

## The articulatory characteristics of the palatals, palatalized velars and velars in Hakka Chinese

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### Abstract

*This paper presents the articulatory characteristics of the palatals, palatalized velar and velar consonants [ç c k<sup>l</sup> k<sup>h</sup> ŋ<sup>l</sup> ŋ<sup>h</sup>] in Hakka Chinese, spoken in the city of Meixian in southeastern China. Palatograms and linguograms show that (i) [ç ŋ ç ŋ<sup>l</sup>] are dorsal palatal; (ii) [k k<sup>l</sup> ŋ] are posterodorsal velar; (iii) the effects of palatalization on [k] and [ŋ] differ, with [k<sup>l</sup>] being slightly fronted, accompanied by extended lateral contact toward the front and with [ŋ<sup>l</sup>] turning into a palatal nasal [ɲ]; and (iv) the effect of a post-consonantal [i] on [ç] is that [ç] becomes 'more palatal'.*

### 1 Introduction

A number of recent publications [3, 4, 9] have been devoted to discussions of the articulatory characteristics of palatal, palatalized velar, and velar consonants. Keating [3] based on the data from Czech claims that palatals, such as [ɲ], do not involve a single part of the tongue, but both the back of the blade and the front of the dorsum. Recasens [9] rejects the idea that palatals are complex segments, and by referring to palatographic and X-ray data also from Czech, he holds that there is only a single continuous constriction covering two articulatory zones, postalveolar and prepalatal during [ç] and [ɲ] in Czech. Keating and Lahiri [5] report that the palatal stops from Czech and Hungary are articulated on the palate with both the blade and the body of the tongue and the lingual contact is mainly lateral extending toward the back from the stop occlusion on to the tongue body. Furthermore, the palatals of both languages exhibit a more forward articulation than for palatalized or fronted velars. They conclude that articulatorily the palatals differ from palatalized or fronted velars.

As for palatalized velar, Keating [3] based on data from Russian claims that it is not a palatal, but a fronted velar, "with the same length of contact as the back velar, but moved forward on the palate" (p. 83). Keating and Lahiri [5] based on the findings of a number of studies of palatalized velar report that the main difference between /k/ and /k<sup>l</sup>/ is that while the nonpalatalized /k/ is on the soft palate, the palatalized /k<sup>l</sup>/ is in front of it, at the border of the two palates and that both the lateral and the central contracts are shifted forward for the palatalized velar.

Keating [4] following Ladefoged [6] distinguishes two types of palatalizations: primary and secondary. While secondary palatalization refers to the situation where palatalization is the addition of a high front tongue position, like that of [i], to another articulation, primary palatalization refers to the process in which the primary articulation is changed so that it comes more palatal. As for palatalized velars, unlike the palatalized labials and coronals, they are not articulatorily more complex for they do not add an articulator specification.

So far the palatal consonants that are referred to in the literature are mostly those of Czech and Hungarian. This study takes a look at the palatal consonants of a member of the Sinitic language family, i.e. Hakka Chinese ([10]). In Hakka Chinese, the [-anterior] consonants consist of the palatals [ç c<sup>h</sup> ɲ ç] and the velars [k k<sup>h</sup> ŋ]. The palatals [ç c<sup>h</sup> ɲ] occur only before [o ɔ u au], whereas the velars [k k<sup>h</sup> ŋ] occur before any vowels and diphthongs except [o ɔ u au]. Thus, [k k<sup>h</sup> ŋ] and the respective [ç c<sup>h</sup> ɲ] are regarded as allophones of the same phonemes. [ç] and [h] are regarded as allophones of the same phoneme, as [ç] only occurs before [o ɔ u au i], whereas [h] occurs before any vowels, except [o ɔ u au i]. This study investigates the articulatory characteristics of the

palatals [c ɲ ç], palatalized velars [kʲ ɲʲ] and velars [k ɲ] in Hakka Chinese and compares its findings with those reported in Keating [3, 4], Keating and Lahiri [5], and Recasens [9].

## 2 Method

Palatograms and linguograms were taken of the Hakka Chinese syllable-initial [-anterior] consonants, including the palatals [c<sup>h</sup> ɲ ç], where [ç] may be followed by [ɔ] and [i], palatalized velars [kʲ ɲʲ], and velars [k ɲ]. Table 1 shows the monosyllabic test words consisting of the consonants in question.

