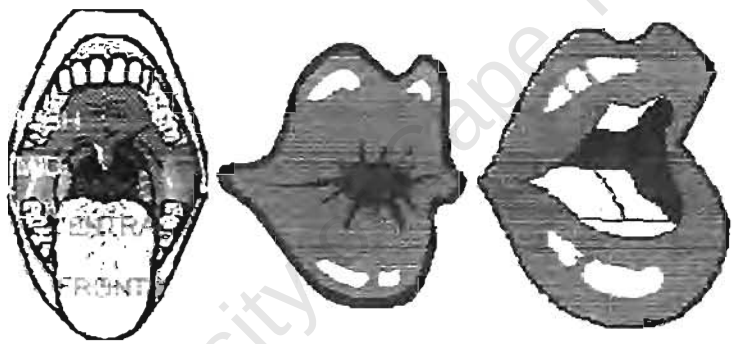
University of Cape Town
Faculty of Humanities
Department of Music

ARTICULATION IN BRASS PLAYING: THE TONGUE - FRIEND OR FOE?



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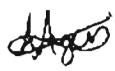
Declaration

This work has not previously been submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work or works of other people has been attributed, and has been cited and referenced.



Angela Gillian Ayers

Abstract

This dissertation attempts to demonstrate the role the tongue plays in articulation in brass playing. It briefly examines oral anatomy, physiology and theories on motor learning, and describes the tongue's position in producing English speech sounds. It shows how these positions are used to teach different articulation techniques on the various brass instruments. Articulation styles and (tonguing) exercises, which could aid in the improvement of tongue articulation, are highlighted. It is hoped that these highlights will add insight for both present and future brass teachers.

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Executive Summary

The tongue plays a central role in brass playing. It is the 'release' of the air by the tongue at different points in the vocal cavity after the air has left the lungs, which starts the 'sound' vibration of the lips and of the brass instrument. Fundamentally, the function of the tongue in the act of articulation is that of a valve which releases air, thus allowing the air to pass between the lips resulting in a vibration, which is amplified and reinforced by the instrument acting as a resonator.

In all brass playing (and in speech) the ideal breathing method is diaphragmatic breathing which ensures steady vocal cord vibration. Exercises for brass players, singers, actors and public speakers aid in strengthening diaphragmatic breathing control. Once the vocal cords have been set in motion by breath, the different speech sounds produced by man are largely dependent on which organs of articulation are used.

> "Speech acquisition is a complex process.... and a motor skill by which the speech organs are controlled to produce rapid and overlapping movements." (Bernthal & Bankson, 1981:56)

In this dissertation, an introduction to relevant aspects of phonology is included. For further research and in-depth reading, one should consult the specialised texts available (e.g. Ladefoged: *A Course in Phonetics*). Motor learning and its relevance to brass playing will also be discussed.

The tongue can be man's friend or foe. Centuries ago, one of the more draconian means of punishment for certain crimes was the cutting out of the person's tongue, leaving him speechless. Man's tongue is vital in the production of most English consonants and vowel sounds. For the purposes of this dissertation the analysis of only English speech sound production has been done.

The dissertation will describe the oral cavity and each organ of articulation as used in speech. Special attention will be given to the tongue, the chief organ of articulation in both speech and brass playing. It will become evident how brass teachers use English speech sounds to convey the position the tongue should take to achieve special articulation techniques (tip-tonguing...syllables "ta", "tu", "te" and "ti" are predominantly used).

In the same way as the *"tongue is to the player as the bow is to the violinist"* (Baines, 1976: 35), much attention is focussed on the tongue's function in brass playing for tone articulation, pitch establishment, regulation of tone quality and tongued syllables. Specific exercises are included which aid in the strengthening and flexibility of the tongue and lips in both speech and brass playing.

In-depth analyses of tongue-dependent articulation techniques in brass playing are given, from the simple (single tonguing) to the most complex (multiple tonguing). In Chapter 5. Articulation Techniques, it becomes most evident how the tongue can be the brass player's friend or foe.

The dissertation concludes by looking more specifically at selected members of the brass orchestral family, and at techniques, articulation styles and contemporary concepts, which pertain especially to each of them.

IT SHOULD BE NOTED THAT FOR THE PURPOSES OF UNIFORMITY ALL PERSONAL PRONOUNS WILL BE USED IN THE MASCULINE FORM THROUGHOUT THIS DISSERTATION.

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Terminology

The table below provides a list of generally accepted definitions pertaining to this dissertation.

Table 1: Terminology used in this Dissertation

WORD OR PHRASE	DEFINITION / DESCRIPTION
Abnormalities	Different, deviating from the norm
Affricates	Speech sound combining a plosive and a fricative in the same place of articulation. [English has two affricates: plosives released with friction - the /ch/ sounds of 'church' and the /j/ and /dge/ of 'judge'.]
Alveolar	A speech sound produced when the tip or the blade of the tongue articulates with the forward part of the alveolar ridge. e.g. /t/ and /d/.
Alveolar ridge	Ridged area in mouth between top front teeth and the hard palate
Ankyloglossia inferior	*'Glossus'* is Latin for tongue. This term means tongue-tied.
Aperture	An opening, a gap.
Apex	Top.
Approximant	A speech sound produced by an articulator which approaches a place of articulation closely, but without friction; the soft palate is raised (also referred to as frictionless continuant). Liquids (/r/ and /l/) and glides (/j/ and /w/).
Articulation (Articulate)	Articulation is the approach or contact of two speech organs. In speech-language pathology, articulation is the shaping of resonated tones into vowels and consonants by the tongue, lips and jaw. It is considered to be the "endpoint" of a model of the process of speech production. Musically, articulation refers to the way a phrase is executed. In vocal pedagogy, it is the production of consonant sounds.
Aspirate(s)	Sound/s blended with the /h/ sound and which carries breath e.g. 'how', 'p(h)at'
Atmospheric pressure	The pressure exerted by the air (on 'everything'). At sea level atmospheric pressure is typically 760mm of mercury, 33 foot of water or 1017mb and decreases as the altitude increases.
Bilabial	A speech sound produced between the lips. The point of maximum constriction is made by the coming together of the two lips. (POA: see Place of Articulation) Lower lip articulates against the upper lip. [meaning "two lips" ~ *bi* = two and *labia* = lip]
Breathing apparatus	The two lungs, the bronchi, trachea, pharynx, nasal passage and the mouth.
Buccal cavity	Cheeks.
Chromatic scale	Ascending or descending in semitones (over an octave distance).
Circular breathing	Two-fold type of breathing. It involves expelling air from one's lips (with the aid of the cheek muscles) whilst simultaneously taking a quick breath through the nose.
Coloratura style	A term describing vocal music which features agility and other virtuoso devices
Consonant	A non-vowel speech sound, e.g. stop, fricative or approximant. All letters in the English alphabet, excluding the "five" vowel sounds; may include blends, e.g. "th".

Continuant	General term for any articulation where the passage of air is not checked as in plosive/stop articulation.
Deglutition	Swallowing.
Dental	Sound made with the tongue tip against the lower portion of the upper teeth (POA) Also referred to as *interdental*. /th/ is an interdental, where the tongue tip is placed between the teeth.
Diaphragm	Muscle which separates man's abdomen and thorax (lung area).
Diastema	A 'space' between the upper lip and the two centre incisors, caused by excessive frenum tissue.
Diphthong	A vowel in which there is a change of quality during a single syllable (such as 'high', 'owl'); two vowels joined together to produce one new sound, e.g. /a/ or /i/ becomes /ai/ [as in 'rain']. Diphthongs have strong moving voicing.
Distortion	Sound which is not clear.
Dorsal-tonguing	To articulate with the tongue at the back of the mouth.
Dorsum	Latin word meaning 'back' of the tongue.
Dynamics	A musical term used to describe the gradations of volume, loud and soft, *forte* and *piano*, varying degrees of loudness and softness, and intensity of a sound.
Embouchure	The setting of lips and facial muscles used when playing a wind instrument.
Epiglottis	Found at the root of the tongue. Cartilage which gets depressed during swallowing to cover the glottis.
Exhalation	Expulsion of air from the lungs.
Extrinsic	External.
Frenotomy	A surgical procedure where the tongue-tie is clipped.
Frenulum	Tissue found either between the upper lip and the two front teeth (upper frenulum), or under the centre of the tongue (lingual frenulum).
Fricatives	Certain consonant sounds (/f/, /th/) made by the friction of breath between the narrow opening created between any articulators. (/ch/ is an affricative-combination of a stop and a fricative) [English has nine fricatives - weak or strong friction noises produced when the articulators are close enough together to cause turbulence in the air flow - /h/, /f/, /v/, /th/ as in 'thing', /th/ as in 'the', /s/, /z/, /sh/ as in "ship", and /z/ as in 'azure'.]
Fundamental tones	Parent note of the harmonic series (first harmonic).
Glottal	At the glottis. (POA) In some cases the two vocal folds (or cords) are brought together. The function of the vocal folds can be part of articulation as well as phonation.
Glottal Stop	Sound produced by the sudden explosive release of breath from behind the closed glottis.
Glottis	This is an opening which occurs between the vocal cords. The glottis can be open or closed. Occasionally this term refers to the general area of the vocal cords.
Hard Palate	Part of the palate comprised of a region of underlying bone. Fixed and immovable. Comprises about two-thirds of the palate.

Harmonics	A tone in the harmonic series of one tone produced by a fundamental tone.
Harmonic Series	Multiples or submultiples of the fundamental notes. In the case of this example "A" is the fundamental or first harmonic, 440Hz, the second harmonic 880Hz, and the third harmonic is 1320Hz, etc.
Hermetic seal	Air-tight closure.
Hyoid Bone	Tongue bone between chin and thyroid cartilage.
Hypoactiviy	Below, less than normal activity.
Inhalation	Breathing in of air into the lungs (inspiration).
Intercostal muscles	Muscle tissue found between ribs.
Interdental	Speech sound produced using the tip of the tongue and upper teeth.
Intrinsic	Internal - "within the structure."
Labial	Speech sound produced using two lips, and a constriction between the dorsum or back of the tongue and the velum. (POA)
Labial-velar	Speech sound produced using lips, simultaneously rounded with velar articulation.
Labiodental	Speech sound produced between the lip and teeth. The lower lip articulates with the upper teeth.
Lamina	Broad, flattened part of the tongue.
Larynx	Cavity in the throat housing the vocal cords. Cartilaginous structure in trachea.
Levator	Muscle which raises the tongue.
Liquid	General term for any approximant articulation that is not related to a vowel.
Macro	Large.
Manner of Articulation (MOA)	Describes way in which the air stream is obstructed when a consonant is made. Six major manners of articulation exist in the English language, namely: Stop, Fricative, Affricative, Nasal, Lateral Liquid and Retroflex.
Mastication	Grinding of food, i.e. chewing.
Median raphe	A longitudinal membrane which is situated in middle of the tongue, dividing the area each side of the dorsum into an arch.
Micro	Small.
Mnemonic	Sound pattern designed to aid one's memory (used in the initial stages of bagpipe teaching).
Monothong	Single vowel sound, e.g. /a/ as in 'bat'. Characterised by strong stable voicing. [American English has some 11 vowels having a single vowel quality, including the nine stressed vowels in the words '*beet, bit, bet, bat, Bert, boot, book, but, bough*' and the two reduced vowels as in the final syllables of '*abbot*' and '*Hubert*']
Multiphonics	Simultaneous sounding of two or more tones which are played and sung, often resulting in the sounding of a third tone.
Nasal	Speech sound pronounced with the velum lowered (open velopharynx) to allow air to pass through the nose. An articulator affects a complete air-tight closure in the mouth, while the soft palate is lowered. [English has three nasals in which the air

	flow is blocked completely at some point in the oral tract, but in which the simultaneous lowering of the velum allows a weak flow of energy to pass through the nose - /m/ as in 'me', /n/ as in 'new' and /ng/ as in 'sing'.]
Neumes	Generic names for each of the signs in old musical notation, e.g. circumflex, gravis, and accentus.
Obstruent	General term for plosive/stop, fricative and affricative articulations.
Overtones	Name of any notes of the harmonic series excluding the fundamental tone/note.
Palatal	Sound produced between the tongue and the palate (hard palate). The front of the tongue articulates with the domed part of the hard palate. (POA)
Pharyngeal	Tongue front articulates against hard palate. *"It is a sphincteric semi-closure of the oro-pharynx, and it can be learned by tickling the back of the throat, provoking retching"* (Catford 1978: 163) (POA)
Pharynx	Cone-shaped cavity at the back of the mouth which opens into the oesophagus.
Phonation	Vibration of vocal cords to produce voice. Process of the production of voice. A speech-language pathologist may describe it as "breathy", "strained", or "normal"
Phonemes	A unit of significant sound in any language.
Place of Articulation (POA)	Describes where in the vocal tract the consonant is made. The ten English articulation placements are *Bilabial, Labiodental, Interdental, Alveolar, Postalveolar, Palatal, Velar, Uvular, Pharyngeal* and *Glottal*. The relationship between the active and passive articulators as they shape or impede the air stream
Plosives	An articulator effects a complete, air-tight, closure in the mouth, while the soft palate is raised (also referred to as a *STOP* articulation). [English has six bursts or explosive sounds produced by complete closure of the vocal tract followed by a rapid release of the closure - /p/, /t/, /k/, /b/, /d/, /g/.]
Postalveolar	Between the palatal ridge and tongue, behind alveolar position. The tip or the blade of the tongue articulates with the back area of the alveolar ridge (POA)
Resonance	The amplification of certain components of the tone produced at the vocal folds along the vocal tract (above the vocal folds and including the oral and nasal cavities). An individual's voice resonance is determined by the shape of his anatomy and by the way this configuration is changed during speaking or singing.
Resonating chamber	Echoing by vibration.
Semi-vowel	General term for any *approximant* articulation that is related to a vowel.
Sibilant	General term for an *obstruent* with a grooved articulator with a consequent high velocity jet of air producing a 'whistling' effect; e.g. /s/ or /sh/ sounds.
Soft palate	Softer back-section of the palate. Part of the palate comprised of connective tissue and muscle. Fleshy and moveable. Makes up the posterior third of the palate.
Spiccato	Italian musical term meaning detached. Term originally referred to a bowing technique. The bow rebounds off the string, the result being notes which are slightly more resonant than staccato notes.
Synergistically	Muscles working together, i.e. not randomly (combined effort).

Thoracic cavity	Chest area.
Uvula	"Pendent-like" fleshy part of soft palate. (at back of)
Uvular	Between the tongue and the *uvula*. The back of the tongue articulates with the very back of the soft palate, including the *uvula*. (POA)
Velar	Between the teeth and the velum. The back of the tongue articulates with the soft palate.(POA)
Velocity	Rate/speed of directional motion.
Velum	Soft palate. Generally defined as the roof of the oral cavity, it separates the *nasal* and *oral* cavities from one another (divided into hard and soft palate).
Voiced/Voiceless	Quality of speech sounds depending on the state of the *Glottis*.
Voiced	Vocal cords held tightly together so that they vibrate with *egressive pulmonic* air.
Voiceless	The vocal folds are held apart, allowing *egressive pulmonic* air to pass unhindered.
Vowel	Speech sounds produced with minimal approximation of the articulators (twenty-one combination sounds are possible). Vowel articulations may be either *monophthongal*, i.e. all articulators are relatively stable within a syllable (also referred to as *pure* or *simple*) or *diphthongal*, i.e. one or more articulators move significantly within a single syllable (also referred to as a *glide* or *complex*).

INTRODUCTION

OBJECTIVES

This dissertation sets out to determine the function of the tongue and whether it proves to be a beginner or professional brass player's friend or foe. Specifics relating to the anatomy of the vocal tract, the function of the tongue in brass playing, various articulation techniques, as well as styles and techniques specific to individual brass instruments will be investigated.

SCOPE AND LIMITATIONS

This dissertation reviews the vocal tract with primary focus on the tongue musculature. The investigation aims to identify the specific nature of the tongue that is required for quality tone and articulation production in brass instruments. This includes a section on the composition and classification of tongue muscles. The logistics behind details of articulation production are reviewed.

The following issues fall outside the scope of this dissertation:

- *The specific identification of muscles of the tongue as used in brass articulation. Owing to individual characteristics, one cannot definitely identify which specific muscles are used for specific articulation forms by different individuals.*
- *The identification and analysis of speech/tongue dysfunctions and disorders have been excluded for reasons of space.*

BACKGROUND

The tongue plays an important role in the production of sound in any brass or wind instrument. It was therefore considered necessary to investigate in depth the various aspects of this role.

The layout and format of this dissertation is as follows:

Section 1 deals with the anatomy of the vocal tract. It includes a review of the oral cavity, the frenulums and the physiology of the tongue. This section concludes with a brief overview of mankind's breathing apparatus.

Section 2 explores phonology: vowels and consonants.

Section 3 covers motor learning (and proprioception).

Section 4 covers the tongue's function in brass playing. Topics included within this section are the articulation of tones, the use of tongued syllables and consonants, and tone production.

Section 5 analyses articulation techniques, including single and multiple tonguing and special/contemporary effects.

Section 6 reviews articulation styles/techniques/contemporary concepts specific to individual brass instruments.

Section 7 consists of conclusions and recommendations.

Section 8 contains the appendix. References are made in the text of the document to the appendixes containing additional or further information.

1. ANATOMY OF THE VOCAL TRACT

1.1. THE ORAL CAVITY

In order to understand the functioning of the tongue, the structure of the oral cavity (which houses the tongue) must be considered. Terminology relating to the oral cavity is listed in Table 2 below.

Table 2: Oral Cavity Terminology

NAME:	LATIN NAME:	ADJECTIVE:
Lips	Labia	Labial
Teeth	Denti	Dental
Alveolar Ridge	--	Alveloar
(Hard) Palate	--	Palatal
Soft Palate	Velum	Velar
Uvula	--	Uvular
Upper throat	Pharynx	Pharyngeal
Voice box	Larynx	Laryngeal
Tongue tip	Apex	Apical
Tongue blade	Lamina	Laminal
Tongue body	Dorsum (back)	Dorsal
Tongue root	--	Radical

The oral cavity contains the tongue, the soft and hard palates, the alveolar ridge, the teeth, the frenulum(s) and the lips (refer to Figure 1 below). All of these, excluding the frenulum(s), are known as articulators and are used during the speech process. The oral cavity is lubricated by saliva, which is produced by the salivary glands that are located at the base of the tongue.

Man's oral cavity is irregular and variable in shape. According to Hanson (1983: 6) it may be viewed as a cylinder which during the speech process is partitioned into front (oral cavity) and rear compartments (pharyngeal cavity) by an obtrusive mass, namely the tongue. The tongue has the capacity to change the shape and length of the vocal tract.

