 中古全濁去). This kind of split is extremely rare among Sinitic languages spoken in northern China.

Another relevant merger occurred in Wutai cluster. *Yin-Ping*, which reflects MC voiceless *Ping* (中古清平), is merged into *Shang*. These two originally contrastive tonal categories together formed a unique tonal category usually referred to as '*Yin-Ping-Shang*' (陰平上), which is also a rare case of tonal evolution in Sinitic family.

2.1.3 *Ping* tone (平聲調)

The evolution of *Ping* tone is the most controversial part of the studies on Jin Chinese. In the tonal inventory of Bingzhou Jin varieties, which are regarded as the most representative accent of Jin group since the provincial capital Taiyuan is contained in this cluster, they are reported that preserve only one *Ping* tonal category in the tonal inventory. The controversy over *Ping* in Bingzhou Jin varieties lies in the way how to interpret the fact that there seems to be only one *Ping* tonal category preserved. Some linguists claim that this single *Ping* tonal category might directly reflect the MC *Ping* without experiencing any tonal merger or split in history. On the contrary, other linguists are arguing that in Jin group, the MC *Ping* had ever split into *Yin-Ping* and *Yang-Ping* according to the voicing value of MC initials (中古聲母) as the other group such as Mandarin had, while in a later period the *Yin-Ping* and *Yang-Ping* were merged again. We agree with the latter hypothesis, and the following discussions of this thesis are all based on this premise. Detailed discussion of this issue will be skipped to Section 2.3. If it is actually the case of a 'splitting-then-merging' evolution for the single *Ping* tonal category, Bingzhou cluster shows a considerably progressive tonal change in its tonal inventory. This unique and progressive phenomenon occurred in Bingzhou cluster probably due to its blocked topographic conditions and relatively advanced culture and economy of this region within Shanxi. This region

basically overlaps with the scope of the Taiyuan basin (太原盆地), which is a narrow geographic unit blocked by the Taihang mountain range (太行山脈) on the east and the Lüliang mountain range (呂梁山脈) on the west. Besides, the Fenhe River (汾河) runs through the whole basin, making the internal water and land transportation very convenient. It might be based upon the interaction of these factors that the unique and progressive tonal change occurred in the Taiyuan basin rather than the other regions in Shanxi.

From *Table 1* (in Page 4), we could see that Zhanghu cluster also preserves only one *Ping* tonal category as Bingzhou cluster does. However, since the formation of this cluster was largely based on a mass migration in later Qing dynasty, we do not make further comment on this cluster.

2.2 Controversial relationship with Mandarin group

The naming of Jin group seems to imply that it is parallel to the southern Sinitic groups such as Wu (吳語), Min (閩語), Yue (粵語), and so forth, and also imply that it is parallel to Mandarin group. However, the relationship between Jin group and Mandarin group remains controversial, as many linguists insist that Jin is no more than a daughter group in Mandarin (Ting Pang-hsin, 1998; Wang Futang, 1999 among others), while others claim for a sister-and-sister relationship between Jin and Mandarin (Li Rong, 1985; Hou Jingyi, 1986; Qiao Quansheng, 2008 among others). We agree with the former viewpoint on this issue. But note that although this issue is still under debate, the term 'Jin' has been conventionalized, and in all contexts, it refers to the group of Chinese dialects that *Ru* tonal categories are preserved and are spoken in Shanxi Province and the adjacent areas as Li Rong (1985) defined. We follow this convention and in this thesis, any reference to 'Mandarin' has excluded all varieties regarded as 'Jin'.

We will discuss in this section whether separating Jin from Mandarin group is an appropriate classification from the following two aspects.

(1) The formation of Jin group (if it is similar to the way that the southern Sinitic groups have been formed);

(2) Early sound changes relevant to the classification in Sinitc family (if Jin keeps consistent with Mandarin group).

2.2.1 Formation of Jin group

In terms of geographic distribution, both Jin and Mandarin (except for the Mandarin varieties which were brought by immigrants in a later period to southwestern China) are spoken in northern China. In Chinese history, early mass migrations were usually flowed from north to south, with the language spoken in the Central Plains region (also known as Zhongyuan 中原地區 in *Pinyin*) at that time

being brought by the immigrants to the south. In early times, most areas in southern China[9] were mainly populated by non-Sinitic (non-Han 漢) nations. These nations were usually backward in culture and economy at that time. Gradually, the minority communities had been incorporated into local Sinitic communities and their members eventually shifted to using Sinitic languages brought by the immigrants. During the process of the language shift, some non-Sinitic native items, especially lexical items, remained and were in turn adopted by the local Sinitic language (Pan Wuyun, 2005, 2009). Since the new settlements in southern China are separated away from northern China which was the cultural and political center of China at that time, the Sinitic language which was brought by the immigrants was generally outside the direct radiation of the later prestige speech spoken in the north. In this way, the Sinitic language brought by the immigrants took root in southern China and experienced relatively independent developments. This is a general outline of the way that southern Sinitic groups were formed.

On the contrary, northern China never received mass migrations from external areas. Also, northern China occupied a central role in politics and culture for a long time. Hence, renewals and replacements in language occurred far more frequently than in southern Sinitic groups. Since Shanxi is a part of northern China, from this perspective, there were no such conditions for Jin to experience an independent evolution to the same extent as southern Sinitic groups did, as either in terms of population structure or geographic space, Jin group had never been split off from a uniform northern China where both Jin and Mandarin are native. Therefore, the so-called uniqueness of Jin should be regarded as the results of local sound creations within the scope of northern China.

Now turning to interpret the uniqueness of Jin, we attribute it to the following three reasons.

(1) Blocked topography of Shanxi;

(2) Fractured internal geographic units (to which the relatively complex internal differentiation is attributable);

(3) Stable internal population (no mass migration having entered Shanxi).

However, unlike Shanxi, the adjacent region of North China Plain (華北平原), which is mainly populated by the people who speak Mandarin varieties, is not featured by the geographic properties and socio-historical context we observed in Shanxi. Although there has been no mass migration from outside that entered North China Plain, this region had experienced a considerably large-scale internal

[9] Generally, northern China refers to the basin of the Yellow River (黃河), and southern China includes all areas south of the Yangtze River (長江). The area where Mandarin varieties are used and the area where southern Sinitic groups are used are basically divided by the Yangtze River.

migration. In the early Ming dynasty, North China Plain had suffered from severe depopulation due to the chaos caused by the wars during the period of Ming's replacement for the Mongolian Yuan (蒙元). Simultaneously, the blocked terrain of Shanxi protected it from the outside chaos. Considering the unbalanced population in northern China, the central government of Ming organized several times of mass migrations to relocate the surplus population from Shanxi and Shandong (山東) to the depopulated regions, in order to reconstruct the local population of these regions. It is recorded that in many counties, the number of new immigrants was even more than that of the surviving native residents. It is doubtless that the population reconstruction would deeply reshape the language spoken in these regions. Benefiting from the internal social stability and the blocked geographic environment, Jin group was able to achieve a relatively independent evolution within northern China. Qiao Quansheng (2003a, 2003b) summarized sixteen sound changes of Jin which are not shared by Mandarin. Qiao assumes that all of these sound changes should occur no later than 500~600 years ago, and some of them even might have occurred for more than a millennium. In his later work (2008), Qiao further mentioned that Jin should be separated from Mandarin and be identified as a sister group to Mandarin.

2.2.2 Early sound change

So far, we have discussed how Jin group and southern Sinitic groups differ in terms of respective historical background of formation. Then, we turn to the historical sound change which may be relevant to the linguistic splits in Sinitic family. Essentially, the way we interpret the relationship between Jin group and Mandarin group equals the way we define these two groups. Different views differ on whether the definition of Mandarin could incorporate or exclude Jin varieties. Note that inside Sinitic family, a certain group of any level should be defined with a cluster of historical sound changes. In principle, varieties which are classified into the same group must share the same evolution of relevant sound changes, and thus we could draw a boundary (=isogloss(es)) between the groups according to these isoglosses reflecting relevant historical sound changes. Ting Pang-hsin (1982) proposed a guideline for the classification of Sinitic languages as follows[10].

> According to the phonological history of Sinitic languages, we should classify large groups with early sound changes, then classify intermediate groups with later sound changes, and finally classify small groups with synchronic sound

[10] Ting' s original statement in Chinese: '以漢語語音史爲根據，用早期歷史性的條件區別大方言；用晚期歷史性條件區別次方言；用現在平面性的條件區別小方言．早期，晚期是相對的名詞，不一定能確指其時間．條件之輕重以相對之先後爲序，最早期的條件最重要，最晚期的條件也就是平面性的語音差異了.'

differences. The 'early' or 'later' here refer to a relative sequence, rather than certain points of time. The earliest sound changes play the most important role in the classification, and the latest sound changes are reflected in synchronic differences.

—Ting Pang-hsin (1982)

According to the guideline proposed by Ting Pang-hsin (1982), Li Xiaofan & Xiang Mengbing (2009) employ three historical sound changes to outline the scope of Mandarin. Dialects that are identified as a Mandarin variety are expected to have undergone these three historical sound changes, or otherwise, they will be ruled out. According to the definition for Mandarin of Li & Xiang, Jin varieties are incorporated into Mandarin group. These three sound changes are as follows.

(1) The reflex of MC initial *Wei* (微母*mɟ-) is not a bilabial m-;

(2) The reflex of MC initial *Ri* (日母*nₒ-) is not a nasal nₒ- or n-;

(3) MC Voiced *Shang* (中古全濁上) has been merged into *Qu* (濁上歸去).

	Mandarin	Jin	Xiang	Gan	Hakka	Wu	Min	Yue
(1)	+	+	−	−	−	−	−	−
(2)	+	+	−	−	−	−	−	−
(3)	+	+	+	+	−	−	−	−

Table 2: Reflection of the three relevant sound changes in main groups of Sinitic family

As *Table 2* illustrates, Mandarin and Jin seem to share all of the three historical sound changes while the southern Sinitic groups basically do not. These three sound changes are essentially a series of sound replacements for the *Qieyun* (《切韻》) system, the MC phonology. It could be summarized that in the common parental stage of present-day Mandarin varieties, this proto-Mandarin took the lead in renewing these three phonemic categories in a certain period, while the southern Sinitic groups remained unchanged. According to this, Jin cannot be parallel to the southern Sinitic groups since its split off from the main body of Mandarin must have occurred in a later period. In this sense, Jin's uniqueness in phonology should be interpreted as the results of local and later sound creations.

On the contrary, Qiao Quansheng (2008) insists a sister-and-sister relationship between Jin group and Mandarin group. Qiao interprets the phonological differences between Jin and Mandarin as early sound changes. According to Qiao, early sound changes are defined with absolute time rather than relative sequence with other changes as Ting Pang-hsin (1982) defined. Qiao claims that sound changes occurring before the end of MC, which was assumed to be in the 12th century by Wang Li

(1980), should all be identified as early sound changes. Qiao (2008) listed the following three so-called 'early sound changes' according to his definition, in order to separate Jin varieties from Mandarin group in an 'early time'.

(4) Jin varieties experienced different procedures of the devoicing of MC voiced initials (中古全濁聲母) (assumed to have occurred in middle Tang dynasty);

(5) Stop-codas were preserved in Jin varieties (stop-coda deletion in Mandarin is assumed to have occurred in the period between late Tang dynasty and early Song dynasty);

(6) Nasal codas were weakened in Jin varieties (assumed to have occurred in the period between late Tang dynasty and early Song dynasty).

In our view, we think that the three sound changes employed by Li Xiaofan & Xiang Mengbing (2009) are more convincing, in that Qiao Quansheng (2008) seems to ignore the relevance degree of different sound changes to historical classification. It is undeniable that sound change (4) listed above could describe part of the difference between Jin and Mandarin, but Qiao told nothing about how this sound change is relevant to the historical classification. If we follow this criterion, Cantonese, a representative dialect of Yue Chinese spoken mainly in Guangzhou (廣州) metropolitan area, Hong Kong (香港), and Macao (澳門), will become inseparable from Mandarin group, which is obviously contrary to the fact. Similarly, if we take the preservation of *Ru* tonal categories (=stop-codas) as the frame of reference, even the concept of Mandarin itself will become invalid because some sub-groups of Mandarin still preserve a *Ru* tonal category in the tonal inventory[11]. In this sense, these sound changes should be interpreted as later rather than early sound changes, as they are unable to contribute to the historical classification.

Wang Futang (1999) also had a comment on the problem of taking the preservation of *Ru* tone as the frame of reference for classification as follows[12]:

> Despite the fact that dialects spoken in southern Shanxi share most of the phonological features that Jin varieties have, and some of those are fairly typical features. However, southern Shanxi dialects are still classified into Mandarin group just for the reason that they no longer preserve a *Ru* tonal category in the tonal inventory. This kind of classification will not only pose a negative influence on the uniformity of Jin group but also exemplifies a negative case of referring

[11] Refer to Liu Xiangbo (2007) for examples of Lower Yangtze Mandarin (江淮官話, also known as 下江官話) and Li Lan (2009) for examples of Southwestern Mandarin (西南官話, also known as 上江官話).

[12] Wang's original statement in Chinese: '山西南部晉南方言具有晉語的大部分重要特點，某些特點的表現還極爲典型，但僅僅因爲沒有入聲就被劃入其他官話方言，這不能不損害晉語本身的完整性.'

to invalid later sound changes to make the historical classification.

—Wang Futang (1999)

2.3 Controversy over *Ping* tone in Bingzhou cluster

In some certain Jin varieties, there is a single *Ping* tonal category at least in citation form. This means that in these Jin varieties the reflexes of MC Voiceless *Ping* (中古清平) and MC Sonorant/Voiced *Ping* (中古次濁平/全濁平) are indistinguishable. This pattern is a notable phenomenon since most Sinitic languages preserve two contrastive *Ping* tonal categories: *Yin-Ping* and *Yang-Ping* which are assumed to have been split from the MC *Ping* tonal category (中古平聲) according to the voicing value of MC initials (中古聲母). The description in the first sentence of this section reflects most Bingzhou Jin varieties including those spoken in the following localities.

(1) Taiyuan Prefecture (太原地區): Taiyuan (太原), Qingxu (清徐), Gujiao (古交), Loufan (婁煩);

(2) Jinzhong Prefecture (晉中地區): Yuci (榆次), Shouyang (壽陽), Taigu (太谷), Yushe (榆社), Qixian (祁縣), Pingyao (平遙), Jiexiu (介休);

(3) Lüliang Prefecture (呂梁地區): Jiaocheng (交城), Wenshui (文水), Xiaoyi (孝義).

Therefore, this property is also conceived of as a distinctive feature by which we could separate Bingzhou cluster from the other clusters of Jin group. Among all Bingzhou Jin varieties listed in the *Language Atlas of China, the 2nd Edition*, only Yuxian (盂縣) in Yangquan Prefecture (陽泉地區) and Lingshi (靈石) in Jinzhong Prefecture exceptionally preserve two *Ping* tonal categories. Both two counties are located along the boundaries of Bingzhou cluster. Despite the fact that there are two contrastive *Ping* tonal categories in their tonal inventories, these two Jin varieties are still qualified for being classified into Bingzhou cluster because they share all other sound changes with other Bingzhou Jin varieties.

2.3.1 Viewpoints in previous research

Recall the description in the beginning of this section: 'There is only one *Ping* tonal category at least citation form'. This description implies the following two possibilities.

(1) In either the citation form or in the sandhi form, there exists only a single *Ping* tonal category;

(2) In the citation form, there is only a single *Ping* tonal category, while in some certain sandhi forms there could exist contrastive *Yin-Ping* and *Yang-Ping*.

Both the two possibilities could be instantiated by currently existing Bingzhou Jin varieties.

(1) Taiyuan, Gujiao, Yuci, Taigu, Shouyang, Yushe, Jiaocheng;

(2) Qingxu, Loufan, Wenshui, Qixian, Pingyao, Jiexiu, Xiaoyi.

Jin varieties in (1) are all spoken in or around Taiyuan City, while those in (2) are located in the south of Taiyuan. The Jin varieties in (2) could exemplify the 'context-dependent distinguishability' between *Yin-Ping* and *Yang-Ping* as we mentioned in Chapter 1.

Controversy arises from the way how to interpret the fact that there is only one *Ping* tonal category in Bingzhou Jin varieties. There are two contrary viewpoints.

(1) Non-split hypothesis: This *Ping* tonal category directly reflects the MC *Ping* (中古平聲) without undergoing any process of tonal split (supported by Wang Linhui, 2003; Qiao Quansheng, 2003a, 2007 among others);

(2) Splitting-then-merging hypothesis: This *Ping* tonal category might have stemmed from the contrastive *Yin-Ping* and *Yang-Ping* split from the MC *Ping* as most Sinitic languages did, but in a later period, these two tonal categories were again merged into one (supported by Ho Dah-an, 1994; Shen Ming, 1999; Wang Lining, 2012 among others).

Wang Linhui (2003), one of the supporters of the non-split hypothesis, argued that the split of the MC *Ping* tonal category should be triggered by the contrastiveness of the voicing value of MC initials (中古平聲). On the other hand, the trigger of the tonal merger of *Yin-Ping* and *Yang-Ping* is hard to be explainable. In addition, the context-dependent distinguishability between *Yin-Ping* and *Yang-Ping* in some tone sandhi forms is less productive, and thus it should be interpreted as a remnant left by the devoiced MC voiced initials (中古全濁聲母). Furthermore, a dictionary named *Fangyan Yingyong Zazi* (《方言應用雜字》) published in 1765 recorded the pronunciation of some characters and lexical items of central Shanxi dialects. In this book, characters that are assumed to carry a *Yin-Ping* tone and those to carry a *Yang-Ping* tone were transcribed with the same phonetic notation. This may imply that the two *Ping* tonal categories had been merged at least before 1765 (Qiao Quansheng, 2003a)[13]. On the other hand, the split of the MC *Ping* (中古平聲) into *Yin-Ping* and *Yang-Ping* had already been reflected in *Zhongyuan Yinyun* (《中原音韻》), an earlier rhyme dictionary which was published in 1324. The two kinds of literature are separated in time by no more than around 400 hundred years. Qiao Quansheng (2003a, 2007) argued that the length of this period

[13] Qiao Quansheng (2003a) cited this evidence from Pan Jiayi (1996).

seems too short for a tonal merger between *Yin-Ping* and *Yang-Ping*. Besides, supporters of the non-split hypothesis also take the indistinguishability between *Yin-Ping* and *Yang-Ping* as one of the evidence for their claims of the sister-and-sister relationship between Jin group and Mandarin group.

On the contrary, among supporters of the splitting-then-merging hypothesis, Ho Dah-an (1994) argued that the earliest literature wherein the split of MC *Ping* tone was mentioned is *Xitanzang* (《悉曇藏》), a book written in the 9th century, and this length of period could be regarded as sufficient for the split plus a succeeding retraced merger. Shen Ming (1999) compared the general contour type of each tonal category across Jin varieties spoken in Shanxi. She found that *Yin-Ping* tends to be an unstable variable in many Jin varieties, in that it had merged either into *Yang-Ping* as in the case of Bingzhou cluster, or into *Shang* as in the case of Wutai cluster. Wang Lining (2012) used the example of *Qu* tone to refute the view that regards the context-dependent distinguishability between *Yin-Ping* and *Yang-Ping* as the remnants left by the devoiced MC Voiced initials (中古全濁聲母), as the supporters of this view cannot explain why this kind of remnants do not exist in *Qu* tone.

2.3.2 Direct evidence supporting the splitting-then-merging hypothesis

In our view, we agree with the splitting-then-merging hypothesis, as we found some direct evidence from our fieldwork data.

In our fieldwork, the MC Voiceless *Ping* (中古清平) and MC Sonorant/Voiced *Ping* (中古次濁/全濁平) tokens uttered by Pingyao, Jiexiu, and Xiaoyi Jin native consultants whom we recruited shown an extremely subtle difference. The tokens of MC Voiceless *Ping* (中古清平) (=*Yin-Ping*) are slightly lower in pitch value than the tokens of MC Sonorant/Voiced *Ping* (中古次濁/全濁平) (=*Yang-Ping*). This difference between *Yin-Ping* and *Yang-Ping* in these three Bingzhou Jin varieties is also in accord with the categorized difference between these two tonal categories in Fenyang Jin. Furthermore, we also examined the repeatability of this subtle difference. The results indicate that it is repeatable in either the averaged pitch value or any variable-controlled pair (=tokens with identical segmental phonemes). This difference could be direct evidence to support the splitting-then-merging hypothesis.

However, this subtle difference in pitch value seems beyond the capturable range for the native speakers, as our consultants claimed that the characters of the two tonal categories were the same. Similarly, this difference is also uncapturable for previous fieldworkers who transcribed tone value in an impressionistic fashion. Thus, as far as we know, this phenomenon has never been reported in any previous descriptive works. This result certified our assumption that this tonal merger in Pingyao,

Jiexiu, and Xiaoyi Jin is a near merger (detailed data will be demonstrated in Chapter 3).

On the other hand, we also recorded the phonetic materials of the Jin varieties spoken in Wenshui and Qixian, the two adjacent counties in the north (closer to Taiyuan). The data indicate that the similar subtle difference in pitch value between *Yin-Ping* and *Yang-Ping* seems not to exist in these two Jin varieties. According to this, we could further draw an isogloss between Wenshui, Qixian in the north and Pingyao, Jiexiu, and Xiaoyi in the south. On the north side, the tonal merger of *Yin-Ping* and *Yang-Ping* has been completed and thus it is a complete merger, while it should be identified as a near merger on the south side because the subtle difference exists. Furthermore, this isogloss also overlaps with the prefectural boundaries in history, as in Ming and Qing dynasties, the two counties on the north side were affiliated to the former Taiyuan Prefecture (舊太原府), while those three counties on the south side were affiliated to the former Fenzhou Prefecture (舊汾州府).

Chapter 3 Fieldwork Data

This chapter is comprised of four sections. Section 3.1 introduces the tone value transcription of the four Jin varieties in previous studies. Section 3.2 introduces our fieldwork and data processing methods. Section 3.3 demonstrates the tonal data of the four Jin varieties in question. Section 3.4 introduces some intuitionistic interpretations of the tonal data.

3.1 Tone value transcription in previous studies

There are mainly three kinds of openly published work that contain the tone value transcriptions of the four Jin varieties in question.

(1) Local chronicles (地方誌) and local dialectal records (地方方言誌);

(2) *Report on Shanxi Dialect Investigation and Study* (《山西方言調查研究報告》: Hou Jingyi & Wen Duanzheng, 1993);

(3) The Collecting and Recording Platform of China Language Resources (中國語言資源保護工程采錄展示平台)[14].

Among the works of (1), there are specialized local dialectal records available for Pingyao, Jiexiu, and Xiaoyi Jin, while there is only an all-encompassing local chronicle for Fenyang, in which a chapter on local dialect is contained[15]. Work (2) is a comprehensive description of the Chinese dialects that are spoken in Shanxi Province. Both work (1) and (2) were completed in the 1980s~1990s. Limited by the general methodology at that time, all phonetic value in these works was transcribed in an impressionistic fashion. Therefore, it was unavoidable for each fieldworker to transcribe tone value by their subjective judgment, which might inevitably result in some problems of inaccuracy.

On the other hand, as a program carried out in the 2010s, tonal transcriptions in work (3) are instrumental-based. Therefore, the accuracy of transcription could basically be guaranteed. Work (3) contains 56 Jin varieties spoken in Shanxi, including Pingyao, Jiexiu, and Xiaoyi while not Fenyang.

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[14] URL: https://zhongguoyuyan.cn/index.html?lang=cn (Last accessed date: Apr. 13, 2022).

[15] Detailed information of these works are as follows.
Pingyao: *A Short Record of Pingyao Dialect* (《平遙方言簡誌》: Hou Jingyi, 1981);
Jiexiu: *A Record of Jiexiu Dialect* (《介休方言誌》: Zhang Yimei, 1991);
Xiaoyi: *A Record of Xiaoyi Dialect* (《孝義方言誌》: Guo Jianrong, 1989);
Fenyang: *The Local Chronicle of Fenyang County Vol.35: the Dialect and Local Folk Adage* (《汾陽縣誌 卷三十五：方言俗語》: The Editorial Board, 1998: 911-912).

Despite the difference in the way of measurement, tone values are all transcribed with Chao letters (Chao Yuen Ren, 1930, a five-point scale) in work (1), (2), and (3). For convenience, we refer to *Yin-Ping*, *Yang-Ping*, *Shang*, *Qu*, *Yin-Ru*, and *Yang-Ru* in the four Jin varieties as T1, T2, T3, T4, T5, and T6 in the following discussions.

Variety	Source	Tone value transcription					
		Ping 平聲		*Shang* T3 上聲	*Qu* T4 去聲	*Ru* 入聲	
		Yin-Ping T1 陰平	*Yang-Ping* T2 陽平			*Yin-Ru* T5 陰入	*Yang-Ru* T6 陽入
Fenyang 汾陽	(a)	{313}	{22}	{424}	{53}	{1}	{212}
	(b)	{324}	{22}	{312}	{55}	{22}	{312}
Pingyao 平遙	(a)	{13}		{53}	{35}	{13}	{53}
	(b)	{13}		{53}	{35}	{13}	{53}
	(c)	{213}		{512}	{24}	{212}	{523}
Jiexiu 介休	(a)	{13}		{423}	{45}	{13}	{423}
	(b)	{13}		{523}	{45}	{13}	{523}
	(c)	{13}		{423}	{45}	{12}	{312}
Xiaoyi 孝義	(a)	{11}		{312}	{53}	{2}	{312}
	(b)	{11}		{312}	{53}	{2}	{312}
	(c)	{33}		{312}	{454}	{3}	{423}

Table 3: Tone value transcriptions of the four Jin varieties in previous studies

According to the transcriptions of these previous studies, the four Jin varieties are common to the fact that T5 and T6 are similar to T2 and T3 respectively in terms of either pitch value or general contour type (refer to the correspondence rules: Shen Ming, 1999). Besides, most of the T3 in the four varieties seem to be uttered as a right-dipping tone which is a kind of tonotype containing a higher onset and a lower offset (Zhu Xiaonong, Zhang Ting, et al, 2012). On the other hand, T1/T2 and T4 are simpler non-dipping tonotypes, but they seem to be distinguishable by pitch value as T1/T2 is usually lower than T4. It is worth noting that Fenyang Jin shows a similarity between T1 and T3, which is interpreted by Shen Ming & Akitani Hiroyuki (2018) as a kind of transitional property of Lüliang cluster of which Fenyang Jin variety is listed as a member. The transitional

distribution of the distinguishability between T1 and T3 could be demonstrated by the following *Table 4*.

Cluster	Distinguishability between T1 and T3
Wutai 五臺片	indistinguishable (merged)
Lüliang 呂梁片	distinguishable but similar in pitch value and contour
Bingzhou 幷州片	distinguishable and obviously different in pitch value and contour

Table 4: Transitional distribution of the distinguishability between Yin-Ping (T1) and Shang (T3)

Additionally, there is a notable internal variation within Fenyang Jin. The previous descriptions of Fenyang Jin variety in previous studies we listed above are usually based on the urban accent[16], while there exists a special kind of rural accent which is spoken in Yanwu Town (演武鎮) which is a small town located 15 km away from the urban area of Fenyang in the southeast. Yanwu accent is reported that preserve only a single *Ping* tonal category in its tonal inventory, which is in accord with Bingzhou Jin varieties. Geographically, Yanwu Town is adjacent to Pingyao and Jiexiu as well. Despite the T1/T2 merger, Yanwu accent is still identified as a Fenyang Jin variety as it shares all other relevant sound changes with the other parts in Fenyang. The tone value transcriptions of Yanwu accent are exhibited in the following *Table 5* (Tian Shiai, 2016). These transcriptions are instrumental-based.

Variety	Tone value transcription				
	Ping T1-T2 平聲	*Shang* T3 上聲	*Qu* T4 去聲	*Ru* 入聲	
				Yin-Ru T5 陰入	*Yang-Ru* T6 陽入
Yanwu, Fenyang 汾陽演武	{33}	{513}	{35}	{33}	{513}

Table 5: Tone value transcriptions of Yanwu accent, Fenyang Jin (Tian Shiai, 2016)

[16] In terms of administrative division, the urban area of Fenyang City is divided as Taiheqiao Sub-district (太和橋街道). The urban accent is spoken in the urban area and the adjacent suburban areas.

3.2 Fieldwork and data processing method

We carried out two times of fieldwork, with the first time (November 2021) being exclusively on Pingyao Jin, while the second time (December 2021~January 2022) covering Pingyao and the other three Jin varieties in question: Fenyang, Jiexiu, and Xiaoyi, together with another two: Wenshui and Qixian which function as a reference group. For each variety, we employed 2~3 native consultants by paying them nominal fees.

During the fieldwork, we rent a noise-proved room in each county for recording. We used a SONY recorder (ICD-PX312M) and the microphone to record the sound (dual track, 16 bits, 22,050 sampling rate), and all sound files were saved as WAVE files. Sound files were analyzed with Praat.

We selected real morphemes as the materials to record. All morphemes to be read by the consultants are syllables comprised of a voiceless plosive plus a monophthong (palatalized /tɕi/</*ki/ and /tsɿ/, /tʂɿ/ also included). These morphemes are listed in Appendix I: Word list (see Page 93).

The numbers of tokens we recorded for one consultant are as follows.

(1) Fenyang: T1 (84), T2 (45), T3 (54), T4 (64), T5 (25), T6 (25), Total (297);

(2) Pingyao: T1 (51), T2 (70), T3 (57), T4 (57), T5 (33), T6 (27), Total (295);

(3) Jiexiu: T1 (44), T2 (45), T3 (51), T4 (42), T5 (24), T6 (24), Total (230);

(4) Xiaoyi: T1 (65), T2 (54), T3 (70), T4 (70), T5 (25), T6 (24), Total (308);

(5) Wenshui: T1 (60), T2 (55), T3 (42), T4 (42), T5 (25), T6 (25), Total (249);

(6) Qixian: T1 (72), T2 (55), T3 (72), T4 (75), T5 (30), T6 (24), Total (328).

