States of the Glottis of Thai Voiceless Stops and Affricates

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INTRODUCTION

Ellis (1869–1889, pp. 1097–1111) and Sweet (1877, pp. 74–75) gave us excellent early European descriptions of the states of the glottis during the different phases of the articulatory stricture of stops. They identified three different phases of an articulatory stricture and called them the on-glide phase, the consonant phase, and the off-glide phase. In this century, Abercrombie (1967, p. 140) and Laver (1994, p. 133) have given us good descriptions of the three phases of a stop. Laver clearly described an additional overlapping phase covering both the release (or offset) phase of an initial consonant and the shutting (or onset) phase of an immediately following vowel. These four phases of an articulatory stricture are frequently called 1.) the shutting (or onset) phase; 2.) the closure (or stricture) phase; 3.) the release (or offset) phase, and 4.) the overlap phase. In this study of the states of the glottis of Standard Thai voiceless stops and affricates my primary focus is on observations of the state of the glottis during the articulatory strictures.

Holder (1669, pp. 30–31) very early made a clear distinction between two states of the glottis: breath and breath vocalized (voice). Sweet (1877, p. 75), unfortunately, used voiceless as an alternate for breath, which has led to confusion, since several states of the glottis are voiceless. I prefer to use voiceless as a cover term meaning ‘without voice,’ which allows us to divide the sounds of the world’s languages into those with voice (voiced) and those without voice (voiceless), while reserving the term breath for a particular voiceless state of the glottis. Catford (1968, p. 319) states that breath and nil phonation are the voiceless phonation types. He defined both breath and nil phonation as produced with a wide open glottis but with a difference in the turbulence of the airflow through the wide open glottis. He stated that the breathed [breθt] state of the glottis has a turbulent airflow through the wide open glottis as in audible breathing and the nil phonation state of the glottis has a non-turbulent airflow through a wide open glottis as in silent breathing. Later Catford (1990, p. 26) described an unphonated state of the glottis as made with either a closed glottis or no air passing through the glottis. Voiceless glottal stops, ejectives, and clicks can thus be said to be unphonated. Recently, Catford (personal communication) stated that he is inclined to believe that neither the nil phonation state of the glottis nor the unphonated state of the glottis is appropriate for describing the state of the glottis used during the closure phase of the articulatory stricture of the voiceless unaspirated oral stops. I totally agree and feel that Catford’s (1964, 1968, 1990) definitions of the breath state of the glottis, the nil phonation state of the glottis, and the unphonated state of the glottis are all equally inappropriate for describing the state of the glottis used during the closure phase of the articulatory stricture of an initial voiceless unaspirated oral stop. Sweet

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(1877, p. 74) stated that in the production of a voiceless unaspirated oral stop with a voiced offglide the glottis is in the position for voice during the stop, but without any air being forced through it. Catford (1977, pp. 114–115) states that voiceless unaspirated oral stops have a narrowed (though not completely closed) glottis that is restricted in a cross sectional area and that voiceless aspirated oral stops have a more or less widely open glottis. From fiberoptic studies done at the University of Edinburgh in 1977, using a native speaker of Bangkok Thai, it became clear to me that the state of the glottis for initial voiceless unaspirated oral stops and the state of the glottis for initial voiceless aspirated oral stops were not both open breath states of the glottis.

Holder (1669, pp. 60, 72) defined a glottal stop as ‘a stop made in the larynx.’ Others, such as Laver (1994, pp. 187–188), have defined it as a maintained glottal closure. Still others, such as Noël-Armfield (1931, p. 107), Heffner (1950, p. 125), Gleason (1955, p. 189), and Jones (1956, p. 19), have defined glottal stop as a closure and opening of the glottis. Jones also added that the glottis must be tightly closed. Sweet (1877, 1906) defined glottal stop as an ordinary cough or the sudden shutting and opening of the glottis, as in a cough. His analogy to a cough may be closer to reality. An ordinary cough is not simply suddenly closing and opening the vocal folds without other constrictions within the supraglottal cavity. There can be quite a bit of supraglottal cavity constriction in an ordinary cough. Glottal stop, up to the present day, is frequently defined simply as a closed or tightly closed glottis without any reference to the ventricular folds, arytenoid cartilages, or supraglottal cavity activities. However, as we will see, either “closed glottis” or “tightly closed glottis” is neither a detailed nor a complete description of the Standard Thai final glottal stop in [tʰəʔ] ‘table.’ A more complete description of glottal stop will be given below.

**VOICELESS STATES OF THE GLOTTIS**

There are three voiceless states of the glottis used in the production of Standard Thai voiceless stops and affricates. They are *breath, prephonation, and unphonated.* The breathed state of the glottis is used in the production of the Thai initial voiceless aspirated oral stops and affricates [ph, th, kh, tch] and the initial [h]. The prephonation state of the glottis is used in the production of the initial Thai voiceless unaspirated oral stops and affricates [p, t, k, tc]. The initial glottal stop, represented by ʔ in the Thai orthography, is in normal non-emphatic conversation not a glottal stop at all. It is most frequently simply a prephonation state of the glottis forming a zero initial onset to a word initial vowel. The unphonated state of the glottis is used in the production of the Thai unreleased final voiceless simultaneous glottal + oral stops [ʔp, ʔt, ʔk] and the final glottal stop [ʔ] in short stressed syllables.