Man's vocal tract, in simplified terms, is an open tube which is generally 17cm in length (males generally have longer vocal tracts than females). If unrestricted, it would be able to support a wavelength, or a formant, of four times its 17cm length, namely 68cm. The lips can lengthen the vocal tract to a small degree, or constrain it and even block it completely.

The vocal tract acts as sound filter. The larynx 'injects' sound into the vocal tract, using air which is expelled from the lungs, vibrating in the range of 100 to 300 Hertz. Vocal tract resonance refers to the "modifications made in the sound generated at the level of the larynx by the various supralaryngeal tissues and cavities." (Benninger, Jacobson & Johnson, 1994: 153) During normal speech production, a "perceptually acceptable balance of nasal and non-nasal resonance can be accomplished through the valving mechanics of the soft palate. The vocal tone that we perceive when we listen to a speaker is actually the acoustic realization of the vibratory characteristics of the voice, modified by the resonating characteristics of the vocal tract." (Benninger, Jacobson & Johnson, 1994: 153/154)

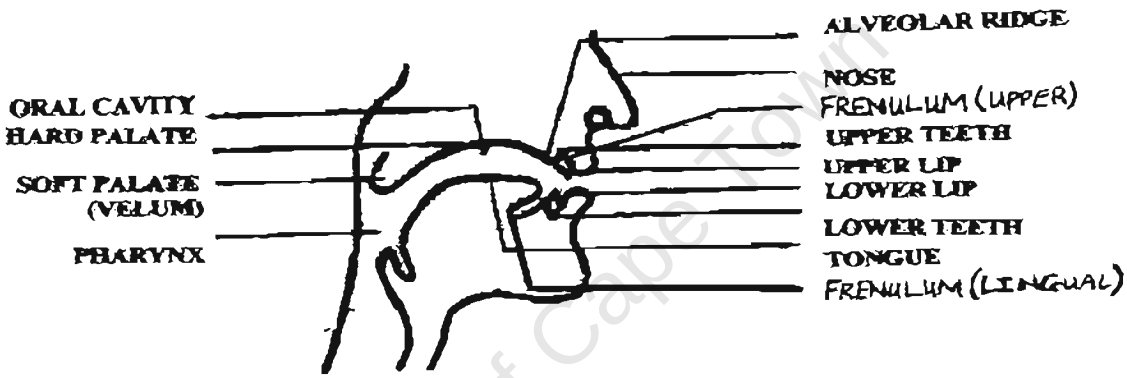


Figure 1: Anatomy of the Vocal Tract

Sourced and re-drawn by the author. (http://www.personal.rdg.ac.uk/~llsroach/phon2/artic_basics.htm)

Speech articulators can influence the efforts of the brass player, with some having more influence than others on the outcome, the sound and articulation successes of brass playing. The shape of the oral cavity and its variable size (as per each individual) plays a role in the direction/focus of the air-column and the speed/velocity of the air stream in brass playing. Players' individual qualities, namely characteristic individual sound and articulation, are founded on the shape of the oral cavity.

1.1.1. The Velum or Soft Palate

The velum or soft palate is largely comprised of muscles and is located behind the hard palate. The velum is extremely active during swallowing, yawning, coughing, gagging and speaking (during speech the tongue 'strikes' (contacts) the velum for the sounds /k/, /g/, and /ŋ/ as in "singing").

The velum is mobile and has three predominant positions:

i. Raised (largely through the *levator palatini* muscle);
ii. Tensed (through the *tensor palatine* muscles);
iii. Lowered (through the *palatoglossus* and *palatopharyngeus* muscles).

If the velum is raised, the opening of the upper part of the air passage (the pharynx) is blocked, the result being that air does not flow through the nose (levator palatine muscle). The tensed position is achieved by the tensor palatine muscles. As the velum is lowered an opening is created which allows air to flow out through the nose.

During the process of normal respiration, the mouth remains closed with the soft palate in a lowered position, while air travels through the nose. During the speech process, the velum is raised (shutting off the upper part of the pharynx) which enables oral sounds to be produced.

Velar consonants (/k/ and /g/) are made when the tongue is in contact with the lower side of the velum. These will be examined in more detail in Section 5.2. with regard to multiple tonguing and its effect on articulation in brass playing.

1.1.2. The Hard Palate

Frequently referred to as the *'roof of the mouth'*, the hard palate is important in articulation, yet acts as a passive partner on a functional level. The tongue is in contact with the hard palate for vegetative (*mastication* of food - broken up in the oral cavity where it is combined with saliva enabling easy swallowing) and speech purposes.

1.1.3. The Alveolar Ridge

The alveolar ridge is located between the top front teeth and the hard palate. It is covered with small ridges and can be explored with one's tongue. The sounds /n/, /l/, /t/ and /d/ are made when the tongue is in contact with the alveolar ridge and are known as *alveolar* sounds. Alveolar sounds are used in single tonguing and will be examined further in Section 5.3.

1.1.4. The Teeth

Teeth function as articulators in various ways during the speech process (see Section 2. Articulation). The embouchure of a brass player is influenced by the position of his teeth. The player's success at mastering a brass instrument may be influenced by:

- Angle/placement of teeth;
- Size of teeth;
- Existence/ non-existence of gaps between teeth.

Since articulation is a key area necessary for voice production (singing and speaking) and wind playing, any abnormalities of teeth alignment that interfere with normal articulation would have adverse effects on the performances of singers and wind instrumentalists. Some brass teachers, prior to accepting new students, will examine their mouth and teeth position first, and on the basis of their findings accept or reject students (Enichlmair, Personal Communication) (see Appendix A: The Teeth and the Impact of Braces).

1.1.5. The Lips

Lips are an important organ in speech. The lips are comprised of a series of interlinking muscle systems, namely the *obicularis oris*, used in lip rounding and shaping of the lips for speech. Outer lip tissue consists of skin, while its inner counterpart consists of mucous membrane (Hanson, 1983: 6).

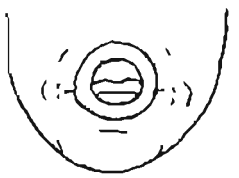
The size and thickness of the lips varies from individual to individual. Lip size is not always characteristically ethnic or race-dependent. Louis Armstrong, the world famous African-American jazz trumpeter, was nick-named "Satchmo" as a child owing to his satchel-like bottom lip.

A thick bottom lip is often considered an asset in brass playing, as it provides a strong foundation on which the embouchure can be based. This does not mean that being thin-lipped is automatically detrimental to brass playing. Lip size in the past has occasionally predetermined which instrument(s) a person should play. This is by no means a fixed *measuring unit*. e.g. a child with thin lips is often viewed as a suitable French horn candidate, while a child with thick or fleshy lips may be considered suited to the tuba (Kierman, Personal Communication). Figure 2 below illustrates *'ideal'* mouthpiece placements for specific brass instruments

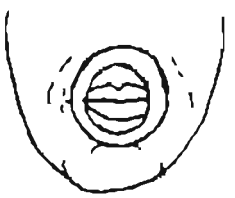
Lip flexibility and strength will be explored in Chapter 3. Motor Learning, Proprioception and the Learning Process.

(i) Ideal trumpet mouthpiece placement

(ii) Ideal French horn mouthpiece placement



(iii) Ideal trombone mouthpiece placement



(iv) Ideal tuba mouthpiece placement

Figure 2: 'Textbook' or 'Ideal' Mouthpiece Placements for Brass Instruments
Sourced and re-drawn by the author (Whitener 1990: 110).

1.1.6. The Frenulums

There are two frenulums, namely the upper frenulum and the lingual frenulum, both comprising mucous membrane. The upper frenulum attaches the lip loosely to the top front central incisors and is visible if one lifts the front of one's top lip. The lingual frenulum attaches the blade of the tongue to the floor of the mouth and is visible if one raises one's tongue tip. Frenulums generally play a minor role in speech production and assist in controlling the amount of lip and tongue movement (see Appendix B).

1.2. ANATOMY OF THE TONGUE

1.2.1. Functions of the Tongue

The tongue is a large and mobile organ that occupies a large percentage of the oral cavity when the mouth is closed. It can be formed into many different shapes and has a wide variety of movements including tip-elevation, grooving, and protrusion. The tongue's original function was the mastication and deglutition of food. The tongue is the chief organ of taste. Another function is that of warming the air during the process of breathing through the mouth. As man evolved, the tongue gained an additional function, becoming an important dynamic articulator in speech.

1.2.2. Areas of the Tongue

The tongue may be divided into specific areas: the tip, blade, front, back and the root (see Table 3). The tongue is shaped like a broad-based anvil. Its broad root connects with the hyoid bone, the epiglottis, the soft palate, and the pharynx. Inspection of the mouth reveals the tongue body, but the root is not visible. The blade is loosely attached to the floor of the mouth by a vertical fold of mucous membrane, known as the lingual frenulum (see 1.1.6. The Frenulums). A diagram of the tongue is shown in Figure 3.

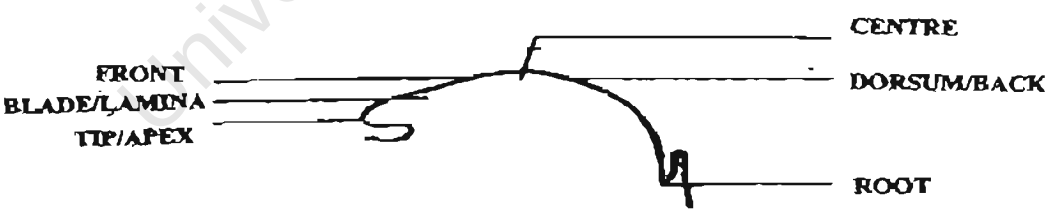


Figure 3: Areas of the Tongue

Sourced and re-drawn by A. Ayers[1]

[1] http://www.personal.rdg.ac.uk/~//roach/phon2/artic_basics.htm

Table 3: Areas/Divisions of the Tongue[2]

NAME	REGION	ADJECTIVE	COMBINATION FORM
Tip/Apex	Tip of tongue	Apical	Apico-
Blade/Lamina	Blade of tongue	Laminal	Lamino-
Front	Tip to middle of top surface of tongue	Frontal	Fronto-
Centre	Central portion of top surface of tongue	Central	Centro-
Dorsum	From middle of top surface to the root of the tongue	Dorsal	Dorso-
Root	Root of tongue	Basal	Baso-

1.2.3. Movement and Muscles of the Tongue

Movements of the tongue are most clearly understood if one considers it as having four muscular attachments, as described in Table 4:

Table 4: Attachments of the Tongue

NAME/REGION	ATTACHMENT LOCATION	DIRECTION OF MOVEMENT
Front of jaw	Behind the chin.	Forwards, downwards and posteriorly.
Skull	In front of the ears.	Upwards and backwards.
Soft Palate (sides of)	Attachment from above and attachment behind the tongue.	Upwards and backwards.
Hyoid Bone	Below the oral cavity (base of the tongue).	Downwards and backwards.

Flexibility and mobility of the tongue are governed by a sophisticated muscular control system consisting of two sets of muscles - namely the intrinsic and extrinsic muscles. According to Hanson (1983:12) the extrinsic and intrinsic muscles work synergistically, moving and shaping the tongue for speech.

[2] Tabulated by A. Ayers from source: http://www.sfu.ca/~saunders/133098/L4/L4_5.html

"Those who have eaten beef tongue are aware of the multidirectional muscle fibres coursing through it. The many muscles, some intrinsic (originating and ending within the tongue) and some extrinsic (with one attachment outside the tongue), are responsible for the rapidity and complexity of the movements of the tongue for speech. It is not unusual for a speaker to be able to elevate and lower the tongue tip eight or more times per second." (Hanson, 1983: 10)

The muscles of the tongue are illustrated in Figure 4.

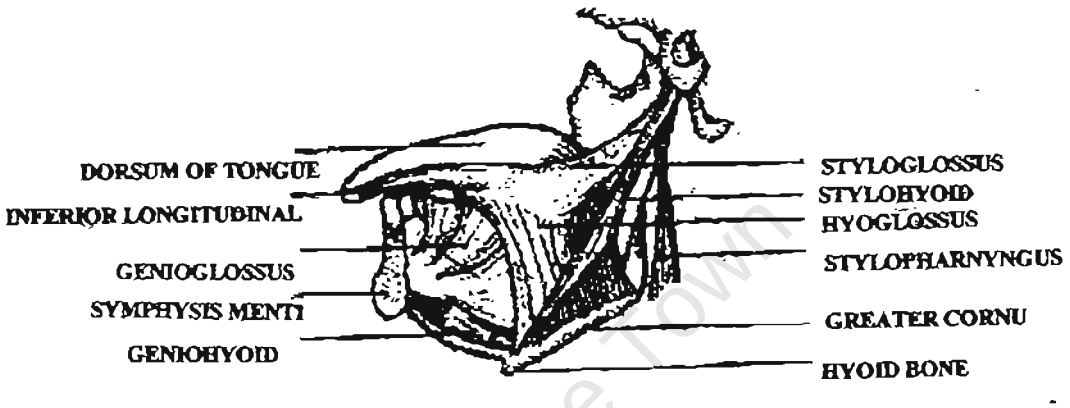


Figure 4: Muscles of the Tongue

Sourced and re-drawn by the author (Hanson, 1983: 10). [The definitions for the muscles/terms found in this diagram can be found in Tables 5 and 6.]

a. Intrinsic Muscles (muscles internal to the tongue - lingual)

According to Crystal (1980: 99) the intrinsic tongue muscle fibres run in three planes, namely vertical, lateral and horizontal, all interlacing with one another. Crystal lists the seven types of tongue movement as:

i. A horizontal anterior-posterior movement of the body of the tongue;
ii. A horizontal anterior-posterior movement of its tip/blade;
iii. A vertical superior/inferior movement of the body;
iv. A vertical superior/inferior movement of the tip/blade;
v. A transverse concave/convex movement;
vi. A spread/ tapered contrast in the front part of the tongue;
vii. A degree of central grooving (see Table 5 below).

The tongue has the ability to mould itself into many shapes. Each portion of the tongue can be lifted, lowered or shaped independently (it can be curled, narrowed, flattened, rounded etc.).

"The principle that no movement is affected by a single muscle working alone, however, is particularly pertinent to tongue function." (Hanson, 1983: 12)

Table 5: Intrinsic Muscles of the Tongue[3]

NAME	LOCATION	ACTION
Superior longitudinal lingual muscle (longitudinal fibres within tongue)	Under the top surface of the tongue from front to back	Shortens the tongue from front to back. Raises tip. Raises margins of tongue. Concave bowing of tongue.
Inferior longitudinal lingual muscle (paired set of muscles) (longitudinal fibres within tongue)	Underside of tongue from front to back (from tip to base)	Shortens and widens the tongue. Depresses apex (turns tip downward) forming a convex tongue dorsum.
Transverse lingual muscle (paired set of muscles) (transverse fibres within tongue)	Runs from lingual septum to each margin of the tongue (does not reach the tip of the tongue)	Narrows and elongates the tongue. Lifts lateral margins of tongue - producing a groove.
Vertical lingual muscle (paired set of muscles) (transverse fibres within tongue)	Confined to the anterior part of the tongue. Runs from superior to inferior longitudinal lingual muscle	Flattens and broadens tongue.

All of the *intrinsic* muscles are innervated by the *hypoglossal* nerve. *Intrinsic* muscles are primarily used to change the shape of the tongue.

b. Extrinsic Muscles

"These four muscles, all paired, function primarily to alter tongue position within the oral cavity, rather than to alter tongue shape, but they work with the intrinsic muscles to vary shape as well. The muscles are the genioglossus, hyoglossis, styoglossis and palatoglossus" (Hanson, 1983: 12) and are responsible for the tongue's movement around the buccal cavity. The muscles join the tongue to the skull, the jaw (the mandible) and the hyoid bone (refer to Table 6 below).

[3] Tabulated by A. Ayers from source: http://www.sfu.ca/~saunders/133098/L4/L4_5.html

Table 6: Extrinsic Muscles of the Tongue (Hanson, 1983:13)

NAME	*ORIGIN*	*LOCATION*	*ACTION*
Genioglossus (largest muscle of the tongue; constitutes most of the tongue's mass) Genio = chin; Glossus = tongue	Superior mental spine of mandible	Under surface of tongue from posterior boundary of the apex to the root and hyoid.	1. Lowest fibres pull hyoid bone forwards and upwards, results in tongue protruding. 2. Posterior oblique fibres - move tongue forward. 3. Vertical fibres - depress anterior and middle section of tongue, produces a concave dorsum. 4. Anterior oblique fibres - depress tongue. 5. Pulls tip posteriorly.
Hyoglossus	Hyoid bone	Rectangular muscle. Courses from the Hyoid bone to the sides/margins and middle of the tongue (interlaces with the styloglossus and intrinsic muscle fibres).	Depresses tongue. Draws tongue downwards and backwards. Flattens sides of tongue.
Styloglossus	Styloid process	Connects styloid process of temporal bone to the side of the tongue. Tongue margin blending with both the inferior longitudinal linguals as well as the hyoglossus.	Retracts and elevates the sides of tongue, causing a 'concavity' of the dorsum. Draws sides upwards.
Palatoglossus (Glossopalatine)	Under surface of soft palate	Margins of tongue. Forms the anterior pillar of the fauces (blends with styloglossus).	Elevates dorsum of tongue and constricts the fauces. Depresses soft palate.
Geniohyoid	Inferior mental spine of mandible	Hyoid bone.	Lowers jaw. Protrudes tongue.

1.2.4. Tongue Flexibility

People have varying degrees of tongue flexibility. Some people have the ability to curl their tongue into the shape of a tunnel, while others are not as flexible and cannot shape their tongue in this manner. Some people have the ability to touch their noses with their tongues - some do not have this ability of tongue extension outside of the mouth. People can develop/improve and increase their tongue flexibility with practice (tongue gymnastics).

The flexibility of one's tongue is essential in brass playing. A highly flexible or mobile tongue is preferable to an inflexible tongue. A person whose tongue is naturally inflexible can increase its flexibility with the aid of exercises based on speech therapy concepts (Appendix C).

1.2.5. Intricacies of the Tongue and Brass Teaching

The complex muscular composition of the tongue allows for the quick, precise movements necessary for brass playing. The sheer intricacies of the tongue's movement capabilities within the context of brass playing should now be evident. Just as the *'Rosetta Stone'* which, when discovered, proved to be the *'key'* to three *'lost'* languages, namely Greek, Demotic and Hieroglyphics and aided in cracking the code of the ancient Egyptian hieroglyphics language, the role of the tongue is the *'key'* to articulation in brass playing. Bearing in mind that mankind shows individual genetic differences, the tongue's role in successful brass playing becomes more complicated.