Since the physical signals of tokens may contain interpersonal random differences, we have to as far as possible eliminate these random differences to identify the underlying parameters, and in turn, categorize the value of each tonal category. For this purpose, we employ the method of logarithm z-score normalization (hereafter LZ) (Zhu Xiaonong, 2004, 2010) to deal with the original pitch value. The formula is as follows, in which *i* refers to the sampling points on the contour. In this research, we select the points of 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, and 100% on the contour of equalized duration of each token.

$$z_i = \frac{y_i - m_y}{s_y} = \frac{\log_{10} x_i - \frac{1}{n}\sum_{i=1}^{n} \log_{10} x_i}{\sqrt{\frac{1}{n-1}\sum_{i=1}^{n} (\log_{10} x_i - \frac{1}{n}\sum_{i=1}^{n} \log_{10} x_i)^2}}$$

We did not treat the whole F0 line measured by Praat as the tonal target of each token. We select the second pulse of the nucleus as the starting point. The first pulse should be abandoned since the voice at this point is usually too weak to be capturable, and thus, it should not be included in the tonal target. As for ending point, we select the point where the amplitude begins to decline obviously and the second formant becomes unclear. We employ the following broadband Figure 1, which is a real token of /ki^{T3}/ (‘杆, pole’, Fenyang Jin) uttered by a Fenyang Jin consultant, to exemplify our criterion for capturing the tonal target part of each token. The scope enclosed by red lines is the tonal target part of this token.

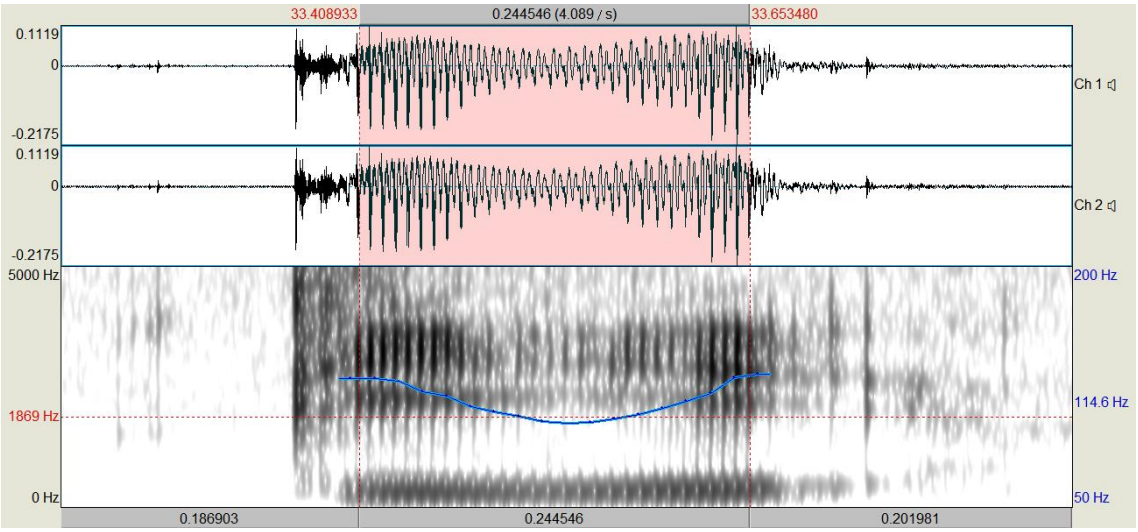

Figure 1: Broadband figure of /ki^{T3}/ (‘杆, pole’, Fenyang Jin)

3.3 Tonal data

The demonstrations of the tonal data follows the sequence of Fenyang→Pingyao→Jiexiu→Xiaoyi.

3.3.1 Tonal data of Fenyang Jin

We recorded tokens from three Fenyang Jin consultants, of which two are native to the urban accent and one is native to Yanwu accent. Their profiles of them are as follows.

(1) FY1 (Urban): Male; Born in 1960s; Low proficiency in Beijing Mandarin;

(2) FY2 (Urban): Male; Born in 1980s; Relatively high proficiency in Beijing Mandarin[17];

[17] A ‘relatively high’ judgment for a consultant’s proficiency in Beijing Mandarin means that s/he can speak fluent Beijing Mandarin (Modern Standard Chinese, also known as *Putonghua* in *Pinyin*), while it is not her/his first language. In all cases of the consultants we employed, their first languages are the local Jin varieties.

(3) FY3 (Yanwu): Male; Born in 1960s; Low proficiency in Beijing Mandarin.

Table 6~8 exhibit the tonal data of FY1 (Urban).

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	120.46	116.24	110.10	105.20	101.89	100.43	100.83	102.85	106.57	114.67	121.52
T2	127.11	123.41	119.68	116.08	113.17	110.60	107.70	105.42	104.43	105.20	104.81
T3	124.40	121.74	114.66	107.89	103.92	102.17	101.55	102.22	105.60	113.97	120.52
T4	127.69	127.61	129.88	131.79	132.54	132.59	133.13	135.17	139.50	143.32	142.82
T5	127.05	126.49	123.27	119.75	116.73	113.25	110.44	109.73	111.20	114.63	116.57
T6	131.62	126.83	123.27	116.90	110.19	107.24	105.02	103.44	104.80	108.61	110.33

Table 6: Averaged value (Hz) at 11 sampling points (FY1)

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	0.40	0.09	-0.38	-0.78	-1.05	-1.18	-1.14	-0.97	-0.66	-0.02	0.49
T2	0.88	0.63	0.36	0.09	-0.13	-0.33	-0.56	-0.75	-0.83	-0.77	-0.80
T3	0.68	0.49	-0.03	-0.55	-0.88	-1.02	-1.07	-1.02	-0.74	-0.08	0.40
T4	0.91	0.91	1.06	1.18	1.23	1.23	1.27	1.41	1.68	1.92	1.90
T5	0.88	0.84	0.61	0.35	0.13	-0.13	-0.35	-0.40	-0.28	-0.02	0.13
T6	1.19	0.87	0.62	0.15	-0.39	-0.60	-0.78	-0.92	-0.81	-0.49	-0.35

Table 7: Averaged LZ-normalized value at 11 sampling points (FY1)

	T1	T2	T3	T4	T5	T6
Duration (ms)	268.92	250.11	276.93	143.67	140.00	227.70
Ave. F0 (Hz)	107.94	112.16	109.60	134.08	116.71	112.80

Table 8: Averaged duration and F0 value (FY1)

Table 9~11 exhibit the tonal data of FY2 (Urban).

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	124.27	117.07	110.82	105.61	102.30	101.44	102.17	103.16	103.14	102.02	100.21
T2	126.97	119.77	114.78	111.44	109.13	107.07	104.81	102.29	99.28	96.30	94.13
T3	124.29	117.39	110.69	104.06	97.78	94.84	96.60	99.83	101.64	100.91	99.50
T4	127.20	124.05	123.00	122.56	122.05	121.40	120.56	119.46	117.82	115.67	112.84

T5	127.44	122.63	117.32	116.08	114.56	112.26	109.81	107.88	105.53	102.86	102.11
T6	130.96	120.77	113.54	105.05	97.11	93.05	92.19	95.22	100.28	101.62	102.26

Table 9: Averaged value (Hz) at 11 sampling points (FY2)

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	1.31	0.71	0.15	-0.34	-0.67	-0.76	-0.68	-0.58	-0.58	-0.69	-0.87
T2	1.54	0.95	0.51	0.21	0.00	-0.20	-0.41	-0.66	-0.96	-1.28	-1.51
T3	1.33	0.74	0.14	-0.49	-1.13	-1.44	-1.25	-0.91	-0.72	-0.80	-0.94
T4	1.56	1.31	1.22	1.19	1.14	1.09	1.02	0.92	0.78	0.59	0.34
T5	1.59	1.20	0.74	0.64	0.50	0.29	0.07	-0.11	-0.34	-0.60	-0.67
T6	1.84	1.02	0.39	-0.40	-1.19	-1.62	-1.74	-1.40	-0.86	-0.73	-0.66

Table 10: Averaged LZ-normalized value at 11 sampling points (FY2)

	T1	T2	T3	T4	T5	T6
Duration (ms)	222.35	215.54	228.82	161.95	138.31	193.25
Ave. F0 (Hz)	105.96	107.49	103.53	120.65	112.39	103.55

Table 11: Averaged duration and F0 value (FY2)

Table 12~14 exhibit the tonal data of FY3 (Yanwu).

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	119.50	115.80	106.80	98.50	91.86	87.14	83.30	79.86	77.19	74.45	70.65
T2	122.54	118.06	111.45	105.71	100.66	96.89	93.72	90.11	85.83	80.88	75.18
T3	143.80	143.90	136.97	123.08	111.58	100.18	95.39	90.48	87.79	83.91	76.33
T4	118.61	121.32	123.67	125.72	128.42	131.61	134.54	136.23	137.56	138.82	139.67
T5	122.24	119.81	116.65	113.36	109.14	104.01	97.94	93.02	88.73	84.47	81.37
T6	151.60	149.99	/	/	77.23	59.93	57.46	64.04	75.53	85.76	86.44

Table 12: Averaged value (Hz) at 11 sampling points (FY3)

As for the data of FY3, we have to mention that most of his T3/T6 tokens are strongly creaky-colored voice, and thus the F0 value on most sampling points is unmeasurable. For T3, we only recorded three tokens in which the F0 value on all sampling points is detectable, while in cases of T6, nearly all tokens were strongly creaky-colored voice. We recorded only one T6 token that has a relatively unbroken F0 line. It is a token of /kəʔ^{T6}/ (‘胳, arm’), which could be detected clear F0 value

on all the sampling points except 20% and 30%. From the pitch value we recorded at each sampling point, it is obvious that this token was realized as a right-dipping tone. However, most of the T6 tokens of FY3 we collected sound like a falling tone without an inflection point. We interpret this as a phenomenon of variation and the right-dipping tone should be an unfrequent and non-contrastive variety of T6. In Table 12~14, the data in the rows of T3 and T6 are based on the tokens that the F0 value is detectable, with those strong creaky-colored tokens being excluded. Since the T6 token we mentioned above has two sampling points (20%, 30%) that are unmeasurable, we instead employ two slashes '/' to fill in the corresponding cells in the table. Despite the undetectability of the F0 value in the creaky-colored T3/T6 tokens, their 0% sampling points (onset) are usually detectable, which is probably because T3 and T6 are high-falling tones with a high and stable onset in the normal range of pitch. According to the comparisons with the tokens of other tonal categories, the T3/T6 tokens uttered by FY3 all start with a much higher F0 value than that of T1/T2 which have similar falling contours. Therefore, it may be the higher onset of T3/T6 that makes them distinguishable from other tonal categories. We demonstrate the broadband figures of a T1 token (/ki^{T1}/, '竿, bamboo pole') and a T3 token (/ki^{T3}/, '杆, pole') to show their difference in onset.

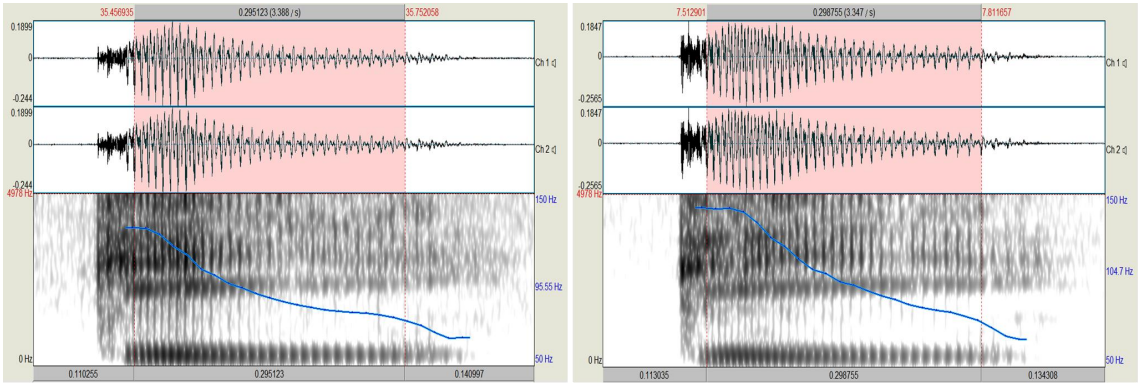

Figure 2: Contrast between [left] *Yin-Ping* (T1) and [right] *Shang* (T3) of FY3

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	0.81	0.67	0.29	-0.08	-0.40	-0.64	-0.85	-1.05	-1.21	-1.38	-1.62
T2	0.93	0.76	0.49	0.25	0.02	-0.15	-0.31	-0.49	-0.72	-0.99	-1.33
T3	1.67	1.67	1.44	0.95	0.49	-0.03	-0.26	-0.49	-0.63	-0.82	-1.24
T4	0.78	0.88	0.97	1.04	1.14	1.25	1.34	1.40	1.44	1.48	1.50
T5	0.92	0.83	0.71	0.57	0.40	0.18	-0.10	-0.34	-0.57	-0.79	-0.96
T6	1.91	1.86	/	/	-1.19	-2.35	-2.55	-2.05	-1.29	-0.71	-0.67

Table 13: Averaged LZ-normalized value at 11 sampling points (FY3)

	T1	T2	T3	T4	T5	T6
Duration (ms)	285.61	260.86	280.12	146.84	163.66	236.33
Ave. F0 (Hz)	91.03	98.25	108.45	130.71	102.91	85.77

Table 14: Averaged duration and F0 value (FY3)

Based on these tonal data, we will then plot the contours of these tonal categories for each consultant of Fenyang Jin. Considering the convenience of interpreting these figures, we will separate the lax tones (舒聲調) T1~T4 and *Ru* tones (入聲調) T5~T6 into two different figures. The figure of equalized duration will be demonstrated first in consideration of the convenience of contrasting the general contours between these tonal categories. The figure of absolute duration will then follow.

Figure 3~4 are the data of FY1 (Urban).

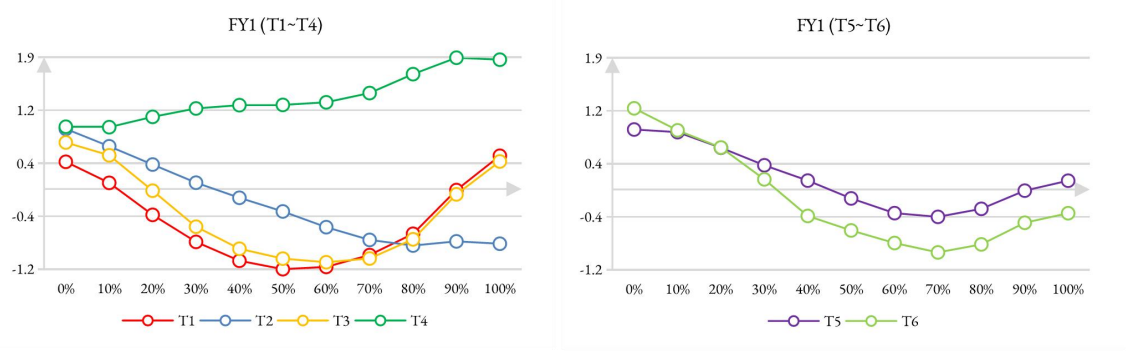

Figure 3: Duration-equalized contour of each tonal category (FY1): [Left] T1~T4; [Right]: T5~T6

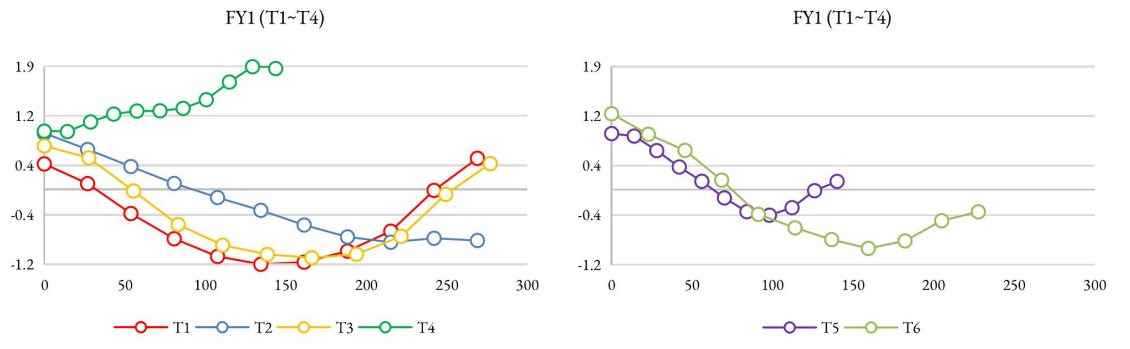

Figure 4: Contour of absolute duration of each tonal category (FY1): [Left] T1~T4; [Right]: T5~T6

Figure 5~6 are the data of FY2 (Urban).

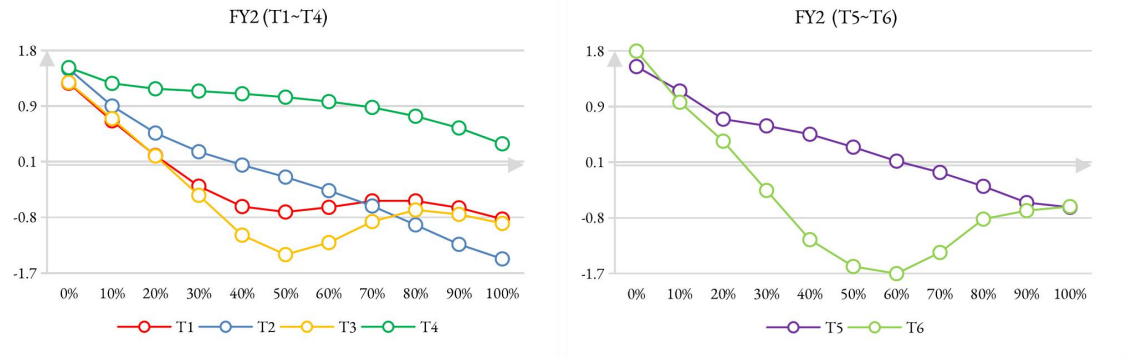

Figure 5: Duration-equalized contour of each tonal category (FY2): [Left] T1~T4; [Right]: T5~T6

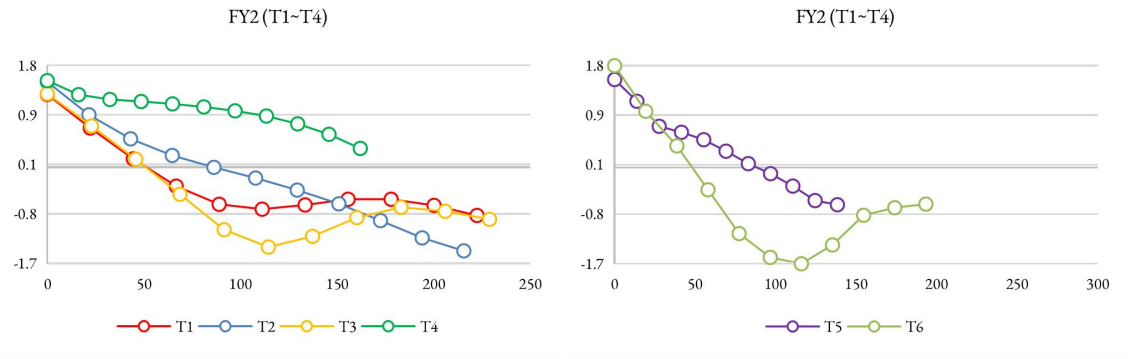

Figure 6: Contour of absolute duration of each tonal category (FY2): [Left] T1~T4; [Right]: T5~T6

Figure 7~8 are the data of FY3 (Yanwu).

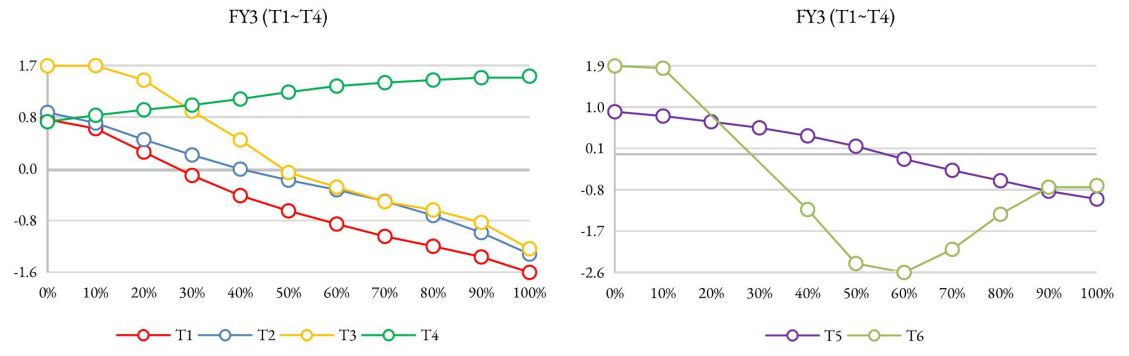

Figure 7: Duration-equalized contour of each tonal category (FY3): [Left] T1~T4; [Right]: T5~T6

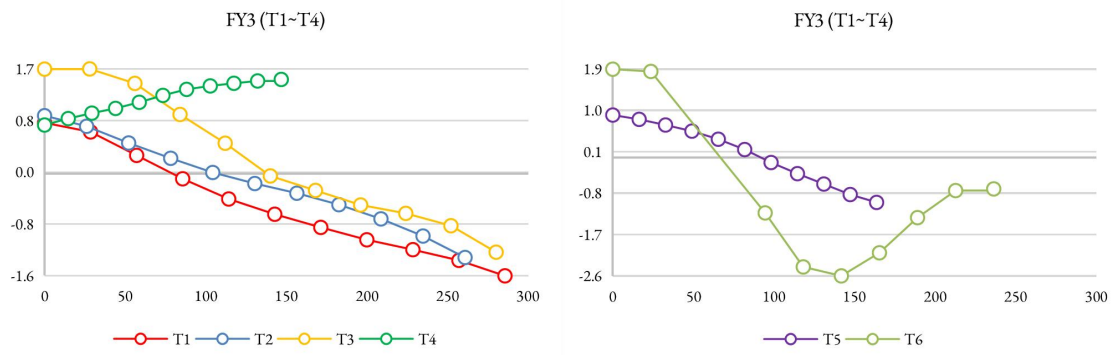

Figure 8: Contour of absolute duration of each tonal category (FY3): [Left] T1~T4; [Right]: T5~T6

3.3.2 Tonal data of Pingyao Jin

We recorded tokens from two Pingyao Jin consultants, of which one is native to the urban accent[18] while another one is native to a kind of countryside accent spoken in Duancun Town (段村鎮). Nevertheless, there is no categorical difference between the two kinds of accents. The two consultants' profiles are as follows.

(1) PY1 (Urban): Male; Born in 1980s; Relatively high proficiency in Beijing Mandarin;

(2) PY2 (Duancun): Male; Born in 1990s; Relatively high proficiency in Beijing Mandarin.

Table 15~17 exhibit the tonal data of PY1.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	145.50	141.43	135.22	129.92	126.52	126.00	129.28	134.62	139.22	142.07	142.91
T2	150.74	146.91	139.77	131.36	123.47	122.58	127.65	136.77	146.18	151.42	150.49
T3	236.29	224.59	187.38	144.45	120.32	114.67	116.09	122.43	131.13	136.26	135.53
T4	122.03	122.94	126.98	134.80	145.06	156.25	166.21	174.64	179.67	181.98	180.08
T5	138.98	127.86	123.91	122.08	121.21	121.70	123.52	125.86	128.24	129.32	130.39
T6	213.69	187.07	161.64	139.11	124.13	118.55	116.88	116.80	118.64	120.83	121.26

Table 15: Averaged LZ-normalized value at 11 sampling points (PY1)

[18] In terms of administrative division, the urban area of Pingyao County is divided as Gutao Town (古陶鎮). The urban accent is basically spoken inside the scope enclosed by the city wall (城墻).

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	0.25	0.09	-0.16	-0.39	-0.53	-0.56	-0.42	-0.20	-0.01	0.11	0.14
T2	0.45	0.31	0.03	-0.32	-0.67	-0.71	-0.48	-0.09	0.28	0.48	0.44
T3	2.97	2.69	1.67	0.20	-0.83	-1.10	-1.03	-0.73	-0.35	-0.13	-0.15
T4	-0.74	-0.70	-0.52	-0.18	0.23	0.65	0.99	1.27	1.43	1.51	1.44
T5	-0.02	-0.49	-0.66	-0.75	-0.78	-0.76	-0.68	-0.58	-0.47	-0.42	-0.37
T6	2.41	1.66	0.84	0.00	-0.64	-0.90	-0.98	-0.98	-0.90	-0.80	-0.77

Table 16: Averaged LZ-normalized value at 11 sampling points (PY1)

	T1	T2	T3	T4	T5	T6
Duration (ms)	332.06	382.90	369.32	258.26	242.99	309.17
Ave. F0 (Hz)	134.83	137.71	148.50	154.01	125.67	136.35

Table 17: Averaged duration and F0 value (PY1)

Table 18~20 exhibit the tonal data of PY2.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	119.26	111.79	107.54	103.90	102.17	101.11	100.84	100.98	101.50	102.66	105.29
T2	125.35	116.66	111.09	106.75	103.88	102.47	101.70	101.96	102.78	104.40	104.72
T3	174.94	155.68	132.06	113.27	103.69	100.11	98.34	97.48	97.66	98.87	101.93
T4	112.96	109.89	109.52	110.20	112.15	115.40	120.90	128.33	136.56	141.66	142.22
T5	127.06	114.18	108.31	104.41	101.96	100.82	100.16	100.78	101.27	101.96	104.28
T6	168.77	151.04	132.77	116.99	106.78	101.81	99.35	98.91	98.51	98.32	101.73

Table 18: Averaged LZ-normalized value at 11 sampling points (PY2)

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	0.51	0.05	-0.23	-0.48	-0.60	-0.67	-0.69	-0.68	-0.64	-0.56	-0.38
T2	0.86	0.35	0.00	-0.28	-0.48	-0.58	-0.63	-0.61	-0.55	-0.44	-0.42
T3	3.25	2.41	1.23	0.14	-0.49	-0.74	-0.87	-0.93	-0.92	-0.83	-0.62
T4	0.12	-0.08	-0.10	-0.06	0.07	0.27	0.60	1.03	1.47	1.74	1.76
T5	0.95	0.20	-0.18	-0.44	-0.61	-0.69	-0.74	-0.69	-0.66	-0.61	-0.45
T6	2.99	2.20	1.28	0.37	-0.28	-0.62	-0.80	-0.83	-0.86	-0.88	-0.63

Table 19: Averaged LZ-normalized value at 11 sampling points (PY2)

	T1	T2	T3	T4	T5	T6
Duration (ms)	262.16	271.17	271.22	192.72	205.12	197.18
Ave. F0 (Hz)	104.40	106.50	113.35	121.17	104.77	113.91

Table 20: Averaged duration and F0 value (PY2)

In the same way that we did for the tonal data of Fenyang Jin above, we will visualize the data of Pingyao Jin by plotting them in the following Figure 9~12.

Figure 9~10 are the data of PY1.

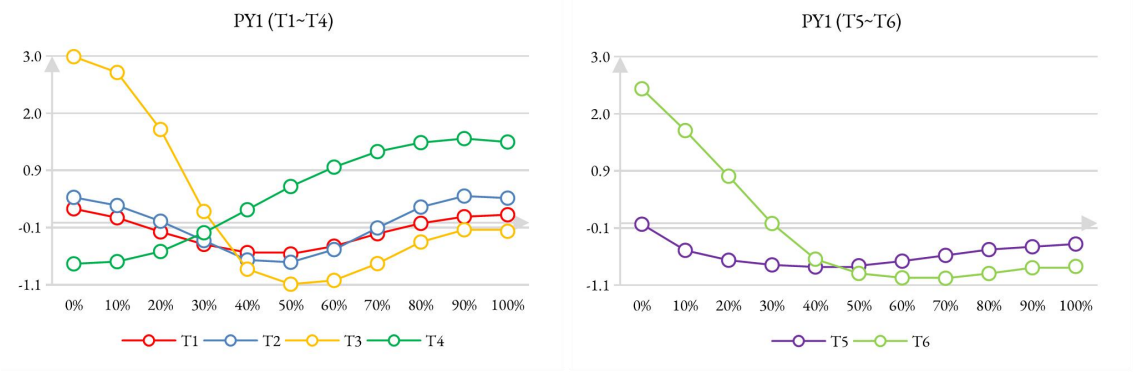

Figure 9: Duration-equalized contour of each tonal category (PY1): [Left] T1~T4; [Right]: T5~T6

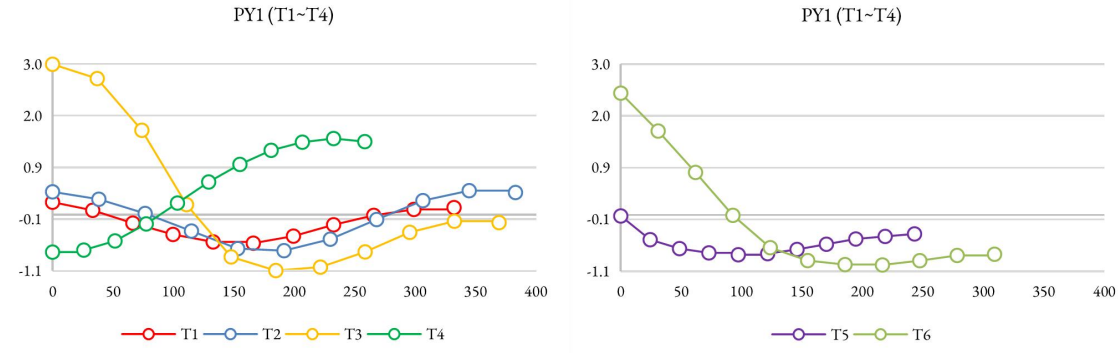

Figure 10: Contour of absolute duration of each tonal category (PY1): [Left] T1~T4; [Right]: T5~T6

Figure 11~12 are the data of PY2.