Table 1. *The test monosyllabic words with the syllable-initial palatals [c<sup>h</sup> ɲ ç], palatalized velars [kʲ ɲʲ] and velars [k ɲ] of Hakka Chinese.*

Consonants		Test words
Palatals	[c <sup>h</sup> ]	[c <sup>h</sup> ɔ] ‘tomato’
	[ɲ]	[ɲau] ‘urine’
	[ç]	[çɔ] ‘boot’ [çi] ‘to hope’
Palatalized velars	[kʲ]	[kʲi] ‘machine’
	[ɲʲ]	[ɲʲi] ‘ear’
Velars	[k]	[ka] ‘family’
	[ɲ]	[ɲa] ‘tooth’

The direct palatography and linguography ([2, 7]) were used in this study. A liquid mixture of charcoal powder and olive oil was painted on either the tongue or palate for recording palatographic or linguographic contact, respectively. Both palatograms and linguograms were taken using a digital camera. To take palatograms, a mirror was inserted in the mouth of the speaker to display contact on the palate. To take linguograms, the tongue of the speaker was photographed after articulation. An upper jaw impression was made for each speaker for tracing an impression of the palate and inferring articulatory positions, using dental impression material. Analysis of contact on the palate involved matching the palatograms of the palatal consonants and the upper jaw impression of the speaker by making reference to the locations of the teeth shown in the two records. The speech data were collected from three male native speakers of Hakka Chinese, aged between 18 to 22. The speakers have lived all their life in the Hakka-speaking county of Meixian in the northeastern part of Guangdong Province in southeastern China.

## 3 Results and Discussion

Figure 1 shows the palatograms and linguograms of [c<sup>h</sup>] of [c<sup>h</sup>ɔ] ‘tomato’, [ɲ] of [ɲau] ‘urine’, and [ç] of [çɔ] ‘boot’ in Hakka Chinese for Speaker 1. A number of observations may be made of the articulatory characteristics of the palatal consonants [c<sup>h</sup> ɲ ç] in Hakka Chinese. (i) The contacts on the upper and lower articulators for [c<sup>h</sup>] and [ɲ] cover a wide area. (ii) During [c<sup>h</sup> ɲ ç] no contact takes place in the dental and alveolar zones and no contact takes place on the apex and blade of the tongue. (iii) For [c<sup>h</sup>] and [ɲ] the contact extends from the postalveolar zone to almost the entire palatal zone. In terms of lingual contact, it extends from the anterodorsal area to the posterodorsal area of the tongue. (iv) [c<sup>h</sup>] and [ɲ] in Hakka may be characterized as ‘dorsal palatal’. (v) The location of the minimal width of the air channel shown in the palatogram of [ç] indicates that [ç] is also ‘palatal’ as in the cases of [c<sup>h</sup>] and [ɲ]. The linguogram of [ç] shows that the narrowest part of the air channel is located roughly at the line dividing the anterodorsum and posterodorsum. [ç] in Hakka may also be characterized as ‘dorsal palatal’.

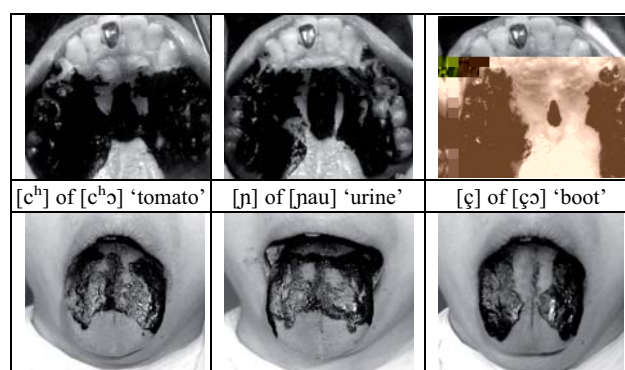


Figure 1: *Palatograms (upper) and linguograms (lower) of [c<sup>h</sup>] of [c<sup>h</sup>ɔ] ‘tomato’, [ɲ] of [ɲau] ‘urine’, and [ç] of [çɔ] ‘boot’ in Hakka Chinese (Speaker 1).*