The challenge for the brass teacher is to teach an individual pupil, with his own physical characteristics, in a manner which pertains specifically to him. An example of such a challenge may be to increase tongue flexibility

1.3. BREATHING APPARATUS

Successful brass playing is dependent on an interaction between tongue articulation and air stream control. In order fully to understand the role of the tongue in brass playing, the breathing apparatus must be considered as well, as the tongue acts as a 'stopper' for the air stream. In speech and brass playing, the instinctive behaviour of breathing may consciously be modified to produce the best results. Articulation (the focal point of this dissertation) implies the alteration and modification of the larger physical mechanism: breathing. Embarking on a description of articulation thus requires an understanding of respiration in brass playing (physiology of man's breathing apparatus).

1.3.1. Anatomy and Physiology of the Breathing Apparatus

Man normally has two lungs (two sponge-like masses of air cells), which are housed in the thoracic cavity (commonly called the chest), and are enclosed by the rib cage for protective purposes. A dome-shaped diaphragm, joined to the lower back ribs and backbone, separates the thoracic cavity from the abdomen (see Figure 5).

Breathing is an involuntary process that is controlled and regulated by the brain stem. It may be divided into two processes - the inhalation and exhalation processes. The automatic action of breathing is dependent on the difference between air pressure in the lungs and in the atmosphere.

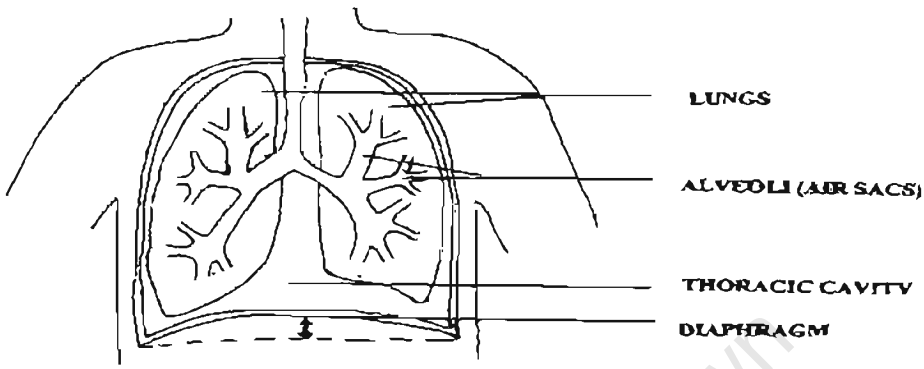


Figure 5: Man's Breathing Apparatus; Depiction of the Diaphragm's Position/s
(Hand-drawn by the author - original graphic depiction)

a. Inhalation Process

During inhalation, owing to the change in chest size, air pressure in the lungs increases above atmospheric pressure. This is achieved by:

- External intercostals muscle raising the ribs (greatest expansion occurs in lower ribs);
- Breast plate expansion;
- Diaphragm contracting (a downward pull - results in a deepening of the chest cavity). The diaphragm now takes a plate-like position, as the lungs fill involuntarily, until atmospheric pressure is once more reached (Johnson, 1999 & 2003).

b. Exhalation Process

During exhalation, the air pressure within the lungs decreases, resulting in

- Air being forced out of the lungs until a return to atmospheric pressure is attained;
- Diaphragm returning to its passive position (supported by abdominal muscles).

c. Breathing Process

Breathing is a process of continuous diffusion, whereby gas moves from a higher concentration to a lower concentration, and vice versa (inhalation and exhalation). This process is usually an unconscious, automatic process, but can come under voluntary control (e.g. be halted for a short time, or altered to allow phrasing in speech or brass playing).

In speaking and brass playing, man needs a sufficient volume of breath and the ability to control the flow of air leaving the lungs. The quality (as well as loudness, phrasing and projection) of one's voice will be affected by one's air control.

1.3.2. Functions of the Air Stream in Brass Playing

A brass player must be able to sustain a sound, i.e. 'blow through.' This concept of 'blowing through' relates to the player's control of his air stream. The tongue, with its enormous flexibility potential (varying tongue levels, positions and placements) plays a significant role in controlling the velocity of the air stream at the start and finish of releases (Jenkins, 1970: 340). For an overall musical effect to result, the air stream must remain constant or be sustained throughout a phrase as well as individual tones (Whitener, 1990: 116).

An open throat, which enables free, unhindered breathing, is the ideal state to achieve in brass playing. One can freely reproduce the feeling of an open throat by placing two fingers vertically between one's teeth, and whispering "who". A variation on this is *'finger-breath'*, where one places one's index finger in front of an open mouth, and breathes in on the word "hoe" and out on the word "toe" (a measure of openness) (Kierman, 1998b).

One highly regarded opinion (Kierman) is that the process of inspiration, expiration and release should ideally be approached as a continuous action. If the air stream is interrupted it causes tension in the throat, thorax and in the chest cavity, resulting in the restriction of the free outward flow of the air stream. This method of breathing is termed *'tidal breathing'*, and is so called from a comparison to ocean tides which are in perpetual motion. Breathing in brass playing should be viewed as a continuous process, which may be compared to the constant lapping of waves on the seashore

(Kierman, Personal Communication). It is difficult to pinpoint where one wave/breath starts and another wave/breath ends (Kierman, 1998a).

Tidal breathing can occur in different amounts (or volumes) - as required for the phrasing of a line of music. Ideally, one would 'break the air flow' into natural-sounding units, or as stipulated by the composer. It should be noted that in orchestral situations, where musicians are required to follow a conductor, tidal breathing is not ideal. A player, for the sake of coherent unity, cannot start a note according to his own breathing cycle (for further documentation on the breathing process, see Appendix E: The Valsalva Mechanism and Appendix F: Circular Breathing).

2. ARTICULATION

There are many similarities between tongue functions in speech and brass playing. Both involve articulation. To gain an understanding of speech production and its function in brass playing, a basic knowledge of phonology (description of sound system used in a language) and articulation (the way in which a sound is produced) is required.

> "Speech has been defined as a system that relates meaning with sound."(Bernthal & Bankson, 1981: 5)

The shape of the vocal tract plays an important role in speech production. The tongue (along with the lips) is the organ of articulation most involved in the production of speech sounds, namely vowels and consonants.

> "Phonetic structure is the result of the articulatory processes that result in the production of the recognizable segments of speech, the consonant and vowel sounds. Each sound has certain features - voicing, place of articulation, manner of articulation - that distinguish it from other sounds." (Benninger, Jacobson & Johnson, 1994: 153/154)

In order to understand articulation, it is necessary to consider briefly the speech production process as a whole. Speech consists of four separate processes, each of which plays a role in brass articulation (Ladefoged, 1971: 2):

i. Air stream process;
ii. Phonation process;
iii. Oro-nasal process;
iv. Articulatory process.

Air stream Process

The flow of the air stream plays an all-important role in both speech production and brass playing. Air that originates in the lungs is called *pulmonic*. *Ingressive* air comes into the body to make a sound. The term *egressive* (outward-flowing) describes the direction of the air passage out of the body. The air stream mechanism is termed *pulmonic-egressive*.

Nearly all speech is formed with a pulmonic-egressive air stream, where air is pushed out of the lungs predominantly under the control of the internal intercostal muscles (Ladefoged, 1971: 23). As speech sounds require air, a brass tone similarly requires air to sound. Most sounds are created by modifying a stream of air that is pushed outward from the lungs.

Phonation Process

Phonation is sound produced by vibrating vocal cords, which are set into motion by the air stream (definition). The act of phonation requires the establishment of several conditions prior to the initiation of sound. Firstly, the vocal cords are brought to a partially closed position. It is possible to start phonation with completely closed vocal cords, which creates a resistance to the exiting airflow. The partially or completely closed position is required for phonation.

Secondly, the muscles of the larynx cause the vocal cord to tense, once again creating a resistance to the exiting airflow. It should be noted that the tension and mass of the vocal cords is determined by the vibrating frequency of the vocal cords (Benninger, Jacobson & Johnson, 1994: 32/33).

In contrast, an open, free-blowing throat with un-tensed vocal cords is the sought-after ideal in brass playing. It should be noted that vocal cords tend to vibrate lightly on the pitch of playing (or a harmonic partial) if the pitch is out of vocal range (Kierman, Personal Communication).

Oro-nasal Process *(Nasality)*

The oro-nasal process, the simplest of the four speech processes, is controlled by the raising and lowering of the velum. Sounds have either oral or nasal resonance. The position of the velum (soft palate) determines its type.

- Lowered - a portion of the air will pass through the nasal cavity (the remainder finding its way through the oral cavity) - *Nasal;*
- Raised - access to the nasal cavity is cut-off, and the air can pass through only the oral cavity - *Oral.*

In brass playing, once again, the aim is to achieve as open a sound as possible. A nasal-sounding tone is generally to be avoided.

Articulation Process

Articulation concerns how a sound is executed (produced). During the articulation process, in both speech and brass playing, there are active and passive articulators.

Active:

An active articulator does most or all of the moving during a speech gesture; e.g. the lower lip or some portion of the tongue are active articulators. In brass playing, the tongue is

primarily responsible for articulating notes (apart from breath releases, where a tone is articulated without the aid of the tongue). The bottom and top lips are the centre of the all-important embouchure, the muscular structure on which all brass playing is based.

Passive:

A passive articulator makes little or no movement during a speech gesture. A passive articulator is generally connected to the skull. It may include the upper lip, the upper teeth, various parts of the upper surface of the oral cavity and the back wall of the pharynx. In brass playing, the teeth and various parts of the oral cavity function as articulation points. Different articulation forms occur at or on varying points.

2.1. VOWELS

The English language consists of twelve vowels (three diphthongs) and twenty-six consonants (Hoffman, Personal Communication).

A vowel is a sound which is usually formed as a distinct pattern of acoustic sound energy which escapes from the "vibrating vocal folds (cords)...through a relatively open vocal tract of a particular shape... each vowel has a characteristic vocal tract shape that is determined by the position of the tongue, jaw, and lips" (Bernthal & Bankson, 1981: 12) which differentiates it from other vowels (Benninger, Jacobson & Johnson, 1994: 64/65).

Vowels are primarily voiced. *Nasal* vowels occur in some languages, e.g. French. In the English language, vowels are described as being rounded, as in "who", or unrounded, as in "he".

It should be noted that a vowel sound is not defined by manner of articulation. During vowel pronunciation the air flows without obstruction, unlike the obstruction experienced while producing consonants. The general shape of the oral cavity is responsible for creating different vowel sounds. Vowels are classified by the highest point/s reached by the tongue in both vertical and horizontal dimensions.

Vowel sounds may be determined by three factors (Ladefoged, 1971: 75):

- Height of the tongue: high / middle / low (state of tongue and lips: tense/lax);
- Position of tongue: front / central / back;
- Shape of lips: rounded / unrounded.

Vowel production is described as either tense or lax (Appendix G).

Tense vowels are characterised by:

- Greater degree of muscular tension;
- Longer duration.

Lax vowels are characterised by:

- Less muscular effort;
- Shorter duration.

Several consonant parameters may be relevant to vowels as well, e.g. state of glottis, nasality (2.2. Consonants). Vowels are partly defined by the highest point reached by the tongue body and one should consider the tongue body as being the active articulator. In the case of high vowels, the tongue body narrows the vocal tract. One should study which passive articulator the narrowing of the vocal tract is closest to, and to what degree the constriction is. See Table 7 for the state of the lips versus the height of the tongue.

- For high front vowels, the tongue body approaches the hard palate;
- For high back vowels, the tongue body approaches the soft palate.

(The vocal tract is narrowed, but not so much as to cause the air flow to become turbulent. The degree of constriction is an approximant).

Table 7: State of Lips (Rounded/Unrounded) vs. Height of the Tongue

STATE OF LIPS				
		FRONT	***CENTRAL***	***BACK***
HEIGHT OF TONGUE	***HIGH***	Unrounded	Unrounded	Rounded
	MIDDLE	Unrounded	Unrounded	Rounded
	LOW	Unrounded	Unrounded	Unrounded

The carrying power of the voice is largely dependent on the way in which vowels are shaped. Good vowel sound quality is dependent on breath control (1.3. Breathing Apparatus).

2.1.1. Cardinal Vowels

Eight cardinal vowels have been proposed, but in reality an infinite number of cardinal vowels are possible. Cardinal vowels act as reference points. A cardinal vowel chart organises the vowel space between the two most extreme tongue body positions: high front and low back. "i" /ee/, "are" /ah/ and "u" /oo/ are physically and acoustically three of the easiest vowels to produce.

Twenty-one sounds are possible from the five main vowel sounds (/a/, /e/, /i/, /o/ and /u/). The vowel sounds fall into two categories, namely *monothongs* and *diphthongs*. Vowels may also be classified as *front* vowels, e.g. /a/ as in 'pat'; or *back* vowels e.g. /u/ as in 'tub'. Vowels serve as nuclei within syllables; a syllable must contain only one vowel (the exceptions to this rule are *diphthongs*).

2.1.2. Monothongs

Monothongs refer to a pure vowel sound. In monothongs (or simple vowels), the tongue body has a relatively stable position throughout. Monothongs are used in brass articulation which does not require slurs, glissandi or fall offs (see 5.1.5. and 5.3.4.). Examples are listed in Table 8.

Table 8: Twelve Monothongs: (Sneddon: 18) Examples by the author.

/AH/ - AS IN 'FAR' (ɑ)	/I/ - AS IN 'KIT' (ɪ)	/EE/ - AS IN 'HEED' (i)
/AW/ - as in 'claw' (ɔ)	/A/ - as in 'hat' (æ)	/A/ - as in 'the' (ə)
/OO/ - as in 'pool' (u)	/U/ - as in 'tub' (ʌ)	/IR/ - as in 'bird' (ɜ)
/E/ - as in 'dead' (ɛ)	/U/ - as in 'pull' (ʊ)	/O/ - as in 'hot' (ɒ)

2.1.3. Diphthongs

Diphthongs (or complex vowels) are two pure vowels which by means of a glide, are uttered as one sound. They are produced with an open vocal tract which progressively changes shape. Diphthongs are used during the execution of slurs with movement from one register to another; e.g. high - low or vice versa, "tee-oh-ah" or "tah-oh-ee". Examples are listed in Table 9

Table 9: Nine Diphthongs: (Sneddon: 18) Examples by the author.

/OW/ - AS IN 'BOW' (ÀÙ)	/O/ - AS IN 'SOLE' (OÙ)	/EAR/ - AS IN 'HERE' (Iə)
/A/ - as in 'say' (eI)	/OY/ - as in 'toy' (I)	/OAR/ - as in 'tore' (ə)
/I/ - as in 'site' (əI)	/AIR/ - as in 'there' (Eə)	/OOR/ - as in 'moor' (ùə)

2.2. CONSONANTS

Consonants are produced by obstructing the vocal tract partially or totally in one or more places (the lips, tongue, teeth, hard and/or soft palate, and the gums) while expelling air from the lungs. A large majority of consonant sounds rely on a flexible tongue, the tongue having freedom of movement in the oral cavity. In brass playing, the beginning of any articulation (apart from a breath attack) requires the use of a consonant, e.g. /k/, /t/ or /d/. (The English language contains twenty-six consonants, including twenty-two single consonants, blends or mixtures).

Consonants are classified according to place-manner-voicing and possible nasality. Place refers to the location of the constriction. Manner refers to the degree or type of closure. Voicing refers to voiced or voiceless (whereby the vocal cords are vibrating or stationary).

2.2.1. Place of Articulation

The place of articulation is the point where two articulators come into contact resulting in an obstruction or blockage of the air stream. The term deals with the relationship between the active and passive articulators as they shape or impede the air stream.

In English there are eight primary places of articulation, which describe where in the vocal tract consonants are made (Table 10 below). The active articulator creates the constriction, while the passive articulator remains stationary.

Table 10: Eight Places of Articulation

PLACE OF ARTICULATION (POA)	DEFINITION:	WORD:
Bilabials	A bilabial sound is the point of maximum constriction made by the coming together of the two lips. e.g. /m/ /p/ /b/: two lips pressed together.	"pie" "my" "buy"
Labiodentals	The lower lip articulates with the upper lip, e.g. /f/ /v/.	"fry" "vie"
Interdentals	The tip of the tongue touches the ridge behind the upper and lower teeth (as in the word "tee*th*") (*Dentals:* Tip of the tongue articulates with the back/bottom of the top teeth).	"thigh" "thy"
Alveolar	The tip or the blade of the tongue articulates with the forward part of the alveolar ridge. e.g. /d/ /t/ /s/ /z/ /n/ /l/. Sound made with the tip of the tongue is an *apico-alveolar* sound. A sound made with the blade is termed *lamino-alveolar.*	"tie" "die"
Postalveolar	*Retroflex:* Tongue tip is curled up and backwards (may be classified as apico-postalveolar).	*"row" "ray"*
Palatal	The front of the tongue articulates with the domed part of the hard palate, e.g. "ship." Given the size the hard palate, one can distinguish between *palato-alveolars, palatals and palato-velar* sounds. In *Palato-alveolars (alveopalatals)* the tip or the blade of the tongue articulates with the back area of the alveolar ridge, e.g. "jump", "*ch*air".	"she" "shed" "chair" "jump"
Velar	The back of the tongue presses against the soft palate (velum) of the mouth during this articulation, e.g. /g/ and /k/.	"hack" "hag" "hang"
Glottal	The vocal folds/cords are brought together; in some cases, the function of the vocal folds can be part of articulation as well as phonation, as in the case of /ʔ/ (sounds "uh-uh") and /h/ in many languages. Glottis sounds are made in the opening between the vocal cords.	"button"

There are active and passive articulators for each place of articulation (see Table 11 below).

Table 11: Active and Passive Articulators

POA:	ARTICULATORS:	ACTIVE:	PASSIVE:	SOUNDS:
Bilabial	Two lips	Lower lip	Upper lip	/p/, /b/, /m/, /w/, /wh/
Labio-dental	Lip against teeth	Lower lip	Upper teeth	/f/, /v/
Dental (Interdental)	Tongue tip against upper teeth	Tongue tip or tongue blade	Upper teeth	/th/ as in 'breath' or 'then'
Alveolar	Tongue tip/blade against alveolar ridge	Tongue blade/tip	Alveolar ridge	/t/, /d/, /n/, /s/, /z/, /l/
Postalveolar (Retroflex)	Tongue tip/blade against teeth ridge	Tongue tip/blade	Area just behind the alveolar ridge	/sh/ as in 'shut'; /zh/ as in 'measure' /r/ (upside down)
Palatal	Tongue body against hard palate	Tongue body	Hard palate	/j/, /ch/
Velar	Tongue body against soft palate (velum)	Tongue body	Soft palate (velum)	/k/, /g/
Uvular	Back of tongue against velum	Back of tongue	Velum	-
Pharyngeal	Tongue against hard palate	Tongue	Hard palate	-
Glottal	Made in larynx	-	-	/ʔ/ as in "uh-uh" ('no')

2.2.2. Manner of Articulation

The manner of articulation describes the type of closure made by articulators and the extent or degree of their obstruction of the air stream.