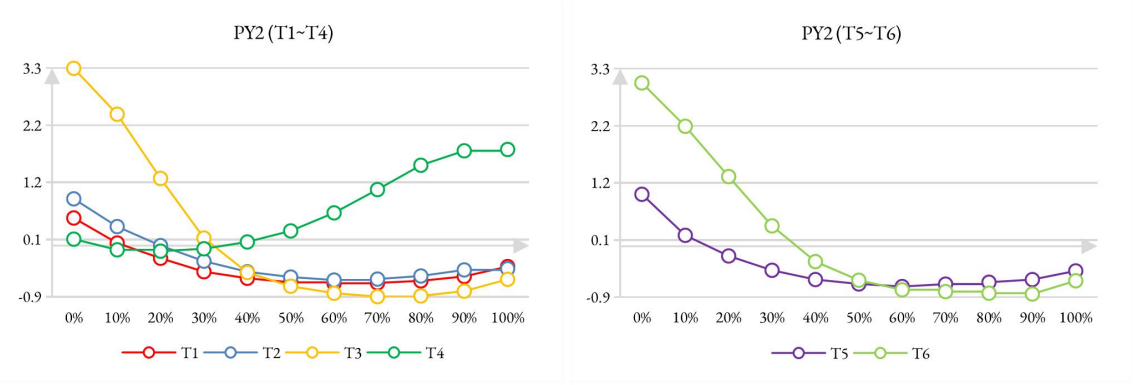

Figure 11: Duration-equalized contour of each tonal category (PY2): [Left] T1~T4; [Right]: T5~T6

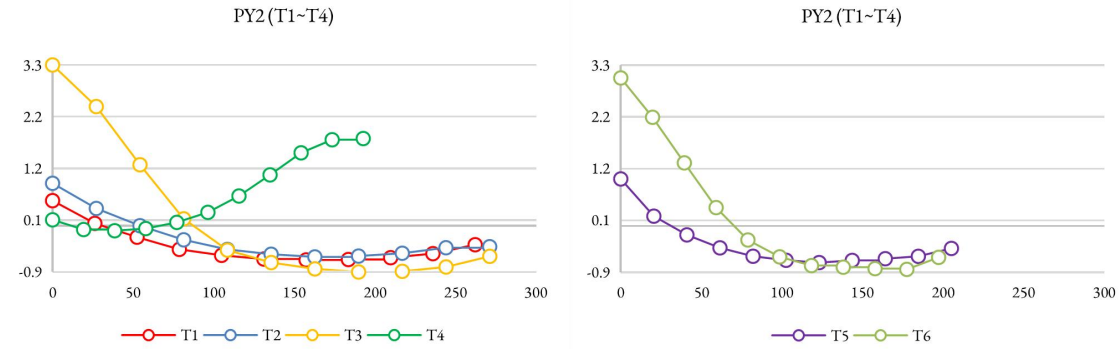

Figure12: Contour of absolute duration of each tonal category (PY2): [Left] T1~T4; [Right]: T5~T6

3.3.3 Tonal data of Jiexiu Jin

We recorded tokens from two Jiexiu Jin consultants. They are both native to the urban accent[19]. Their profiles are as follows.

(1) JX1: Male; Born in 1970s; Low proficiency in Beijing Mandarin;

(2) JX2: Male; Born in 1980s; Relatively high proficiency in Beijing Mandarin.

Table 21~23 exhibit the tonal data of JX1.

[19] In terms of administrative division, the urban area of Jiexiu County is divided as Beiguan Sub-district (北關街道). The urban accent is spoken in the urban area as well as the adjacent suburban areas.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	156.03	147.62	144.39	142.23	141.66	142.66	145.92	151.45	158.14	160.61	154.34
T2	158.03	153.80	151.49	149.10	149.05	150.96	155.46	162.13	168.52	171.10	163.53
T3	242.99	232.70	208.27	179.60	159.25	148.72	144.43	144.53	147.49	149.75	146.22
T4	158.59	159.15	164.83	171.70	178.47	184.62	189.85	192.58	192.26	186.95	177.49
T5	158.25	140.23	133.85	129.52	126.45	126.20	128.94	134.29	141.61	148.92	146.03
T6	227.71	216.41	191.58	161.43	141.36	134.26	132.71	135.25	138.86	140.50	136.43

Table 21: Averaged LZ-normalized value at 11 sampling points (JX1)

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	-0.11	-0.48	-0.63	-0.73	-0.76	-0.71	-0.57	-0.32	-0.04	0.07	-0.19
T2	-0.03	-0.21	-0.31	-0.41	-0.41	-0.33	-0.13	0.14	0.40	0.50	0.20
T3	2.79	2.51	1.78	0.81	0.02	-0.43	-0.62	-0.62	-0.49	-0.39	-0.54
T4	-0.02	-0.02	0.22	0.49	0.74	0.97	1.15	1.25	1.24	1.07	0.73
T5	-0.24	-0.96	-1.18	-1.35	-1.48	-1.49	-1.34	-1.03	-0.67	-0.37	-0.52
T6	1.87	1.60	0.88	-0.11	-0.91	-1.23	-1.29	-1.19	-1.00	-0.90	-0.99

Table 22: Averaged LZ-normalized value at 11 sampling points (JX1)

	T1	T2	T3	T4	T5	T6
Duration (ms)	261.35	252.02	286.55	156.24	250.95	253.49
Ave. F0 (Hz)	148.94	157.30	177.03	178.90	136.07	157.39

Table 23: Averaged duration and F0 value (JX1)

Table 24~26 exhibit the tonal data of JX2.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	134.03	128.23	124.41	121.79	122.12	124.89	129.45	134.53	140.59	146.69	146.55
T2	133.68	129.09	127.12	125.72	126.22	129.14	133.97	139.87	146.19	151.54	150.94
T3	183.20	184.26	169.11	145.08	126.25	119.11	121.19	127.98	136.54	143.74	142.91
T4	136.37	134.75	138.50	144.53	150.68	156.50	161.88	166.91	171.00	172.01	168.61
T5	137.10	130.42	125.75	124.12	124.75	127.07	130.15	134.01	138.24	141.64	141.17
T6	156.28	148.94	140.34	131.41	124.16	119.03	120.68	126.40	133.19	138.04	137.00

Table 24: Averaged LZ-normalized value at 11 sampling points (JX2)

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	-0.38	-0.71	-0.93	-1.08	-1.06	-0.89	-0.63	-0.34	-0.01	0.30	0.29
T2	-0.40	-0.66	-0.77	-0.85	-0.82	-0.65	-0.38	-0.05	0.28	0.54	0.51
T3	1.95	1.98	1.34	0.20	-0.83	-1.26	-1.13	-0.72	-0.24	0.13	0.09
T4	-0.25	-0.34	-0.14	0.18	0.49	0.77	1.02	1.25	1.43	1.48	1.33
T5	-0.21	-0.59	-0.88	-0.98	-0.95	-0.80	-0.61	-0.39	-0.15	0.03	0.01
T6	0.71	0.34	-0.07	-0.53	-0.95	-1.27	-1.17	-0.83	-0.44	-0.18	-0.24

Table 25: Averaged LZ-normalized value at 11 sampling points (JX2)

	T1	T2	T3	T4	T5	T6
Duration (ms)	395.14	380.13	409.51	257.12	213.51	379.61
Ave. F0 (Hz)	131.28	135.13	143.69	154.93	131.52	132.86

Table 26: Averaged duration and F0 value (JX2)

The tonal data of Jiexiu Jin are plotted in the following Figure 13-16.

Figure 13~14 exhibit data of JX1.

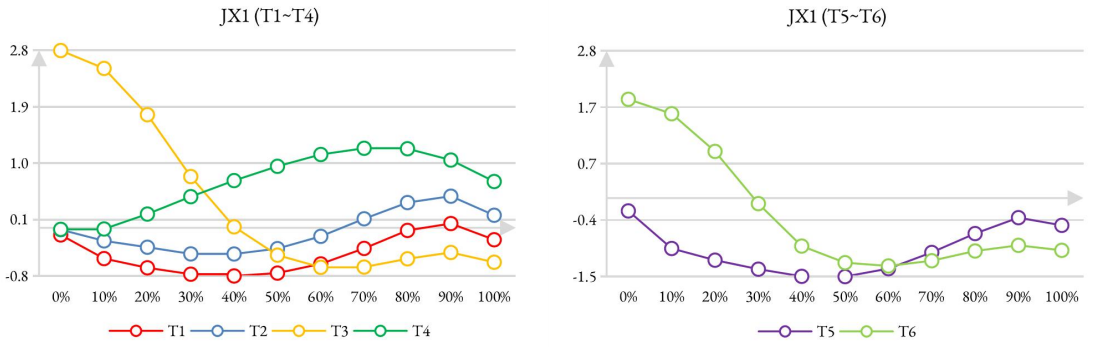

Figure 13: Duration-equalized contour of each tonal category (JX1): [Left] T1~T4; [Right]: T5~T6

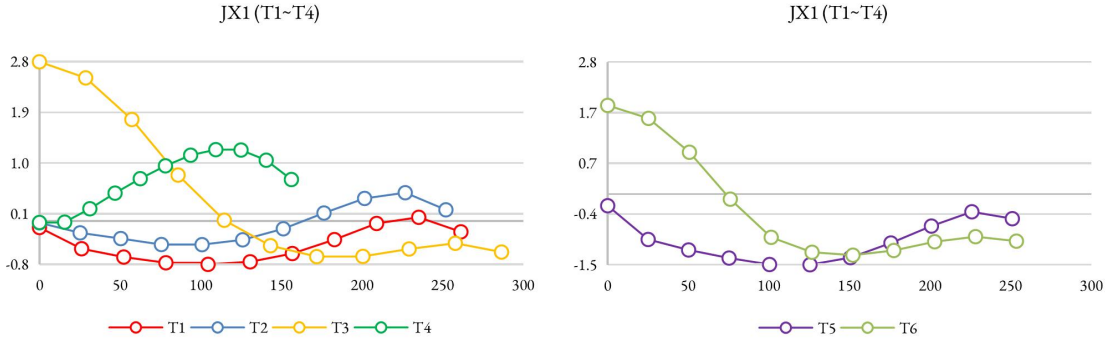

Figure 14: Contour of absolute duration of each tonal category (JX1): [Left] T1~T4; [Right]: T5~T6

Figure 15~16 exhibit data of JX2.

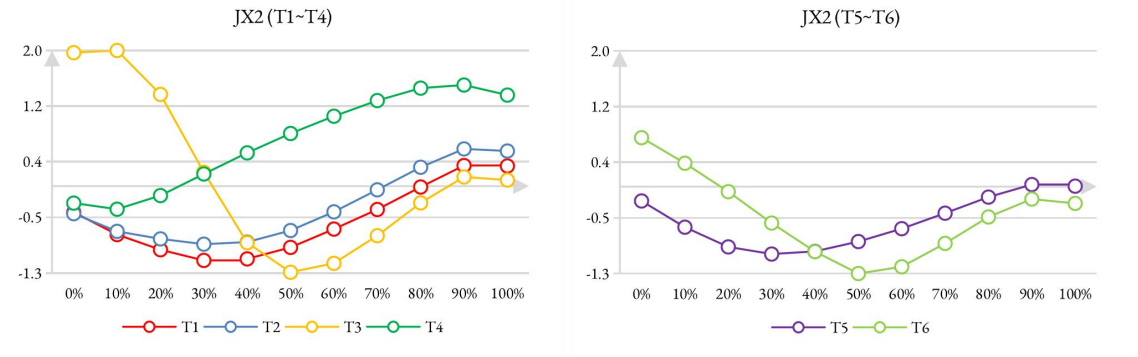

Figure 15: Duration-equalized contour of each tonal category (JX2): [Left] T1~T4; [Right]: T5~T6

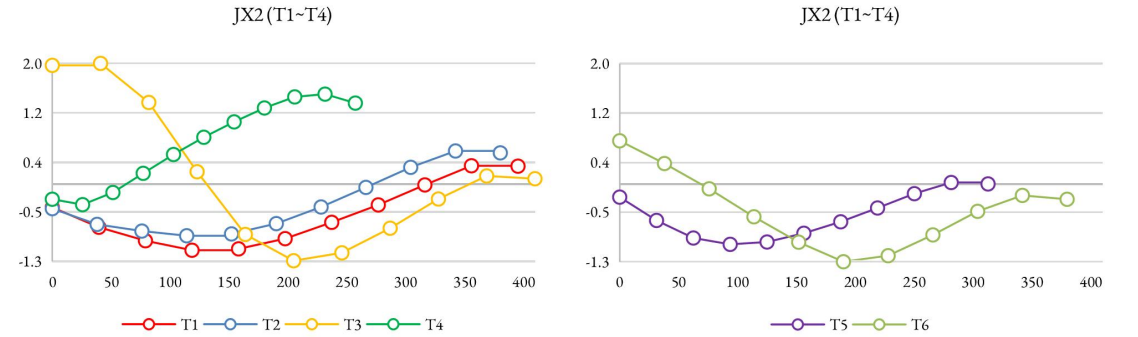

Figure 16: Contour of absolute duration of each tonal category (JX2): [Left] T1~T4; [Right]: T5~T6

3.3.4 Tonal data of Xiaoyi Jin

We recorded tokens from two Xiaoyi Jin consultants. These two consultants are both native to the urban accent[20]. The following are the profiles of these two consultants.

(1) XY1: Male; Born in 1950s; Low proficiency in Beijing Mandarin;

(2) XY2: Male; Born in 1980s; Relatively high proficiency in Beijing Mandarin.

Table 27~29 exhibit the tonal data of XY1.

[20] In terms of administrative division, the urban area of Xiaoyi City is divided as two sub-districts: Zhongyanglou (中陽樓街道) and Xinxi (新義街道). The two sub-districts basically correspond to the town and the newly-built town respectively. The urban accent is spoken in these two regions.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	107.84	107.96	105.50	101.13	97.33	95.19	94.00	93.66	92.88	89.65	81.65
T2	114.84	117.54	115.38	111.14	107.76	106.35	107.10	109.05	110.79	108.86	99.68
T3	138.71	143.39	136.14	122.32	117.99	118.66	117.72	117.75	118.32	115.82	107.27
T4	126.86	132.45	141.04	147.86	154.06	158.04	159.12	158.31	154.51	147.66	137.05
T5	114.96	112.71	110.52	108.63	106.47	104.49	103.04	101.37	99.83	97.41	92.76
T6	145.87	150.48	141.97	120.20	111.53	111.95	112.95	111.66	109.04	105.34	97.72

Table 27: Averaged LZ-normalized value at 11 sampling points (XY1)

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	-0.26	-0.26	-0.39	-0.61	-0.82	-0.94	-1.01	-1.04	-1.10	-1.29	-1.77
T2	0.08	0.20	0.10	-0.09	-0.26	-0.32	-0.29	-0.20	-0.12	-0.21	-0.68
T3	1.08	1.25	0.94	0.38	0.22	0.25	0.21	0.21	0.22	0.09	-0.32
T4	0.61	0.84	1.16	1.41	1.62	1.76	1.79	1.77	1.64	1.39	0.98
T5	0.11	0.00	-0.11	-0.20	-0.30	-0.40	-0.48	-0.57	-0.65	-0.78	-1.04
T6	1.36	1.53	1.23	0.34	-0.06	-0.04	0.01	-0.05	-0.17	-0.36	-0.76

Table 28: Averaged LZ-normalized value at 11 sampling points (XY1)

	T1	T2	T3	T4	T5	T6
Duration (ms)	296.82	310.39	285.94	168.26	171.81	199.39
Ave. F0 (Hz)	97.18	110.27	123.32	148.61	104.85	120.05

Table 29: Averaged duration and F0 value (XY1)

Table 30~32 exhibit the tonal data of XY2.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	117.76	115.77	113.31	110.37	106.86	103.95	102.03	101.40	102.16	102.18	100.70
T2	126.20	120.73	116.88	112.24	108.12	104.87	104.08	104.12	104.15	104.15	102.06
T3	140.34	141.59	132.40	/	/	/	107.83	104.18	103.35	102.95	100.63
T4	122.81	121.30	121.38	121.63	121.30	120.68	119.97	118.14	115.49	113.33	111.17
T5	118.55	117.73	116.85	115.04	112.64	110.07	108.66	107.45	106.07	104.73	103.25
T6	133.59	132.99	127.83	/	/	/	114.80	111.93	109.28	105.92	103.32

Table 30: Averaged LZ-normalized value at 11 sampling points of each tonal category (XY2)

F0 lines of the T3/T6 tokens uttered by XY2 are usually broken in 30~50%. This is due to the accompanimental creaky or breathy voice. Therefore, we use the same slashes to fill in these cells.

	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	0.51	0.33	0.09	-0.19	-0.54	-0.84	-1.05	-1.12	-1.04	-1.04	-1.20
T2	1.27	0.79	0.44	0.00	-0.41	-0.75	-0.83	-0.82	-0.82	-0.82	-1.05
T3	2.44	2.54	1.80	/	/	/	-0.44	-0.82	-0.90	-0.95	-1.20
T4	0.98	0.83	0.84	0.86	0.83	0.78	0.72	0.55	0.29	0.08	-0.12
T5	0.59	0.51	0.43	0.26	0.03	-0.22	-0.36	-0.48	-0.62	-0.76	-0.92
T6	1.88	1.85	1.41	/	/	/	0.25	-0.03	-0.29	-0.64	-0.91

Table 31: Averaged LZ-normalized value at 11 sampling points of tonal category (XY2)

	T1	T2	T3	T4	T5	T6
Duration (ms)	242.70	245.15	239.02	152.55	145.79	169.77
Ave. F0 (Hz)	106.73	109.29	111.82	119.03	111.03	115.87

Table 32: Averaged duration and F0 value of each tonal category (XY2)

Tonal data of XY1 and XY2 exhibited above are plotted in Figure 17~20 below.

Figure 17~18 show the data of XY1.

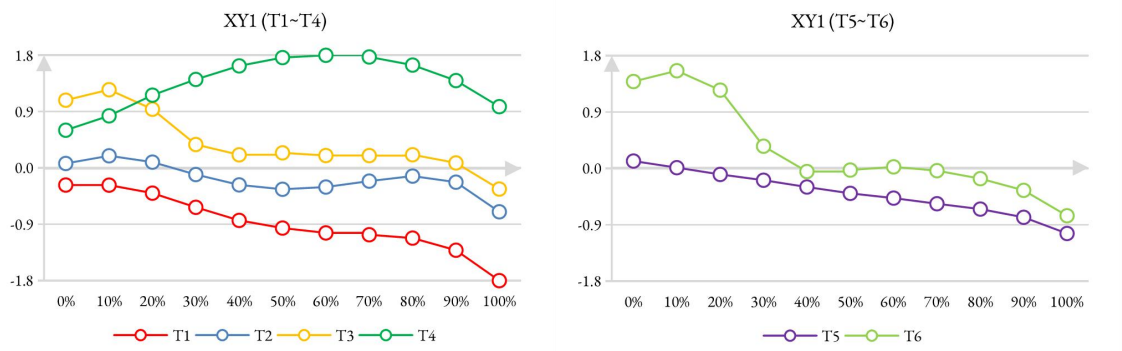

Figure 17: Duration-equalized contour of each tonal category (XY1): [Left] T1~T4; [Right]: T5~T6

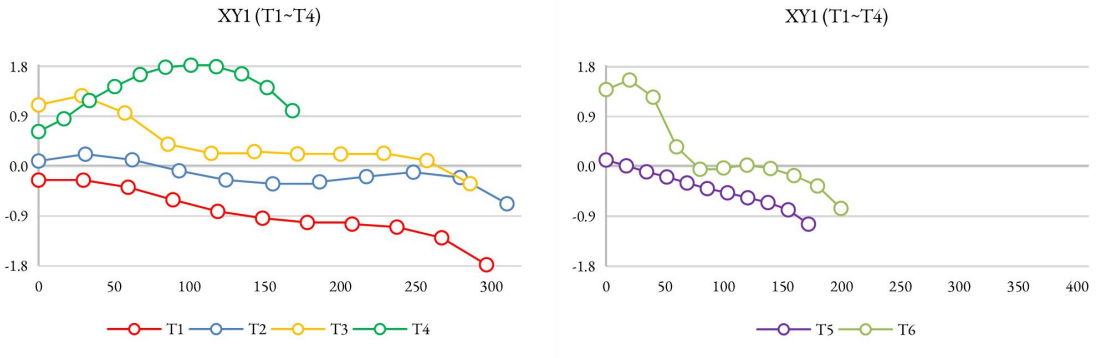

Figure 18: Contour of absolute duration of each tonal category (XY1): [Left] T1~T4; [Right]: T5~T6

Figure 19~20 visualize the tonal realization of XY2.

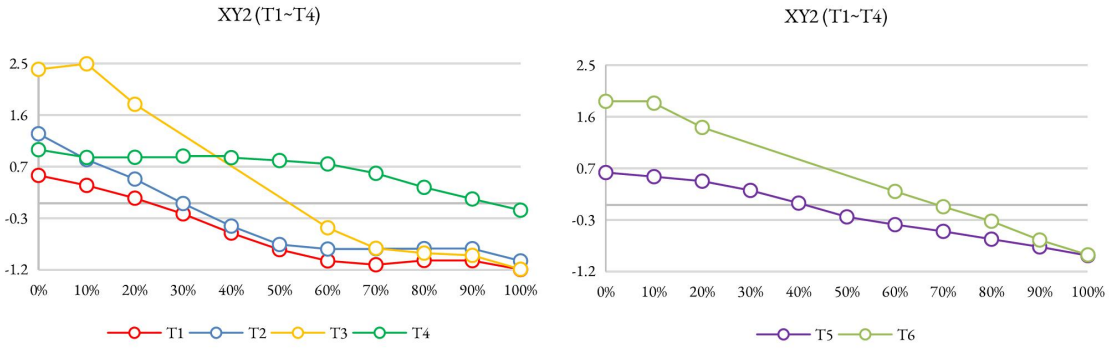

Figure 19: Duration-equalized contour of each tonal category (XY2): [Left] T1~T4; [Right]: T5~T6

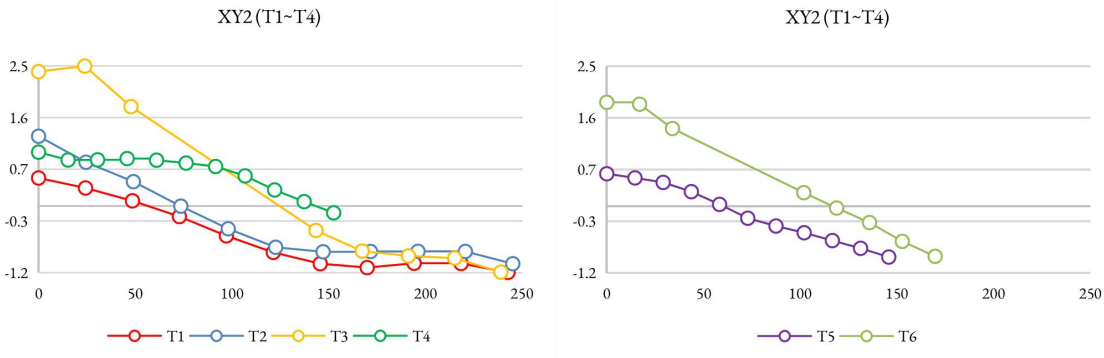

Figure 20: Contour of absolute duration of each tonal category (XY2): [Left] T1~T4; [Right]: T5~T6

3.3.5 Tone value transcription of the fieldwork data

We introduce two models that have been applied in tone value transcriptions. The first one is 'Chao

letters' (also known as 'the five-point scale', 五度制) which is the most widely used system in studies of Chinese phonology. In this model, pitch height is divided into five degrees that are labeled with 1~5 respectively, with the increasing number indicating increasing pitch value (Chao Yuen Ren, 1930). When the Chao letters were designed, instrumental phonetics still remained under-developed and tone value had to be transcribed based on fieldworks' impressionistic judgement. In this context, contrastive registers which are distinguished by phonation were not taken into consideration in this model. Despite this demerit, similar five-point scale was adopted by most of Chinese phonological studies in which tone transcription was involved. The second one is 'multi-register and four-point scale' (分域四度制, hereafter MRFP) which is proposed by Zhu Xiaonong (Zhu Xiaonong & Wu Hede, 2007; Zhu Xiaonong, 2010, 2012a). This model employs a three-register scale in which each register is further divided into four degrees. Registers are defined by phonation: A normal register contains tones articulated with normal voice; A high register usually contains tones articulated with fortis voice or falsetto; A low register usually contains tones articulated with slack voice or voiced obstruent onsets. This model could be demonstrated by the following Figure 21.

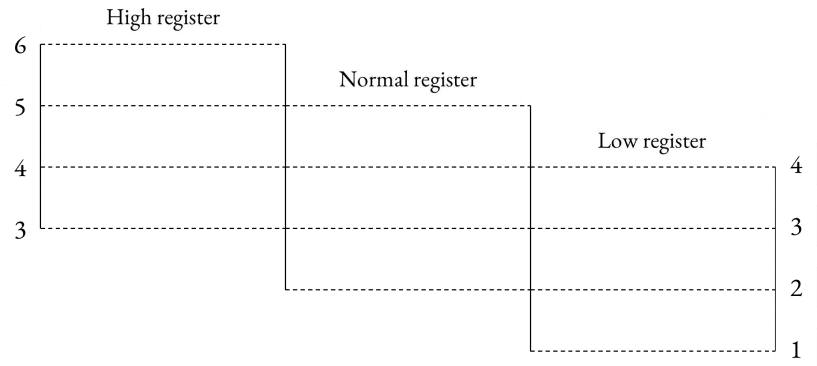

Figure 21: Multi-register and four-point scale

Besides, those tones articulated with creaky voice are assigned an additional degree '0' as their pitch heights are usually too low to be detectable by the instruments. We primarily adopt the model of MRFP to transcribe the tone value of the fieldwork data because in the following Chapter 5, we will attempt to reconstruct the tonal evolution history of this region with the evolution comparative method which is based on this model. On the other hand, in order to facilitate the comparisons with previous studies, we also exhibit the corresponding transcriptions on a five-point scale.

According to the fieldwork data, only a normal register is activated in all cases of the consultants we recruited. Although creaky voice is involved in part of the tokens articulated by FY3, this does not form a low register which is contrastive with the normal register. Since the different tonal categories

could differ in their duration, the transcriptions of those with significantly shorter duration will be underlined. The transcriptions are primarily based on the averaged pitch height of the 10~90% part of the equalized duration.

The following Table 33 exhibits the tone value transcriptions of FY1 (Fenyang, urban, elder).

Tonal model	T1	T2	T3	T4	T5	T6
MRFP	{323}	{42}	{423}	{5}	{$\underline{43}^{4}$}	{$\underline{42}^{3}$}
Five-point	{313}	{41}	{413}	{5}	{$\underline{42}^{3}$}	{$\underline{41}^{2}$}

Table 33: Tone value transcription of FY1 (Fenyang, urban, elder)

In the transcriptions for T5 and T6, a superscribed number which is one degree higher than the preceding scaling point is added. This indicates that there exists a non-significant rising tail at the end of the duration. The subscribed numbers do not mean that the pitch value has to rise to the specific height represented by that degree. On the other hand, the rising tails in T5 and T6 might be generated based on different principles. It has been mentioned in Chapter 2 that T5 and T6 have been largely assimilated with T2 and T3 respectively across Jin group (Shen Ming, 1999). According to this, we assume that T5 and T2 as well as T6 and T3 might have been underlyingly merged (see Section 3.4 for details). Under this assumption, the stem parts of T5 and T6, which are {$\underline{43}$} and {$\underline{42}$} respectively, could be interpreted as two truncated varieties of the same underlying forms of T2 ({42}) and T3 ({423}) respectively, as they have shorter duration and could be ended with a glottal stop [ʔ]. If it is the case, the rising tail of T5 might be generated because the end parts of the vowels were pharyngealized. Similar phenomenon of a *Ru* tone that shares similar pitch height and contour with a lax tone in the tonal inventory has also been confirmed in Yangzhou (揚州) Mandarin, a Jianghuai Mandarin (江淮官話) variety (Tang Zhiqiang & Li Shanpeng, 2018). On the other hand, the rising tail of T6 should be a truncated realization of the rising half of {423}, which could be supported by the fact that the inflection points (the points at which the lowest pitch height is) come at similar time (about 160 ms).

The following Table 34 exhibits the tone value transcriptions of FY2 (Fenyang, urban, younger).

Tonal model	T1	T2	T3	T4	T5	T6
MRFP	{533}	{52}	{423}	{5}	{$\underline{53}$}	{$\underline{423}$}
Five-point	{422}	{51}	{412}	{5}	{$\underline{52}$}	{$\underline{412}$}

Table 34: Tone value transcription of FY2 (Fenyang, urban, younger)

The case of FY2 is similar to that of FY1, in that the inflection points both of T3 and T6 come at similar time (about 115 ms).

The following Table 35 exhibits the tone value transcriptions of FY3 (Fenyang, Yanwu).

Tonal model	T1	T2	T3	T4	T5	T6
MRFP	{42^{L}}	{42^{H}}	{52}	{5}	{43}	{50}
Five-point	{41^{L}}	{41^{H}}	{52}	{5}	{42}	{50}

Table 35: Tone value transcription of FY3 (Fenyang, Yanwu)

Although T1 (*Yin-Ping*) and T2 (*Yang-Ping*) are conceived of as a merged tonal category in the previous relevant studies, we measured a subtle difference in pitch height between the tokens of these two tonal categories. In order to distinguish them, a superscribed capital letter 'L' or 'H' is added. All tokens of T6 are strongly creaky-colored, and therefore we have to employ a special degree of '0' to transcribe this tonal category. As we mentioned before, T6 of FY3 has a right-dipping variety that should be transcribed as [523]. But since this kind of variety was much less frequent than [50], we transcribed this tonal category primarily as {50}.