Discussion 1. (i) The patterns of contact during the Hakka palatals [c<sup>h</sup>], [ɲ] and [ç] of the respective monosyllables [c<sup>h</sup>ɔ], [ɲau] and [çɔ] are in agreement with what is described in Ladefoged and Maddieson [8], in that, “palatal articulations, which use the body of the tongue rather than the blade, fall outside of the Coronal class of articulations” (p. 31). The observation is based on a palatal articulation from Hungarian. Absence of blade involvement is also

found to be true for articulation of palatal consonants of a number of languages referred to in Recasens [9]. Conflicting data are presented in Keating and Lahiri [5], as while there is no blade involvement during palatal stops in Hungarian (Fig. 3, p. 82), articulation of the Czech palatal stops involves the blade (Fig. 2, p. 80). This brings us to take note of the fact that Keating's [3] earlier claim that palatal consonants are complex segments must have been based on the Czech data alone, without taking into consideration the data from Hungarian and other languages referred to in Recasens [9]. (ii) The palatograms and linguograms of [c<sup>h</sup>ɲ] of Hakka Chinese show that palatal articulation is contiguous rather than complex, given that complexity of segment as in the case of double articulation is defined in terms of non-contiguous places of articulations ([1]), rather than adjacent contacts on the tongue suggested in Keating [3]. The Hakka data are in agreement with Recasens' [9] contention that palatals are not complex segments and palatal articulation "is one continuous constriction and thus one place of articulation only" (p. 271). (iii) Recasens [9] based on linguograms and X-ray pictures characterizes the Czech fricative [ç] as being "articulated with the front of the tongue dorsum" (p. 275) and adds that "the tongue regions involved are the predorsum and/or the mediodorsum according to whether the constriction is more or less fronted" (p. 275). He concludes that [ç] is mostly predorso-prepalatal and mediodorso-mediopalatal and refers to these consonants as front palatals. The articulation of [ç] in Hakka characterized as 'dorsal palatal' is similar

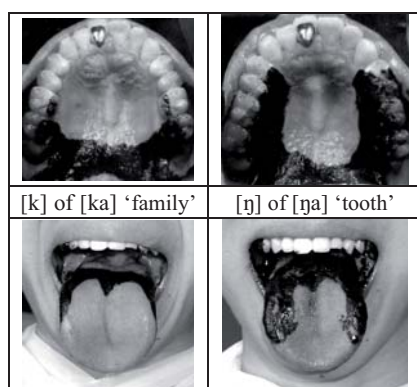


Figure 2: Palatograms (upper) and linguograms (lower) of [k] of [ka] 'family' and [ŋ] of [ŋa] 'tooth' in Hakka Chinese (Speaker 1).

to the Czech [ç], except during the Hakka [ç] the constriction is formed by raising the mid-dorsum, rather than anterodorsum, against the front half of the domal region, i.e. the palatal zone, rather than the prepalatal zone.

Figure 2 shows the palatograms and linguograms of [k ɲ] of Hakka Chinese. As can be seen, while both [k ɲ] involve a stop occlusion on the soft palate, [ɲ] compared to [k] is articulated with extended lateral contact. As for the contact on the tongue, for both [k ɲ] it is on the back part of the posterodorsal area. [k ɲ] may be characterized as 'posterodorsal velar'.

Discussion 2. That the contact during [k] is short has been reported in the literature. In Ladefoged and Maddieson [8], the movement trajectories for a point on the tongue rear during [k] in Ewe (Fig. 2.16, p. 34) suggest that the contact on the soft palate is short (in contact length) and brief. In Keating [3], the velar contact is described as being "much shorter, partly overlapping with where the back-most contact for the palatals is seen" (p. 81-82). While the velar contact is also short for [k] in Hakka, the contacts on the palate during [c<sup>h</sup>] (Fig. 1) and [k] (Fig. 2) in Hakka do not overlap, although the lingual contacts for [c<sup>h</sup>] and [k] do seem to overlap or more precisely the stop occlusion during [k] is on the back part of the large contact area on the tongue during [c<sup>h</sup>].