There are six major manners of articulation (continuants vs. stops) (see Table 12).

Table 12: Manners of Articulation

SIX MANNERS:	DESCRIPTIONS:	EXAMPLES:
Stops / Plosives	Sounds made by a total/complete obstruction of the vocal tract. Articulation is accompanied by a sudden release (explosion) of air. Terms are not synonymous: nasal sounds are stops (where the air is blocked), but are not plosive sounds as a release of air does not follow their articulation.	(English) ▪ Lips: /p/ and /b/ ▪ Teeth-ridge: /t/ and /d/ ▪ Soft palate: /k/ and /g/ ▪ Glottal stop.
Fricatives	Continuant, non-abrupt sounds made with a narrow constriction, resulting in the air creating a noisy sound as it escapes through the constricted passage. Pressure build-up is absent. Sound is uttered continuously with friction between the air stream and the speech organs.	"s̲ue" "z̲oo"
Affricates	Combination of plosive (stop) and fricative segments: articulation begins with a complete blockage/closure of the air stream (plosive), followed by a gradual release of the air stream (fricative). The plosive + fricative nature of affricates may explain why they are represented by diagraph symbols (symbols used in the phonetic transcription of English sounds which are suggestive of their ambiguous, hybrid nature).	/sh/- 'ship' /dj/- 'judge' /ch/- 'church'
Nasals	Similar to plosives, involving complete oral closure. Nasals are sounds produced by forcing the air through the nasal cavity instead of the oral cavity. Velum allows air into nasal cavities to resonate.	/m/, /n/ and /ŋ/.
Liquids	Air flow is slightly obstructed, yet flows more freely than in fricatives ▪ Laterals: tongue raised to alveolar ridge, yet air escapes via the slackened sides. e.g. /l/ as in "lay" where the sound energy from the vibrating vocal cords escapes laterally (hence the term laterals), or through the sides of the mouth cavity. ▪ Retroflex: Tip of tongue is curled back behind alveolar ridge, /r/ as in "ray" (also labelled *Rhotic*) /r/ may be produced in various ways, e.g. the tongue may have a bunched appearance located in the centre or near the front of the oral cavity. ▪ Trill: Vibration of uvula or the tongue on the alveolar ridge. e.g. /r/ ▪ Flap/Tap: Single tap of the tip of the tongue, as in the word "butter".	/l/ and /r/. (See examples for laterals, retroflexes, trills and flaps/taps within the text).
Glides (or semi-vowels)	Little or no obstruction of the air passage occurs. Owing to the articulation manner resembling that of vowels, glides may be referred to as semi-vowels. Glide sounds are characterised by a "gliding" or gradually changing articulatory shape.	"y̲ou" /j/ and "w̲ait".

2.2.3. Voicing

Voicing describes the vibration of the vocal cords in the larynx, which is termed *voiced* or *voiceless* (classification of consonants). *Voiced* is when the vocal cords vibrate (all vowels are *voiced*) /v/, *voiceless* when vocal cords do not vibrate during articulation /f/. It should be noted that *voiceless* vowels are very rare. Table 13 displays the four most common breath and voiced consonants applicable in brass playing:

Table 13: Consonant Classification

	CONSONANT CLASSIFICATION	SOUND/S
1.	Breath Consonants (or Aspirates)	/t/ /k/
2.	Voiced consonants (or Vocal)	/d/ /g/

Anyone learning English has a total of twenty-one vowel and twenty-six consonant sounds to learn. Except for the *labial* and *glottal* consonants, all vowels and consonants depend on the versatility of the tongue for their unique identity.

Rapidity of tongue movements permits intelligible, smooth and connected speech. Considerable variation of tongue pressures against other structures is essential. e.g. contact for the production of /s/ (as in 'sea') is light, whereas the production of the voiced /d/ (as in 'door') is sealed.

Movement of the tongue is either a conscious or an unconscious act. During the act of swallowing, an unconscious act, the use of one's tongue comes into play automatically. A person does not consciously need to think of moving the tongue during this natural process as it occurs numerous times a day and is linked with the salivation process. In brass playing, tongue movement is conscious, as one uses the tongue to create specific intended articulations.

2.2.4. Language Differences and Articulation

The languages of some nationalities have slower tongue speeds than others. Slower rates of speech, possibly owing to cultural differences, should not affect one's ability to move the tongue. In brass playing circles, it has been noted that people of Latin American heritage tend to have naturally quick multiple tonguing at their disposal.

This is believed to be linked to the nature of their language (Kierman and Johnson, Personal Communications) (see Appendix H).

In some South African Afrikaans communities the pure consonant /t/ is not commonly used. Within the Cape-Coloured Afrikaans dialects a softening of /t/ consonants occurs; e.g. /t/ is commonly pronounced as /dt/ as in 'hoed' or 'dat'. This softening of the /t/ consonant sound is a problem which frequently has to be overcome in brass playing (Kierman, Personal Communication) (see Appendix F).

3. MOTOR LEARNING, PROPRIOCEPTION AND THE LEARNING PROCESS

3.1. MOTOR LEARNING

While the tongue is a highly flexible organ, the precise movements that are required for brass playing do not come instantaneously to beginner players. Rather, they are learned over a period of time, initially under careful voluntary control, and later automatically (without conscious thought). The term motor learning refers to how a motor skill is acquired (Hudson, Personal Communication). This process of motor learning occurs with any type of complex movement (e.g. tying shoelaces, kicking a ball, dancing). In this section the processes that occur while learning tonguing in brass are described.

A number of stages need to be completed during the process of learning (namely perception, comprehension and response). Perception and cognition are important factors in motor learning. It should be noted that practice is an important aid in the development of motor learning, which can be divided into three branches:

- Acquisition of motor skills;
- Perceptual motor development (psychomotor development);
- Academic skill and concept development (Humphrey, 1975:12).

All three are involved in learning an instrument. Teachers of beginner brass players deal primarily with the first two divisions, which relate to the learning of techniques. The third, dealing with skills and concepts, applies to advanced players, who have honed their motor learning processes (proprioception) to a fine degree. Successful playing eventually involves an integration of all three.

Vision and visual perception play an important role in the learning and performance of motor skills (Williams, 1983: 118). The co-ordination of eyes and hands together into precise motions (eye-hand co-ordination skills) may be defined as fine motor control. This control represents an "important and integral part of the total motor development of the young child and clearly reflects the increasing capacity of the CNS (central nervous system) to pick up and process visual input and to translate that input into skilful, well-executed motor behaviours." (Williams, 1983:171) Reasonable motor co-ordination is necessary for advancement in music (see Table 14).

"Throughout our long infancy our brains are building up internal models or schemas of our bodies and of the external world, and integrating the separate schemas, built up in relation to the different senses, into overall models of our bodies and of the world. To these models, and to expectations derived from them, the brain refers the impressions streaming in from our senses in the act of perception...We can readily imagine that a musician's brain, in the course of his long learning, builds up internal schemas in the shape of his instrument, and of the sounds it produces, which become intimately related to the schema of his body that was built up during infancy and childhood. In his attack, the skilled string player can assume a posture, and execute movements, that will sound the required note with little or no error, correcting his intonation, if necessary, by hearing. The advantages of beginning this learning process at the earliest possible age are admitted by everyone. Neural plasticity diminishes with increasing age." (Critchley & Henson, 1977: 57)

Table 14: Four categories of foundational perceptual-motor behaviour

MOTOR CONTROL	DEFINITION	SKILL	USE IN BRASS PLAYING
Gross	Skilful use of total body in large muscle (gross motor) activities which require intricate temporal and spatial co-ordination of movement by a number of body parts, either sequentially or simultaneously.	Walking, running, hopping, skipping, jumping, throwing, catching, striking, balancing.	Holding instrument correctly.
Fine	Defined as behaviour that involves the use of individual body parts, especially the hands and fingers, in manipulating and/or controlling small objects in precision acts. Fine motor control behaviours are frequently referred to as eye-hand co-ordination or visuo-motor integration behaviours and include such skills as cutting, colouring, writing, pasting, etc. The defining feature of fine motor control is that it involves a close functional relationship between small muscles of the hands and fingers (or feet) (may involve use or non-use of eyes).	Writing, threading beads, sewing, knitting.	Control of valves/slides. Tongue movements.
Simple auditory, visual and tactile-kinaesthetic	Perceptual behaviours involve the detection, recognition, discrimination, and interpretation of simple stimuli received through individual sensory modalities.	Identifying the tune of a nursery rhyme, building a puzzle.	Auditory - hears the instrument's sound.
Body awareness	Recognition, identification, and differentiation of parts, dimensions, positions, movements, and spatial locations of the body. Provide the foundation for the child's awareness of the physical dimensions or capacity of his body and his understanding of the relationship between his body and the movement of his body and the surrounding environment (Williams, 1983).	Crossing the midline (division between the right- and left-hand sides of one's body).	Awareness of position of tongue in mouth (especially as one cannot see it).

Any fine motor skill is not learned in isolation. Its acquisition, over repeated attempts, is dependent on various types of feedback - auditory, tactile, and proprioception. Proprioception is important in brass playing and will be discussed further (see 3.2.).

3.2. PROPRIOCEPTION

Proprioception is commonly regarded as mankind's sixth sense; it is the sensing and non-verbal understanding of the language of the somatic self and the position of one's body in space. Proprioceptive sense plays an important role in mankind's innate learning process/abilities. Proprioceptors are sensory nerve 'terminals' which provide information regarding the movements and positioning of the body. These proprioceptive systems are responsible for "carrying information derived from stimulation of receptors in muscles, tendons and joints of the body as it is moved into and out of a balanced position." (Williams, 1983: 264)

Proprioception involves three different but related sensory systems: kinaesthetic, visceral and vestibular senses. The kinaesthetic sense is relevant to brass playing. It is the awareness and transmission of body movement information (how muscles, joints, ligaments and tendons feel when they are tense and or relaxed).

3.3. THE LEARNING PROCESS

The learning of a physical skill progresses through different stages to arrive at a terminal behaviour:

- Cognitive involvement, i.e. conscious control of action;
- Changes in speed of skill execution;
- Stepped progressions of element inclusion to arrive at a terminal behaviour which can be seen as people learn to play instruments.

In brass playing, one initially learns the physical mechanism of how valves (and slides) function in combination with the breath and embouchure. While these physical mechanisms are being explored, one needs to learn how to read music and to hear pitches/sounds. Ideally, equal development of each stage would result.

In motor learning, the concept of imagery can serve as a valid practice tactic. Some physical actions may be so complex that the mastering of the action cannot be learned as a "whole" unit. It should be broken into individual smaller units for learning. If "whole" learning were to be attempted, the resulting behaviour would be incomplete or error-ridden.

Music learning involves a sophisticated performer bringing developed imagery skills (particularly auditory and kinaesthetic skills) to bear upon a new and unfamiliar composition. Varying tactics come into play, namely part-learning, chaining, chunking, mental practice as

well as attendance at an 'ideal performance,' to create a whole musically sound unit.[4] The execution of motor movements (slides and valves in combination with the embouchure) should initially be done slowly. The process may be gradually speeded up once comprehended and aided by muscle memory. It should be noted that the execution of the same skill at two different speeds elicits two different neuromuscular patterns. Slow-speed mental or physical rehearsal should be used only to allow for memory of performance components in the formative stage of skill learning. Speed should be added once memorisation is complete, as well as ensuring the maintenance of musical accuracy. Music learning has shown evidence for the efficacy of slow performance models.[5]

From personal experience, it can be stated that the flexibility and sheer strength of the lips, is paramount to the overall success of one's brass playing ability. The strength and flexibility of the lips is not merely a result of the state of one's muscles (as the case may be for weight-lifters), but includes the functioning of the brain as patterns are involved. The development of a brass embouchure occurs through the repetition of exercises with specific goals in mind; e.g. slurring intervals greater than an octave should only be studied once slurs less than an octave have been mastered.

As in gymnastics or ballet, the ideal is to start brass playing at an early age. Youngsters have greater flexibility and suppleness than older people, whose muscles become 'rigid' and 'set' in muscular movement, where range becomes more restricted with age (mass generalisation). At an early age, one can train and extend one's muscles to achieve specific outcomes.

The strength and flexibility of a brass player's lips is initially developed during the learning processes, and has to be maintained and 'kept in shape'. Exercises may include combinations of long-note and slur exercises, extending throughout the whole range of the instrument (isometric vs. isotonic) exercises.

In brass (and wind) playing an "elaborate synchronisation of numerous controlled movements combines to form the necessary embouchure." (Critchley & Henson, 1977: 370) Brass instrumentalists require intact, optimally functioning motor and sensory nerve supplies to the embouchure (the lips, the cheeks, the tongue and the teeth).

[4] http://www-rohan.sdsu.edu/dept/coachsci/csa/vol26/rushall5.htm
(Extracted from Rushall, B.S., & Lippman, L.G. (1997). The role of imagery in physical performance. *International Journal for Sport Psychology, 29, 57-72.)* (Lim & Lippman, 1991; Rosenthal, 1984; Zurcher, 1975)
[5] http://www-rohan.sdsu.edu/dept/coachsci/csa/vol26/rushall5.htm
(Extracted from Rushall, B.S., & Lippman, L.G. (1997). The role of imagery in physical performance. *International Journal for Sport Psychology, 29, 57-72.)*

> "Briefly it can be said that by some process of training, combining both learning and practice, a particular set of movements, simple or complex, can eventually be affected with an unusually high degree of efficiency. A skilled motion is not necessarily a delicate one, though in musicianship most of the motor skills comprise delicate, small-range, complex and highly co-ordinated little movements." (Critchley & Henson, 1977: 372)

3.4. ADAPTATION OF TEACHING APPROACHES

Teachers need to be able to vary their teaching approaches to suit the needs of individual students. A teacher with the ability to look at different focal points, will assist the student in building his strengths and eliminating or improving his weaknesses. One needs to identify the range of dysfunctions which could occur, and analyse how these dysfunctions affect articulation in brass playing.

In the following chapters, the links between phonology (the position which the tongue and lips take for producing English speech sounds), motor learning and brass playing and their use in brass articulation techniques will become evident.

When teaching young brass players new and intricate tonguing techniques, the teacher often gets the player to 'say' a specific consonant sound. For example /t/ (breathed), /d/ (voiced), /k/ (velar or pharynx) - and then to combine these sounds with vowels, e.g. /ti/, /tu/, /du/, /k/ - /qu/. The young player now 'feels' the position of his tongue and lips in relation to the soft/hard palate or pharynx. He can 'feel' the change of size in his oral cavity, as a result of his changing tongue shape. This hands-on or self-discovery approach allows the learner to experience proprioceptive and tactile feedback for himself. This is an essential aspect when learning to play an instrument.

By using 'new' conceptualised tongue and lip positions, and supporting these sounds with controlled diaphragmatic breathing, the brass player should achieve a variety of tonguing articulation techniques (e.g. 5.1. Single Tonguing and 5.3.1. Flutter Tonguing).

An overly tense or limp body restricts the accessing of proprioceptive information stored within parts of the body (pictures, sounds and feelings are not fully accessible). Conversely, being in a state of dynamic relaxation opens up the self to a greater range of information, comprehension and memory. In brass playing, one aims for as relaxed an approach as possible, since tension disrupts the breathing mechanism, as well as causing muscular (embouchure) strain.

4. THE TONGUE'S FUNCTION IN BRASS PLAYING

The tongue plays a three-fold role in all brass playing, namely:

- Articulation of sounds/tones;
- Pitch establishment;
- Regulation of tone quality and timbre.

Generally, the tip of the tongue is used to begin the tone, followed by the arch of the tongue controlling the pitch and the timbre. The brass player (and his tongue) needs to develop a muscular or tonal memory (see 3. Motor Learning) for the 'positions' required by the tongue in order to produce good or optimal sounds (tones) and special effects (see 5.3.). Movements of the tongue act as a valve, allowing the passage of air to initiate the brass player's 'lip' vibration.

It should not come as a surprise that the tongue, with its multi-purpose role, can be either the brass player's *'friend'* or *'foe'*. The following sections should make quite clear how *'mighty'* a role the tongue plays in brass playing. It should also become evident how 'the mighty' can fall, should the brass player's tongue function poorly, leading to sloppy articulation, inaccurate pitching and inferior tone quality.

4.1. ARTICULATION OF TONES

A brass player requires the ability to capture (or recapture) the essence of Baroque, Classical, Romantic, and Contemporary music at a moment's notice. The tongue serves as an aid in stylistic tone development. Articulation in brass-instrumental performance serves the same basic functions as in speech, namely, to make the sounds more or less distinct and expressive.

During speech, one is usually unconscious of the use of the tongue. Speech has become automatic, similar to other automatic functions such as normal breathing (i.e. breathing differing from that used during brass playing or physical exertion, e.g. various sports such as soccer or rugby). An exception to this feeling of autonomy may be tongue twisters. The tongue may feel clumsy and unco-ordinated, owing to the often excessive repetition of a specific consonant sound; e.g. 'red lorry, yellow lorry, red lorry, yellow lorry,' or 'she sells sea shells on the seashore, and the seashells that she sells are seashells I'm sure, she sells....'

The tongue initiates an 'attack', 'stroke' or 'release' of the air, resulting in tone production. The term *'attack'* implies vigour and/or aggression, and is not ideal for use in the context of muscular activity. Thus, it is advisable to use the term *'release,'* where the tongue, acting as a valve, releases the air which then passes through the embouchure aperture. The term *'release'* will therefore be used in the rest of this dissertation.

4.1.1. Articulation

The tongue is used to release "any note which is not slurred from the preceding note" (Baines, 1976: 35). This concept developed over centuries of brass playing, has resulted in the development of numerous types of articulation (Faulkener, 1963: 205).

Co-ordination of the fingers with the tongue, embouchure and air stream are essential elements in brass-playing. The fingers need to be flexible enough to synchronise with rapid tonguing, which is based on the velocity of the air stream. The term *'velocity'* is found in several of the older brass methods and texts, e.g. Arban and St. Jacome. Within these contexts, *'velocity'* almost certainly refers to the speed of the tongue and not the air stream (Jenkins, 1970: 340).