The following Table 36 exhibits the tone value transcriptions of PY1 (Pingyao, elder).

Tonal model	T1	T2	T3	T4	T5	T6
MRFP	{22^{L}}	{22^{H}}	{523}	{24}	{2}	{522}
Five-point	{11^{L}}	{11^{H}}	{512}	{14}	{1}	{511}

Table 36: Tone value transcription of PY1 (Pingyao, elder)

The following Table 37 exhibits the tone value transcription of PY2 (Pingyao, younger).

Tonal model	T1	T2	T3	T4	T5	T6
MRFP	{22^{L}}	{22^{H}}	{522}	{24}	{2}	{522}
Five-point	{11^{L}}	{11^{H}}	{511}	{14}	{1}	{511}

Table 37: Tone value transcription of PY2 (Pingyao, younger)

The following Table 38 exhibits the tone value transcription of JX1 (Jiexiu, elder).

Tonal model	T1	T2	T3	T4	T5	T6
MRFP	{23^{L}}	{23^{H}}	{523}	{24}	{23}	{423}
Five-point	{12^{L}}	{12^{H}}	{512}	{24}	{12}	{412}

Table 38: Tone value transcription of JX1 (Jiexiu, elder)

The following Table 39 exhibits the tone value transcription of JX2 (Jiexiu, younger).

Tonal model	T1	T2	T3	T4	T5	T6
MRFP	{24^{L}}	{24^{H}}	{523}	{35}	{23}	{423}
Five-point	{13^{L}}	{13^{H}}	{513}	{25}	{12}	{312}

Table 39: Tone value transcription of JX2 (Jiexiu, younger)

The following Table 40 exhibits the tone value transcription of XY1 (Xiaoyi, elder).

Tonal model	T1	T2	T3	T4	T5	T6
MRFP	{43}	{44}	{544}	{45}	{3}	{54^{3}}
Five-point	{32}	{33}	{533}	{45}	{3}	{53^{2}}

Table 40: Tone value transcription of XY1 (Xiaoyi, elder)

There exists a falling tail in the ends of T6 tokens uttered by XY1. This is caused by sudden close of the glottis.

The following Table 41 exhibits the tone value transcription of XY2 (Xiaoyi, younger).

Tonal model	T1	T2	T3	T4	T5	T6
MRFP	{42^{L}}	{42^{H}}	{52}	{4}	{42}	{52}
Five-point	{31^{L}}	{31^{H}}	{51}	{3}	{31}	{51}

Table 41: Tone value transcription of XY2 (Xiaoyi, younger)

3.4 Intuitionistic interpretation

We will discuss three worth noticing phenomena that could be observed intuitionistically: (1) The subtle difference in pitch height between T1 and T2; (2) The shorter duration of T4; (3) The laxation of *Ru* tones (T5, T6).

3.4.1 The subtle difference in pitch height between T1 and T2: A case of near merger

From the visualized tone contours uttered by FY3, PY1, PY2, JX1, JX2, XY1, and XY2, we could intuitively observe that T1 is always slightly lower in pitch height than T2 in Pingyao, Jiexiu, Xiaoyi, and Yanwu Fenyang Jin. We carried out a series of t-tests between these T1 tokens and T2 tokens, and

the results indicate that this subtle difference is significant, rather than a random variation.

Variety	Consultant	Ave. F0 (Hz) (T1/T2)	Transcription	*P*
Yanwu, Fenyang	FY3	91.03/**98.25**	$42^{L}/42^{H}$	0.0000
Pingyao	PY1	134.83/**137.71**	$22^{L}/22^{H}$	0.0004
	PY2	104.40/**106.50**	$22^{L}/22^{H}$	0.0056
Jiexiu	JX1	148.94/**157.30**	$23^{L}/23^{H}$	0.0009
	JX2	131.28/**135.13**	$24^{L}/24^{H}$	0.0021
Xiaoyi	XY1	97.18/**110.27**	32/33	0.0000
	XY2	106.73/**109.29**	$42^{L}/42^{H}$	0.0274

Table 42: The difference in pitch height between T1 and T2

Since the calculated *P* values of the seven consultants are all >0.05, this difference in pitch height between T1 and T2 could be regarded as significant. Simultaneously, the differences in specific pitch height narrow in the younger generations, and the *P* values increase as well, which indicates that the difference seems to be undergoing neutralization in the younger generations.

We assume that this subtle difference in pitch height may be a residual underlying feature of T1. That is, T1 had ever been lower in pitch height than T2 before the T1-T2 merger was initiated. Despite this subtle difference between T1 and T2, all the Pingyao, Jiexiu, Xiaoyi, and Yanwu Fenyang Jin consultants whom we recruited for the fieldwork denied any distinctiveness between T1 and T2. In other words, they perceive the two tonal categories as the same one. As far as we know, Labov is the first scholar who observed the asymmetry between production and perception. For instance, Labov, et al. (1972) found that speakers could differentiate words like '*source*' and '*sauce*' in production, but report no distinction between them in perception. Labov in his (1975) work proposed a concept termed 'near merger' to explain this phenomenon that two originally distinctive phonemic categories have been neutralized in perception of the speakers but this process has not been fully completed.

Similar phenomena of near merger in tonal categories have also been confirmed in some Sinitic languages, such as Hong Kong (香港) Cantonese, Dalian (大連) Mandarin, and a specific Xinyang (信陽) Mandarin variety which is spoken in a dialect island located in Lishui (溧水) District, Nanjing (南京) as far as we know. In the case of Hong Kong Cantonese, there is a lexical *Yin-Shang* (陰上) which is transcribed as {35} on a five-point scale in the tonal inventory. Simultaneously, Hong Kong Cantonese also has a morphological derivation called '*pinjam*' (變音) in which a nominal morpheme

carrying a {35} tone could be derived from the semantically related verbal morphemes carrying a tone of *Yang-Ping* (陽平, {11}), *Yin-Qu* (陰去, {33}), or *Yang-Qu* (陽去, {22})[21]. Although the lexical {35} and the morphological {35} are perceived as the same tone by the native speakers, the former one is slightly lower in pitch height than the latter one according to an instrumental-based study conducted by Yu Alan C. L. (2007).

As for Dalian Mandarin, Liu Te-hsin (2009) reported that *Yin-Ping* (陰平, {51} on a five-point scale) and *Qu* (去聲, {51}) have been merged in their citation forms among the young generation. However, the duration of *Yin-Ping* (433 ms) is longer than that of *Qu* (326 ms). This is probably since the {51} *Yin-Ping* might have been derived from a right-dipping tone which still remains in the old generation's speech. The more complicated dipping contour naturally requires a longer duration than the simpler falling contour.

Xinyang Mandarin is a variety of Zhongyuan Mandarin (中原官話) spoken in southern Henan. Due to the depopulation caused by Taiping Civil War (太平天國之亂), Nanjing and the adjacent areas had received a large number of immigrants originally from Xinyang (mainly from Guangshan County光山縣 and Luoshan County羅山縣) since 1860s. A typical modern Zhongyuan Mandarin variety is featured by the tonal evolution that *Yin-Ru* (陰入, MC Voiceless/Sonorant *Ru* 中古清/次濁入) has been merged into *Yin-Ping* (陰平) while *Yang-Ru* (陽入, MC Voiced *Ru* 中古全濁入) has been merged into *Yang-Ping* (陽平). However, the old generation of the modern descendants of the Xinyang immigrants who are living in Lishui District, Nanjing still preserve subtle but significant differences between *Yin-Ru*/*Yin-Ping*, as well as *Yang-Ru*/*Yang-Ping* (Meng Xiaohong, 2018).

Turning to the cases of our fieldwork data, it is obvious that the subtle difference between T1 and T2 in Pingyao, Jiexiu, Xiaoyi, and Yanwu Fenyang Jin satisfies the definition of 'near merger' proposed by Labov (1975). First, the subtle difference in pitch height is significant; Second, the native speakers reported no difference in perception.

In Chapter 2, we have mentioned that the T1-T2 merger in Bingzhou Jin varieties should be a progressive sound change compared to most Sinitic languages. Considering the relatively advanced economy and culture of the provincial capital Taiyuan, this tonal merger might have been initiated in Taiyuan Jin. On the other hand, the preservation of the subtle difference in Pingyao, Jiexiu, Xiaoyi, and Yanwu Fenyang Jin is probably due to the separated location from Taiyuan, especially historical administrative boundaries separating them from the counties which were affiliated to the former

[21] For instance, /jɐu^{11}/ (油, 'to grease')→/jɐu^{35}/ (油, 'oil'); /wa^{22}/ (話, 'to say')→/wa^{35}/ (話, 'an utterance'); /sou^{33}/ (掃, 'to sweep')→/sou^{35}/ (掃, 'a broom').

Taiyuan Prefecture. Furthermore, we also investigated the Jin varieties of Wenshui (文水) and Qixian (祁縣), the two adjacent counties in the north of the region of the former Fenzhou Prefecture. The averaged pitch value of T1/T2 tokens uttered by Wenshui and Qixian Jin consultants is exhibited in the following Table 43~44.

	Ave.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	111.97	127.49	124.31	116.71	113.09	111.01	109.98	108.14	106.74	105.15	106.85	101.62
T2	111.24	128.13	122.84	118.53	114.93	111.91	109.06	108.57	106.71	104.30	105.72	100.14

Table 43: Averaged pitch value of T1/T2 (Wenshui Jin)

	Ave.	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
T1	184.69	226.98	225.09	221.28	212.18	199.97	186.41	173.86	161.75	152.65	144.38	136.92
T2	185.08	225.19	224.34	222.67	214.70	201.28	187.25	174.18	160.71	152.36	142.46	134.00

Table 44: Averaged pitch value of T1/T2 (Qixian Jin)

Since the averaged pitch value on each sampling point shows basically no difference between T1 and T2, the T1-T2 merger in Wenshui and Qixian Jin could be regarded as a complete merger. Thus, we could further draw an isogloss reflecting whether the T1-T2 merger is a complete merger or a near merger between Wenshui, Qixian in the north and Fenyang, Pingyao, Jiexiu, and Xiaoyi in the south.

3.4.2 The shorter duration of T4

Generally, a *Qu* tone (T4 in the Jin varieties in question) is regarded as longer in duration than *Ru* tones since *Qu* tone is a lax tone without being ended with a stop coda. Across the nine consultants whom we recruited, the average duration of T4 is significantly shorter than that of the other lax tones (T1, T2, and T3). Furthermore, the averaged duration of T4 tokens uttered by FY3, JX1, and XY1 is even shorter than both T5 and T6, the two *Ru* tones. If taking the duration of T1 as the frame of reference, the ratios of the other five tonal categories to T1 are as the following Table 45 exhibits.

Variety	Consultant	T1	T2	T3	T4	T5	T6
Fenyang	FY1	1.00	0.93	1.03	0.53	0.52	0.85
	FY2	1.00	0.97	1.03	0.73	0.62	0.87
	FY3	1.00	0.91	0.98	0.51	0.57	0.83
Pingyao	PY1	1.00	1.15	1.11	0.78	0.73	0.93
	PY2	1.00	1.03	1.03	0.74	0.78	0.75

Jiexiu	JX1	1.00	0.96	1.10	0.60	0.96	0.97
	JX2	1.00	0.96	1.03	0.65	0.54	0.96
Xiaoyi	XY1	1.00	1.05	0.96	0.57	0.58	0.67
	XY2	1.00	1.01	0.98	0.63	0.60	0.70
Average		1.00	1.00	1.03	0.64	0.66	0.84

Table 45: Relative length of the six tonal categories

From Table 45, it is observable that the duration of T4 is significantly shorter than the other lax tones. However, the difference in duration between T4 and the other three lax tones has not been phonologically categorized in the four Jin varieties in question, since T4 in these Jin varieties could be sufficiently separated from the other lax tones in terms of tonotype. On the other hand, a case in which T4 is separated from another lax tone (T2) with a similar tonotype by the contrast in length has been reported in Yuanshi (元氏) Jin, a Jin variety spoken in a county affiliated to Shijiazhuang (石家莊) Prefecture, Hebei (河北) Province. In in tonal inventory of Yuanshi Jin, T2 is a normal {52} (on a MRFP scale), while T4 is a shorter {52} (Zhu Xiaonong, 2012b). Therefore, it is potential that the shortening of T4 could make phonological sense in Jin varieties. This phenomenon is also likely to serve as an important hint of the historical studies on Jin group.

3.4.3 Tha laxation of *Ru* tones (T5 and T6)

Sinitic linguists agree that *Ru* tones are defined by two properties that are unshared by the lax tones (舒聲調): (1) shorter duration; (2) stop coda. Accordingly, the laxation of *Ru* tones refers to a series of sound changes wherein these two exclusive features undergo weakening and in turn, the *Ru* tones are assimilated with the lax tones. Specifically, the changes include the duration lengthening and the syllable opening. Note that the second change could contain an intermediate stage that the three phonemic unreleased stop coda /-p/, /-t/, and /-k/ of MC phonology are merged into a glottal stop coda /-ʔ/. Both the two patterns are reflected in modern Chinese dialects. Cantonese (廣東話) could represent the pattern of complete preservation of the three MC unreleased stop codas, while Shanghai (上海) Wu could represent the pattern of a merged /-ʔ/. Completely laxated *Ru* tones are no longer contrastive by neither shorter duration nor the stop codas. Traditionally, Jin varieties are assumed to be the same pattern as Shanghai Wu.

Zhu Xiaonong, Jiao Lei, et al. (2008) discussed which relevant feature should the *Ru* tones are defined primarily by and proposed that as a contrastive tonal category, the primary property of any

Ru tone should be its pitch value and both the shorter duration and the stop codas are secondary. They also generalized a laxation route diagram to outline this procedure based on real examples. We use the following Figure 22 to repeat this diagram, in which the unreleased stop codas are uniformly represented with a '-P'.

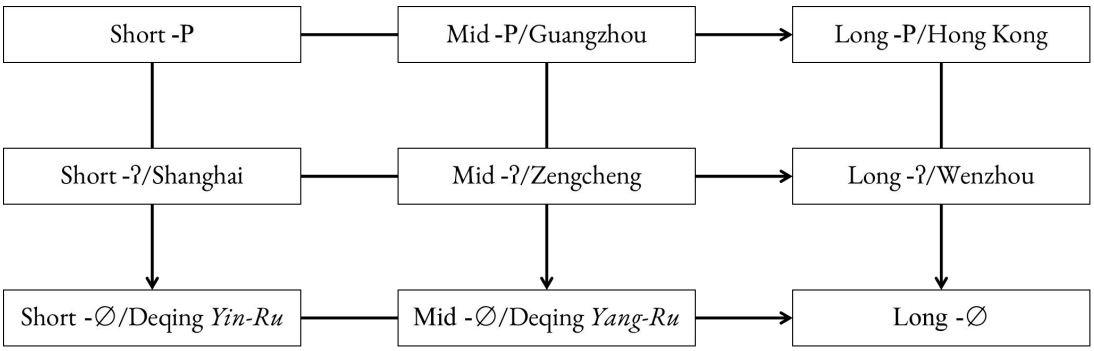

Figure 22: Process of the laxation of *Ru* tones

In Figure 22, the top-left box represents a stage wherein the short duration and the unreleased stop codas are all preserved in *Ru* tones, while the bottom-right one represents a fully neutralized stage. The horizontal arrows pointing to the right describe duration lengthening, and the vertical ones pointing to the bottom represent syllable opening in which an intermediate stage of neutralized /-ʔ/ is involved. According to the changes of the two dimensions, the laxation of *Ru* tones could be divided into nine stages. Each box in the figure represents a certain stage which could be exemplified by an existing Chinese dialect (indicated after the '/' in the boxes). Zhu Xiaonong, Jiao Lei, et al (2008) provides an empirical reference that the 'short', 'mid', and 'long' duration is around 100 ms, 200 ms, and 300 ms respectively.

The averaged duration (ms) of T5 and T6 tokens uttered by the consultants we recruited is as follows.

Variety	Consultant	Duration of T5 (ms)	Duration of T6 (ms)
Fenyang	FY1	140.00	227.70
	FY2	138.31	193.25
	FY3	163.66	236.33
Pingyao	PY1	242.99	309.17
	PY2	205.12	197.18
Jiexiu	JX1	250.95	253.49

	JX2	213.51	379.61
Xiaoyi	XY1	171.81	199.39
	XY2	145.79	169.77

Table 46 : Averaged duration of T5/T6

It is obvious that the progress of duration lengthening varies case by case. However, the contrast in duration seems to be better preserved in T5, since the duration of T6 is longer, which indicates that it has been more assimilated with the lax tones. This tendency has been reported by Sun Yuwei (2020). The property that T6 is more prone to the duration lengthening is probably due to the fact that in most cases of these Jin varieties we investigated, T6 has a dipping contour which requires a longer duration than those with simpler contours to be fully articulated. With respect to the syllable opening, we measured few cases in which the glottal coda /-ʔ/ appeared regularly. In general, the *Ru* tones (T5 and T6) in the cases under discussion should be in the stage of 'mid -∅'.

On the other hand, T5 and T6 are extremely similar to T2 and T3 in terms of pitch height and contour. Furthermore, they perform similarly to T2 and T3 respectively in tone sandhi formats (Hou Jingyi & Wen Duanzheng, 1993). Thus, they are likely to have been underlyingly merged with T2 and T3 respectively. Nevertheless, since syllables bearing *Ru* tones usually have exclusive nuclei in these Jin varieties, it is basically impossible to form minimal pairs to carry out perception tests on the native speakers. In this thesis, we treat T5 and T6 as non-contrastive categories with T2 and T3.

Chapter 4 Multidimensional Analysis

This chapter is comprised of three sections. Section 4.1 introduces the tonal space model in which tonal categories could be arranged according to relevant perceptual dimensions. Section 4.2 presents the multidimensional analysis results of the fieldwork data. In Section 4.3, we will discuss how the four Jin varieties differ in the way of distinguishing tonal categories based on the analysis results.

4.1 Tonal space model

Like the way that vowels could be arranged in a space defined by their first and second formant frequency, Hombert (1977) first proposed a space-like model in which tones are organized according to universal phonetic principles. Hombert introduced four factors that may be relevant to the perceptual distance of different tones: average F0 value, onset, offset, and slope of the tone.

The theory of adaptive dispersion posits that a selected sound in a given language has to maximize perceptual distance with other sounds and simultaneously minimize its articulatory effort (Liljencrants & Lindblom, 1972). According to this, a language that categorizes similar sounds would be disfavored. However, this kind of language does exist. For instance, Black Miao, a Hmong-Mien language that has five contrastive level tones in its tonal inventory, could be a problematic case for linguists. To deal with this disfavored tonal inventory, Kuang Jianjing (2013) employed a tonal space model to visualize the dispersion of these level tones, and the result showed that pitch contrast was enhanced by non-modal phonation and most of these level tones were well dispersed in the tonal space. That is, they are well distinguished.

On the other hand, unlike the universal vowel acoustic space, there is no universal tonal space since perceptual dimensions vary language by language. We referred to some previous studies and summarized what specific dimensions were activated in some representative tonal languages. Furthermore, even within a single language, different dimensions could contribute to the tonal perception in varying degrees. In the following cases, a '>' indicates the left dimension is more relevant to the tonal perception than the right one.

(1) Cantonese: contour > direction > average pitch (Gandour, 1981);

(2) Thai: average pitch > direction > duration > slope > offset (Gandour, 1983);

(3) Northern Vietnamese: voice quality > slope > contour/offset (Brunelle, 2009);

(4) Southern Vietnamese: slope > voice quality > contour > offset (Brunelle, 2009).

Therefore, tonal space should be language-specific. In the next section, we will introduce the way how we identified relevant perceptual dimensions in Fenyang, Pingyao, Jiexiu, and Xiaoyi Jin.

4.2 Multidimensional scaling of T1~T4

4.2.1 Operation method

As we mentioned in the preceding Section 4.1, although multi-dimensions may be relevant to tonal perception, they vary in the degree of relevance. In this research, we introduce the multidimensional scaling (hereafter MDS) to identify what dimensions are relevant to tonal perception in the four Jin varieties in question. Since a tonal system is a complex mechanism, we assume that there may be totally more than two dimensions relevant to tonal perception in a certain tonal language. MDS could help us project a multidimensional system into a two-dimensional space through a dimension reduction process. The arrangement of tokens in two-dimensional space is calculated based on quantified distance. Empirically, the tonal systems of languages spoken in northern China are likely to be more simplified than those in the southern Sinitic groups. Thus, a two-dimensional system is usually sufficient to well distinguish all tonal categories. We use the 'isoMDS()' function in the MASS package in R to realize the MDS scaling. The procedure follows the steps below.

(1) Record the F0 value of each token on nine sampling points (10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% of the equalized duration);

(2) Calculate the distance between all tokens in the testing pool at the nine sampling points with the Euclidean distance formula;

(3) Conduct the 'isoMDS' function on the matrix formed by all calculated Euclidean distance between the tokens.

As for the tokens to be tested, in consideration of the similarity between T2 and T5, T3 and T6, we only analyzed tokens of T1~T4. For each tonal category, we selected 8~10 tokens with different nucleus in order to eliminate the influence from the intrinsic acoustic properties of a certain vowel.

4.2.2 Analysis result

We conducted MDS analysis for the fieldwork data of six representative consultants: FY1, FY2, FY3 (Fenyang); PY1 (Pingyao); JX1 (Jiexiu); XY1 (Xiaoyi). The analyzed results will be demonstrated in this sequence. The data processed in the analyses are listed in Appendix II: Data analyzed in MDS (see

Page 99).

Figure 23 demonstrates the result of FY1 (Fenyang, urban, elder).

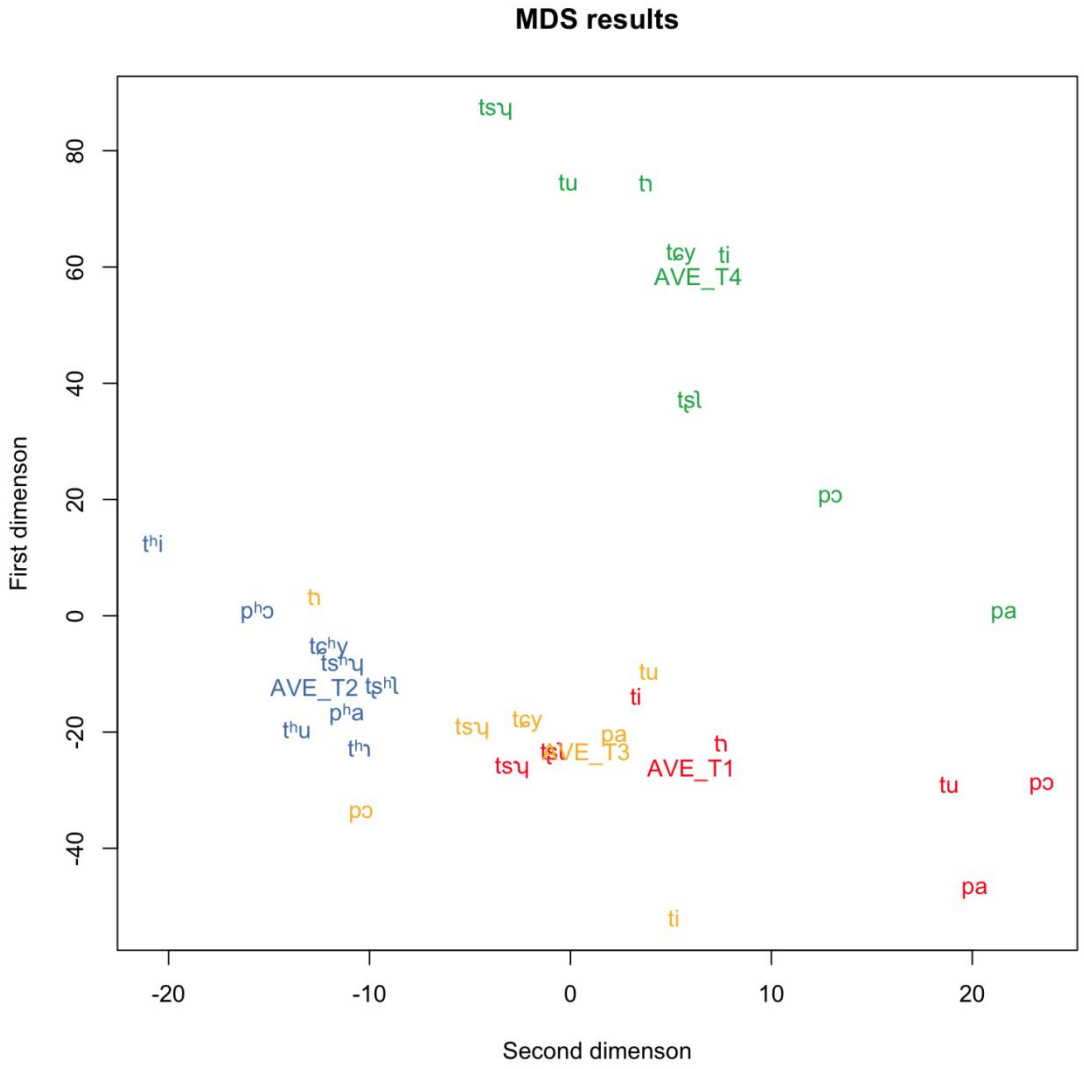

Figure 23: MDS results of FY1 (T1~T4)

In Figure 23 and the following MDS result figures, T1/T2/T3/T4 tokens are highlighted in red/blue/yellow/green color respectively. We compared the dispersion of the tokens in Figure 23 with the original data of FY1 and found that the first dimension seemed to correlate with the average F0 value while the second might be paired with the onset. Except for T1 and T3 which are regarded as two categories that are being merged, tonal categories appear to be well distinguished within this tonal space whose boundaries were defined primarily by average F0 and secondarily by onset. After the identification of relevant perceptual dimensions, it is in turn worth noting that the two dimensions

are matched with different scaling ranges in the figure, with the first dimension (=average F0) being up to around 140 while the second dimension (=onset) being less than 50. First dimensions are always assigned a larger scaling range. The scaling ranges reflect the size of this tonal space. If a dimension is assigned a larger scaling range, it means that in this dimension tokens are more dispersed. That is, they are better distinguished by this dimension. Thus, increasing index indicates increasing contribution to the tonal perception. In the case of FY1, it seems that average F0 contributes more than onset.

FY1 (Fenyang, urban, elder): average F0 (scaling range: around 140) > onset (scaling range: around 50).

Figure 24 demonstrates the result of FY2 (Fenyang, urban, younger).

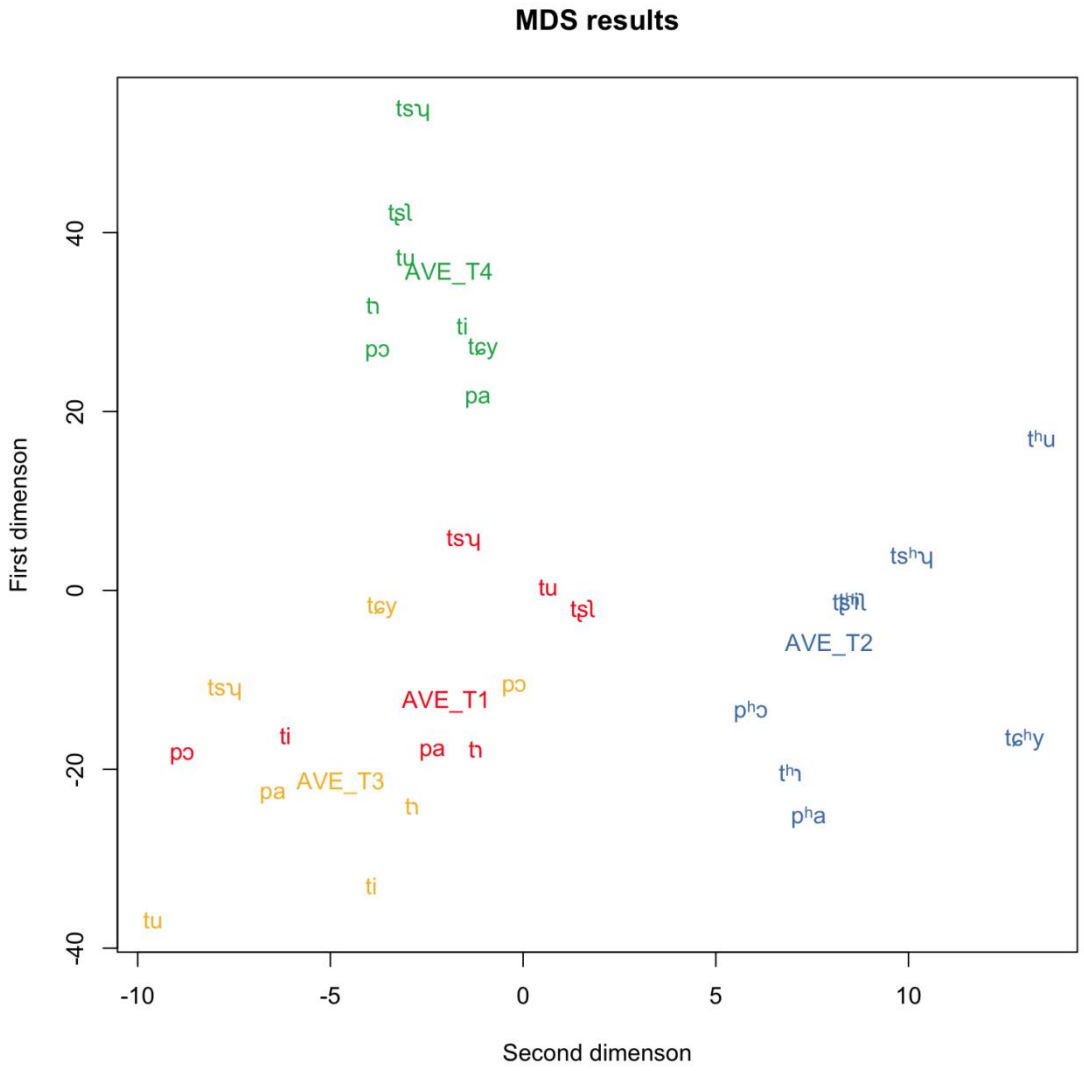

Figure 24: MDS results of FY2 (T1~T4)

Although the dispersion of the tokens in Figure 24 shows a slight difference from that of Figure 24, we could still observe the same pattern of correlation between the first, second dimension, and average F0, onset respectively. In the case of FY2, it is also average F0 that contributes more to the tonal perception because the tokens are dispersed in a larger range by this dimension.