Figure 3 shows the palatograms and linguograms of [k<sup>j</sup>] of [k<sup>j</sup>i] 'machine', [ŋ<sup>j</sup>] of [ŋ<sup>j</sup>i] 'ear', and [ç<sup>j</sup>] of [ç<sup>j</sup>i] 'to hope'. As can be seen, the effects of palatalization on [k] and [ŋ] differ. A comparison of the corresponding palatograms and linguograms of [k] (Fig. 2) with those of [k<sup>j</sup>] (Fig. 3)

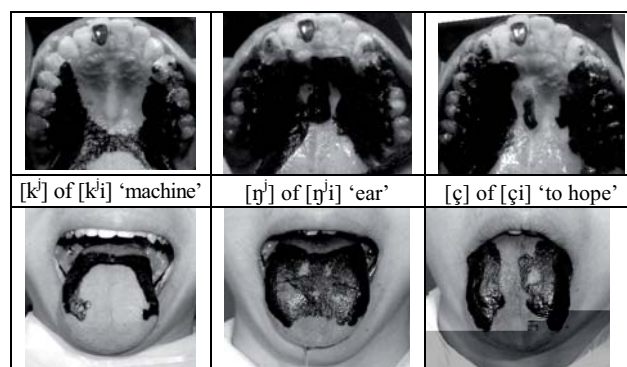


Figure 3: Palatograms (upper) and linguograms (lower) of [k<sup>j</sup>] of [k<sup>j</sup>i] 'machine', [ŋ<sup>j</sup>] of [ŋ<sup>j</sup>i] 'ear', and [ç<sup>j</sup>] of [ç<sup>j</sup>i] 'to hope' in Hakka Chinese (Speaker 1).

shows that the effects of palatalization on [k] (Fig. 2) are threefold: (i) fronting of the velar contact, (ii) reduction of the size of velar contact, and (ii) forward extension of lateral contact. Despite the effects, the palatalized [k] has not turned it into a palatal stop. It remains a velar stop, though a fronted one. This is not the case for its nasal counterpart. Due to the effect of palatalization, [ŋ] in effect has become a palatal nasal. This is evidenced by the fact that there is no apparent difference between the corresponding palatogram and linguogram of [ŋ] (Fig. 1) and those of [ŋʲ] (Fig. 3). A comparison of the corresponding palatogram and linguogram of [ç] of [çɔ] (Fig. 1) and those of [ç] of [çi] (Fig. 3) shows that [ç] of [çi] is 'more palatal' than [ç] of [çɔ], as while the location of the narrowest part of the air channel has not shifted, the width of the air channel has been reduced, which is an indication that the tongue body has been further raised.

Discussion 3. (i) The contact patterns of [k] and [kʲ] in Hakka Chinese are similar to what has been reported in Keating and Lahiri [5] about the articulation of non-palatalized and palatalized velar stops in Russian: "... the /k/ and /kʲ/ are much more similar; the non-palatalized /k/ is clearly on the soft palate, while the palatalized /kʲ/ is just in front of it, at the border of the two palates" (p. 84). While the stop occlusions on the palate during [k] and [kʲ] in Hakka Chinese are also in distinct locations, no parallelism is observed in lingual contact for [k] and [kʲ]. A comparison of the linguograms of [k] (Fig. 2) and [kʲ] (Fig. 3) shows there is no apparent difference in the location of the stop occlusion on the dorsal area of the tongue, except for the extended lateral contact toward the front during [kʲ]. This suggests [kʲ] is achieved by raising the dorsum, not the blade, accompanied by a slight fronting of the tongue, but not a change of the location of contact on the back part of the posterodorsum during [k]. (ii) The palatalization data from Hakka Chinese confirm Keating's [3] observation that "The palatalized velar is simply a fronted velar ... velars may be front or back, but fronting a velar does not turn it into a palatal" (p. 83). As shown earlier, despite the effect of palatalization, [kʲ] in Hakka Chinese remains basically a velar stop, though a fronted one. (iii) The data of palatalization of [k] and [ŋ] in Hakka Chinese illustrate the distinction between primary palatalization and secondary

palatalization ([4, 6]). While [kʲ] constitutes a case of secondary palatalization, where [k] receives a secondary articulation, [ŋʲ] a case of primary palatalization, where the primary articulation is affected, i.e., [ŋ] becoming [ŋʲ], and there is no separate secondary articulation.

#### 4 Summary

Based on the articulatory data on the consonants of Hakka Chinese presented in this study, [c<sup>h</sup> ɲ ç ŋʲ] are characterized as *dorsal palatal* and [k ŋ kʲ] as *posterodorsal velar*. The data show that palatalization turns the velar nasal [ŋ] into a palatal, but not [k]. [kʲ] has a fronted stop occlusion relative to that for [k] and remains basically a velar. A comparison of the articulatory data from three speakers shows that the patterns of contacts on the palate and the tongue are similar with only minor between-speaker variations.

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