The "tongue is to the player as the bow is to the violinist." (Baines, 1976: 35) This description or concept of the tongue in relation to a bow was also made by the Russian Timofei Dokschitzer, a virtuoso trumpet player and revolutionary pedagogue. On the violin, it is the pressure of the forefinger and the suddenness of the stroke that determines the character of the release (Deye, 1947: 11). In brass instruments, the tongue release may be varied in strength and speed to match the appropriate loudness and character of the music. The player has a variety of ways to begin a note, just as a well-trained violinist has several ways of bowing (see 5. Articulation Technique, 5.1. Single Tonguing).

In the discussion on tongue position/s below, it should be noted that every person has an individually shaped oral cavity with his own set of teeth, as well as his own sized tongue, which may result in variations in tongue position and placement.

a. Tip-tonguing

Tip-tonguing is the most widely used articulation technique, suitable for the execution of accents and staccato articulation (see 5.1.2. Staccato and 5.1.7. Accents). The tongue tip is positioned behind the top teeth at the junction with the hard palate. Movement is downward and backwards. The syllables "ta", "tu", "te" and "ti" are predominantly used (listed in *'height'* order of the tongue - the placement of "ta" is low while in comparison, "ti" is high) (Sherman, 1990: 24). "The strength of this articulation may be controlled by varying the speed of the tongue movement, the shape of the tip formation and the location of the tip as it touches on the back of the teeth." (Sherman, 1990: 24)

b. Dorsal-tonguing

The tongue tip remains low in the mouth, placed behind the bottom teeth. The dorsal surface of the tongue arches forward (Sherman, 1990: 24). The point of contact by the tongue occurs higher on the palate. Syllables primarily used are "da", "du", "de" or "di" (once more, the order is given in tongue placement from low to high, in its varying gradations).

Two advantages of 'arched' tonguing (where the basic dorsal placement remains unchanged) are:

- Tongue is positioned for higher register articulation with the tip low in the mouth, the dorsum elevated toward the palate;
- A wide variety of articulation strengths are possible (Sherman, 1990: 24).

The tongue is divided into two arched halves by the longitudinal membrane (the median raphe), forming a groove. "The column of air is guided along this channel when the dorsal surface is removed from the hard palate....the farther forward the dorsal surface is positioned on the flat palate, the more closely the dorsal-tonguing will resemble tip-tonguing." (Sherman, 1990: 24) This tonguing style is predominantly used in legato articulation (see 5.1.1.).

c. Pharynx-tonguing

Pharynx - or back-tonguing is used in multiple-tonguing (see 5.2.). The uvula is used to stop the air stream for specific sounds, in this case the sound /k/. It should

be noted that this stoppage of air (which results in the stoppage of tone or sound), directly contradicts the generally accepted concept where sound is said to *'float'* on the air stream.

The current trend is to lessen the use of the uvula (Kierman, Personal Communication). This is achieved by producing the /k/ syllable further forward in the mouth, as in the syllable /q/ or the word 'queue'. The points of contact between the normal /t/ and /k/ articulations are drawn closer together. This is the desired effect, as this increases one's ability to control the 'floating' sound. By having shortened this distance between the production of the two focal points (/t/ and /k/ - now /q/), the tongue has the ability to move faster (or more quickly), thus lessening the possibility of a time-lag (a slow tongue motion with faster fingers may result in a time lag, or vice versa). The /q/ placement for secondary tonguing becomes more explosive, making the balance with /d/ or /t/ easier (a discussion of glottal articulation may be found in Philip Farkas' *'The Art of French Horn Playing,' 1956*). The areas of the tongue used in the pronunciation of different sounds are listed in Table 15.

Table 15: Progression of Tongue Placement/Striking Point on the Hard Palate

SYLLABIC PRONOUNCIATION	*AREA OF TONGUE USED DURING ARTICULATION*
"tuh"	Forward-most
"duh"	↓
"nuh"	↓
"lah"	↓
"q"	↓
"kah"	Back-most

4.1.2. Tongue Placement and the 'Tonguing Controversy'

The lack of agreement among prominent teachers, performers and authors in regard to articulation (tonguing) on brass instruments, is ample proof that this is a subject of considerable controversy, and one which is unlikely to subside. According to the world famous cornet-soloist and teacher, Herbert Clarke, this subject has caused more

controversy than any other pertaining to cornet and trumpet playing (Fitzgerald, 1946, 3). The disagreements are equally common with regard to trombone, French horn, baritone, and the tuba. However, the differences of opinion are primarily related to the method of articulation rather than the desired musical results.

There are two primary schools of thought concerning the act of tonguing, and they will be referred to as **A** and **B** in Table 16 below:

Table 16: Two Schools of Thought on Tonguing

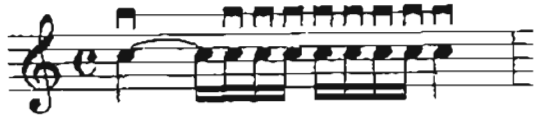
A.		B.
The tip of the tongue makes contact with the inner portion of the upper lip and teeth.	**VS.**	The tip of the tongue contacts only the back part of the upper teeth.

Points to which both schools subscribe are as follows:

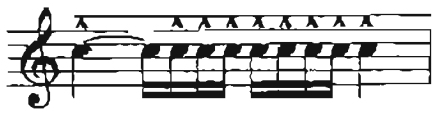
- Tonguing is an act of release. The column of air is propelled through the lips to produce the vibrations of tone only as the tongue is withdrawn from the point of contact.
- The tongue must never go between the lips during the act of tonguing.
- The kind of release is determined by four factors:
  - i. The speed with which the tongue is withdrawn (tongue placement before and after release).
  - ii. The size of the opening through which the air is released.
  - iii. The amount of breath pressure at the moment of release.
  - iv. The manner in which breath pressure is maintained throughout the life of the tone.
- The tongue is not used to stop the tone during the act of single tonguing.

Example i.) below depicts two alternative tonguing methods:

i. On a good air stream where the tongue does not disturb or stop the air flow;
ii. When the tongue disrupts and stops the air stream, thus stopping the tone/s.



i.) Air stream flows freely (tonguing 'floats' on air).



ii.) Air stream is impeded or broken by the tongue, resulting in separate bursts of air.

Example 1: Depiction of Tonguing (i. and ii.)

Sourced and renotated by the author (Whitener, 1990, 116).

Opinions of prominent brass technicians siding with these two schools of thought are given below:

A. **St. Jacome** ~ "the tongue, made (as) thin as possible, is introduced between the teeth until it encounters the lips between which it is placed conveniently; it is pressed strongly or lightly against the upper lip (according to whether a loud or soft sound is desired)." (Fitzgerald, 1946: 4)

This is controversial, as different pedagogues believe that the tongue should never touch the lips while playing as it disrupts the embouchure.

B. **Arban** ~ "the tongue ought to be placed against the teeth of the upper jaw in such a way that the mouth is hermetically sealed." (Fitzgerald, 1946: 4)

Clarke ~ Same as Arban with additional specific recommendation that "the tongue should be placed at the base of the upper teeth." (Fitzgerald, 1946: 4)

A 'middle-of-the-road' observation is that the "placement of the tip of the tongue varies with individual players. The most common location is in the upper front corner of the mouth at the gum line of the front upper teeth. Some players prefer a lower placement, at the middle or bottom of the upper teeth." (Whitener, 1990: 112)

Low brass instruments require larger mouthpieces. Low brass players may find that the tongue touches the inner part of the upper lip in tonguing, which may result in the tongue disturbing the embouchure, thus hindering the release (Fitzgerald, 1946:4). Unfortunately, there is no meeting of minds on this most important function of brass instrument playing, as both may result in the desired musical effect/s.

In conclusion, a word of advice from the pen of Herbert L. Clarke:

> "The foundation is the same for all: scales, intervals, and exercises to acquire control of the muscles of the lips, tongue, and fingers. Wind control is ninety-eight percent of correct wind instrument playing from the flute to the tuba.... There are no rules in cornet playing. Every cornet player I ever saw or knew played differently." (Deye, 1947: 14)

4.1.3. Tongue Position/Placement

Below are two figures (6 and 7) representing the alternative tongue positions for playing brass instruments in accordance with recognized styles.

Figure 6: Low Tongue Placement/Position

Sourced and re-drawn by the author (Whitener, 1979: 24)

Figure 7: High Tongue Placement/Position

Sourced and re-drawn by the author (Whitener, 1979: 24)

An individual's physical characteristics should be considered in determining where the tongue comes into contact with the upper teeth (refer to Table 17):

Table 17: Tongue Type and Usage during Articulation Process (Fitzgerald, 1949: 23)

TYPE OF TONGUE SURFACE	AREA OF TONGUE USED DURING ARTICULATION
Broad	Curve tongue downward, therefore point of contact with upper teeth occurs just above the tip of the upper-side of the tongue.
Narrow/Short	Tip of tongue used behind upper teeth.

4.2. PHONOLOGY IN BRASS PLAYING: VOWELS & CONSONANTS

The shape of the oral cavity affects the tone produced and to some extent this shape is determined by the vowel sound used (Deye, 1947: 11). The back of the tongue must remain low and flat (as close to the floor of the mouth as possible), preventing interference with air stream flow.

The position or placement of the tongue at the start of a release is determined by the consonant used, e.g. "doo", "too". The position of the tongue, after the initial release, is determined by the vowel sound used. There are conflicting views over which vowel sound should follow the consonant; e.g. "oo", "ee", "ah".

The vowel sound can either aid or impede in tone production. The muscles at the base of the tongue ideally should remain relaxed. If they become constricted, it may result in sympathetic tension of the throat muscles, resulting in the air stream being interrupted. This type of tension, resulting in constricted throat and tongue muscles, is one of the most common problems to be found in brass players (Deye, 1947: 12). The tongue, especially the middle section and the base, should remain loose and relaxed. In the production of articulation only the tip of the tongue should be used.

The greater the velocity of the air stream, the lighter the action of the tongue should be, and vice versa (air velocity is also linked with dynamic levels). The tip of the tongue is best used in a forward and upward motion rather than back and forth. The ideal to be achieved is a tongue operating correctly while remaining free from throat and/or facial tension/s (Blake, Personal Communication)

4.2.1. Use of Tongued Syllables and Consonants

A brass player may use various syllables in the execution of articulations, the two most common being "t" as in 'time' and "d" as in 'dot' (Table 18).

Table 18: Tongue Syllables used in Brass Articulations

"T" ~ TIP-TONGUING	*"D" ~ DORSAL TONGUING*
A breath consonant	A voiced consonant
Hear air before voice	Hear voice immediately
Tendency to give an explosive beginning to notes	Throat is more relaxed
Diaphragm: lack of resistance	Diaphragm pulls up and in more intensely
Slowness of response	Faster, surer responses
---	Enhances tone quality
---	Triple-tonguing "du-du-gu" is more relaxed, faster and obtains more tone quality than the usually recommended "tu-tu-ku"
Hard release	Soft release
---	Aids in controlling release of air: LEGATO

Beginners are often encouraged to use the traditional *"tu,"* as this will develop stronger tongue muscles. This syllable, however, also results in a slowness of response, owing to the lack of resistance to diaphragm and weak tonguing. In the South African context my supervisor Mr S.A. Kierman has found it more beneficial to begin with "da" or "de" as opposed to "tu" (Kierman, Personal Communication).

Comparisons between articulation qualities on different brass instruments prove to be interesting. A 'release' on the trombone is less explosive than on its counterpart, the trumpet (Kierman, Personal Communication). Both use the syllables /t/ and /d/ in the articulation act.

4.2.2. Vowel Formation

The formation of vowels has a considerable bearing on pitch and tone quality. Within different registers of brass instruments, different vowel sounds are used (see Tables 19, 20 and 21). It should be noted that no specific vowel sound is fixed to a specific individual note. Varying vowel combinations are used based on an individual's oral cavity (resonating chamber). Physical differences may affect articulation, sound, and tuning; e.g. higher palates may result in 'flatter' tuning.

Table 19: Varying Consonant and Vowel Sounds Used in Brass/Wind Articulation

CONSONANTS	VOWELS
/t/ - ordinary tonguing	"oo" (as in 'pool')
/d/ - legato tonguing	"ee" (as in 'beat')
/l/	"ah" (as in 'art')
/r/	"uh" (as in 'touch')
/k/	"e" (as in 'bed')
/g/	"oe" (as in 'toe')
-	"aw" (as in 'jaw')

4.2.3. Consonants

Table 20: Consonant /t/ with Varying Syllables (Used in Ordinary Tonguing)

SYLLABLES	DESCRIPTION
"too"	Produces a fairly sharp release. The explosion is not too great.
"tee"	Used in register change - from middle to high. A smaller air column results due to higher tongue position, thus higher tones sound more easily.
"tah"	Aids in production of broader, heavier tones. Aids tone quality when 'switching' from low to high registers, and vice versa (advised for trombone, baritone and tuba students).
"toe"	Aids in maintaining the maximum area of resonance within the oral cavity (often recommended for French horn students).
"taw"	Broader vowel sound, similar to "tah" (advised for trombone, baritone and tuba students).
"tu"	American-based, the tongue is relaxed. More like the "tah" sound. Advised by Arban and Clarke.
"thu" or "tü"	The French-based "tü" (or Afrikaans /u/), has a higher tongue than the American syllable usage. Advised by St. Jacome (in American texts it is notated as "thu" to differentiate from their own "tu", similar to "too").

It should be noted that it is difficult to verbalise/describe the actual tongue positions, owing to the individuality of each player. A general observation is that students learn more rapidly by imitation. Sound paints a vivid aural picture (Enichlmair, Personal Communication).

4.2.4. Syllables

Table 21: Syllables - Register Specific

REGISTER	DESCRIPTION
Low	Broad vowel sound "taw" (as in 'tall') and/or "toe"
Middle	"tah" (as in 'top') or "too"
High	Bright vowel sound "tuh" (as in 'ton') or "tih" (as in 'tin') "tee"- extreme high register

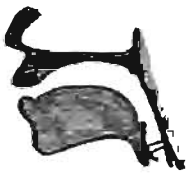
"Ah" is an open, easily enunciated vowel sound, where the tongue occupies the bottom of the oral cavity. The /h/ assures "diaphragmatic action proportionate to the extent sounded and amount of air following." (Magnell, 1962: 310) This syllable aids in terminating the tone without resorting to an unwanted "tawt" release.

Two well-known brass pedagogues, Remington and Reinhardt, have contrasting opinions on the use of syllables while playing. While Reinhardt recommends the use of vowel sounds in the process of slurring, Remington denies this and suggests the avoidance of shifting tongue positions (Kierman, Personal Communication).

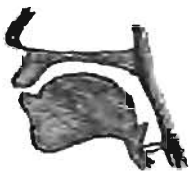
The use of vocalised syllables aids in pitch location or placement (McKee, 1962: 313), as well as smooth slur production within different registers. Generally it is found that pitches in close proximity are easily accessible. The embouchure and air stream do not need to be altered to achieve the desired pitches. The slurring of larger intervals often proves to be troublesome, descending intervals being easier to navigate than their ascending counterparts.

The positions of the tongue corresponding to various vowel sounds are shown in Figure 8.

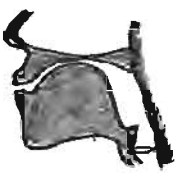
a.) "ah" - minimum elevation of front/back of tongue.



b.) "oh" - slight elevation of the back of the tongue.



c.) "oo" - maximum elevation of the back of the tongue.



d.) "ee" - maximum frontal elevation of the tongue (Hall, 1955. 174)

Figure 8: Position of Tongue In Relation to Specific Vowel Sounds.

Sourced and re-drawn by the author.[6]

4.2.5. Tone and Pitch Production in Relation to Brass Articulation

Poor tonguing may result in sloppy articulation and inaccurate pitching, as well as an inferior tone quality. Tonguing is inevitably involved in technical displays. It is often needed in the execution of difficult technical passages, such as variations found near the end of a virtuosic solo work, where speed and technical brilliance/fluency of the tongue are required (Appendices I and J).

a. Common Problems Resulting in Poor Tone

The common causes of a poor tone are the constriction of the mouth caused by closing the jaw, the tensing of the tongue, the choking of the throat and the use of the tongue to release the note (Appendix C: Valsalva Mechanism). It is difficult to separate the tensions of the jaw, tongue or throat. If the tone is poor, any one or a combination of these factors may be the cause. Since the jaw, tongue and throat are connected, the tension from one will spread to the others. One should consider the jaw, tongue and throat as one unit (Appendix K).

[6] http://www.sfu.ca/~saunders/133098/L4/L4_5.html

- Closed Jaw

  A solution may be to simply think 'open the mouth,' 'drop the jaw slightly' or any similar idea that will result in the separation of the teeth and enlarging the size of the oral cavity.

- Stiff Tongue

  A stiff tongue is detrimental to the process of articulation in brass playing. Relaxation is essential. To achieve this ideal, one needs to lower the back of one's tongue (by articulating "too", "taw", or "toe") which aids in movement of the tip of the tongue.

- Tight Throat

  A brass player suffering from a tight throat needs to relax and open the choked throat. This may be achieved by using vowels such as "oo", "aw" or "oe" which aid in lowering the base of the tongue, while continuing to breathe deeply.

- Tongue Release

  Poor tone quality may also result if one uses the tongue to cut off a tone. If the tongue is used it acts like a valve - stopping the air stream, and thereby stopping the sound (see 5.1.8. Tongue Stop/Cut off).

b. Increased Range Through the Use of Syllables

The placement of the back of the tongue within the oral cavity and its effect on the quality and pitch of a tone should be taken into consideration for the development of increased range production.

> "Trumpet teachers have long been in disagreement concerning the manner in which the tongue and the mouth cavity are employed to aid the lips in changing register. Some teachers have stated that the tongue is never used as such an aid, while others have said that the proper shaping of the tongue into various vowel formations is all important. Still others maintain that the tongue and mouth are used not for register changes but for variation in tonal quality. The use of a particular mouth formation after attack is implied through the syllable used in articulation, as in 'tu', 'du', 'tah', 'tee', 'dee'." (Hall, 1955: 173)

5. ARTICULATION TECHNIQUES

Following in the footsteps of Timofei Dokschitzer, the famous "virtuoso trumpeter with the soul of a violinist" (Doksidser, 1980a: 23), the author uses the term 'articulation' in a broad sense in this context. It is not a synonym for 'tonguing' but "all the possible ways of starting, holding and ending a note" (Doksidser, 1980a: 23).

Each articulation type is comprised of three sections - "the beginning, the stationary part and the end.... the nomenclature of many types of articulation has been borrowed from string players and this terminology has become generally accepted." (Doksidser, 1980b: 23)

Articulation symbols, along with tempo and dynamic indications, serve as 'road signs' in music. In order to understand the intent of the composer, one needs to be able to read and understand the notated signs. Conventional notation allows for people of all nationalities to unite in a common understanding - that of the language of music.