FY2 (Fenyang, urban, younger): average F0 (scaling range: around 100) > onset (scaling range: around 25).

Figure 25 demonstrates the result of FY3 (Fenyang, Yanwu).

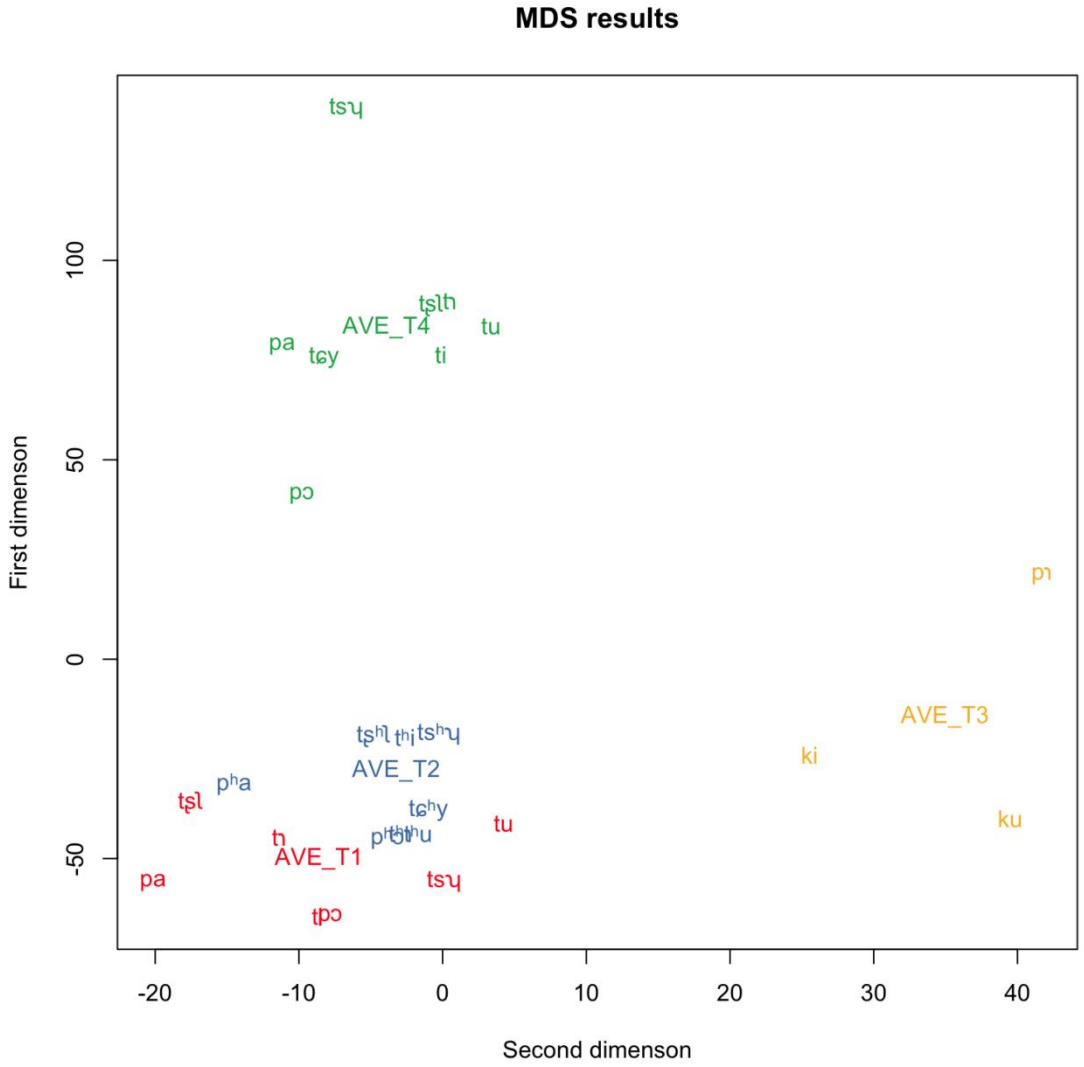

Figure 25: MDS results of FY3 (T1~T4)

The two relevant perceptual dimensions in the phonology of FY3 are identical to that of FY1

and FY2. Additionally, it seems that onset is likely to be assigned more functional load to distinguish tonal categories than in the other two Fenyang Jin cases. More specifically, by the dimension of onset, the phonology of FY3 maximizes the contrastiveness of T3 and separates it away from other tonal categories according to its higher onset.

FY3 (Fenyang, Yanwu): average F0 (scaling range: >200) > onset (scaling range: >60).

Figure 26 demonstrates the result of PY1 (Pingyao).

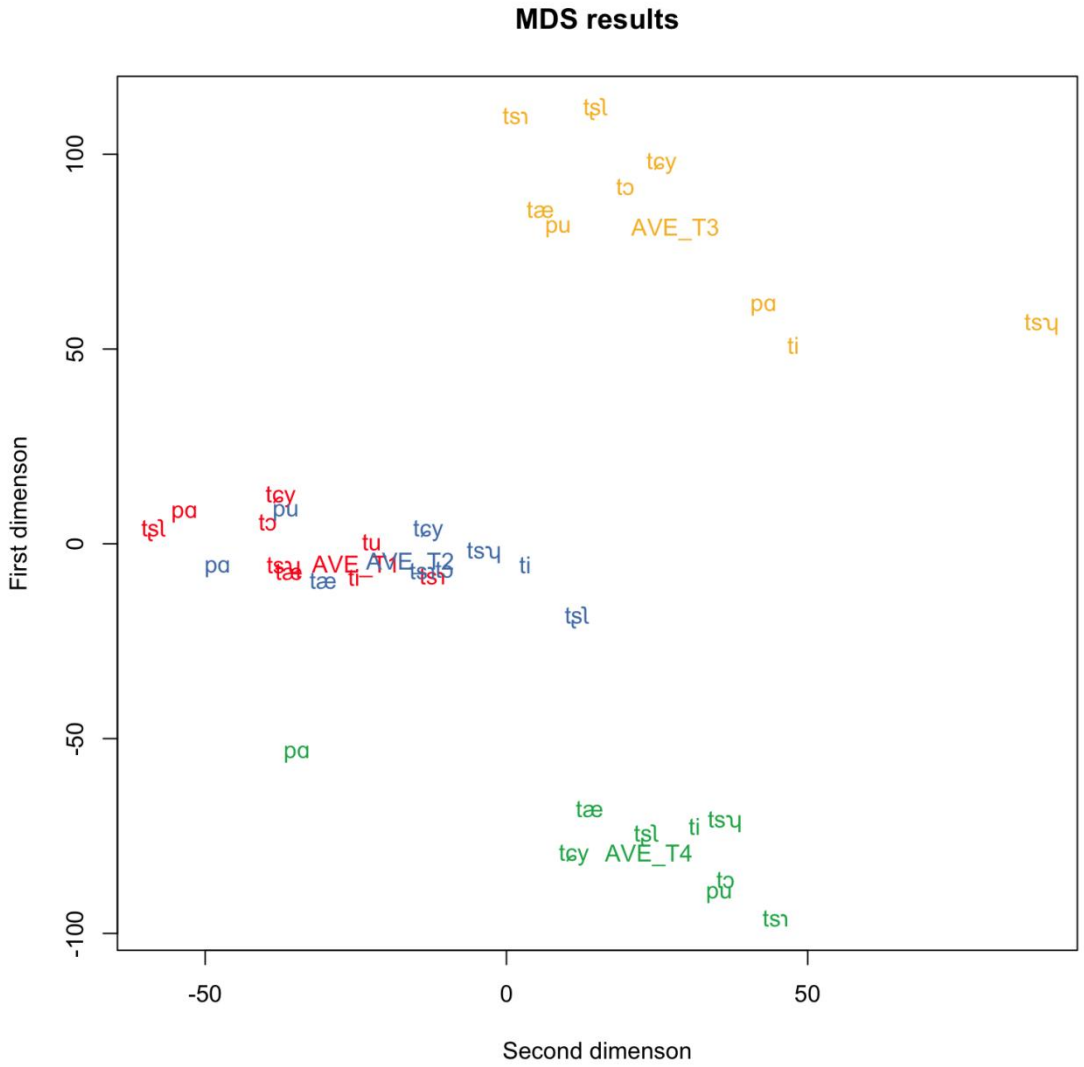

Figure 26: MDS results of PY1 (T1~T4)

The result of PY1 shows an opposite pattern in which the first dimension correlates with the onset while the secondary one correlates with the average F0. That is, tonal categories in the

phonology of PY1 are primarily distinguished by their onsets while the average F0 functions as an assistant tool.

PY1 (Pingyao): onset (scaling range: >200) > average F0 (scaling range: around 150).

Figure 27 demonstrates the result of JX1 (Jiexiu).

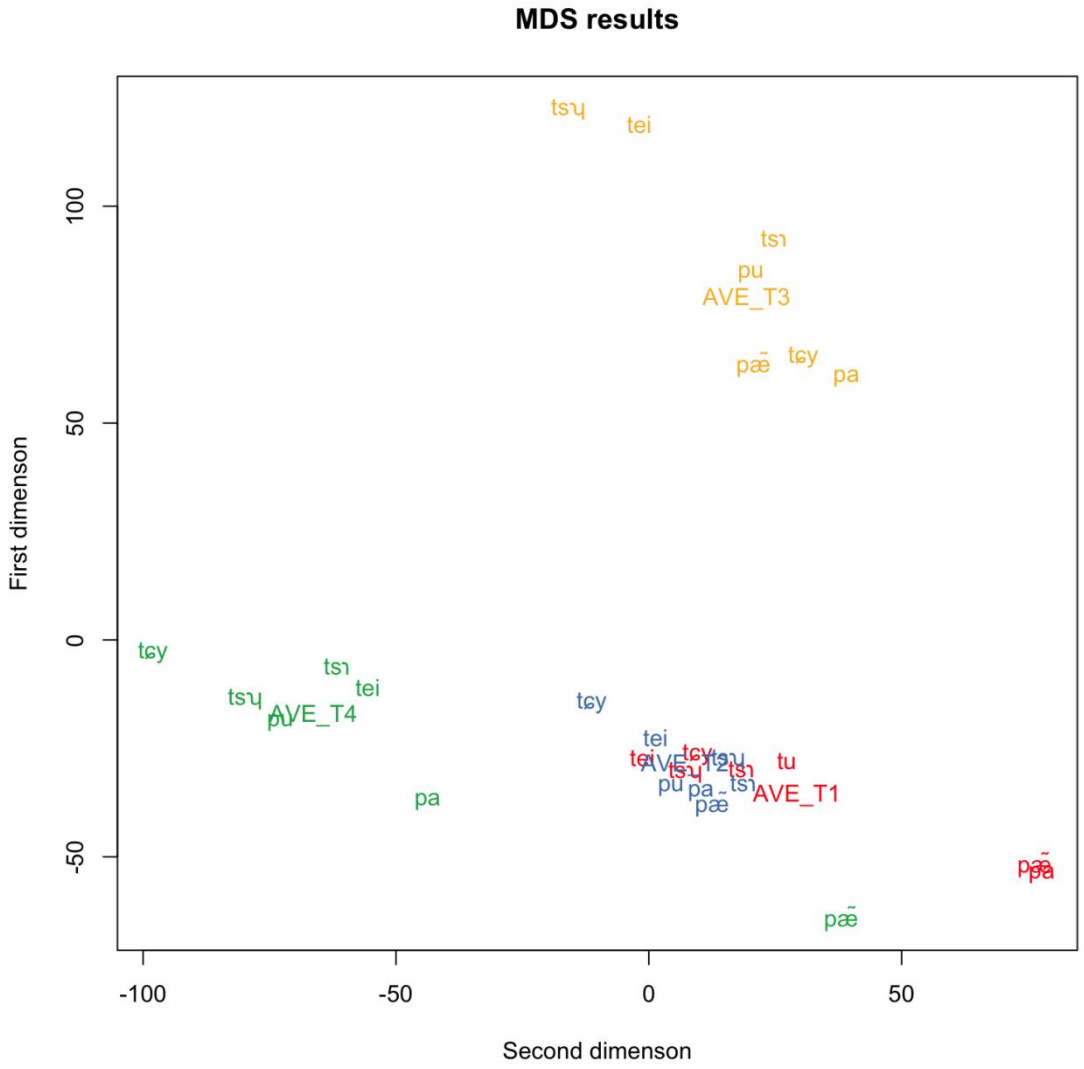

Figure 27: MDS results of JX1 (T1~T4)

The result of JX1 is in accord with that of PY1 in that the first dimension is paired with the onset and the second dimension with the average F0.

JX1 (Jiexiu): onset (scaling range: around 200) > average F0 (scaling range: around 200).

Figure 28 demonstrates the result of XY1 (Xiaoyi).

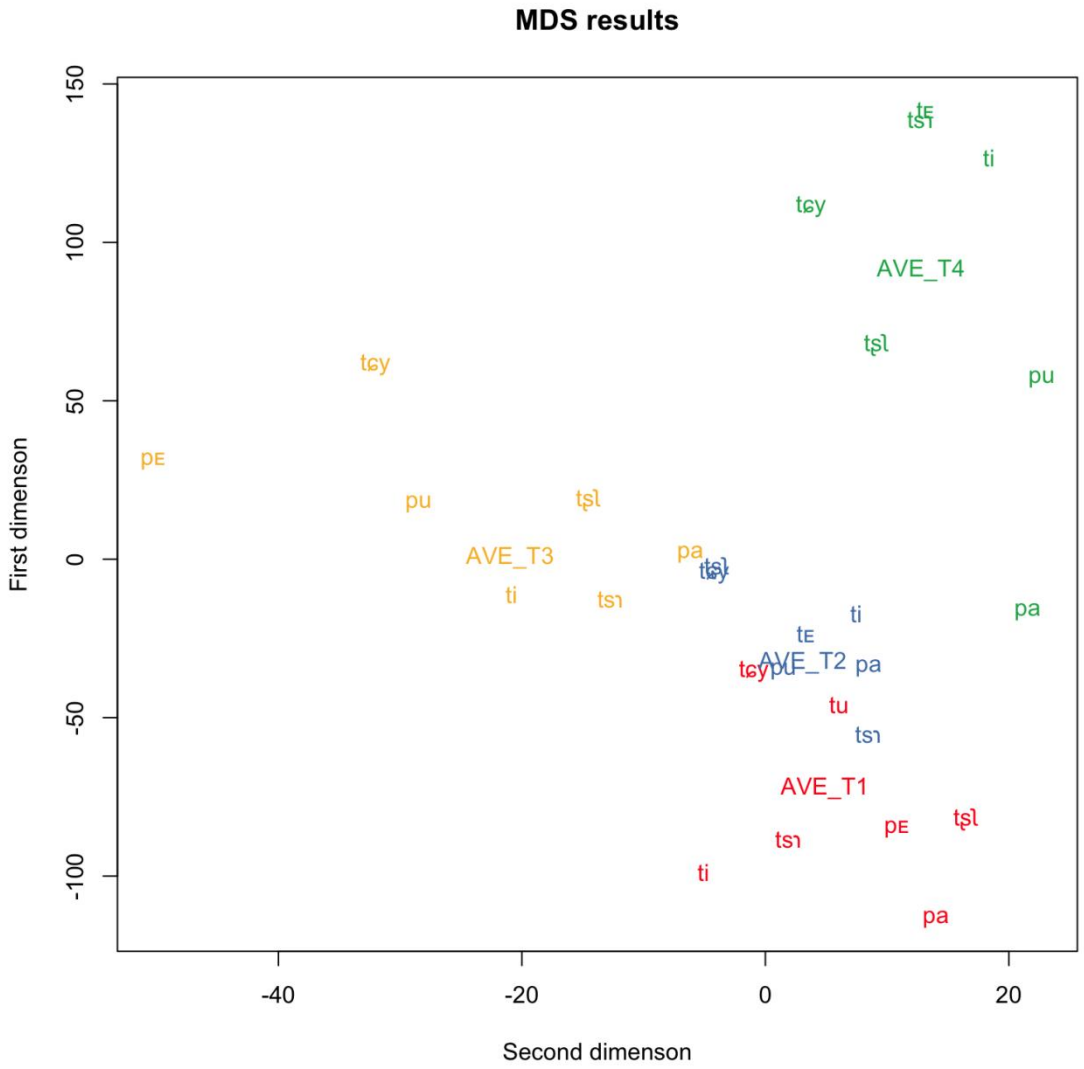

Figure 28: MDS results of XY1 (T1~T4)

The result of XY1 shows a pattern similar to that of the three Fenyang Jin consultants, as the first dimension correlates with the average F0 and the second dimension is paired with the onset.

XY1 (Xiaoyi): average F0 (scaling range: >250) > onset (scaling range: around 80).

4.3 Interpretation of the MDS results

According to the MDS results we calculated, among the four Jin varieties, some common ground and differentiation in the tonal perception could be summarized. The common ground is that all of the

four Jin varieties employ the same two perceptual dimensions to maintain the tonal contrast: average F0 and onset. The differentiation, on the other hand, is stemmed from the two different patterns of relevance of the two perceptual dimensions.

Employing the same perceptual dimensions is totally predictable since the general contour type and the pitch value of each tonal category are similar among the four Jin varieties. Given the fact that the tonal categories are generally similar, the differentiation should be a local sound change. But it is still a crucial clue by which we could track the possible specific tonal evolution that triggered the internal splits in this group. According to the analysis data, the four Jin varieties could be generally divided into two groups. The first group contains Fenyang and Xiaoyi Jin, featured by the primacy of average F0 to distinguish tonal categories. On the other hand, Pingyao and Jiexiu Jin form another group that primarily employs onset as the perceptual dimension to contrast tonal categories.

Turning to the dispersion of the tokens, which was visualized by the MDS analysis, we found that for all of the six tested consultants, the tonal perception system seems to work in the following ways.

> The tonal space is first primarily divided into two parts by the first dimension: the upper half and the lower half. There must be a certain tonal category that is dispersed in the upper half of the tonal space by the first dimension, and the remaining three tonal categories are all dispersed in the lower half. That is, the one in the upper half is the most contrastive tonal category. In Fenyang and Xiaoyi Jin, this tonal category is T4 while in Pingyao and Jiexiu Jin it is T3. The remaining three, on the other hand, are distinguished by the second dimension.

Based on this guideline and the analyzed results, the two groups could be summarized as follows.

Group	The most contrastive tonal category	Relevance of perceptual dimensions
Fenyang, Xiaoyi (汾陽，孝義)	T4 (*Qu*)	Average F0 > Onset
Pingyao, Jiexiu (平遙，介休)	T3 (*Shang*)	Onset > Average F0

Table 47: Different patterns of the two perceptual dimensions to the tonal contrast

Since T1 and T2 were never the most contrastive tonal category that is firstly distinguished by the first dimension, changes occurring in these two tonal categories are likely to pose no influence on this differentiation between the groups. Thus, we should turn to T3 and T4 to seek for an answer. Comparing T3 and T4 across the four Jin varieties in question, we found that T3 shows nearly no notable differentiation since it is usually a dipping-like tone or a high-falling tone, both starting from a high onset and heading for the lowest boundary of the speaker's F0 range. But as for T4, we found

that in Fenyang/Xiaoyi group, it is a high-level/rising tone while in Pingyao/Jiexiu group, it is a mid-rising tone which is much lower in relative average F0 than that in the former group. Therefore, we attribute the differentiation between the two groups to the changes in T4. Specifically, a lowered T4 will lose its contrastiveness in average F0, and after the lowering of T4, T3, as a dipping or falling tone, becomes the most contrastive one by its highest onset. Obviously, all consultants of Pingyao and Jiexiu Jin reflect this pattern. Thus, Pingyao and Jiexiu Jin may have a closer relationship. On the other hand, in consideration of the considerable difference in general contour type, we are not sure about whether Fenyang and Xiaoyi Jin have a closer relationship as Pingyao and Jiexiu Jin do. This issue will be discussed in detail in the succeeding Chapter 5.

To summarize, we are informed by the MDS analysis results of the following two crucial clues.

(1) Tonal perception of the four Jin varieties is controlled mainly by two factors: average F0 and onset. Thus, these two perceptual dimensions are likely to be relevant to the tonal evolution of these four Jin varieties.

(2) Changes in T4 may be the essential reason that has triggered the splits in the common parental stage of these four Jin varieties.

In the next Chapter 5, we will carry out a series of reconstructions of the tonal evolution history shared by the four Jin varieties spoken in the former Fenzhou Prefecture.

Chapter 5 Tonal Evolution History of the Four Jin Varieties

This chapter is comprised of four sections. Section 5.1 introduces the evolutionary comparative method on which we rely to reconstruct the tonal evolution history of the four Jin varieties spoken in the region of the former Fenzhou Prefecture. Section 5.2 demonstrates the tonotypes we match with T1~T6 of each consultant. In Section 5.3, we discuss how the tonal evolution history is reconstructed. In the final Section 5.4, we demonstrate a tree diagram describing the tonal evolution history we reconstruct.

5.1 Evolutionary comparative method

In order to reconstruct the tonal evolution history of the four Jin varieties spoken in the region of the former Fenzhou Prefecture, we adopt the methodology termed 'evolutionary comparative method' (hereafter ECM). ECM was first formally proposed by Zhu Xiaonong (2018). This methodology could provide us with an effective tool for the studies of evolutionary phonology which takes phonological typology as its empirical base.

According to Zhu Xiaonong (2018), ECM consists of two specific comparison methods: (1) comparison of internal variation; (2) comparison of external patterns. Internal comparisons refer to studies using the method that observes synchronic variations and in turn explores the potential sound change. External comparisons intend to identify the temporal sequence of sound changes across linguistic varieties within a certain region with an aim to reconstruct the phonological history of this region. In this research, we will employ both the internal and external comparison method.

As mentioned above, evolutionary phonological studies rely on phonological typology. Based on the large amount of acoustic data that were accumulated in several times of fieldwork, Zhu Xiaonong (2014, 2018) established a 'universal tonotype inventory' which contains dozens of generalized tonotypes and is expected to be sufficient to cover all kinds of contrastive tonotypes in tonal languages. In this inventory, a tone could be assigned a proper position according to three parameters: general type (contour and height), register, and length. Among the three parameters, the general type functions as the most important one, and any tone could be divided into five kinds of general types. Four of them are featured as [+contour, –height]: 'falling', 'rising', 'level', and 'dipping'. The remaining one is 'low' which is featured as ([–contour, +height]). Any tonotype is named after its specific contour or pitch height (usually preposed modifier plus the general type). Relevant tonotypes

of our fieldwork data are all included in this inventory.

The following Table 48 exhibits the universal tonotype inventory proposed by Zhu Xiaonong (2014, 2018). Hereafter, all tone value transcriptions are based on a multi-register and four-point (MRFP) scale unless particularly stated. Since no contrastive registers are activated in the four Jin varieties, only the tone value transcriptions of normal registers are listed. The tonotypes that are involved in the discussions of this thesis are given in bold.

General type	Tonotype	Length		Possible variety (long, normal)
		Long tone (normal)	Short tone (normal)	
Low[22] 低調	level-low 平低調	**{22}**		
	rising-low 升低調	{23}		
	falling-low 降低調	{32}		
	dipping-low 凹低調	{323}		
Level 平拱調	high-level 高平調	{55}	{5}	[45, 554, 54]
	mid-level 中平調	**{44}**	{4}	**[43,** 443**]**
	low-level 低平調	{33}	{3}	[32, 332]
Rising 升拱調	slight-rising 微升調	{45}	**{45}**	
	high-rising 高升調	{35}	**{35}**	[25]
	mid-slight-rising 中微升調	{34}		
	mid-rising 中升調	{24}	**{24}**	[243]
	right-convex-rising 後凸升調	{354}		[353, 243]
Falling 降拱調	high-slight-falling 高微降調	{54}		[43]
	high-falling 高降調	**{53}**	{52}	**[52]**
	mid-slight-falling 中微降調	{43}		
	mid-falling 中降調	**{42}**	{42}	[43]
	high-convex-falling 高彎降調	{552}		[553, 452]
	mid-convex-falling 中彎降調	{342}		[442, 332]
Dipping	central-dipping 央凹調	**{323}**		[303, 223, 324]

[22] Among the low type, {22}, {23}, and {32} are originally referred to as '最低平調' (the lowest level tone), '最低升調' (the lowest rising tone), and '最低降調' (the lowest falling tone) by Zhu Xiaonong (2014). For convenience, we rename them 'level-low' (平低調), 'rising-low' (升低調), and so forth. In this way, their primary distinctive feature 'low' could be highlighted.

凹拱調	left-dipping 前凹調	{324}		[325]
	right-dipping 後凹調	**{523}**		**[423]**
	falling-level 降平調	{422}		**[544, 533, 522]**
	double-inflecting 兩折調	{4242}		[5232, 3242]

Table 48: Universal tonotype inventory (Modified based on Zhu Xiaonong, 2014, 2018[23])

It should be noted that in this universal tonotype inventory shown by Table 48, any tone value transcription enclosed in the braces '{}' refers to a categorized representation, and it may correspond to more than one specific variety in surface representation. A tonotype should be defined by its acoustic and perceptual features (Zhu Xiaonong, 2018). Zhu did not categorize a 'convex contour' that is parallel to the dipping type, and classified this type of tonotypes into falling or rising types according to their primary perceptual features. Zhu Xiaonong (2014) argues that convex-like tones are likely to be a transitional stage between falling and rising tones, and the perceptual targets of this type of tones are usually assigned to the falling or rising parts. The tonotypes listed in above Table 47 were generalized by Zhu based on some previous studies on specific general types[24]. Note that for any low tonotype, it is primarily featured by the pitch height feature 'low'. Specific shapes (such as the preposed modifier 'falling', 'level', and so forth) are no more than a secondary feature since within

[23] The following modifications are made:

(1) The low tonotypes of {23}, {32}, and {323} are separately listed under the category of low type. In Zhu's original version, they are treated as varieties of {22}.

(2) A tonotype of 'falling-level' contour is added under the category of dipping type. This kind of intermediate tonotype is absent from Zhu's original version, but it has ever been mentioned by Zhu Xiaonong (2014, 2018) for the discussion on Jiangyin (江陰) Wu (吳語).

(3) Three short rising tonotypes of {45}, {35}, and {24} are added. In Zhu's original version, short tones are only comprised of falling tones of {52}, {42}, and level tones of {5}, {4}, {3}. It is understandable that dipping types may be missing in short tones due to their complex contour. However, rising types are probably immune from this limitation in that the short falling tonotypes have been confirmed. Besides, a short rising tone of {35} (falsetto, arranged in a high register) was actually identified by Wang Caiyu & Zhu Xiaonong (2015) for the discussions on a variety of Jianli (監利) Gan (贛語).

(4) {323} appears twice in our modified version, once as a dipping-low tone while once as a central-dipping tone. The same issue also exists in Zhu's original version, since he listed [323] as a possible variety of purely low tone {323} while the central-dipping tone was simultaneously transcribed as {323}. However, no explanation has been offered by Zhu. In our opinion, the dipping-low {323} and the central-dipping {323} are essentially different, but they have to be assigned the same transcription due to the insufficiency of the four-point scale. If based on a five-point scale, the dipping-low should be transcribed as {212}, and the central-dipping should be {323~313}. For convenience, we still employ the multi-register and four-point (MRFP) scale since the ambiguity of {323} does not affect the following discussions.

[24] Detailed information of these works are as follows.

Level type: Zhu Xiaonong (2012a), Zhu Xiaonong, Shi Defu, et al. (2012);
Rising type: Mai Yun (2014), Wang Caiyu & Zhu Xiaonong (2015);
Dipping type: Zhu Xiaonong, Zhang Ting, et al. (2012);
Low and falling type: Zhu Xiaonong (2012b), Lam Man Fong, et al. (2013), Shen Ruiqing, et al. (2017).

such a limited range of pitch height, the contrastiveness between these specific shapes has been largely weakened, and in turn, undergone anti-categorization.

5.2 Tonotype of each tonal category

In Chapter 3, we transcribed the pitch value of each tonal category in the four Jin varieties based on our first-hand acoustic data collected in the fieldwork. In the last section, we introduced the universal tonotype inventory, and now we turn to match these categorized tonotypes with the tone value we have transcribed.

In the following discussions, we divide the six tonal categories into two groups: a group of the long tones (T1~T3) and a group of the short tones (T4~T6). Traditionally, T4 (*Qu* 去聲) would never be grouped with T5 (*Yin-Ru* 陰入) and T6 (*Yang-Ru* 陽入) because any morpheme in a Sinitic language that carries a *Qu* tone never ends in a coda which is a reflex of any of the MC stop coda /*-p/, /*-t/, or /*-k/, and its duration is usually longer than that of *Ru* tones. However, all T4 tokens we recorded in the fieldwork were realized in a shorter duration than T5/T6, and they were frequently accompanied by a glottal stop coda [-ʔ]. Since the tonotype of T4 seems not easy to be confused with that of other tonal categories, the [-ʔ] here is likely not to be a categorized phonemic unit which has been encoded in the underlying representations of these syllables bearing a T4 tone. Nevertheless, since we have mentioned in Subsection 3.4.2 that in some certain Jin varieties the short duration of T4 could serve for phonological contrast, we determine to identify T4 as a short tone.