The photographs in Figure 1 are single-frame excerpts of the state of the glottis during the articulatory stricture of Cardinal Consonant pronunciations of initial voiceless aspirated oral stops, initial voiceless unaspirated oral stops, final voiceless unreleased glottal + oral stop double articulations, and final glottal stop in a short stressed syllable. The composite drawings below the photographs were derived from numerous photographs of the three voiceless states of the glottis in several languages including Standard Thai and Cantonese. Both the photographs and the drawings clearly represent the norm for the three voiceless states of the glottis of Standard Thai.
The top of each photograph and drawing in Figure 1 depicts the anterior portion of the laryngeal cavity and the bottom, the posterior portion of the laryngeal cavity.

![Breath](image1)

![Prephonation](image2)

![Unphonated (glottal stop)](image3)

Figure 1. Photographs and drawings of three voiceless states of the glottis.

In the breathed state of the glottis in Figure 1 the vocal folds, ventricular folds, and arytenoids are widely abducted but not to the extent of forced inhalation. In forced inhalation the glottis and arytenoids can reach their maximum width of two or more times the width in a breathed state of the glottis. The breathed state of the glottis is characterized by a slightly turbulent airstream through a widely abducted glottis and arytenoid cartilages. Also in the breathed state of the glottis, the degree of aspiration can influence the width of the glottal opening and the width of the arytenoid cartilages’ opening. The heavier the aspiration the wider open they are. During heavy aspiration in stressed syllables they can approximate the state of glottis for forced exhalation. There are two major differences between forced inhalation, forced exhalation, breath, and prephonation. First, only in the prephonation state of the glottis are the arytenoid cartilages adducted as for modal voice, and the vocal folds form a narrowed convex-convex opening medially in the glottis. Second, in the prephonation state of the glottis there seems to be insufficient subglottal air pressure during the closure phase of the articulatory stricture to initiate an airflow through the glottis. An airflow through the partially open glottis does not appear to be initiated until during the release phase of the consonant and the overlapping onset phase of the following vowel, when the subglottal air pressure increases and a small amount of air flows through the narrowed glottis at a higher rate of speed. This small amount of air is used to initiate the first stage of the glottal cycles of voice and produces a predictable small amount of Voice Onset Time lag before the full voicing cycles of the following vowel are reached. The rapid airflow through the glottis and the elasticity of the vocal fold tissue with the resulting Bernoulli effect cause a negative pressure between the medial edges of the vocal folds that sucks them together, initiating the vibratory movements of the vocal
folds being sucked together and blown apart at a very rapid rate, thus initiating the full voicing cycles of the following vowel. The unphonated state of the glottis for final glottal stop and oral + glottal double stop articulations clearly shows the complete adduction of the vocal folds but also the partial adduction of the ventricular folds. Although the partial adduction of the ventricular folds reinforcing the glottal closure may vary in the degree of adduction it was, in my observations, never completely absent. It appears to be an important component of both the Thai final glottal stop in short stressed syllables and the Thai final unreleased oral + glottal double stop articulations [ʔp], [ʔt], and [ʔk].

**STANDARD THAI ORTHOGRAPHY AND GLOTTAL STOP**

The modern Standard Thai script is of Indic origin, as are all non-Chinese or non-Roman scripts of Southeast Asia. In the original Indic script called Brahmi, as in all the Southeast Asian scripts derived from it, the system is basically a syllabic consonant system. In this type of system a written consonant symbol is followed by an unwritten inherent vowel which is usually [a]. What is important to our discussion here, is the fact that this kind of syllabic alphabet cannot have an initial vowel. So for example, in the Standard Thai word ถว ‘younger paternal uncle or aunt,’ ถ represents a historical glottal stop that is no longer phonetically there, and ว represents the long vowel [a:], which is the only sound heard in an unemphatic pronunciation of the word. An important part of the historical reconstruction of Ancient Tai is based on the Thai script and the existence historically of initial prevocalic glottal stops, preglottalized approximants, and preglottalized voiced stops (or preglottalized voiced nasals) such as *ʔa, *ʔi, *ʔj, *ʔw, *ʔd, and *ʔn. Today only the preglottalized vowels and a few examples of the preglottalized approximant ภว[*ʔj], are still reflected in the spelling of Standard Thai.

There are, presently, two symbols in written Standard Thai used to represent glottal stop. Written Thai ถ is used for the initial mute “glottal stop,” and ช is used for a final true glottal stop. Danivathana (1987, pp. 69–70) states that in the early Sukhothai and King Li Thai scripts of the 13th and 14th centuries, three of the functions of an inverted ancestral form of ช were: (1) it represented ʔa? when used alone in a stressed syllable, as in ฉประ[ʔa?] ‘to patch’; (2) it represented glottal stop after other stressed short vowels; and (3) it was occasionally used after syllable final unaspirated stops. Did it represent final double stop articulations [ʔp], [ʔt], and [ʔk], as Danivathana seems to imply? If it did, the scribe was a very good phonetician for his time. De la Loubère (1693, pp. 173–79) recognized only final glottal stop in Thai, and it was represented by : in his early romanization of Thai. Chuenkongchoo (1956, p. 11) states that in the isolative style of speech in Standard Thai, the initial glottal plosive is different from the final glottal stop. He also states that in other styles of speech the initial glottal plosive and the final glottal stop may be absent. Here he appears to be referring to the fact that glottal stops can serve to demarcate syllable boundaries of emphatically stressed short vowels as in ถraj ‘what’ and ถเวลาถก ‘papaya,’ which in normal conversation become ถraj and ถเวลาถก with stress only on the last syllable. What is interesting here is that not only did he recognize that the initial and final glottal stops were different but he also called them by different terms. The