Varying forms of articulation are available. The first technique or style to be addressed will be that of the single tonguing unit (its varying forms aid in emphasising and adding different inflections to music), followed by multiple tonguing and additional special effects.

5.1. SINGLE TONGUING

As mentioned previously, the tongue articulates tones by acting as an air release valve, causing the lips to vibrate. "The beginner brass performer needs to be concerned with tones that are either slurred or tongued. The slurred passages require an articulation only at the start of the passage." (Zorn, 1995: 7)

In trumpet playing, the term 'release' is often used to describe how a note is started. As stated in 4.1., the term 'release' will be used in place of *'attack.'* There are three kinds of release, namely:

i. Normal
ii. Soft
iii. Secondary

The functions of these different types of release are detailed in Table 22.

"The normal attack, as the basic type, since it exists independently, has the widest application. It makes it possible to achieve a wide variety of sound. The soft and the secondary attack carry out subordinate functions: they are not used to articulate initial notes and are not used independently, without the normal attack. The soft and secondary attack, make it possible to achieve a degree of expressiveness and virtuosity in sound which is beyond the capacity of the normal attack." (release) (Doksidser, 1980a: 30)

In brass playing, one strives to attain a clear precise release, avoiding additional guttural sounds, which may inhibit the execution of a pure release. "A precise attack (release) guarantees accurate sound production without extraneous sounds, affection or interruption." (Doksidser, 1980a: 30)

Sound quality is the final arbiter of brass-playing success. The concept of tonguing on a stream of air features once more, as well as 'block' sounds. One should avoid creating a *'swelling'* sound (also described as a pushed sound, resulting in "twa's") which would result in uneven, featureless music (Kierman, Personal Communication). "In all three types of attack (release) it is an essential rule that the required intensity of sound should appear at the moment of attack, and not after it." (breath support) (Doksidser, 1980a: 30) (see Tables 22 and 23)

Table 22: Functions of the three types of Releases

	TYPE OF RELEASES	SYLLABLE PRONUNCIATION	FUNCTION
1.	Normal	"too", "ta" or "tee"	▪ Principal method of releasing a note ▪ Used after a breath is taken ▪ Only release to produce correct and precise tone production of initial notes ▪ Ability to create various nuances and characteristic - loud, soft, long, accented, and unaccented
2.	Soft	"doo", "da" or "dee"	▪ Not used for release of initial notes ▪ Used to play extended series of notes, linked together in one breath ▪ Used in alternation with the normal release - facilitates in extended performance of rhythmic patterns ▪ In legato playing, the soft release may aid in the execution of slurs played over wide intervals
3.	Secondary	"koo", "ka" or "kee"	▪ Used in alternation with the normal or soft release - not used alone ▪ Double and triple tonguing (see 6.2.) ▪ Must sound similar to normal articulated releases - the goal is to match the sounds until indistinguishable which is normal/secondary

Table 23: Correct Tonguing (Farkas, 1956: 50)

BASED ON FARKAS' HORN METHOD
Tongue works across the air stream. ▪ Tip must remain pointed and curled upward to meet upper teeth and gums ▪ Release - obtained by bringing tongue down and backward
Enunciate "too" or "doo" (intensity dependent). ▪ "too" - hard release ▪ "doo" - soft release
Regulate 'force' used in release. ▪ Generally better definition is obtainable by attacking progressively farther forward onto the teeth if a harder or sharper release is desired ▪ Conversely, tonguing higher onto the gums and farther back in the mouth will produce softer releases
Focus the embouchure carefully on the 'centre' of each note. ▪ No amount of correct tonguing can produce clear notes unless the notes are already cleanly pre-formed by the lips

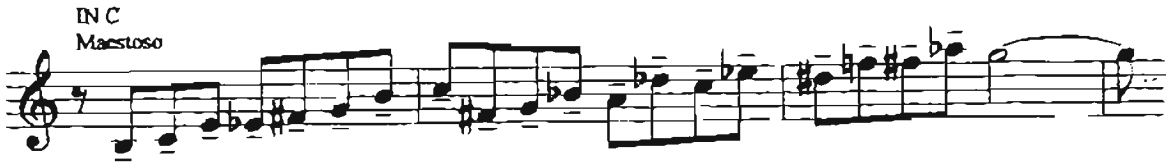
In music, three terms (nomenclature) are used to describe how a release should sound.

i. Detaché
ii. Marcato
iii. Martelé

i. *Detaché*

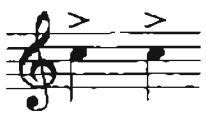
Example 2: Detaché

The French word *detaché* means "detached, separated....detaché is not an accented articulation but it must be vigorous and definite." (notated as per Example 2) (Doksidser, 1980b: 36) This articulation form uses the normal attack as its basis. This nomenclature generally refers to string players who use different bow movements for each note, namely up or down bow movements. The beginning of *detaché* is unaccented. The middle section maintains the same dynamic, while the ending is rounded, open-ended, using no tongue (Excerpt 1 displays *detaché* in the context of music) (Doksidser, 1980b: 54).



Excerpt 1: Honegger, *Intrada*

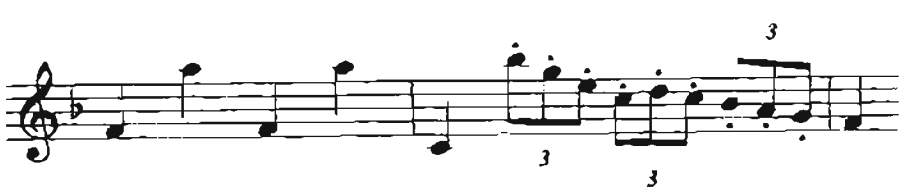
ii. *Marcato*



Example 3: Marcato

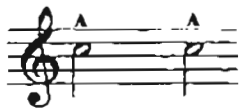
Marcato is an Italian term meaning "emphasised, picked out, marked...involves an emphatic articulation of the note." (notated as per Example 3 above) (Doksidser, 1980b: 36). This form of articulation aids brass players in developing a good release. "The marcato articulation is used particularly often in dramatic, heroic and march-like music." (Doksidser, 1980b: 37). The tones should be accented, emphasised and well-marked. A slight decrescendo should occur while sustaining the tone for its full value.

In *marcato,* the tongue strikes the teeth in a deliberate manner to sound the accent. The tongue's action can be likened to that of a clapper striking a bell and producing a ringing note sound. In the musical sense, this word is connected with dynamics and relates to the nature of the beginning of the note. *Marcato* involves an emphatic articulation of the note, and in doing so, it has entered common usage as a term for a type of articulation. The beginning of a *marcato* note is accented, the middle section diminuendos/dies away (i.e. reduction in volume) while the ending is open without the use of the tongue (Doksidser, 1980b: 54) (Excerpt 2 displays *marcato).*



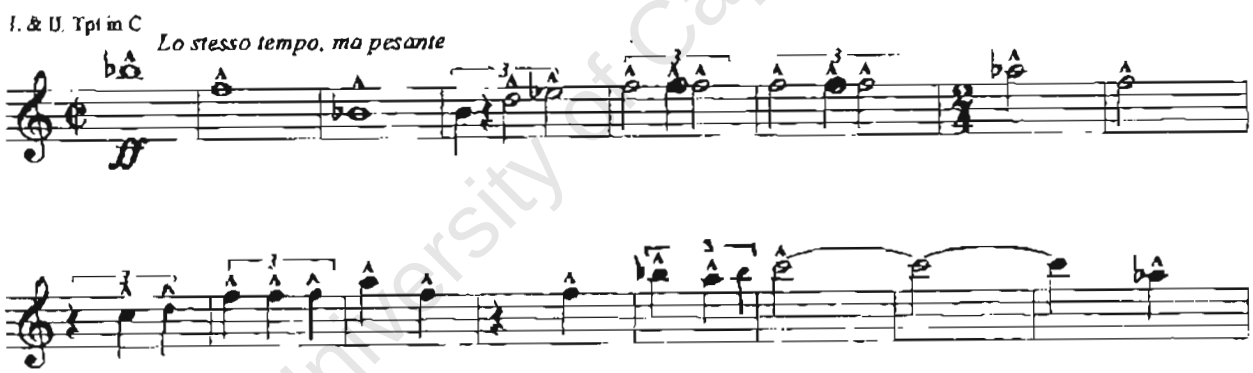
Excerpt 2: Haydn, Trumpet Concerto

iii. *Martelé*



Example 4: *Martelé*

Martelé, the French word for "hammered - stamped, precise, hard, is a percussive articulation (Example 4). It is similar in character to staccato but is distinguished from staccato by its harder, heavier sound. *Martelé* is a less expressive type of articulation than *detaché* or *marcato*; its sound is rather coarse, hard and somewhat formal. It is rarely used" (Doksidser, 1980b: 37). In the production of *martelé* articulation, the beginning makes use of a normal release. The middle section is stationary, maintaining the same dynamic level, while the ending is closed. The tongue is not used to end this articulation (Doksidser, 1980b: 54) (Excerpt 3 displays martelé).



Excerpt 3: Bartok, Concerto for Orchestra

Various Tonguing Styles found in Brass Playing

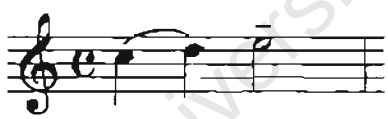
A brass player needs to be able to interpret score markings according to the style of the composition. These interpretations are similar to a string player's decisions on types of bowing. It should be noted that bowing is often left to the player's or section leader's discretion. A large amount of music appears without expression or phrasing marks. "Unmarked music is not necessarily played detached. Players must be able to recognise the musical styles in order to choose suitable tonguings." (Zorn, 1995: 126)

The different tonguing styles are compared in Table 24.

Table 24: Comparison between Tonguing Styles

LEGATO TONGUING	STACCATO TONGUING	MARCATO TONGUING
Pointedly less rigid.	Pointedly rigid.	Pointedly rigid.
Seems to make the reverse stroke from a position slightly lower than normal.	Makes the reverse stroke from a normal position.	Makes the reverse stroke from a normal position.
Offers a large surface to the point of contact (varies in size).	Offers only a slight surface area to the point of contact (tip/apex of the tongue).	Offers a slightly larger surface area than in staccato tonguing to the point of contact.
Travels approx. 6mm in making the stroke.	Travels approx. 3mm in making a stroke.	Travels approx. 2mm in making a stroke.
Touches the point of contact very lightly.	Touches the point of contact very lightly.	Touches the point of contact with weight.
In some instances, does not contact the upper teeth at any time, depends on person - shape of mouth, size of tongue, tongue placement, etc.	Contact with both the upper teeth and the inner part of the upper lip, in most cases (points of contact depend on size of tongue).	Seems to come less in contact with the upper teeth.

5.1.1. Legato

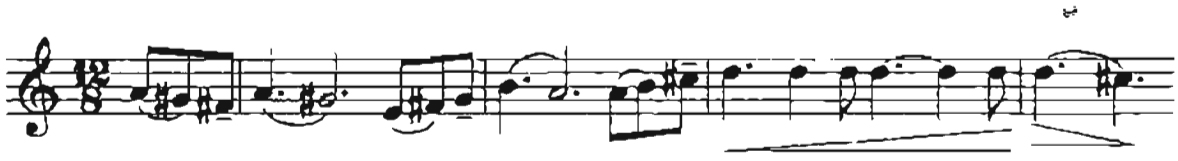


Example 5: Legato

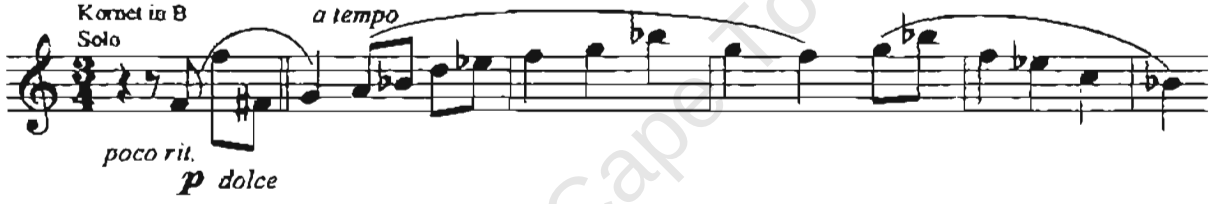
Legato articulation in brass playing results when the player's tongue interrupts the air stream slightly (similar tongue placement occurs when the player pronounces the syllable "doo" or "da" in either the dorsal or the tip-tonguing position). "The action is similar to a finger touching a stream of water from a hose just lightly enough to produce a bobble in the stream." (Zorn, 1995: 7)

"The correct approach to legato style on the trumpet and cornet demands both maturity and practice." (Sherman, 1990: 30) In elementary books, the initial exercises focus the student's attention on one note at a time. The note is articulated and released without concern for what follows each single note.

Initially, beginner brass players often have limited or undeveloped breath control, as well as an inability to hold the embouchure muscles steady. In developing a smooth legato style, one needs to maintain a continuous air-flow. Interruptions of the air steam results in broken musical phrases and distorted tone. Ideally legato tones should be as smooth as possible (Excerpts 4 and 5 display legato style).

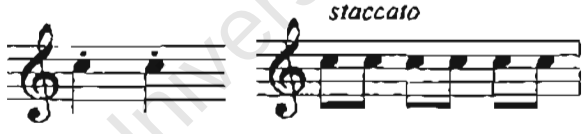


Excerpt 4: Tchaikovsky, Symphony V



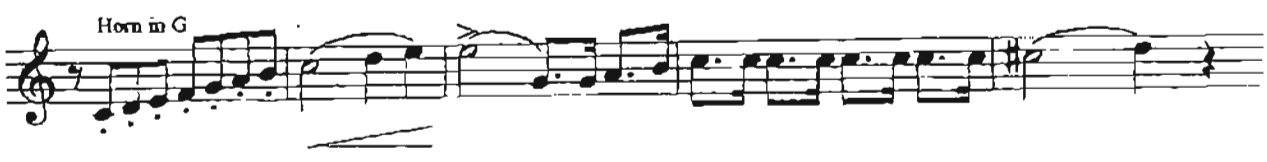
Excerpt 5: Prokofieff, Romeo and Juliet

5.1.2. Staccato

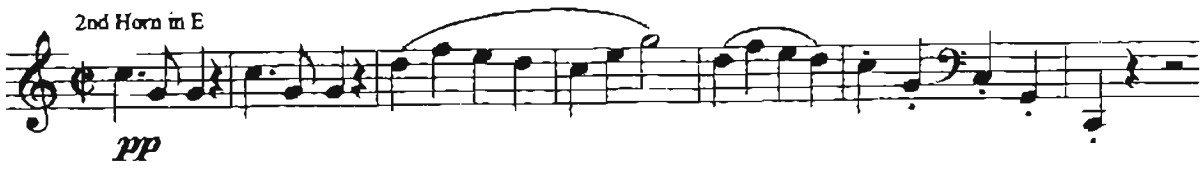


Example 6: Staccato

Staccato, a rather vague Italian term, means 'detached' or 'broken up'. The dot shortens or decreases the note value by half. In *staccato* articulation "the attack *(release)* is sharp, the note short and the ending light, without the tongue." (Doksidser, 1980b: 37) *Staccato* should ideally be light, crisp releases (see Example 6).



Excerpt 6: Rossini, *Barber of Seville* Overture

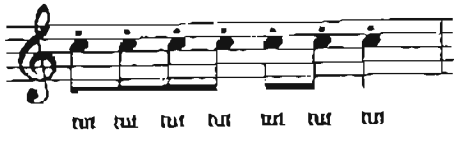


Excerpt 7: Beethoven, *Fidelio* Overture

Brass students, who are beginners, are often initially taught to think of *staccato* as 'short'. A more subjective or correct view would be staccato as 'detached' or 'lightened'. Less tongue is used to produce *staccato*. It should be noted that *staccato* notes should be terminated by stopping the air stream, and not by closing the throat (glottal closure) or stopping the tone with the tongue (tongue stop), thus the short *staccato* notes resonate more, giving the listener an impression similar to *spiccato* as achieved on string instruments. The beginning of a *staccato* note is an accented short note, using normal and/or secondary release. The ending is open with no use of the tongue (Doksidser, 1980b: 54) (Excerpts 6 and 7 display *staccato* articulation).

On brass instruments *staccato* tonguing is more difficult to execute than *legato* tonguing, owing to the fact that the tones must be separated and stopped entirely with one's breath. Co-ordination of the embouchure and the tongue needs to be carefully organised.

Stopping of the tone is usually accomplished with the breathing muscles, resulting in a "ringing quality similar to a string pizzicato or a xylophone tone." (Zorn, 1995: 126) Only in very rare circumstances should the tone be stopped with the tongue (Example 7 displays incorrect or poor articulation. See Section 5.1.8. Tongue Stop). One should generally avoid using the tongue to stop a note while playing *staccato*.



Example 7: Example of Poor Articulation

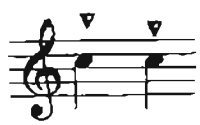
"Theoretically, the staccato marking refers to the duration of the tone and not necessarily the attack. However, in rapid staccato passages, the start or tongue attack (release) is usually made more pointed or definite." (Zorn, 1995: 126) The

degree of separation between tones and how short the tones should be are subject to a wide variety of interpretations.

In playing staccato, the prime consideration is to have space between notes (hence, the faster the passage, the less the time there is to produce the notes and the spaces) (Farkas, 1956: 50).

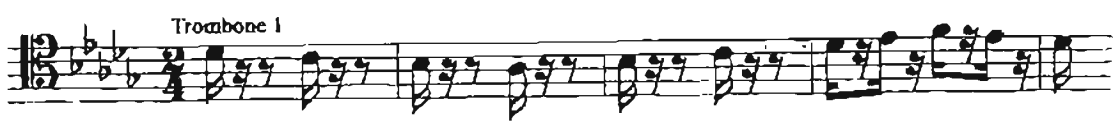
> "The length of any staccato note can be varied in a hundred different ways, and musicianship determines how short the notes should be for any particular passage. There is too great a tendency for students to assume that staccato notes are simply to be played as short as possible. Actually there is infinite variety in the staccato effects that can be used, and in many melodic passages the student has to be urged to make his staccato long enough!" (Farkas, 1956: 51)

5.1.3. Staccatissimo

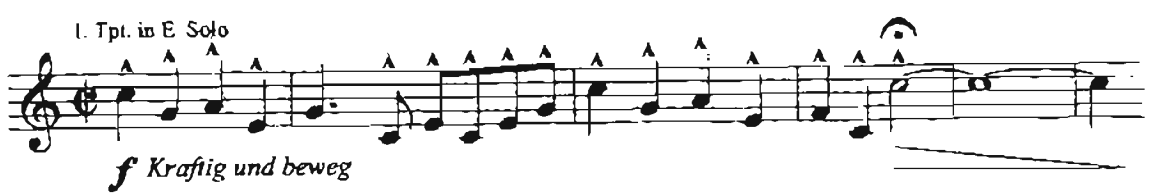


Example 8: Staccatissimo

Occasionally composers ask for individual notes to be kept extremely short to maintain clarity or to create a percussive effect. This is accomplished by playing the notes as short as possible - *staccatissimo* (use of "tooh" - notated in Example 8 above). To achieve this, the brass player must make the beginning, middle and end of the note as *'dry'* as possible. The air column is forcibly stopped, making the note duration as short as possible - *'dry'* or *secco*. Excerpts 8 and 9 are illustrations of *staccatissimo*.