In addition to T4 (*Qu*), we also separate T1 (*Yin-Ping* 陰平) and T2 (*Yang-Ping* 陽平) as two distinct tonal categories. As far as we know, all previous studies in which Pingyao, Jiexiu, or Xiaoyi Jin was involved followed the traditional view that Bingzhou Jin varieties do not distinguish T1 and T2. In this research, in order to reconstruct the tonal history of the pre-T1-T2 merger time, separating these two tonal categories is required.

The following Table 49 demonstrates the tonotypes we have matched with the three long tones: T1, T2, and T3.

Variety | Consultant		Tone value transcription | Tonotype		
		T1 (*Yin-Ping* 陰平)	T2 (*Yang-Ping* 陽平)	T3 (*Shang* 上聲)
Fenyang 汾陽 (Urban 城區)	FY1	{323} central-dipping 央凹調	{42} mid-falling 中降調	{423} right-dipping 後凹調
	FY2	{533} falling-level 降平調	{52} high-falling 高降調	{423} right-dipping 後凹調
(Yanwu 演武)	FY3	{42^{L}} mid-falling 中降調	{42^{H}} mid-falling 中降調	{52} high-falling 高降調
Pingyao 平遙	PY1	{22^{L}} level-low 平低調	{22^{H}} level-low 平低調	{523} right-dipping 後凹調
	PY2	{22^{L}} level-low 平低調	{22^{H}} level-low 平低調	{522} falling-level 降平調
Jiexiu 介休	JX1	{23^{L}} rising-low 升低調	{23^{H}} rising-low 升低調	{523} right-dipping 後凹調
	JX2	{24^{L}} mid-rising 中升調	{24^{H}} mid-rising 中升調	{523} right-dipping 後凹調
Xiaoyi 孝義	XY1	{43} mid-level 中平調	{44} mid-level 中平調	{544} falling-level 降平調
	XY2	{42^{L}} mid-falling 中降調	{42^{H}} mid-falling 中降調	{52} high-falling 高降調

Table 49: Tonotype of the long tones

Table 50 demonstrates the tonotypes of short tones: T4, T5, and T6. As we mentioned in Subsection 3.4.3, in this thesis T5 and T6 are not treated as distinctive tonal categories with T2 and T3 respectively. Therefore, they are assigned the identical tonotypes with corresponding T2 and T3 despite subtle differences in the tone value transcriptions.

Variety | Consultant		Tone value transcription | Tonotype		
		T4 (*Qu* 去聲)	T5 (*Yin-Ru* 陰入)	T6 (*Yang-Ru* 陽入)
Fenyang 汾陽 (Urban 城區)	FY1	{5} high-level 高平調	{43[4]} (T2: mid-falling 中降調)	{42[3]} (T3: right-dipping 後凹調)
	FY2	{5} high-level 高平調	{53} (T2: high-falling 高降調)	{423} (T3: right-dipping 後凹調)
(Yanwu 演武)	FY3	{5} high-level 高平調	{43} (T2: mid-falling 中降調)	{50} (T3: high-falling 高降調)
Pingyao 平遙	PY1	{24} mid-rising 中升調	{2} (T2: level-low 平低調)	{522} (T3: right-dipping 後凹調)
	PY2	{24} mid-rising 中升調	{2} (T2: level-low 平低調)	{522} (T3: falling-level 降平調)
Jiexiu 介休	JX1	{24} mid-rising 中升調	{23} (T2: rising-low 升低調)	{423} (T3: right-dipping 後凹調)
	JX2	{35} high-rising 高升調	{23} (T2: mid-rising 中升調)	{423} (T3: right-dipping 後凹調)
Xiaoyi 孝義	XY1	{45} slight-rising 微升調	{3} (T2: mid-level 中平調)	{544} (T3: falling-level 降平調)
	XY2	{4} mid-level 中平調	{42} (T2: mid-falling 中降調)	{52} (T3: high-falling 高降調)

Table 50: Tonotypes of short tones

5.3 Reconstruction of the tonal evolution history

It is assumed that the evolution of a tonal category could be triggered in two different kinds of contexts. One is the case we refer to as 'natural evolution' in which the tonal category evolves along the chain that could be empirically generalized (later to be introduced in Subsection 5.3.1). Another one is the case in which changes in a tonal category are triggered by external factors such as mergers or contact. With regard to the four Jin varieties in question, T1 (*Yin-Ping*) is a variable that tends to be merged into T2 (*Yang-Ping*) or T3 (*Shang*), with the former pattern being represented by Bingzhou cluster and the latter pattern by Wutai cluster (Shen Ming, 1999). Accordingly, it is reasonable to

hypothesize that the evolution of both T2 and T3 should be natural patterns, while that of T1 should be largely influenced by T2 or T3. Thus, the contour of T1 is expected to evolve along the way that it becomes increasingly more similar to that of T2 or T3, until the time when it is completely merged. The reconstruction of the tonal evolution history will be based on the assumption we have discussed in the preceding chapters that the T1-T2 merger is a near merger rather than a complete merger in Pingyao, Jiexiu, Xiaoyi, and Yanwu Fenyang Jin.

5.3.1 Generalized tonal evolution rules

In order to track the potential paths of tonal evolution, Zhu Xiaonong (2018) also generalized four chain-like tonal evolution chains based on relevant previous studies on the tonal evolution of several representative tonal languages. Besides the four chains, Zhu also proposed a 'low tone transformation channel' which indicates that a low tone could be transformed freely as long as its essential feature 'low' remains unaltered. The four generalized evolution chains are as follows.

(1) Rule 1: Clockwise evolution chain;

(2) Rule 2: Anti-clockwise evolution chain;

(3) Rule 3: Level tone lowering chain;

(4) Rule 4: Mid-level tone radiation chain.

These chains are demonstrated in the following Figure 29 (on the next page).

In Figure 29, the bottommost box represents the low tone transformation channel. This channel is assumed to contain all tonotypes primarily featured by 'low'. Recall that low tones are featured by [−contour, +height], and thus, any tonotype in this channel is assumed to be free to be converted into another low tonotype since its primary feature remains unaltered. On the other hand, the low tone transformation channel also functions as a terminal in this system since the (anti-)clockwise chains and the level tone lowering chain can flow into it. In Figure 29, we could see that either the clockwise chain (highlighted in red), the anti-clockwise chain (in blue), or the level tone lowering chain (in yellow) has one arrow which points to the bottommost box representing the low tone transformation channel. For any non-low tone that evolves into a low tone, its original contour features would undergo a process of anti-categorization, and its identification would be substituted by its lowered pitch value. However, the original contour types may also be preserved as a secondary feature. For instance, a level-low tone might have been a low-level tone in the last stage, and in similar

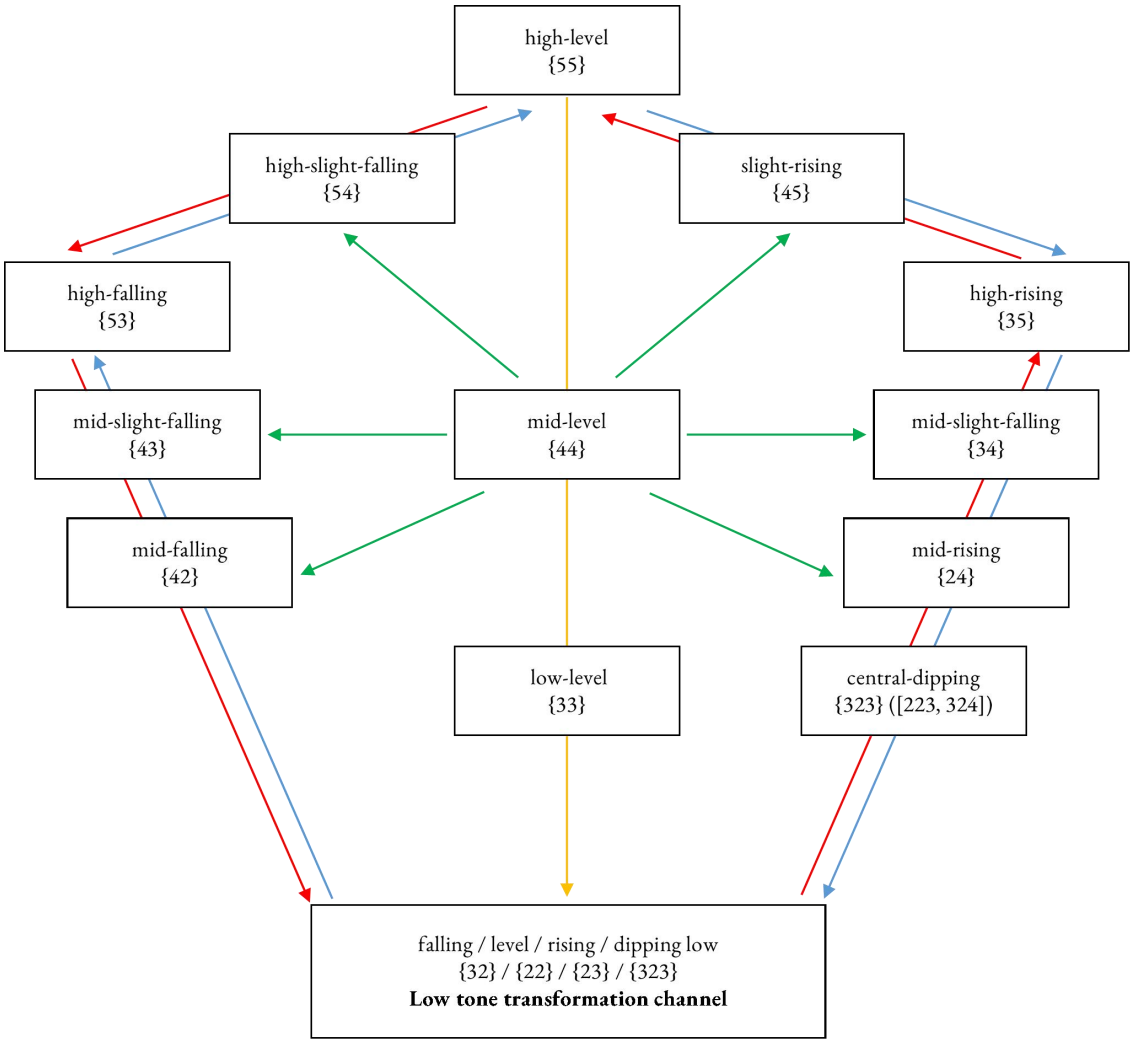

Figure 29: Tonal evolution chains (Zhu Xiaonong, 2018)

(continued from Page 70) way, a falling-low tone might be derived from a mid-falling tone. Once a non-low tone becomes a low tone, it is free to be transformed into the other low tonotypes within the low tone transformation channel.

5.3.2 Reconstructions

In this subsection, we will demonstrate detailed reconstructions by tonal category. Discussions in this subsection follow the sequence of T2→T3→T1→T4→T5/T6.

Before the reconstructions, we introduce two principles that will guide our following works. The first principle is that since we recruited consultants of different generations in the fieldwork, materials of a certain Jin variety should be strictly arranged in a generational order. In cross-variety comparisons, it is the materials from the elder generations that should be prioritized. In principle, materials of the

younger generations should be derived from that of the elder generations. The second principle is that geographical adjacency should be prioritized. Specifically, any reconstruction which arrives at a result grouping two nonadjacent varieties (e.g. Pingyao/Xiaoyi or Fenyang/Jiexiu) is disfavored.

5.3.2.1 Reconstruction of T2 (*Yang-Ping* 陽平)

We start from T2, because T2 is regarded as a case of natural evolution and it exhibits more varied differentiation than T3. We repeat the tonotypes we have matched with the tone value we transcribed in the following Table 51.

T2 (*Yang-Ping* 陽平)				
Variety	Consultant	General type	Tonotype	Transcription
Xiaoyi 孝義	XY1	level 平拱調	mid-level 中平調	{44}
	XY2	falling 降拱調	mid-falling 中降調	{42}
Fenyang 汾陽 (Urban 城區)	FY1			{42}
	FY2		high-falling 高降調	{52}
(Yanwu 演武)	FY3		mid-falling 中降調	{42}
Pingyao 平遙	PY1	low 低調	level-low 平低調	{22}
	PY2			{22}
Jiexiu 介休	JX1		rising-low 升低調	{23}
	JX2	rising 升拱調	mid-rising 中升調	{24}

Table 51: Tonotypes of T2 (*Yang-Ping* 陽平)

From Table 51, we could intuitively see that in Fenyang and Pingyao Jin, it seems no internal variation of T2 in terms of the general contour types among respective consultants. Therefore, we could reconstruct a falling tone of the early stage for Fenyang Jin, and a low tone for Pingyao Jin respectively.

As for Jiexiu Jin, we could see that the elder consultant JX1 uttered T2 with a low tone (a rising type) as the adjacent Pingyao Jin while the younger JX2 uttered it with a mid-rising tone. According to the anti-clockwise chain and relative generations of these two consultants, the mid-rising T2 (JX2) may have been derived from a rising-low tone (JX1). Thus, we reconstruct a low tone for the early stage of Jiexiu Jin. Furthermore, since Pingyao and Jiexiu are geographically adjacent to each other, we could further assume a common earlier stage only shared by Pingyao and Jiexiu Jin, in which T2 was a low tone. According to our consultants, they all agreed that among all Jin varieties, Pingyao and Jiexiu

Jin have the highest mutual intelligibility. The native speaker's language intuition could also support our reconstruction.

In the cases of Xiaoyi Jin, T2 uttered by XY1 (the elder generation) is identified as a mid-level tone while that by XY2 (the younger generation) is a mid-falling tone. From *Figure 27* above, only the mid-level tone radiation could link these two tonotypes directly. Taking the relative generations into consideration, we reconstruct a mid-level T2 for the early stage of Xiaoyi Jin.

So far, we have reconstructed respective general contour types in the early stage of each Jin variety in question, and these reconstructions are based on internal comparisons. Considering the similarity and geographical adjacency between Pingyao and Jiexiu Jin, we have further reconstructed a potential common earlier stage shared exclusively by these two Jin varieties This is based on an external comparison. Grouping Pingyao and Jiexiu Jin together also reflects the MDS analysis results that have been discussed in preceding Chapter 4. The internal evolution of each Jin variety could be simply summarized as follows.

(Early Fenyang) *unspecified falling T2 > (FY1, FY3) mid-falling T2 > (FY2) high-falling T2;

(Early Pingyao-Jiexiu) *unspecified low T2 >

(Pingyao) (PY1, PY2) level-low T2, or

(Jiexiu) (JX1) rising-low T2 > (JX2) mid-rising T2;

(Early Xiaoyi) *mid-level T2 > (XY1) mid-level T2 > (XY2) mid-falling T2.

If we further reconstruct a T2 of the common earlier stage shared by all of the four Jin varieties, this T2 is most likely to be a mid-level tone since only this tonotype could directly derive a falling tone through the radiation path (Fenyang) and a low tone through level tone lowering path (Pingyao-Jiexiu). In Fenyang Jin, the mid-falling T2 could be further raised and in turn, become a high-falling tone as the younger FY2 utters. In Pingyao-Jiexiu, T2 might have been a level-low tone. In Pingyao Jin, this tonotype is preserved while in Jiexiu Jin, it might have been converted into a rising-low tone as JX1 utters, and in a later time been further raised to a mid-rising tone as JX2 utters. Finally, Xiaoyi Jin is the most conservative pattern as the mid-level T2 has been preserved until the generation of consultant XY1. In the younger generation represented by XY2, it has been radiated to a mid-falling type as in Fenyang Jin. Although Xiaoyi and Fenyang are geographically linked, XY2 is of a different generation from FY1 or FY2. Therefore, we do not group Fenyang and Xiaoyi Jin and tend to separate them in an early stage.

Besides, we rule out the possibility that the low-level T2 in Pingyao-Jiexiu Jin was derived from a

falling tone as in Fenyang Jin. In other words, Pingyao-Jiexiu Jin should not be a further split group from Fenyang. This assumption is unexplainable for whether the evolution chain between Xiaoyi and Jiexiu was blocked. Also, if it is the case, we have to reconstruct one more intermediate stage of a falling-low T2 between Fenyang and Pingyao-Jiexiu Jin, which is not supported by any existing examples in this region.

One way that could verify our reconstructions is to observe whether the tonotypes of the same tonal category in the adjacent Jin varieties outside the region of these four county-level divisions could be well incorporated in the evolution chains that have been reconstructed. In the south, this region borders a county called Lingshi (靈石). Lingshi Jin is also identified as a Bingzhou Jin variety, but it preserves two contrastive *Ping* tones probably due to the great distance from Taiyuan. T2 of Lingshi Jin is transcribed as {44} on a five-point scale (Wang Qiong, 2012), which is a mid-level tone, and comparable with T2 of Xiaoyi Jin. On the north side, this region borders Wenshui and Qixian. As we demonstrated in Section 3.4, T2 in these two Jin varieties are both falling tone, comparable with Fenyang Jin. Since both in the south and north, the adjacent Jin varieties are compatible to our reconstructions, the validity could be proved.

5.3.2.2 Reconstruction of T3 (*Shang* 上聲)

T3 is another tonal category that is assumed to reflect a natural pattern of tonal evolution. In most cases of our consultants, the tonotype of T3 appears to be a right-dipping tone. Dipping tones have a series of unique tonal evolution chains which are not unfolded in Figure 29 above. Zhu Xiaonong (2014) discussed dipping tones detailedly and generalized a network of tonal evolution in which dipping tones are involved. We simplified Zhu's network into the following Figure 30 in which the chains relevant to our fieldwork data are highlighted in dark black.

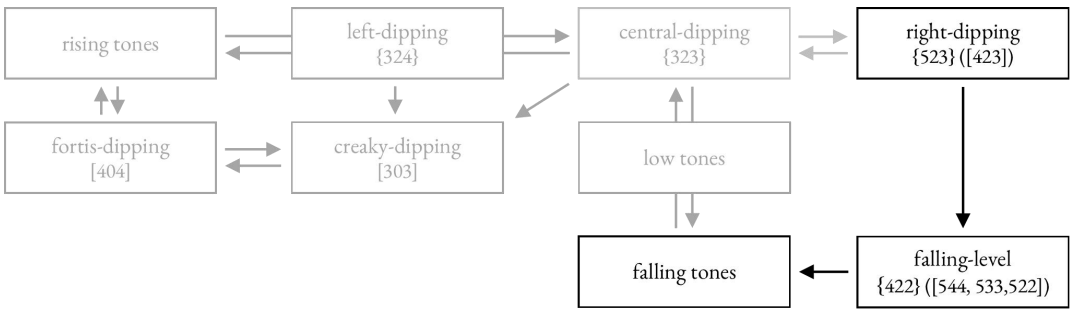

Figure 30: Dipping tone evolution network (Zhu Xiaonong, 2014)

We repeat the tonotypes we have matched with T3 using the following Table 52.

T3 (*Shang* 上聲)				
Variety	Consultant	General type	Tonotype	Transcription
Fenyang 汾陽 (Urban 城區)	FY1	dipping 凹拱調	right-dipping 後凹調	{423}
	FY2			{423}
(Yanwu 演武)	FY3	falling 降拱調	high-falling 高降調	{52}
Pingyao 平遙	PY1	dipping 凹拱調	right-dipping 後凹調	{523}
	PY2		falling-level 降平調	{522}
Jiexiu 介休	JX1		right-dipping 後凹調	{523}
	JX2			{523}
Xiaoyi 孝義	XY1		falling-level 降平調	{544}
	XY2	falling 降拱調	high-falling 高降調	{52}

Table 52: Tonotypes of T3 (*Shang* 上聲)

The evolution of T3 seems much simpler than that of T2 since there are five of the nine consultants uttering T3 with a right-dipping tone. Especially, among the consultants of Fenyang, Pingyao, and Jiexiu Jin, those of the elder generation utter right-dipping T3. Besides the right-dipping tone, another two relevant tonotypes are falling-level tone and high-falling tone. According to the dipping tone evolution network exhibited by Figure 30, there is a possible path that could link up these three tonotypes. That is the one starting from a right-dipping tone and finally evolving into a falling tone, via an intermediate stage of a falling-level tone. This path has been confirmed in Jiangyin (江陰) Wu (吳語) (Zhu Xiaonong, 2014, 2018). Therefore, we hereby select a right-dipping tone as the common earlier T3 of the four Jin varieties.

We could further resort to the comparisons with the neighboring Jin varieties outside this region. The scope should be limited to the Taiyuan basin (太原盆地), where Bingzhou Jin varieties are spoken. According to the data recorded by Wei Yang & Zhu Xiaonong (2020)[25], five Jin varieties in this area have a falling T3. These varieties include Taiyuan (太原), Yuci (榆次), Qingxu (清徐), Jiaocheng (交城), and Wenshui (文水). These five administrative divisions are geographically linked with each other, together forming a region that is bordered by Fenhe river (汾河) on the northwest side of the Taiyuan basin[26]. On the other hand, the remaining Jin varieties on the southeastern side of

[25] Wei Yang & Zhu Xiaonong (2020) is a study on Bingzhou cluster, and thus they did not include Fenyang Jin in their work. In this section, any reference to the tone value of Fenyang Jin is based on our fieldwork data.

[26] The Fenhe river flows through the downtown Taiyuan. Additionally, Yuci is also a city located on the east of the Fenhe river, but its urban area has been integrated into the metropolitan area of Taiyuan.

the Taiyuan basin include Qixian (祁縣), Pingyao (平遙), Jiexiu (介休), and Xiaoyi (孝義). They all have a right-dipping T3. In consideration of the advancement in economy and culture of Taiyuan, the geographic distribution of these two kinds of T3 could be interpreted as a differentiation between a progressive pattern (on the northwestern side) and a conservative pattern (southeastern side). In the former pattern, T3 had ever been a dipping tone but it evolved into a falling tone in a certain period as the rising half of the contour had been deleted. On the other hand, in the later pattern, the dipping T3 is preserved. Upon this assumption, reconstructing a right-dipping T3 for the four Jin varieties in question becomes more reasonable. On the other hand, similar tonal evolution from a dipping tone to a falling tone could also occur in this region, nevertheless probably at a slower pace. Two consultants we recruited utter T3 with a falling-level tone (PY2, XY1). As our reconstruction above predicts, the falling-level T3 may be an intermediate form via which the right-dipping T3 further evolved into a falling tone. Empirically, the difference between a right-dipping tone and a falling-level tone within a similar pitch range is hard to be aurally captured. Within a right-dipping tone, the latter rising half of the contour sounds much weaker than the former falling half either in terms of pitch value or duration. Hence, the latter half probably carries less functional load in the tonal perception. During the fieldwork, we found that in some cases a falling-level tone could occur as a free variation of a right-dipping tone. Once the later half has been completely deleted, the falling-level tone evolves into a falling tone. XY1 and XY2 may be ideal examples demonstrating this procedure, as the elder consultant uttered T3 with a falling-level tone while the younger uttered with a falling tone. We cannot tell whether the falling-level T3 (PY2, XY1) or the falling T3 (FY3, XY2) was derived as the result of natural evolution, or primarily due to the influence of Taiyuan Jin. But this does not affect the validity of our reconstruction.

5.3.2.3 Reconstruction of T1 (*Yin-Ping* 陰平)

As we mentioned several times in preceding sections, T1 is a variable in the tonal inventory as it has been basically merged into T2 (*Yang-Ping*) or T3 (*Shang*), or is exactly in the process of relevant mergers. The T1-T2 merger is the type represented by Bingzhou cluster, while the other type, the T1-T3 merger, is represented by Wutai cluster and Lüliang cluster. It has been mentioned hereinabove that to what extent that T1 and T2 have merged may vary among Bingzhou Jin varieties. According to our fieldwork, we confirmed that the T1-T2 merger in some Bingzhou Jin varieties should be identified as a near merger rather than a complete merger because a repeatable subtle difference between these two tonal categories was

measured. Pingyao, Jiexiu, and Xiaoyi Jin are all the cases of the near merger. On the other hand, T1 and T3 have been merged at least in citation form in most Wutai Jin varieties, while in Lüliang Jin varieties they are still contrastive tonal categories but T1 has been markedly assimilated to T3.

According to which tonal category T1 is merged into, we divide the consultants into three groups. Two consultants of Fenyang Jin, FY1 and FY2, are listed separately as two independent groups, and the remaining seven consultants otherwise form a large group. FY1 is a typical type of Lüliang cluster as T1 has been markedly assimilated to T3, despite the fact that these two tonal categories are still contrastive. The third group comprised of all consultants except FY1 and FY2 represents the type of Bingzhou cluster, as their T1 has been basically merged into T2. As for FY2, we assume that he probably represents a multi-layer type. That is, this type originally has a Lüliang bottom layer, while this bottom layer is being covered by an external layer from Bingzhou cluster (probably mainly from the accent of provincial capital Taiyuan). The external layer stopped the original T1-T3 merger set by the bottom Lüliang layer, and in turn, initiated the assimilation of T1 into T2.

With respect to the reconstruction of T1, we have to consider two factors in advance. First, since there is no exception among the nine consultants that T1 is slightly lower in pitch than T2 and T3, the merger must occur in the way that T1 was pulled upwards from below to fit the contour of T2 or T3. Second, any merger between two originally contrastive tonal categories must be triggered by enough similarity both in terms of contour and pitch value. Therefore, the two factors require that a reconstructed T1 must be lower in pitch than the reconstructed T2 and T3, and have a sufficiently similar contour that could be transformed into T2 or T3 without too much effort. Given these requirements, the most acceptable candidate of the reconstructed T1 must be an unspecified low tone. We will then discuss in detail how a low T1 is merged into T2 or T3 in the four daughter Jin varieties.

We start the discussion from the group only containing FY1. Since the reconstructed T3 is a right-dipping tone, T1 in early Fenyang Jin is qualified to be triggered the merger into T3 only if it is a dipping-low tone since its secondary feature of 'dipping' could satisfy the requirements of similarity to T3 in contour, and simultaneously the primary feature of 'low' could meet the condition of pitch value. In addition, left-dipping is the dominated tonotype of T1 and T3 in most Jin varieties of Fenzhou sub-cluster of Lüliang cluster, other than Fenyang Jin (see Table 52). We assume that it is probably in an intermediate stage of a central-dipping tone that these varieties and Fenyang Jin split.

Variety	T1 (*Yin-Ping* 陰平)	T3 (*Shang* 上聲)
Jingle 靜樂	{324}	{213}
Xingxian 興縣	{324}	{213}
Lanxian 嵐縣	{324}	{213}
Linxian 臨縣	{24}	{312}
Fangshan 方山	{214}	{312}
Lishi 離石	{213}	{312}
Liulin 柳林	{214}	{314}
Zhongyang 中陽	{424}	{313}
Shilou 石樓	{214}	{413}
Wubu 吳堡	{213}	{412}

Table 52: Five-point-based tone value of T1/T3 in varieties of Fenzhou sub-cluster (Shen Ming & Akitani Hiroyuki, 2018)

Turning to the group of the T1-T2 merger, it is probably a level-low T1 in Pingyao-Jiexiu and Xiaoyi Jin that triggered this merger, since T2 we reconstructed above is a mid-level tone. In the fieldwork data of XY1, T1 exhibits a subtle difference from T2 in slope, as the former is uttered with a slight falling-like contour. We are of the opinion that this does not mean that T1 originally had a falling contour and the falling likeness exactly reflects its bottom-layer feature that has not been completely covered by the external layer from T2. We interpret this falling-like contour of T1 in the way that the T1-T2 merger might have started from the assimilation of their onsets. That is, once the phonology of XY1 begins to no longer maintain the contrastiveness between T1 and T2, the relevant perceptual dimension by which T1 and T2 are distinguished from each other will accordingly begin to eliminate this contrastiveness. Our MDS analysis of XY1 also supports this assumption. First and foremost, onset is exactly the relevant dimension to the tonal contrast between T1 and T2. Second, onset is not the primary dimension to distinguish tonal categories, and thus it is probably more likely to be invalidated to distinguish tonal categories. Therefore, it might be due to the invalidation of onset to distinguish T1 and T2 that the merger was triggered. The left half which contains the onset was firstly raised to approach T2 while the remaining right half lags behind since it does not contain the onset. In all the near merger cases of T1/T2, our fieldwork data show that T1 preserves a subtly

lower pitch than T2. On the other hand, for the speakers, if this subtle difference in pitch has been weakened into a range that is uncapturable for themselves, they will no longer perceive these two tonal categories as a contrastive pair. As a result, the original evolution path of the merged tonal category is stopped, and then it will be integrated into that of the target tonal category. Except for XY1, all other consultants in this group could exemplify the integrated evolution of T1/T2.

Reconstructing a level-low T1 is also appropriate for Pingyao and Jiexiu Jin. Recall that we reconstructed a level-low T2 for early Pingyao-Jiexiu Jin, while we reconstructed a mid-level T2 for the common earlier stage of the four Jin varieties. It means that T2 should have undergone a lowering evolution when early Pingyao-Jiexiu Jin was descended from the last stage. If it is the case, the problem may arise as the merger seems to be a converse pattern: it is T2 that seems to have been pulled downwards to approach T1 from above. Therefore, reconstructing an intermediate low-level T2 for Early Pingyao-Jiexiu Jin becomes a necessary step. With the T2 being a low-level, a level-low T1 could satisfy the requirements of triggering the merger. The merged T1-T2 was then further lowered to a level-low. Based on this pattern, the level-low T2 was further converted into a rising-low tone in early Jiexiu Jin, while it was preserved in early Pingyao Jin. Thus, Jiexiu Jin was split away. As for Yanwu Fenyang Jin (FY3), its mid-falling T1 might be descended from a falling-low tone which had been in turn derived from an unspecified low T1. It is from this unspecified low T1 that the dipping-low T1 in Early Urban Fenyang Jin and the falling low-T1 in Early Yanwu Fenyang Jin were split from each other.

Finally, we assume that the type represented by FY2 is derived from that of FY1. For the younger generation in Shanxi Province, there are increasingly more people holding experience in studying or living in the provincial capital Taiyuan, which inevitably pose some impact on their accent. Probably influenced by this, T1 in the phonology of FY2, which should have been a right-dipping tone, was pulled by the falling T2 away from its origin evolution path to another path heading for a falling tone. And at present, it seems in the intermediate stage as a falling-level tone.

So far, we have reconstructed the tonotypes of three long tones T1, T2, and T3 in a common earlier stage which we would like to refer to as Fenzhou Jin. It is from this common stage that the four daughter Jin varieties in question were descended.

5.3.2.4 Reconstruction of T4 (*Qu* 去聲)

The evolution of T4 is similar to that of T2. Tonotypes we have matched with T4 are shown in Table 54.

T4 (*Qu* 去聲)				
Variety	Consultant	General type	Tonotype	Transcription
Xiaoyi 孝義	XY1	rising 升拱調	slight-rising 微升調	{45}
	XY2	level 平拱調	mid-level 中平調	{4}
Fenyang 汾陽 (Urban 城區)	FY1		high-level 高平調	{5}
	FY2			{5}
(Yanwu 演武)	FY3			{5}
Pingyao 平遙	PY1	rising 升拱調	mid-rising 中升調	{24}
	PY2			{24}
Jiexiu 介休	JX1			{24}
	JX2		high-rising 高升調	{35}

Table 54: Tonotypes of T4 (*Qu* 去聲)

We could see that there seems no internal variation in terms of general contour type in Fenyang, Pingyao, and Jiexiu Jin. Hereby, we reconstruct a high-level T4 for early Fenyang Jin and a mid-rising for early Pingyao-Jiexiu Jin. Turning to Xiaoyi Jin, the elder XY1 uttered T4 with a slight-rising tone, which is exactly the intermediate stage between a high-level tone and lower rising tones on the (anti-)clockwise evolution chains. XY2, the younger generation of Xiaoyi Jin, uttered a mid-level T4 which is derivable from the high-rising tone via or directly passing through an intermediate high-level tone. Given this, we reconstruct a slight-rising T4 for the common Fenzhou Jin stage. Same as in the evolution of T2, XY1 preserves this tonotype while in Fenyang and Pingyao-Jiexiu Jin, it evolved into another tonotypes. By the evolution of T4, Fenyang, Pingyao-Jiexiu, and Xiaoyi could be split from the common Fenzhou Jin. This is in accord with the MDS analysis results that the change in T4 triggered a split of Pingyao-Jiexiu.

Since the evolution of T4 among the four Jin varieties basically overlaps with that of T2, the internal differentiation of the common Fenzhou Jin might have been initiated by the changes of T2/T4. The tonal mergers seem to have occurred in a more recent period.

5.3.2.5 T5 and T6 (*Ru* tones 入聲類)

Our fieldwork data also show that T5 (*Yin-Ru*) and T6 (*Yang-Ru*) are highly consistent with T2 (*Yang-Ping*) and T3 (*Shang*) respectively in terms of either contour or pitch value, which reflects the correspondence rules generalized by Shen Ming (1999). Besides, at least in the four Jin varieties we are discussing, the two pairs (T2/T5 and T3/T6) also perform similarly in tone sandhi (refer to specific studies mentioned in Chapter 2 and 3).

Based on this, we tend to favor the view that regards T2/T5 and T3/T6 as two merged tonal categories. Although we measured minor differences between the two tones in each pair, we interpret these difference as irrelevant to the contrastiveness between the two tonal categories in each pair. First, there are minor differences in pitch value caused by the fact that there are only no more than two kinds of nucleus that could bear a *Ru* tone, while non-*Ru* tones could be born by syllables with various nuclei[27]. Due to the limited number of *Ru* tone character, we recorded much less kinds of tokens of T5 and T6 than that of T1~T4. In addition, the intrinsic acoustic properties of those vowels which are permitted in the position of nucleus in *Ru* tone syllables are also potential to pose an impact on the pitch value. Second, in cases of PY1, T3 shows a dipping tone while T6 seems to be a falling-level contour. This difference may be due to the shorter duration of T6 which limits the full realization of the underlying dipping contour. Thus it seemingly emerges as a truncated falling-level tone in surface representation.

Since nearly all Jin varieties in Shanxi reflect the correspondence rules between T2 and T5 as well as T3 and T6 (Shen Ming, 1999), we believe that the tonal mergers of these two pairs of may have been initiated in a very early period (even probably in the proto-Jin stage). In this sense, the differences between T2 and T5, or between T3 and T6 may be purely reflections of the intrinsic acoustic properties of respective nuclei and irrelevant to any tonal contrast. Thus, it would be meaningless to reconstruct an ancestral form for T5 and T6, as their natural evolution might have been stopped for a long period.

5.4 Tone-based tree diagram

Based on the reconstructions we have proposed, we could summarize a tone-based tree diagram for the four Jin varieties as the following *Figure 28* (on Page 76) demonstrates. Tonotypes given in bold refer to sound creation.

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[27] In the four Jin varieties we investigated, the nuclei which are permitted on *Ru* tone syllables are all low or mid-low vowels. Pitch of these kinds of vowels is usually lower than higher vowels according to their intrinsic acoustic properties.

With this tree diagram, we could summarize the tonal evolution in the four Jin varieties spoken in the region of the former Fenzhou Prefecture as follows.

(1) Pingyao and Jiexiu Jin are more closely related, which is consistent with the local people's intuition and our MDS analysis results;

(2) The earliest splits were initiated from the sound creation of T2 and T4;

(3) The merger of T1 might have occurred in a recent time;

(4) Within Fenyang Jin, it is the merger of T1 that triggered the split between the urban accent and Yanwu accent, as they merged T1 into different target tonal categories;

(5) The split between Pingyao and Jiexiu Jin is likely to have been triggered by the differentiation of T2;

(6) Although Xiaoyi Jin tends to be more conservative in early times, it seems to be considerably unstable in recent period, which may be due to some social factors[28].

[28] Xiaoyi City is an important coal industrial base in China, and it received a large number of non-local workers.

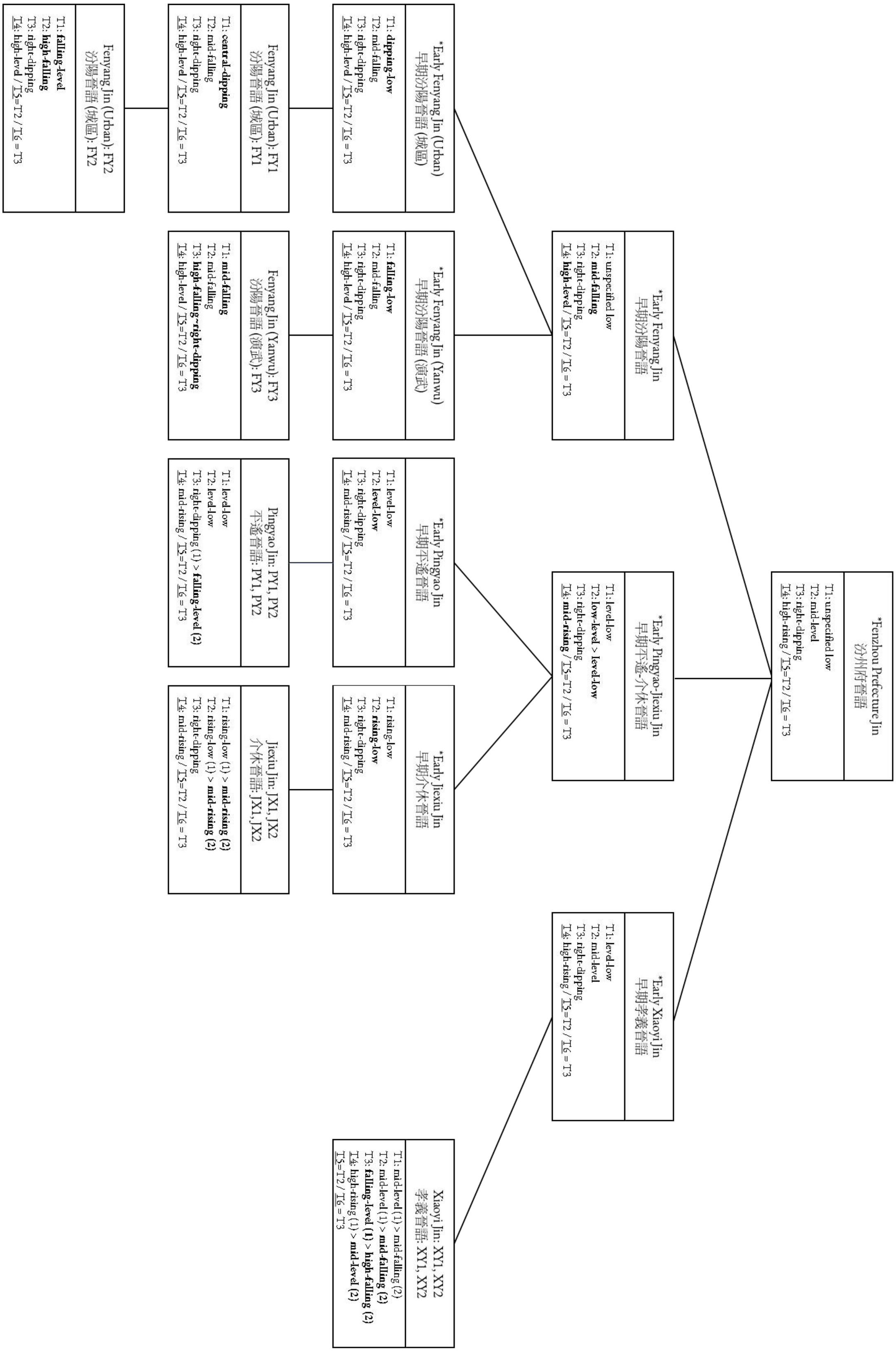

Figure 31: Tone-based tree diagram of the four Jin varieties

Chapter 6 Summary and Future Direction

6.1 Summary

This thesis is titled 'a research on the lexical tones of the four Jin Chinese varieties'. Under this title, we have detailedly discussed the following four issues about these Jin varieties.

(1) Chapter 2: Historical background;

(2) Chapter 3: Demonstration of the first-hand fieldwork data;

(3) Chapter 4: Multidimensional analysis of the fieldwork data;

(4) Chapter 5: Reconstruction of the tonal evolution.

In Chapter 2, we introduced a controversy over the relationship between Jin and Mandarin. With regard to this issue, some linguists who claim a sister-to-sister relationship take the indistinguishability between T1 (*Yin-Ping*) and T2 (*Yang-Ping*) in Bingzhou Jin varieties as a piece of evidence (non-split hypothesis).

Based on the fieldwork data we have introduced in Chapter 3, we do not agree with supporters of 'non-split hypothesis'. We measured a subtle but repeatable difference in pitch value between T1 and T2 in Pingyao, Jiexiu, Xiaoyi, and Yanwu Fenyang Jin. Although the difference to this extent is beyond the range that is capturable by native speakers' tonal perception, this still indicates that the tonal merger between T1 and T2 exists in these Jin while it is still a near merger. Besides, since in the adjacent Jin varieties spoken in Wenshui and Qixian in the north, this subtle difference was not detected. If we take this subtle difference as the frame of reference, we could further draw an isogloss, separated by which the northern group is featured by a complete T1-T2 merger, while the southern group shows a near T1-T2 merger. In addition, this isogloss overlaps with the administrative boundary of the former Taiyuan Prefecture and Fenzhou Prefecture in Ming and Qing dynasties.

In Chapter 4, we conducted a series of multidimensional scaling analyses by resorting to the function of 'isoMDS()' in R. The results helped us identify two dimensions relevant to the tonal perception of the four Jin varieties. That is, average F0 and onset. We further assumed that the differentiation of the four Jin varieties may be reflected in the difference in how the two perceptual dimensions are relevant to the tonal contrast.

In Chapter 5, we tried to reconstruct the tonal evolution for the four Jin varieties. The

reconstructions outline an early split that was initiated from the changes in T2 and T4. The MDS results also support our reconstructions. Compared to Fenyang and Xiaoyi Jin, Pingyao and Jiexiu Jin seem to be more closely related. We reconstructed a direct shared parental node for these two Jin varieties.

Finally, the original contributions of this thesis could be summarized as follows.

(1) We identified the fact that the T1-T2 merger in the region of the former Fenzhou Prefecture (Fenyang, Pingyao, Jiexiu, Xiaoyi) is a near merger, and in turn drew a isogloss between this type and the complete merger type (Wenshui, Qixian, and northward to the Taiyuan metropolitan area). This discovery could also provide direct evidence to support that the *Ping* tonal category in Bingzhou Jin varieties experienced a 'splitting-then-merging' evolution.

(2) We identified that average F0 and onset are the two relevant dimensions to the tonal perception of these Jin varieties. Considering the similarities in general contour type of each tonal category among most Jin varieties, this conclusion is probably also applicable to studies on other Jin varieties.

(3) We reconstructed the tonal evolution history of these Jin varieties, which could provide a reference frame for further studies in this field.

6.2 Future direction

Previous studies have proved that tonal evolution is a valid reference frame to track the history of Jin group. This thesis repeated this validity for a local group containing four Jin varieties which are spoken in a prefectural administrative division. Nevertheless, historical classifications should strictly follow the relative chronological sequence, otherwise, the validity of classification would be doubted. In this research, we have discussed how the T1-T2 should be an invalid frame of reference to separate Bingzhou cluster and Lüliang cluster, as Fenyang Jin could be well integrated with Pingyao, Jiexiu, and Xiaoyi Jin in terms of tonology.

On the other hand, it has been pointed out that Bingzhou cluster and Lüliang cluster are likely to be more closely related compared to other clusters (Shen Ming, 2006). Based on this, we further assume a re-classification of the Jin varieties currently classified into Bingzhou cluster and Lüliang cluster, which contains three internal units: the region of the former Taiyuan Prefecture, the region of the former Fenzhou Prefecture, and the Lüliang mountainous areas. The T1-T2 merger firstly occurred in the region of the former Taiyuan Prefecture, and it was later diffused into the region of the former Fenzhou Prefecture.

Since the region of the former Fenzhou Prefecture has been discussed in this thesis, in the follow-up studies, we plan to extend our research to the other two regions. The reconstructions of the tonal evolution history of these three regions could together contribute to the work of reconstructing the phonological history of central Shanxi.

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Appendix I: Word list[29]

Fenyang (汾陽)

Nucleus	T1		T2	T3	T4	T5	T6
/a/	/pa/ 巴		/pʰa/ 爬	/pa/ 靶	/pa/ 霸	/paʔ/ 八	/paʔ/ 拔
				/ta/ 打	/ta/ 大	/taʔ/ 搭	/taʔ/ 答
/ã/	/pã/ 班	/pʰã/ 攀		/pã/ 板			
	/tã/ 單	/tʰã/ 攤	/tʰã/ 彈	/tã/ 膽	/tã/ 旦		
	/kã/ 乾	/kʰã/ 刊		/kã/ 敢	/kã/ 幹		
/ɔ/	/pɔ/ 幫		/pʰɔ/ 旁	/pɔ/ 綁	/pɔ/ 棒		
	/tɔ/ 當[30]	/tʰɔ/ 湯	/tʰɔ/ 堂	/tɔ/ 黨	/tɔ/ 當[31]		
	/kɔ/ 光		/kʰɔ/ 狂	/kɔ/ 廣			
/ə/						/pəʔ/ 泊	/pəʔ/ 薄
						/təʔ/ 得	/təʔ/ 達
						/kəʔ/ 各	/kəʔ/ 胳
/i/	/pi/ 鞭	/pʰi/ 偏	/pʰi/ 便[32]	/pi/ 辯	/pi/ 便[33]		
	/ti/ 掂	/tʰi/ 天	/tʰi/ 甜	/ti/ 點	/ti/ 店		
	/ki/ 竿			/ki/ 杆			
/ɿ/			/pʰɿ/ 皮	/pɿ/ 比	/pɿ/ 備		
	/tɿ/ 低	/tʰɿ/ 基	/tʰɿ/ 蹄	/tɿ/ 底	/tɿ/ 帝		
	/tsɿ/ 梯	/tsʰɿ/ 妻	/tsʰɿ/ 騎	/tsɿ/ 己	/tsɿ/ 計		
/ʅ/	/tʂʅ/ 知	/tʂʰʅ/ 癡	/tʂʰʅ/ 池		/tʂʅ/ 智		
/u/	/pu/ 玻	/pʰu/ 波	/pʰu/ 盤		/pu/ 半		
	/tu/ 端		/tʰu/ 團	/tu/ 短	/tu/ 斷		

[29] These words (=characters=morphemes) are selected from relevant local dialectal records. The phonological transcriptions are faithful to their sources. Some symbols that are not accepted by IPA are involved: ɻ ([ʐ], buzzed continuation of the consonant), ɻ̩ ([ʐ̩], buzzed continuation of the consonant), ɥ̩ ([ɹ̩ʷ], syllabic labialized alveolar approximant), ɐ ([ɐ̟], mid front unrounded vowel).

[30] 'To work as; to serve as', '當做'.

[31] 'To pawn', '當鋪'.

[32] 'Cheap', '便宜'.

[33] 'Convenient', '便利'.

	/ku/ 宮	/kʰu/ 科		/ku/ 戈			
/y/			/tɕʰy/ 全	/tɕy/ 捲	/tɕy/ 卷		
/ɥ/	/tsɥ/ 居		/tsʰɥ/ 渠	/tsɥ/ 舉	/tsɥ/ 巨		
Total	28 (×3=84)		15 (×3=45)	18 (×3=54)	16 (×4=64)	5 (×5=25)	5 (×5=25)

Pingyao (平遙)

Nucleus	T1	T2	T3	T4	T5	T6
/ɑ/	/pɑ/ 巴	/pɑ/ 爬	/pɑ/ 把	/pɑ/ 霸		
	/tsɑ/ 渣	/tsɑ/ 茶	/tsɑ/ 咋	/tsɑ/ 詐		
	/kɑ/ 哥		/kɑ/ 生	/kɑ/ □[34]	/pʌʔ/ 八	/pʌʔ/ 拔
/æ/	/pæ/ 背	/pæ/ 陪	/pæ/ 擺	/pæ/ 倍	/pʌʔ/ 撥	/pʌʔ/ 薄
	/tæ/ 呆	/tæ/ 臺	/tæ/ 歹	/tæ/ 戴	/pʌʔ/ 缽	/pʌʔ/ 箔
	/kæ/ 該		/kæ/ 改	/kæ/ 概	/pʌʔ/ 北	/pʌʔ/ 脖
/ʌ/					/tʌʔ/ 德	/tʌʔ/ 達
					/tʌʔ/ 得	/tʌʔ/ 鐸
					/tʌʔ/ 搭	/tʌʔ/ 踱
/ɔ/	/pɔ/ 包	/pɔ/ 刨	/pɔ/ 保	/pɔ/ 抱	/kʌʔ/ 割	/kʌʔ/ 核
	/tɔ/ 刀	/tɔ/ 桃	/tɔ/ 島	/tɔ/ 到	/kʌʔ/ 葛	/kʌʔ/ 蛤
	/kɔ/ 糕		/kɔ/ 稿	/kɔ/ 告	/kʌʔ/ 各	
/i/		/pi/ 皮	/pi/ 彼	/pi/ 閉	/kʌʔ/ 閣	
	/ti/ 釘	/ti/ 蹄	/ti/ 底	/ti/ 帝		
	/ki/ 基	/ki/ 騎	/ki/ 己	/ki/ 計		
/ɿ/	/tsɿ/ 支	/tsɿ/ 瓷	/tsɿ/ 紫	/tsɿ/ 至		
/ʅ/	/tʂʅ/ 知	/tʂʅ/ 遲	/tʂʅ/ 整	/tʂʅ/ 正		
/u/		/pu/ 葡	/pu/ 補	/pu/ 布		
	/tu/ 都		/tu/ 堵	/tu/ 妒		
	/ku/ 姑		/ku/ 古	/ku/ 故		
/y/	/tɕy/ 居	/tɕy/ 渠	/tɕy/ 舉	/tɕy/ 巨		
/ɥ/	/tsɥ/ 豬	/tsɥ/ 廚	/tsɥ/ 主	/tsɥ/ 著		

[34] 'To obstruct'. The correpsonding character is unknown.

Total	17 (×3=51)	14 (×5=70)	19 (×3=57)	19 (×3=57)	11 (×3=33)	9 (×3=27)

Jiexiu (介休)

Nucleus	T1	T2	T3	T4	T5	T6
/a/	/pa/ 巴	/pa/ 爬	/pa/ 靶	/pa/ 霸		
			/ta/ 打	/ta/ 大		
			/ka/ 嘎			
/æ̃/	/pæ̃/ 班	/pæ̃/ 盤	/pæ̃/ 板	/pæ̃/ 半		
	/tæ̃/ 擔	/tæ̃/ 彈	/tæ̃/ 膽	/tæ̃/ 淡		
	/pæ̃/ 甘		/pæ̃/ 感			
/ʌ/					/pʌʔ/ 八	/pʌʔ/ 拔
					/tʌʔ/ 德	/tʌʔ/ 達
					/kʌʔ/ 各	/kʌʔ/ 胳
/ə/			/tʂə/ 者	/tʂə/ 蔗		
/ɛ/	/tʂɛ/ 遮		/tʂɛ/ 這			
/i/			/pi/ 比	/pi/ 病		
	/ti/ 低	/ti/ 蹄	/ti/ 底	/ti/ 地		
		/tɕi/ 騎	/tɕi/ 己	/tɕi/ 計		
/ɿ/	/tsɿ/ 資	/tsɿ/ 瓷	/tsɿ/ 紫	/tsɿ/ 字		
/u/		/pu/ 葡	/pu/ 補	/pu/ 怖		
	/tu/ 都		/tu/ 堵	/tu/ 度		
	/ku/ 姑		/ku/ 古	/ku/ 故		
/y/	/tɕy/ 居	/tɕy/ 渠	/tɕy/ 舉	/tɕy/ 巨		
/ʯ/	/tsʯ/ 豬	/tsʯ/ 廚	/tsʯ/ 煮	/tsʯ/ 住		
Total	11 (×4=44)	9 (×5=45)	17 (×3=51)	14 (×3=42)	3 (×8=24)	3 (×8=24)

Xiaoyi (孝義)

Nucleus	T1	T2	T3	T4	T5	T6
/a/	/pa/ 巴	/pa/ 爬	/pa/ 靶	/pa/ 霸	/paʔ/ 八	/paʔ/ 拔
	/ta/ 大		/ta/ 打	/ta/ 大	/taʔ/ 搭	/taʔ/ 答
	/ka/ 哥		/ka/ 嘎			

/ə/					/pəʔ/ 不	/pəʔ/ 薄
					/təʔ/ 德	
					/kəʔ/ 各	/kəʔ/ 胳
/ɤ/			/kɤ/ 哥	/kɤ/ 告		
/ɛ/	/pɛ/ 婆[35]		/pɛ/ 簸	/pɛ/ 婆[36]		
	/tɛ/ 多	/tɛ/ 馱		/tɛ/ 大		
	/kɛ/ 哥					
/i/		/pi/ 貶	/pi/ 比	/pi/ 幣		
	/ti/ 低	/ti/ 蹄	/ti/ 底	/ti/ 帝		
	/tɕi/ 基	/tɕi/ 騎	/tɕi/ 己	/tɕi/ 計		
/ɿ/	/tsɿ/ 資	/tsɿ/ 瓷	/tsɿ/ 紫	/tsɿ/ 字		
/ʅ/	/tʂʅ/ 知	/tʂʅ/ 遲	/tʂʅ/ 整	/tʂʅ/ 治		
/u/		/pu/ 葡	/pu/ 補	/pu/ 怖		
	/tu/ 都		/tu/ 堵	/tu/ 度		
	/ku/ 姑		/ku/ 古	/ku/ 故		
/y/	/tɕy/ 居	/tɕy/ 渠	/tɕy/ 舉	/tɕy/ 巨		
Total	13 (×5=65)	9 (×6=54)	14 (×5=70)	14 (×5=70)	5 (×5=25)	4 (×6=24)

Wenshui (文水)

Nucleus	T1	T2	T3	T4	T5	T6
/a/	/pa/ 巴	/pa/ 爬	/pa/ 靶	/pa/ 霸	/paʔ/ 八	/paʔ/ 拔
			/ta/ 打	/ta/ 大	/taʔ/ 搭	/taʔ/ 達
			/ka/ 嘎		/kaʔ/ 各	
/ə/					/pəʔ/ 不	/pəʔ/ 薄
						/təʔ/ 鐸
					/kəʔ/ 閣	/kəʔ/ 胳
/e/	/pe/ 杯	/pe/ 賠		/pe/ 背		
		/te/ 臺		/te/ 戴		
	/ke/ 該		/ke/ 改	/ke/ 蓋		

[35] ‘Wife (dialectal)’, ‘婆姨’.

[36] ‘Maternal grandmother’, ‘外婆’.

/i/	/pi/ 標	/pi/ 瓢	/pi/ 表			
	/ti/ 碉	/ti/ 調		/ti/ 釣		
		/tɕi/ 茄				
/ɿ/			/pɿ/ 比	/pɿ/ 痺		
	/tɿ/ 低	/tɿ/ 蹄	/tɿ/ 底	/tɿ/ 第		
	/tsɿ/ 支	/tsɿ/ 瓷	/tsɿ/ 紫	/tsɿ/ 字		
/u/	/pu/ 梆	/pu/ 葡	/pu/ 補	/pu/ 怖		
		/pu/ 旁	/pu/ 榜	/pu/ 謗		
	/tu/ 都	/tu/ 堂	/tu/ 堵	/tu/ 杜		
	/tu/ 當[37]		/tu/ 黨	/tu/ 當[38]		
	/ku/ 姑		/ku/ 古	/ku/ 故		
	/ku/ 鋼		/ku/ 廣			
Total	12 (×5=60)	11 (×5=55)	14 (×3=42)	14 (×3=42)	5 (×5=25)	5 (×5=25)

Qixian (祁縣)

Nucleus	T1	T2	T3	T4	T5	T6
/a/	/pa/ 巴	/pa/ 爬	/pa/ 靶	/pa/ 霸		
	/ta/ 當		/ta/ 打	/ta/ 大		
	/ka/ 剛		/ka/ 嘎	/ka/ 杠		
/ɑ/					/pɑʔ/ 扒	/pɑʔ/ 博
					/tɑʔ/ 搭	/tɑʔ/ 達
					/kɑʔ/ 各	
/ã/	/pã/ 班		/pã/ 板	/pã/ 辦		
	/tã/ 擔	/tã/ 彈	/tã/ 膽	/tã/ 旦		
	/kã/ 尷		/kã/ 港	/kã/ 杠		
/ə/					/pəʔ/ 不	/pəʔ/ 薄
					/təʔ/ 植	/təʔ/ 直
					/kəʔ/ 胳	
/ə̃/	/pə̃/ 崩	/pə̃/ 盆	/pə̃/ 本	/pə̃/ 笨		

[37] ‘To work as; to serve as’, ‘當做’.

[38] ‘To pawn’, ‘當鋪’.

	/tə̃/ 燈	/tə̃/ 疼	/tə̃/ 等	/tə̃/ 鄧		
	/kə̃/ 根		/kə̃/ 耿	/kə̃/ 更		
/o/			/po/ 綁			
	/to/ 多[39]		/to/ 朵	/to/ 剁		
	/ko/ 鍋		/ko/ 果	/ko/ 過		
/i/	/ti/ 爹		/ti/ 低			
		/tɕi/ 茄	/tɕi/ 姐	/tɕi/ 借		
/ɿ/	/pɿ/ 敝		/pɿ/ 比	/pɿ/ 幣		
	/tɿ/ 堤	/tɿ/ 蹄	/tɿ/ 底	/tɿ/ 弟		
	/tsɿ/ 支	/tsɿ/ 慈	/tsɿ/ 紫	/tsɿ/ 字		
/u/		/pu/ 葡	/pu/ 補	/pu/ 怖		
	/tu/ 都		/tu/ 堵	/tu/ 杜		
	/ku/ 姑		/ku/ 古	/ku/ 故		
/ɯ/	/pɯ/ 波	/pɯ/ 婆	/pɯ/ 簸	/pɯ/ 簸		
	/tɯ/ 多[40]			/tɯ/ 舵		
	/kɯ/ 歌			/kɯ/ 個		
/ɯ̃/	/pɯ̃/ 般	/pɯ̃/ 盤		/pɯ̃/ 半		
	/tɯ̃/ 瞻		/tɯ̃/ 展	/tɯ̃/ 戰		
	/kɯ̃/ 甘		/kɯ̃/ 感	/kɯ̃/ 幹		
/y/	/tɕy/ 居	/tɕy/ 渠	/tɕy/ 舉	/tɕy/ 巨		
Total	24 (×3=72)	11 (×5=55)	24 (×3=72)	25 (×3=75)	6 (×5=30)	4 (×6=24)

[39] Literary reading.
[40] Colloquial reading.