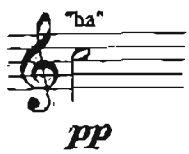
Excerpt 8: Tchaikovsky, Symphony IV, 3rd movement



Excerpt 9: Humperdinck, *Hansel and Gretel*

In *staccatissimo* the beginning of the note is accented, using a normal tongue release. The ending of the note is closed, with the tongue stopping the note, thus shortening its length (Doksidser, 1980b: 54).

5.1.4. Breath Releases



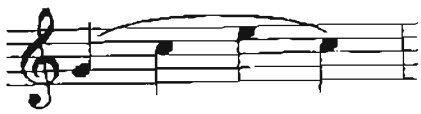
Example 9: Breath Release

The *Breath Release* (or diaphragmatic release) eliminates the percussive release commonly found in amateur brass and wind performances. The syllables "hoo", "hee", "hu", "hah" and "hi" are used for this exhaled breath-push (Example 9). The diaphragmatic or abdominal area releases a spurt of air, which is then breathed into the lips using the above-mentioned syllables. The result is an imperceptible start which can be played in all dynamic ranges without a noisy release. Brass players often resort to using this release when having to match woodwind entries - "when this is done by woodwind and brass sections together, it is one of the most delightful wind techniques." (Faulkener, 1963: 206)

A danger to be aware of is that when using breath releases, one tends to sound late. A breath release is "precarious as there will inevitably be an element of waiting for (the) note to get going when it is ready, rather than being in precise control as (one may be) when tonguing."[7] In orchestral, chamber music and even solo situations this can be a liability, yet at the same time the matching of releases is important (see Appendix K: Test for Clean Release: 'Chicago Sound'). The breath release "*poo*" should be avoided at all costs as it disrupts the embouchure, resulting in excessive lip movement.

[7] http://freespace.virgin.net/pip.eastop/html/tico.htm

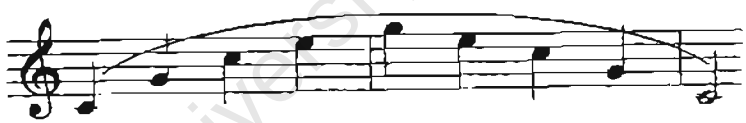
5.1.5. Slurs



Example 10: Slurs

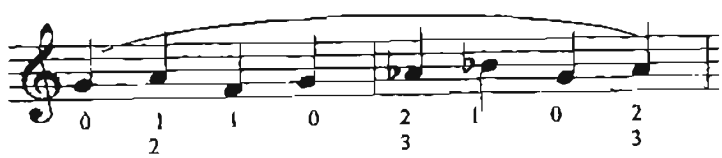
Slurs are classified as movement between different pitches without initiating the start of various successive tones with the tongue. In the execution of a slur, the primary consideration is that the connection between notes must be smooth and without a break in the sound (Example 10). Continuous air motion is essential as any interruption to the air flow or sound in the space between two slurred notes will negatively affect the quality of the slur. Slurred phrases require articulation to be used only at the start of a passage of slurred notes.

There are two types of slurs, the lip slur and the valve slur. The lip slur makes use of the harmonic series to change note pitches without changing the valve combinations (Example 11).



Example 11: Lip Slurs

The valve slur makes use of valves to change pitches. Attention should be paid to ensure that one blows through the valve changes, and valve motion needs to be quick and accurate (Example 12).



Example 12: Valve Slurs

Both types of slurs should be "carefully timed to provide a clean, almost imperceptible change. Through great mastery of timing, German and Viennese hornists produce long, expressive 'glides' from note to note in romantic repertoire." (Whitener, 1990: 114)

Brief assessment of a controversial aspect in brass playing has sparked an ongoing debate (Kierman, Personal Communication). Wind pressure needs to be increased when ascending to achieve an evenness of volume between slurred notes. This is necessary to compensate for a smaller aperture and the greater resistance, which is encountered on the upper partial of the slur. In descending slurred passages, the air flow should rise as well. This is to compensate for a more relaxed embouchure and larger aperture. The shift in air pressure used in the execution of slurred intervals is accompanied by jaw and tongue movement. "Sometimes it is useful (particularly in ascending) to crescendo on the lower note and let the momentum carry the sound to the higher note." (Whitener, 1990: 114)

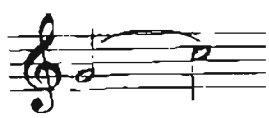
In slurring, syllabic pronunciation is used (Table 25). Descending slurs are the reversal of their ascending counterparts.

Table 25: Use of Syllables in Slurring: (Whitener, 1990: 110)

ASCENDING SLURS:	*PRIME USAGE*
"ah" changes to "ee" or "ah - oo - ee".	Trumpet players.
"oh" changes to "oo" or "oh - ah - oo".	Horn players and low brass instruments.

A further exploration of *upward* and downward *slurs* in brass playing follows.

a. Upward Slurs



Example 13: Upward Slur

In the execution of upward slurs, three basic physical changes occur:

- Abdominal support of the air column increases (Example 13);
- Muscles in the corners of the embouchure become firmer (additional support);
- Tongue arches inside the mouth - increases the velocity of the air stream.

To assist the tongue's upward movement (arching), one should use the syllable "*ee.*" If response of the upper note of the slur occurs, it can be "assisted by adding an "h" to the tongue arch, and forming a "hee" sound. The "h" produces a small breath impulse and will help to overcome the added resistance of the upper note." (Sherman, 1990: 31)

The throat should remain open, as tone distortion will occur if closure occurs. (see 4.2.4. Conflicting points of view - Remington and Reinhardt). The corners of the embouchure should not be allowed to assume a smiling position as a constricted aperture would result, leading to restricted air flow, which in turn leads to a thin, pinched and anaemic sound.

At a slow tempo, changes occurring in the abdominal and embouchure musculature may occur prior to the actual note change. The tongue arch occurs at the moment of oscillation between two tones.

b. Downward Slurs

Example 14: Downward Slur

In the execution of downward lip slurs (Example 14), muscle relaxation occurs. The tongue is lowered in the mouth resulting in an enlargement of the oral cavity. In the execution of downward *slurs* the "embouchure muscles become less firm and the diaphragm support of the air column is reduced." (Sherman, 1990: 31)

c. Errors in Lip Slurring

Despite correct 'set-ups' in musculature, errors may occur. Errors in lip slurring may be the result of several factors, namely:

- An underdeveloped embouchure;
- Inadequate breath support;
- Inaccurate tongue position (Table 26).

Table 26: Errors in Lip Slurring

ERROR	RESULT
Slowness of lip muscles adjustment.	The pitch of the first note of: ▪ An upward slur - goes sharp ▪ A downward slur - goes flat.
Lack of breath support control.	The temporary interruption in air-flow may result in the stoppage of tones between slurred notes.
Habitual *'lifting'* or *'shortening'* of the last note of a slurred sequence.	Incorrect musicality.
Emphasis of a tongued note at the beginning of a slurred phrase - should be avoided, unless an accent is indicated.	Incorrect musicality.
Speed-related errors (speed, or lack of speed with which embouchure muscles, breath support and tongue position/s change).	Intermediate note sounds between two slurred pitches. This is owing to slowness in the necessary physical adjustments/re-adjustments. Missed upward slur by going too high or too low (landing on another harmonic of the same harmonic series - brass instruments have seven basic positions, thus it is easy to land on another tone). Similarly, a missed downward slur may result from: ▪ Poor auditory skills: a lack of inner hearing of the pitch the player seeks ▪ Physical, the muscle adjustments are slow. Correction can be achieved by tonguing both notes to set the pitch impression, thus when the pitch change is secure, the slur can be added (Sherman, 1990: 31).

d. Optimal Slurring Facility

Ideally, a brass player should strive for complete control over his embouchure, thus allowing optimal adjustments of aperture to facilitate vibrations at different frequencies. This control enables the player to exploit the full range of his instrument.

The tongue, working synergistically together with the jaw, rises within the mouth, resulting in a concentration and redirection of the air stream in a downward course whilst ascending. In a descending slur the tongue flattens.

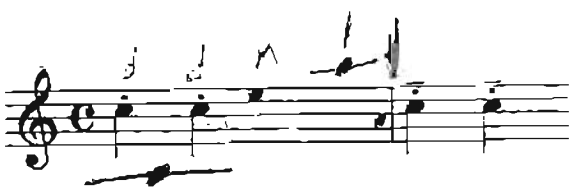
Syllable usage aids in the development of clean, well-established *slurs*. Once proper tongue motion is established, many players do not consciously think of forming syllables as they play (Whitener, 1990: 110).

e. Matching Tonguing and Slurring

The process of tonguing and slurring intervals should be matched as much as possible. If contrasting modes of operation are used, rapid and accurate shifting from tonguing or slurring at any tempo and in any register would be impractical, if not impossible.

Players usually do not have an equal facility of tonguing and slurring. In general, younger players seem to acquire tongue control easily, while more mature players have a better control of legato-style playing. "Practice and concentration alone produce this professional touch." (Tetzlaff, 1955: 107)

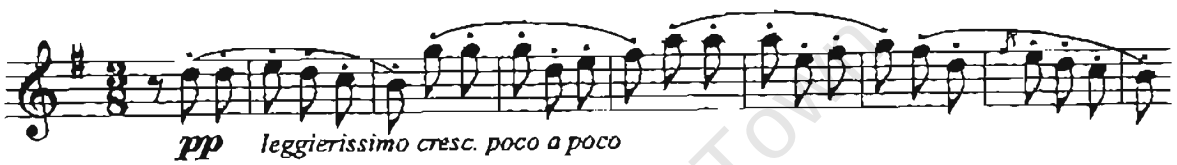
5.1.6. Portato



Example 15: ***Portato***

The Italian term *portato* means 'carried.' The *portato* effect is similar to *legato* tonguing. Both notes are initiated with a soft "da" release. Their endings, however, differ. In contrast to legato tonguing, *portato* articulated notes are stressed (an expression sometimes called an *agogic* accent) (Law, 1961: 166). The term *leggiero* may be associated with this form of articulation, implying the use of a light tongue.

Portato is commonly employed in soft, slow passages. Prime examples are the brass chorales written by Johannes Brahms. Chabrier's *España* is a good example of *portato* usage (Excerpt 10).



Excerpt 10: Chabrier, *España*

5.1.7. Accents

Accents add emphasis to certain notes in music. Various kinds of *accents* are used by composers to achieve specific effects. An ample supply of air, a quick tongue release and a firm tongue stroke emphasising the beginning of the note are required to produce accent tonguing. "The tones should not be poked, since the focus of the action should be on the release of the air and not the tongue." (Zorn, 1995: 126)

Bell-like accents are uniquely exciting when played on brass instruments and are typically found in fanfare-features. A general observation is that the principal part of the note should be played at the suggested musical dynamic. The accent should be superimposed upon the existing dynamic. Accents which will be explored here are *sforzando, rinforzando* and *forte-piano* (for *marcato,* see 5.1. Single Tonguing, B. *Marcato*).

a. Sforzando (sfz)

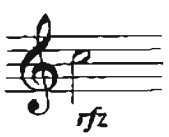
Example 16: Sforzando

The *sforzando* accent (Example 16) is more exaggerated than normal accent tonguing. "Many players find they need to place the tongue between the teeth in a sort of spitting action in order to achieve the desired effect. The result is an explosive, heavy attack." (release) (Zorn, 1995: 127)

The desired effect is an explosive sound, where the tongue draws back exceedingly quickly, resulting in the release of great air pressure built up within the breathing mechanism.

Sforzando is frequently used in contemporary, avant-garde and jazz performance. It is the heaviest accent type available where the volume of the note lowers after the accent has been sounded.

b. Rinforzando (rfz)



Example 17: Rinforzando

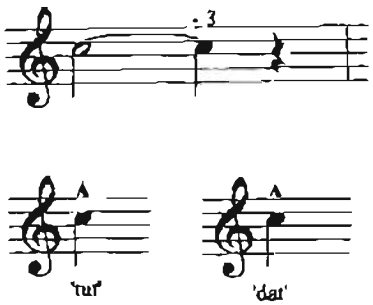
Similar to *sfz*, this type of accent "has less definition at the beginning of the note. The rinforzando is actually like a quick and strong crescendo and is executed more with the breath than the tongue." (Sherman, 1990: 28) (Example 17)

c. Forte-piano (fp)

Example 18: forte-piano

The *forte-piano* accent (Example 18) results in a sudden, substantial dynamic change. The beginning of a note is loud, followed by an immediate tapering of the sound of the tone.

5.1.8. Tongue Stop/Cut-Off



Example 19: Various Tongue Stops/Cut-offs

This type of articulation is a cause of major debate in the world of brass playing. One view is that a brass player should never end a note with the tongue. In order to stop the tone, "the flow of air from the breath is stopped. The player should be careful not to stop the tone with the tongue, as in 'dood' or 'dude'. This stops the tone too abruptly." (Zorn, 1995: 7) This is primarily to avoid players using abrupt unmusical endings (Example 19). The end of notes (or phrases) should be 'tailed-off', thereby emphasising the musicality of the line.

However, *tongue stop* or *cut-off* effects are often required in contemporary music, e.g. jazz, pop, or stage band music. It can be compared fairly accurately to "the effect of letting the bath plug slam back into the plug hole as the water is running out."[8] The tongue is responsible for stopping the flow of air by either blocking its path, or moving out of the way to let the air flow pass. The tongue stop may be used as a technical practice aid in that it helps to strengthen the tongue muscle (e.g. Shuebruck's Tongue Trainers).

5.2. MULTIPLE TONGUING

In the previous century (nineteenth century) multiple tonguing was 'in vogue,' being a prominent feature in early cornet solos which often contained variations written in a coloratura style. These virtuoso band pieces have been replaced by pieces containing "greater stylistic variety and musical quality but with less use of multiple tonguing." (Barrow, 1997: 72) e.g. Arban's *Carnival of Venice* exemplifies a virtuoso piece with varying uses of multiple tonguing.

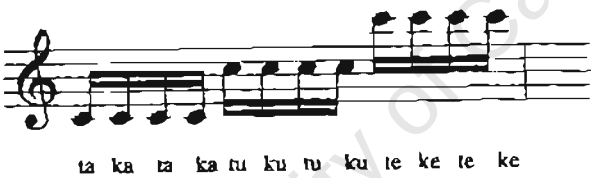
[8] http://freespace.virgin.net/pip.eastop/html/tico.htm

One of the first remaining brass methods to refer to double tonguing is a Tutor (1638) by a Tuscan court trumpeter named Fantini.

> "From these it is easy to develop a general rule to use unequal articulations (alternating syllables beginning with strong consonants such as "t" or "d" with those beginning with weaker ones such as "r" or "l") on intervals of a second, with equal ones reserved for notes on the same pitch or in arpeggiated figures."
>
> (Herbert & Wallace, 1997: 96)

Prior to being introduced to multiple tonguing, a player needs a solid foundation, one where rapid, light and accurate articulation is achieved. The "ultimate goal of multiple tonguing is to duplicate a series of rapid single articulations." (Sherman, 1990: 82) (see Appendix H: Influence of the 'Mother' tongue on articulation) The varying 'art forms' of double, triple and doodle tonguing will be explored below.

5.2.1. Double Tonguing



Example 20: Double Tonguing

> "Even the fastest single-tongue requires time to 'reset' or recoil to its position for the next attack, and the amount of time determines the speed of the tonguing."
> (Farkas, 1963: 49)

A child calling his pet cat, 'kitty-kitty-kitty,' is essentially using the consonants used in the production of double tonguing. In double tonguing the consonant /k/ is inserted between the /t's/ (Example 20).

To develop fast multiple tonguing, one should avoid creating a complete hermetic seal with the tongue (air stream blockage). To avoid this seal, the consonant /t/ should be replaced with /d/ (initial release is lightened), while substituting the consonant /g/ (as in 'goal') for /k/. Faster and lighter double tonguing is attained (e.g. "dih - gih"). In addition, one can use the syllable /l/, aiding in the creation of a smooth and rapid

tonguing style, e.g. "l" with vowel sounds - "lah", "lee", "li", "lo", 'lu" and "loo" which is one of the most relaxed positions (Faulkener, 1963: 206).

During the spatial difference in point of contact, /k/ generally tends to sound less articulate and weak, thus it has to be articulated harder than its counterpart. The closer the point of contact between the syllables, the better the rhythmic accuracy and tone production will be (Grocock, 1954: 115) (4.1.1. c.) Pharynx Tonguing, /q/).

Double tonguing should ideally resemble even-spaced single tonguing (Enichlmair, Personal Communication). Initially speed is unimportant. Slow, evenly tongued passages are imperative, enabling one to pinpoint unwanted instability. Speed should be increased in stages. Slow tempos aid in co-ordination of valve or slide work with tongue articulations (3. Motor Learning). Musical results will be ineffective if speed and clarity cannot be maintained over an extended period of time.

To increase the strength of the /k's/, one can articulate /k/ on its own: "k-k-k-k"; or reverse the traditional double tonguing unit, placing the emphasis on the /k/ consonant which is sounded first (Farkas, 1963: 49). Producing /k/ in the throat should be avoided, as this will lead to distortion of tone and limitations in speed (Sherman, 1990: 83). Register-based vowel sounds can be used (Table 27).

Table 27: Double-Tonguing Vowel Sound Variations

VOWELS	*"T-K"*	*"D-G"*
"u"	"tu-ku"	"du-gu"
"i" or "ih"	"ti-ki" or "ki-ti" (also "tih-kih")	"di-gi"
"oo"	"too-koo" or "koo-too"	"doo-goo"
"ah"	"tah-kah"	"dah-kah"
"oe"	"toe-koe"	"doe-koe"
"aw"	"taw-kaw"	"daw-gaw"

The variations "tah-kah" and "taw-kaw" encourage the maintenance of a 'more natural embouchure,' and an open throat (Jones, 1973: 427). The syllable "ku" or "koo", which can be enunciated forward in the mouth, tends to occur back in the throat. The syllable "ke" is enunciated further forward when compared with "ku" (Grocock, 1954: 115).