Appendix II: Data analyzed in MDS

Consultant FY1 (Fenyang, urban, elder), t = sampling point											
Label	Mor.	Tone	t1	t2	t3	t4	t5	t6	t7	t8	t9
pa	巴	T1	101.28	98.61	96.20	94.86	93.52	93.71	95.76	102.25	111.53
pɔ	邦	T1	104.45	100.80	99.04	98.74	99.56	102.02	105.78	110.81	120.63
ti	掂	T1	120.81	109.95	107.19	106.95	110.20	111.14	109.42	105.62	112.81
tɿ	低	T1	115.48	109.54	104.27	104.01	103.76	104.61	105.80	108.60	115.39
tʂʅ	知	T1	118.53	113.81	110.52	106.53	101.35	100.47	103.61	106.78	109.65
tu	端	T1	108.68	103.15	99.30	98.60	98.99	101.49	105.93	111.77	117.75
tsɥ	居	T1	122.40	116.80	109.71	103.50	100.49	99.38	101.01	104.12	110.99
AveT1	(無)	T1	116.24	110.10	105.20	101.89	100.43	100.83	102.85	106.57	114.67
pʰa	爬	T2	118.28	117.20	115.43	112.15	107.97	106.16	103.69	103.99	105.01
pʰɔ	龐	T2	129.14	123.46	119.15	117.27	117.42	115.63	110.77	108.43	109.52
tʰi	甜	T2	127.14	125.85	126.10	126.34	122.54	117.97	116.49	111.55	107.10
tʰɿ	蹄	T2	119.67	116.24	112.26	109.07	107.61	104.48	100.51	100.20	104.68
tʂʰʅ	池	T2	119.69	117.92	115.16	112.51	111.19	109.29	106.79	105.28	106.88
tʰu	團	T2	119.63	115.22	112.48	111.12	109.50	107.30	103.27	100.73	101.95
tsʰɥ	渠	T2	126.94	121.10	117.89	114.49	110.47	107.44	107.71	107.27	108.61
tɕʰy	全	T2	124.88	122.78	118.06	115.63	114.00	110.19	107.71	106.84	109.71
AveT2	(無)	T2	123.41	119.68	116.08	113.17	110.60	107.70	105.42	104.43	105.20
pa	靶	T3	118.46	112.86	108.83	104.94	104.18	104.27	104.25	106.74	114.34
pɔ	綁	T3	128.24	122.90	109.63	99.01	97.49	97.02	96.39	100.53	109.18
ti	點	T3	114.59	104.45	96.05	90.22	93.39	93.59	94.67	95.27	102.45
tɿ	底	T3	127.22	127.05	123.82	116.25	112.53	113.52	112.41	112.53	111.99
tu	短	T3	127.49	120.39	112.87	106.71	102.80	103.40	107.35	112.31	122.57
tsɥ	舉	T3	132.11	119.76	109.01	106.53	105.55	102.11	101.58	105.07	116.71
tɕy	卷	T3	123.96	119.15	111.95	106.76	103.69	103.45	102.82	107.01	115.42
AveT3	(無)	T3	121.74	114.66	107.89	103.92	102.17	101.55	102.22	105.60	113.97
pa	霸	T4	108.14	109.19	109.98	109.94	110.35	112.64	116.78	122.67	128.44

pɔ	棒	T4	118.03	118.68	118.50	118.49	118.48	119.03	120.61	126.53	135.17
ti	店	T4	127.85	130.50	132.39	133.20	133.67	134.87	138.46	142.55	144.52
tɪ	帝	T4	139.61	137.12	136.77	136.57	136.21	136.94	139.36	145.33	151.32
tʂl	智	T4	123.66	125.30	125.52	125.34	125.13	125.29	127.00	131.14	134.62
tu	斷	T4	131.31	136.05	137.87	140.14	140.57	141.33	141.82	143.47	144.12
tsɥ	巨	T4	133.88	140.19	145.19	146.92	146.33	144.57	144.60	145.74	147.49
tɕy	卷	T4	128.89	131.57	133.19	133.30	133.44	135.07	137.71	140.86	143.82
AveT4	（無）	T4	127.61	129.88	131.79	132.54	132.59	133.13	135.17	139.50	143.32
Consultant FY2 (Fenyang, urban, younger), t = sampling point											
Label	Mor.	Tone	t1	t2	t3	t4	t5	t6	t7	t8	t9
pa	巴	T1	112.60	107.89	103.79	100.86	100.00	100.38	101.31	101.14	100.69
pɔ	邦	T1	110.83	106.32	101.68	100.10	99.02	100.09	101.86	103.01	103.19
ti	掂	T1	115.04	107.48	103.12	100.17	99.03	101.15	103.19	103.52	103.03
tɪ	低	T1	117.22	112.73	106.69	100.48	96.98	97.79	100.24	100.90	100.03
tʂl	知	T1	122.20	115.69	110.29	106.65	106.01	106.33	105.94	103.93	102.24
tu	端	T1	121.56	115.58	111.54	108.10	106.93	106.46	106.50	106.21	104.39
tsɥ	居	T1	122.12	114.99	110.64	109.59	109.52	109.48	109.22	108.53	106.96
AveT1	（無）	T1	117.07	110.82	105.61	102.30	101.44	102.17	103.16	103.14	102.02
pʰa	爬	T2	110.59	105.36	103.49	102.15	100.77	98.91	96.87	94.57	92.31
pʰɔ	龐	T2	116.50	109.93	106.94	105.72	104.46	102.49	101.17	98.31	95.63
tʰi	甜	T2	119.73	116.11	113.15	111.00	109.21	107.12	103.96	100.52	97.60
tʰɪ	蹄	T2	112.98	109.32	105.78	103.78	101.79	99.62	97.70	95.82	93.49
tʂʰl	池	T2	121.80	116.90	113.21	110.62	108.39	106.37	104.05	100.92	96.96
tʰu	團	T2	128.61	123.91	121.31	119.17	115.80	112.14	107.08	103.90	103.84
tsʰɥ	渠	T2	125.09	119.65	115.38	112.15	110.19	108.08	105.83	101.63	98.30
tɕʰy	全	T2	118.40	113.02	108.88	106.08	103.23	100.81	98.38	94.42	88.50
AveT2	（無）	T2	119.77	114.78	111.44	109.13	107.07	104.81	102.29	99.28	96.30
pa	靶	T3	113.76	106.32	99.51	96.90	97.22	99.24	100.34	100.55	100.11
pɔ	綁	T3	116.46	112.53	107.99	103.91	101.56	102.57	103.41	102.66	101.22
ti	點	T3	116.04	109.07	101.72	95.14	90.60	90.85	93.05	96.77	98.78
tɪ	底	T3	118.71	109.94	101.78	95.60	95.70	98.11	99.20	98.98	97.96

tu	短	T3	117.14	108.17	98.91	89.99	86.07	89.31	96.07	99.30	98.16
tsɥ	舉	T3	122.39	115.66	107.75	99.40	97.65	99.73	103.74	105.45	101.71
tɕy	卷	T3	124.65	116.46	110.11	105.25	103.13	103.98	107.33	107.11	104.34
AveT3	（無）	T3	117.39	110.69	104.06	97.78	94.84	96.60	99.83	101.64	100.91
pa	霸	T4	119.43	117.78	118.29	117.61	116.20	115.28	114.41	112.56	110.87
pɔ	棒	T4	123.88	119.39	118.52	117.93	117.41	116.76	116.31	115.81	115.17
ti	店	T4	123.91	121.40	120.15	119.62	119.36	118.32	117.32	115.83	113.58
tɪ	帝	T4	121.01	120.72	120.53	120.27	120.08	119.72	119.07	117.70	114.97
tʂl	智	T4	126.35	125.58	124.80	123.99	123.25	122.60	121.91	120.76	119.17
tu	斷	T4	123.32	122.94	122.66	122.27	122.06	121.93	120.94	118.98	116.90
tsɥ	巨	T4	130.91	128.49	127.98	128.15	128.04	127.42	126.28	124.26	121.83
tɕy	卷	T4	123.18	120.89	120.02	119.16	118.08	116.90	115.67	114.57	113.16
AveT4	（無）	T4	124.05	123.00	122.56	122.05	121.40	120.56	119.46	117.82	115.67
Consultant FY3 (Fenyang, Yanwu), t = sampling point											
Label	Mor.	Tone	t1	t2	t3	t4	t5	t6	t7	t8	t9
pa	巴	T1	109.95	102.06	92.84	85.60	82.04	79.90	79.41	77.47	75.67
pɔ	邦	T1	115.14	105.93	96.50	89.69	82.73	78.20	73.98	70.64	64.92
ti	掂	T1	114.86	104.60	97.46	91.05	84.92	77.75	70.98	68.30	68.60
tɪ	低	T1	119.67	108.31	98.92	92.18	86.72	82.29	80.10	81.23	82.31
tʂl	知	T1	115.45	105.36	97.92	92.03	88.89	86.08	85.73	87.42	88.58
tu	端	T1	124.84	116.70	105.50	96.90	90.76	87.35	82.74	78.77	76.65
tsɥ	居	T1	116.59	112.62	104.59	94.45	87.58	81.03	77.38	73.21	66.61
AveT1	（無）	T1	115.80	106.80	98.50	91.86	87.14	83.30	79.86	77.19	74.45
pʰa	爬	T2	111.46	104.95	99.13	95.96	93.69	90.98	89.51	88.18	82.15
pʰɔ	龐	T2	118.79	110.22	102.26	94.63	88.93	86.00	82.38	78.22	75.40
tʰi	甜	T2	118.18	113.58	108.79	104.18	99.52	95.72	92.21	88.79	86.53
tʰɪ	蹄	T2	120.88	110.34	102.31	95.40	91.12	87.46	83.28	77.35	75.15
tʂʰl	池	T2	117.10	111.93	107.12	103.12	99.62	95.95	93.95	90.65	85.94
tʰu	團	T2	119.94	109.83	104.43	96.20	92.80	87.32	82.23	78.62	72.82
tsʰɥ	渠	T2	121.87	114.88	108.61	103.50	98.51	96.59	94.79	90.60	84.11
tɕʰy	全	T2	117.91	111.20	104.37	98.77	93.67	91.21	86.64	80.49	72.15

AveT2	（無）	T2	118.06	111.45	105.71	100.66	96.89	93.72	90.11	85.83	80.88
pɿ	比	T3	146.41	142.64	132.41	124.05	117.12	112.76	105.16	101.32	93.86
ki	杆	T3	141.26	129.16	116.04	105.27	98.15	92.93	87.70	83.50	80.87
ku	戈	T3	144.04	139.10	120.80	105.42	85.27	80.46	78.59	78.54	77.00
AveT3	（無）	T3	143.90	136.97	123.08	111.58	100.18	95.39	90.48	87.79	83.91
pa	霸	T4	116.61	118.00	121.01	125.57	129.79	133.05	135.14	136.01	138.24
pɔ	棒	T4	115.45	116.19	116.41	116.59	116.92	117.84	118.34	118.89	119.06
ti	店	T4	121.53	124.45	126.56	129.18	131.11	131.93	132.63	133.04	133.21
tɿ	帝	T4	123.16	127.55	130.01	132.24	133.82	135.28	136.24	139.30	144.15
tʂɿ	智	T4	123.71	126.16	128.05	130.30	132.23	135.32	138.80	140.32	141.72
tu	斷	T4	126.02	127.92	129.48	130.71	131.98	133.89	136.13	136.48	137.08
tsɥ	巨	T4	123.64	128.88	132.17	136.79	148.23	158.31	162.36	163.93	165.31
tɕy	卷	T4	121.23	121.34	121.81	122.96	125.38	128.86	133.85	136.89	138.97
AveT4	（無）	T4	121.32	123.67	125.72	128.42	131.61	134.54	136.23	137.56	138.82
Consultant PY1 (Pingyao), t = sampling point											
Label	Mor.	Tone	t1	t2	t3	t4	t5	t6	t7	t8	t9
pɑ	巴	T1	135.69	128.12	119.41	117.16	114.71	115.04	118.80	125.20	132.52
tæ	呆	T1	137.60	128.34	121.81	119.46	121.72	127.74	134.56	137.29	138.35
tɔ	刀	T1	141.99	132.80	126.16	120.05	118.07	121.10	126.98	131.14	132.65
ti	釘	T1	140.74	133.66	128.86	125.58	126.27	131.90	136.13	139.53	142.19
tsɿ	支	T1	146.16	140.37	134.15	128.58	128.71	132.85	139.39	143.77	147.40
tʂɿ	知	T1	128.42	124.76	122.78	120.23	115.70	116.22	120.39	124.38	126.91
tu	都	T1	145.49	138.61	133.52	130.25	127.77	128.03	131.77	136.05	140.18
tsɥ	豬	T1	135.58	128.84	124.68	122.45	120.52	123.39	131.47	137.10	139.89
tɕy	居	T1	142.36	138.73	132.21	123.63	120.53	120.65	122.96	127.15	131.50
AveT1	（無）	T1	141.43	135.22	129.92	126.52	126.00	129.28	134.62	139.22	142.07
pɑ	爬	T2	131.24	123.80	119.36	115.58	114.81	119.73	128.54	136.17	140.81
tæ	臺	T2	138.23	131.15	124.19	121.11	122.09	127.91	136.12	141.71	144.11
tɔ	桃	T2	148.76	142.25	134.38	129.03	126.94	130.76	140.08	146.65	149.24
ti	蹄	T2	156.30	148.16	139.05	129.08	127.78	135.54	145.31	150.96	153.84
tsɿ	瓷	T2	145.51	140.28	132.14	123.21	120.88	123.69	135.34	148.28	159.56

tʂɻ	遲	T2	151.60	146.89	140.03	135.01	134.96	140.98	149.97	157.83	162.40
pu	葡	T2	146.93	134.07	121.94	112.98	112.17	118.22	127.97	137.67	141.40
tsɥ	廚	T2	152.38	145.11	136.48	126.93	125.15	125.59	133.24	149.21	161.62
tɕy	渠	T2	150.27	147.30	136.91	123.47	121.66	127.40	134.65	143.92	146.35
AveT2	（無）	T2	146.91	139.77	131.36	123.47	122.58	127.65	136.77	146.18	151.42
pɑ	靶	T3	217.91	187.64	151.48	124.47	120.21	125.31	134.91	145.27	146.68
tæ	歹	T3	214.26	179.45	145.39	116.40	109.90	109.97	114.17	120.87	123.16
tɔ	島	T3	225.91	187.60	144.28	121.80	114.56	113.46	116.76	120.54	123.18
ti	底	T3	214.41	185.39	153.31	133.14	127.55	132.67	139.47	144.95	146.32
tsɿ	紫	T3	226.44	190.05	138.12	105.93	98.95	98.80	103.49	114.79	125.42
tʂɻ	整	T3	236.23	195.63	132.94	106.65	101.30	102.52	112.94	120.96	127.44
pu	補	T3	227.25	164.89	127.86	113.85	110.68	114.78	121.36	126.66	130.64
tsɥ	主	T3	233.93	207.00	170.88	147.68	140.21	140.47	143.49	152.95	158.46
tɕy	舉	T3	226.53	198.56	150.13	120.36	113.94	111.26	115.35	120.78	125.67
AveT3	（無）	T3	224.59	187.38	144.45	120.32	114.67	116.09	122.43	131.13	136.26
pɑ	霸	T4	110.65	112.27	116.07	123.56	131.91	140.78	148.85	156.50	158.85
tæ	戴	T4	124.68	127.88	134.00	140.97	149.07	161.76	169.52	171.28	172.35
tɔ	到	T4	125.90	130.10	138.70	149.53	164.35	173.45	181.91	183.91	184.33
ti	帝	T4	129.58	133.29	142.86	151.44	160.59	166.74	172.40	175.70	176.70
tsɿ	至	T4	123.82	129.43	141.83	153.37	167.93	176.74	185.77	190.83	194.77
tʂɻ	正	T4	126.64	128.32	135.35	144.34	154.66	165.08	170.81	177.28	182.46
pu	布	T4	122.20	128.91	138.68	149.64	161.90	171.10	182.00	186.62	190.59
tsɥ	著	T4	133.84	136.85	142.24	147.79	157.00	165.22	174.23	182.08	183.80
tɕy	巨	T4	118.29	121.07	128.11	138.21	152.05	161.50	170.91	177.70	180.33
AveT4	（無）	T4	122.94	126.98	134.80	145.06	156.25	166.21	174.64	179.67	181.98
Consultant JX1 (Jiexiu), t = sampling point											
Label	Mor.	Tone	t1	t2	t3	t4	t5	t6	t7	t8	t9
pa	巴	T1	132.30	129.74	127.65	126.76	127.03	127.62	132.79	137.78	143.47
pæ̃	班	T1	135.19	130.49	128.00	126.83	127.10	130.35	133.94	137.41	141.88
tei	低	T1	156.35	153.32	151.10	152.10	154.28	159.66	167.00	173.99	170.30
tsɿ	資	T1	151.05	148.71	148.24	147.86	149.12	153.25	158.49	163.07	158.53

tu	都	T1	151.37	149.44	147.61	146.75	146.55	148.53	152.37	157.03	155.53
tsɥ	豬	T1	154.63	149.91	147.96	148.29	148.94	154.67	161.20	170.86	173.20
tɕy	居	T1	157.00	151.94	149.01	148.60	149.77	153.62	159.39	167.40	171.62
AveT1	（無）	T1	147.62	144.39	142.23	141.66	142.66	145.92	151.45	158.14	160.61
pa	爬	T2	149.54	147.13	144.58	146.18	150.77	154.44	160.81	167.64	170.22
pǽ	盤	T2	149.45	145.95	143.12	143.33	147.25	153.42	162.91	167.83	169.79
tei	蹄	T2	154.77	154.98	155.62	155.73	156.47	157.99	162.09	165.99	168.44
tsɿ	瓷	T2	149.43	147.69	146.26	146.48	146.90	150.33	156.33	162.92	164.61
pu	葡	T2	150.82	149.68	147.12	148.63	150.90	155.64	163.06	171.68	175.83
tsɥ	廚	T2	153.42	151.47	148.32	146.86	147.44	150.91	156.26	163.43	167.99
tɕy	渠	T2	164.01	162.72	159.65	157.87	157.44	160.88	167.39	174.90	178.97
AveT2	（無）	T2	153.80	151.49	149.10	149.05	150.96	155.46	162.13	168.52	171.10
pa	靶	T3	214.57	197.27	176.56	157.43	144.96	139.01	137.22	138.89	140.43
pǽ	板	T3	230.03	197.00	165.44	149.47	143.01	145.06	149.19	154.93	155.55
tei	底	T3	258.56	232.54	200.49	176.86	158.00	149.50	148.09	150.01	151.08
tsɿ	紫	T3	246.28	214.31	180.16	154.55	145.72	142.23	142.15	144.94	150.46
pu	補	T3	231.19	212.35	187.72	161.42	150.38	144.64	141.97	141.53	145.28
tsɥ	主	T3	268.95	236.46	193.94	171.21	158.60	153.26	154.60	162.43	166.33
tɕy	舉	T3	224.55	200.19	170.13	151.64	144.13	140.30	142.33	145.34	148.22
AveT3	（無）	T3	232.70	208.27	179.60	159.25	148.72	144.43	144.53	147.49	149.75
pa	霸	T4	142.68	155.00	160.34	166.39	172.62	182.36	184.98	185.18	183.10
pǽ	半	T4	125.92	128.08	132.25	137.26	143.54	148.37	152.92	154.35	156.00
tei	地	T4	163.79	167.86	171.37	176.59	181.06	184.23	186.51	185.66	181.46
tsɿ	字	T4	166.74	170.89	175.60	180.50	183.63	187.55	189.02	186.95	179.83
pu	布	T4	158.55	163.36	172.80	180.93	187.27	192.42	196.50	195.70	187.60
tsɥ	著	T4	164.10	167.39	174.83	183.74	190.07	195.07	197.87	197.73	192.47
tɕy	巨	T4	171.01	176.38	184.25	190.60	197.09	201.65	204.76	204.65	196.83
AveT4	（無）	T4	159.15	164.83	171.70	178.47	184.62	189.85	192.58	192.26	186.95
Consultant XY1 (Xiaoyi), t = sampling point											
Label	Mor.	Tone	t1	t2	t3	t4	t5	t6	t7	t8	t9
pa	巴	T1	93.34	89.52	86.95	84.16	81.56	80.52	79.65	78.03	75.46

pɛ	婆	T1	99.62	99.21	95.54	93.12	91.10	90.50	90.26	89.41	86.83
ti	低	T1	110.27	104.83	97.29	89.27	86.48	82.47	80.89	79.52	75.95
tsɿ	支	T1	106.95	103.06	96.70	91.28	89.78	88.05	86.93	85.49	82.28
tʂl	知	T1	98.15	96.41	94.20	91.77	90.19	90.38	91.87	94.10	93.32
tu	都	T1	111.43	111.33	109.68	107.62	105.42	104.22	103.58	102.47	99.23
tɕy	居	T1	119.11	116.75	113.14	111.13	108.95	107.80	107.07	105.37	101.36
AveT1	（無）	T1	107.96	105.50	101.13	97.33	95.19	94.00	93.66	92.88	89.65
pa	爬	T2	111.96	111.97	109.53	107.25	106.22	107.19	109.34	111.09	111.07
tɛ	馱	T2	118.84	116.54	114.50	111.49	111.29	112.21	113.04	113.14	110.88
ti	蹄	T2	116.14	116.41	114.88	113.18	113.78	116.04	117.94	117.94	111.69
tsɿ	瓷	T2	109.66	106.00	101.83	98.99	98.77	100.33	103.33	103.54	101.17
tʂl	遲	T2	128.55	126.34	120.47	116.27	114.18	115.71	119.40	123.66	123.01
pu	葡	T2	117.27	115.94	112.67	109.39	106.48	106.07	106.92	107.66	105.94
tɕy	渠	T2	130.81	124.50	116.76	113.76	114.38	116.79	120.05	123.08	121.81
AveT2	（無）	T2	117.54	115.38	111.14	107.76	106.35	107.10	109.05	110.79	108.86
pa	靶	T3	137.18	123.71	114.83	118.49	121.18	119.96	121.05	122.09	120.79
pɛ	簸	T3	165.90	161.41	142.89	125.18	122.03	120.72	122.98	126.65	123.65
ti	底	T3	138.92	134.22	116.36	114.88	115.83	115.21	116.20	113.65	107.25
tsɿ	紫	T3	135.26	128.78	113.58	112.19	111.29	110.43	113.71	118.15	118.23
tʂl	整	T3	136.98	140.53	129.11	119.03	123.06	123.38	123.85	127.95	130.70
pu	補	T3	142.25	148.33	137.28	125.75	124.41	119.90	118.72	122.08	119.55
tɕy	舉	T3	160.00	158.78	145.19	138.07	137.24	138.39	137.90	138.89	138.13
AveT3	（無）	T3	143.39	136.14	122.32	117.99	118.66	117.72	117.75	118.32	115.82
pa	霸	T4	106.44	111.17	115.13	119.09	120.51	120.39	118.85	114.59	106.77
tɛ	大	T4	143.10	153.34	163.09	173.96	178.98	179.59	177.75	171.41	161.96
ti	帝	T4	134.12	148.61	156.90	164.20	171.72	173.19	172.29	169.33	165.62
tsɿ	字	T4	141.40	153.22	163.51	173.39	178.84	179.14	176.19	167.71	157.54
tʂl	治	T4	131.13	136.53	141.93	146.11	148.71	150.03	148.57	144.51	136.97
pu	補	T4	120.86	125.86	133.35	139.36	142.71	145.47	147.60	147.71	145.37
tɕy	巨	T4	142.59	152.55	156.90	160.45	163.08	164.14	164.52	161.35	153.99
AveT4	（無）	T4	132.45	141.04	147.86	154.06	158.04	159.12	158.31	154.51	147.66

A Research on Lexical Tones of Four Jin Chinese Varieties Spoken in the Former Fenzhou Prefecture

ABSTRACT in English

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Located in central Shanxi, Fenzhou Prefecture (汾州府) was an administrative division in Ming and Qing dynasties, mainly including four counties: Fenyang (汾陽), Pingyao (平遙), Jiexiu (介休), and Xiaoyi (孝義). Linguistically, there lies an important isogloss indicating whether *Yin-Ping* (陰平) and *Yang-Ping* (陽平) are distinguishable in this region. The current internal classification of Jin group (晉語) employs this criterion to separate Bingzhou cluster (并州片) and Lüliang cluster (呂梁片), as in the former cluster these two tonal categories are not distinguishable, while in the latter they are (Hou Jingyi, 1986; Shen Ming, 2006). Among the four counties, Fenyang Jin is classified in Lüliang cluster while the other three are classified in Bingzhou cluster. Since these four counties are closely related in terms of history, culture, geography, and the Jin varieties spoken in this region are mutually more intelligible among the local people compared to other neighboring Jin varieties, we hypothesize that the four Jin varieties may share a recent common parental stage which could be separated from other neighboring Jin varieties. However, according to the current classification of Jin group, Fenyang Jin has not been grouped with the other three. Motivated by this incoordination between and the current classification of Jin group and the geographic contiguity as well as the shared socio-historical context in this region, it is necessary to re-evaluate whether the (in)distinguishability between *Yin-Ping* and *Yang-Ping* is a valid frame of reference to make historical classification for the Jin varieties in this region. Unfortunately, many Jin varieties still remain poorly documented, and the existing impressionistic descriptions transcribed in earlier times could provide us with little available clues for further discussions on the tonal evolution history of this region. In order to explore this issue, we carried out a series of investigations in this research including: (1) fieldwork; (2) statistical analysis; (3) reconstruction of the tonal categories and tonotypes of the common parental language in this region.

First, we organized two times of fieldwork in six county-level divisions in central Shanxi during which we recorded relatively sufficient first-hand phonetic materials of these Jin varieties. Our data indicate that the indistinguishability between *Yin-Ping* and *Yang-Ping* observed in Bingzhou Jin varieties might have originated from a tonal merger of these two tonal categories, and in Pingyao, Jiexiu, and Xiaoyi Jin, this merger is likely to be a near merger because we measured a subtle but repeatable difference in pitch value (fundamental frequency, F0) between the tokens of these two tonal categories.

Second, in order to identify what perceptual dimensions may be relevant to tonal contrast of these Jin varieties, we conducted a series of multidimensional scaling analyses for the fieldwork data. The results indicate that it is likely to be average pitch value and onset that are relevant to the tonal contrast.

Third, we reconstructed the tonotypes of each tonal category in the common parental stage shared by these Jin varieties in this region, as well as their tonal evolution procedure by employing the evolutionary comparative method (Zhu Xiaonong, 2018). According to our reconstruction, from the common parental stage, the earliest split is likely to have been triggered by the differentiation in *Yang-Ping* (陽平) and *Qu* (去聲). By this differentiation, the parental language was divided into three: Fenyang, Xiaoyi, and Pingyao-Jiexiu. Hence, the *Yin-Ping*/*Yang-Ping* merger should be a change that occurred more recently. According to principles in historical comparative linguistics, this tonal merger should be invalid to separate Fenyang from the other three varieties by this tonal merger.

This research is an attempt to reconstruct a local tonal evolution history. The methodology we employed is proved to be effective in studies on the phonological history of Jin group.

Keywords: Jin Chinese; tonal evolution; evolutionary comparative method; Fenyang, Pingyao, Jiexiu, Xiaoyi

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原汾州府四縣晉語的聲調研究

摘要（中文）

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汾州府是明清時期山西中部的一個地方行政區劃單位，主要下轄汾陽、平遙、介休、孝義四縣。語言學上，“平聲是否分陰陽”的同言線恰好通過該區域。現行的晉語分區方案（侯精一 1986；沈明 2006）以該條同言線爲準，將山西中西部的晉語方言劃分爲幷州片與呂梁片，前者幷州片不分陰陽平，而後者呂梁片分陰陽平。原汾州府所轄四縣中的汾陽的方言被劃歸至呂梁片，而其餘三縣的方言則被劃歸至幷州片。這四縣在歷史、文化，以及地理空間上都緊密相連、不可分割，當地居民保有共同的文化認同感，方言相較於周邊其他縣級行政區也有更高的互通度。因此我們認爲該四縣方言很可能共享著一個晚近的共同來源，能與周邊其他方言區分開來。但是，根據現行的晉語分區方案，汾陽方言與其餘三縣相分離。這種存在於語言學分類與地理空間上的連貫分佈、共同社會歷史背景之間的錯位使我們開始懷疑以“平聲是否分陰陽”這一聲調語音條件作爲該區域方言分區的條件是否有效。目前，很多晉語方言點不但仍舊缺乏詳實可用的描寫，現有的資料也大都基於早期的手耳記音方式所記錄，音值並不準確。所以該區域的聲調演化史很難在沒有可用語料的情況下得到進一步探討。爲了進一步研究該課題，我們在本文中實施了以下研究：（1）田野調查；（2）統計學分析；（3）構擬該區域原始方言的調類調型與分化史。

首先，我們兩赴山西省中部，對六個縣級行政區（包括汾平介孝四縣市，以及兩個參照組：文水、祁縣）的晉語方言進行了田野調查，其間搜集了相對充分的一手語音材料。我們的語料顯示：幷州片方言所體現的“平聲不分陰陽”的現象應該是該兩調類合併的結果。此外，我們還在平遙、介休、孝義三地晉語方言的陰、陽平字中測量到了一個微小，但並非隨機出現的基頻值（F0）的差異。此現象可說明陰、陽平的合併在該三地應當仍然處於“近似合併”的階段。

其次，爲了確認哪些認知維度在這些晉語方言中起到了區分各種調類的作用，

我們採用多維標度法對田野調查中所獲取的數據進行了一些列的分析。結果表明，這些晉語方言的母語者似乎是藉助平均基頻值與調頭兩個維度進行調類區分。

最後，我們用演化比較法（朱曉農 2018）構擬出了該區域原始方言的調類及調型，並推演出了一種該區域內方言中聲調演化、合併的歷史。根據我們的構擬，從共同的原始語階段起，最早的一次分化應該由陽平及去聲的變化所啓動。這次分化分出了三組：汾陽、孝義、平遙-介休。因此，陰、陽平的合併應該是個更晚近的時期裡發生的變化。根據歷史比較語言學的原則，這次調類合併並不具將汾陽晉語與其他三地分離開的效力。

本研究是一次構擬區域聲調演化史的嘗試，同時聲調的演化對於探究晉語的音韻史也是一個有效的維度。

關鍵詞：晉語；聲調演化；演化比較法；汾平介孝

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