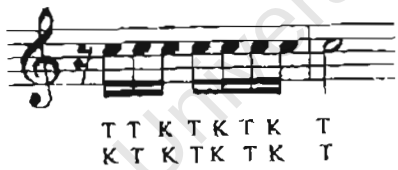
In the lower register double tonguing response tends to be slower. "Work in this region will ensure both greater speed and clarity" throughout the entire instrument's/player's range (Barrow, 1997: 72). Borrowed from the practice of drum rudiments, a pattern covering all gradations of tempo can yield marked progress (Appendix D).

The decision to start with /t/ or /k/ is quite ordered, as all even numbered groups start with a /t/. Examples of double tonguing are given below (Example 21 and Excerpts 11, 12 and 13).

i.)

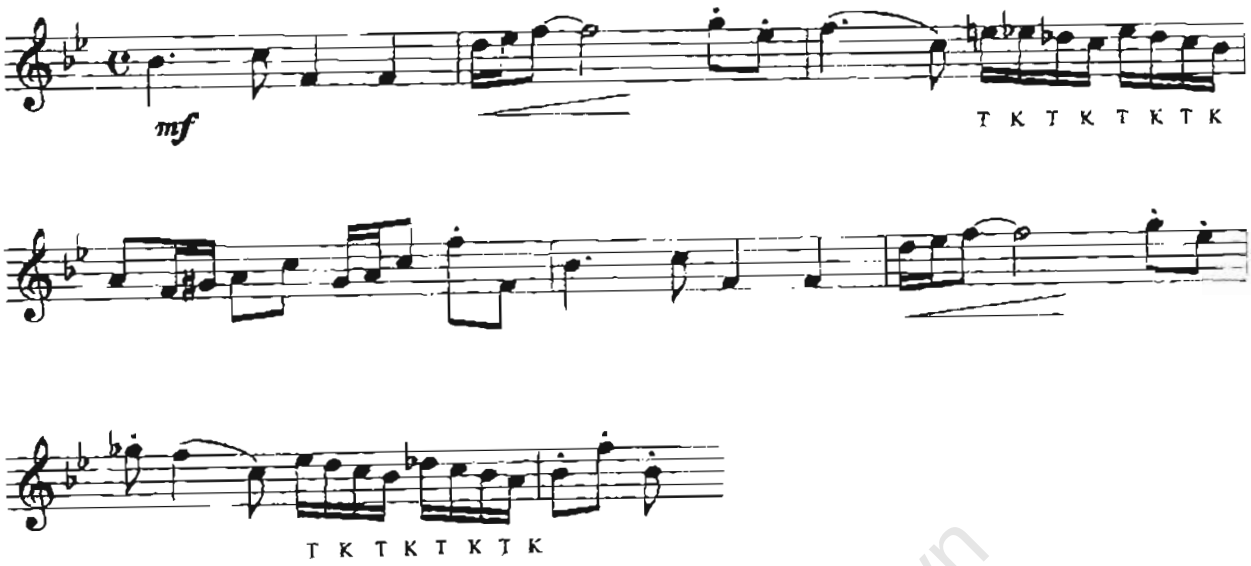
If a passage starts on an 'off-beat' (uneven number of notes), the player should start with a /k/.

ii.)

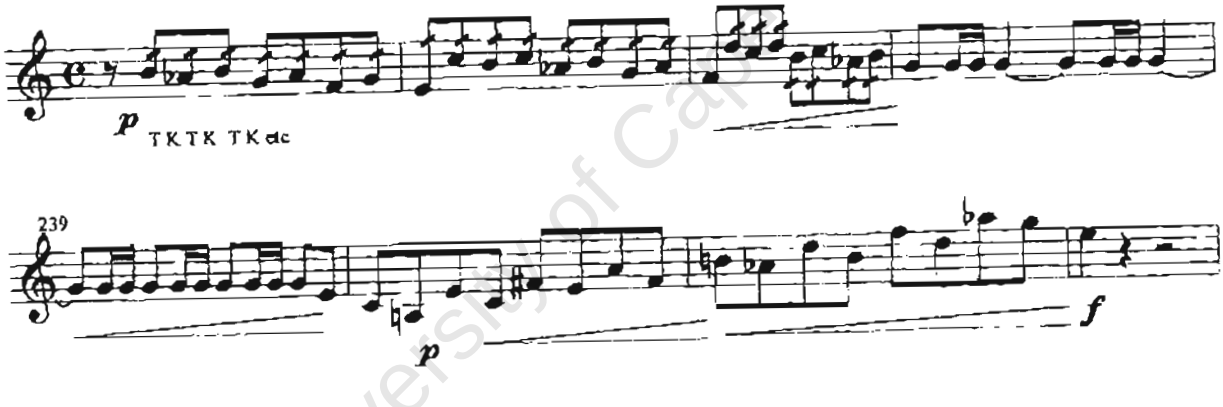


Example 21: Examples of Double Tonguing (i. and ii.)

Excerpts 11 & 12 are examples of double tonguing from solo repertoire for trumpet. Excerpt 13 is an example from orchestral literature. These excerpts are given below:



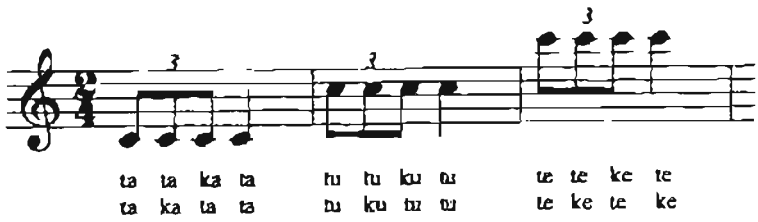
Excerpt 11: Arutjunjan, Concerto



Excerpt 12: Goedicke, *Concert Etude*

Excerpt 13: Sibelius, *Finlandia*

5.2.2. Triple Tonguing



Example 22: Triple Tonguing

Triple tonguing (Example 22) is predominantly used in the execution of triplet patterns. Triple tonguing helps to energise slow tonguing.

> "At a high speed, these players can, however, articulate two "t's" in rapid succession quite successfully. This is where Triple tonguing enters. As in double tonguing, the player may substitute "k", allowing the tip of the tongue time to reset, thus avoiding a sluggish third "t"." (Farkas, 1963: 50)

Variations of triple tonguing are shown in Table 28.

Table 28: Triple-Tonguing Variations

VOWEL	"T-T-K"	"D-D-G"	"T-K-T" OR "K-T-K"	"D-G-D" OR "G-D-G"
"u"	"tu-tu-ku"	"du-du-gu"	"tu-ku-tu"	"du-gu-du"
"ih" or "i"	"tih-tih-kih" or "ti-ti-ki"	"dih-dih-gih"	"ti-ki-ti"	"dih-gih-dih"
"u - i"	"tu-tu-ki"	"du-du-gi"	"tu-ki-tu"	"du-gi-du"
"ee"	"tee-tee-kee"	"dee-dee-kee"	"tee-kee-tee"	"dee-gee-dee"

The most common and effective triple tonguing method, as found in the Arban method, is "t-t-k". Despite its favoured use, this approach is not effective in all brass playing. For example: if "t-t-k" is solely used in passages where accents and/or wide intervals occur, the musical sensitivity of the passage or the technical ability of the player may detrimentally alter the results (Jones, 1973: 427) (Table 28).

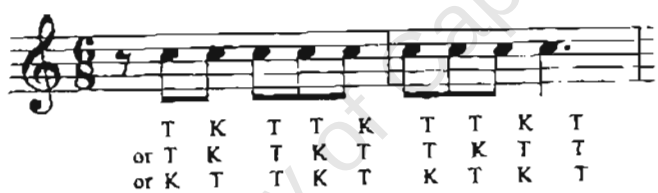
Flautists tend to use the "t-k-t" variation when a series of triple tongue units is played. It is interesting to note that they cycle "two "t's" and one "k" just like the brass

players' articulation" (Farkas, 1963: 50), resulting in "tih-kih-tih, tih-kih-tih, tih-kih-tih".

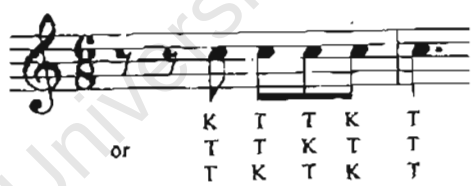
A double tongue based variation, frequently used by brass players, is "t-k-t, k-t-k, t-k-t" (every third tone is accented). "This effect is perfectly permissible, and can be clearer and stronger than the usual triple-tonguing pattern." (Wick, 1971: 45). World famous horn soloist Barry Tuckwell, in his book "Playing the Horn," (1981) advises using the syllables "ki-te-te".

- In triple tonguing, when a passage begins with the last two notes of the triplet, the notes are played as if doubled tongued "t-k" (Example 23: i);
- Similarly, if the passage begins with the last note of the triplet grouping, the note is tongued "k" (Example 23: ii);
- 'Double-tongue' version of triple-tonguing, as used by flautists (Example 23: iii).

i)



ii)



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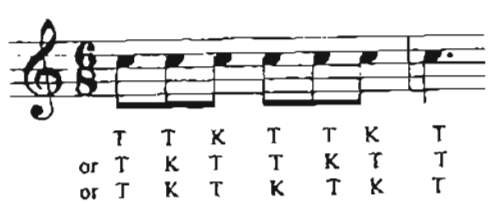
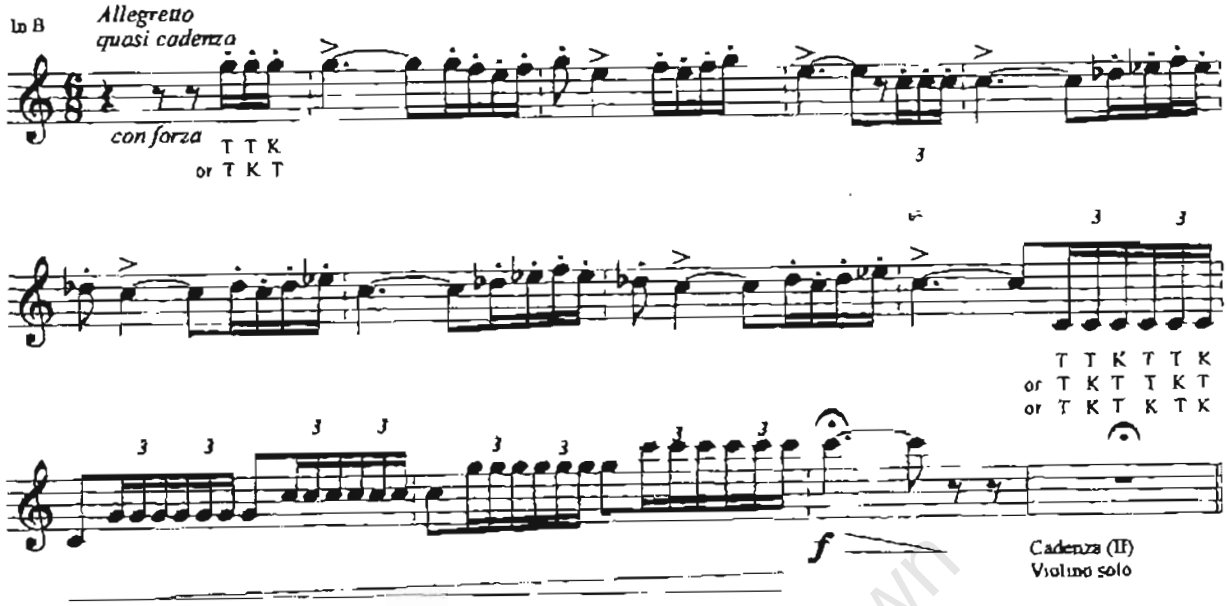
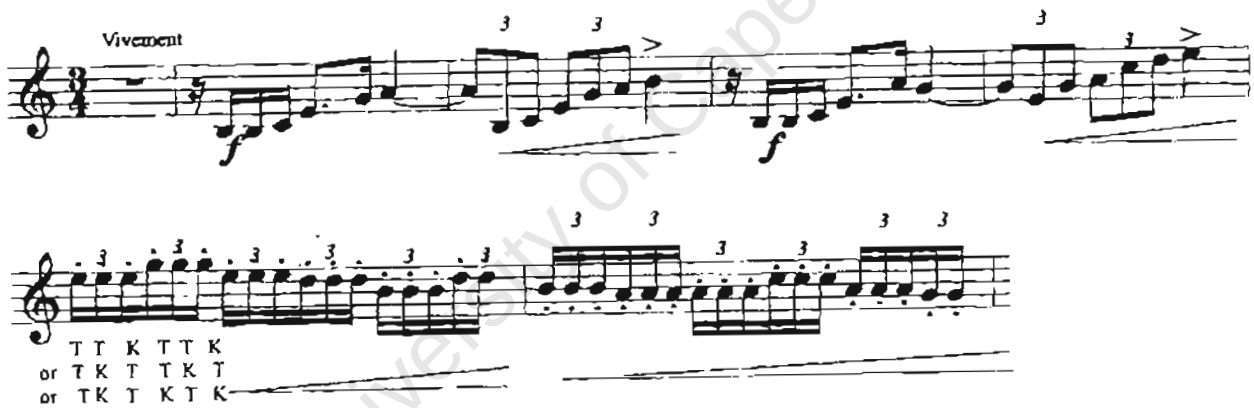


Example 23: Triple Tonguing (i. ii. and iii)

Examples of triple tonguing from brass solo and orchestral repertoire are seen in Excerpts 14, 15 and 16:



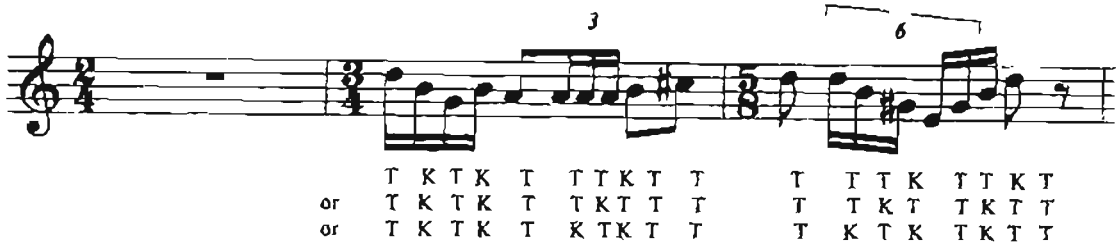
Excerpt 14: Rimsky-Korsakov, *Cappriccio Espagnol*



Excerpt 15: Jolivet, *Air De Bravoure*

Excerpt 16: Rossini, *La Gazza Ladra*

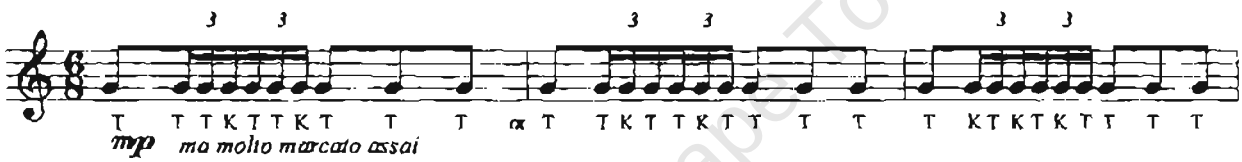
A famous piece where a combination of double and triple tonguing is used is Stravinsky's *Histoire Du Soldat.* The combinations and forms which can be used are left to the performer's discretion (Excerpt 17).



Excerpt 17: Stravinsky, *Histoire Du Soldat*

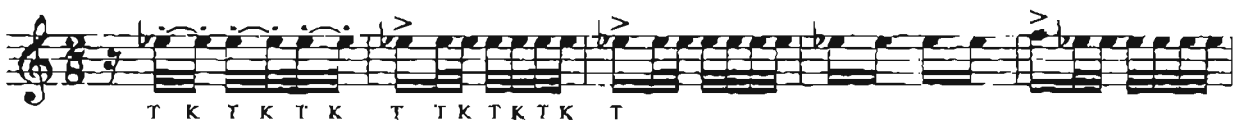
Rimsky-Korsakov's *Scheherazade* is another example where the different forms of multiple tonguing are combined (Excerpt 18).

i.)



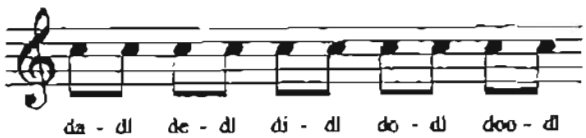
ii.)

iii.)



Excerpt 18: Rimsky-Korsakov, *Scheherazade*

5.2.3. Doodle Tonguing



Example 24: Doodle Tonguing

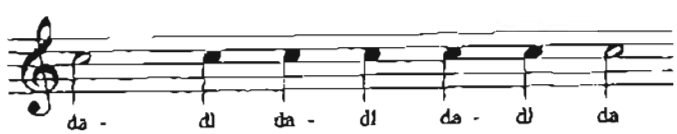
Doodle tonguing makes use of the consonant "d" and the soft rebound "l" sound, (pronounced as "ul", as in 'full') in combination with the vowel series "a-e-i-o-u" (Table 29). Consonant and vowel combinations result in "da-dle, de-dle, di-dle, do-dle, doo-dle."[9] This form of multiple tonguing is predominantly used by trombone players within the jazz field, resembling scat singing in its use of mixed vowel sounds.[10]

Table 29: Use of Register-Based Vowel Sounds[11]

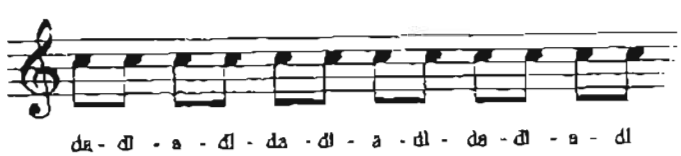
REGISTER	VOWEL	RESULT
Low register	"o"	Enhances sound owing to a larger throat cavity.
Middle register	"a"	In-between low and high registers.
High register	"e"	Focuses and concentrates air stream.

Examples of doodle tonguing are given below:

i.)

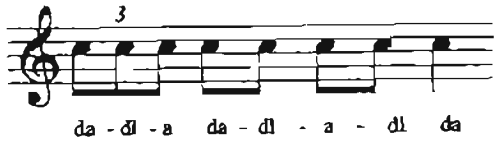


ii.)



[9] http://www.trombone.org/articles/library/conradherwig-mc.asp BERNOTAS, Bob. *"Mastercloss with Conrad Herwig: An Introduction to Doodle Tonguing"* ITA website
[10] Ibid
[11] Ibid.

iii.)



Example 25: Examples of Doodle Tonguing (i. ii. and iii.)

Useful exercises for doodle tongue development are Arban's single tonguing exercises. If one could 'match' doodle-tonguing to single tonguing, one should be unable to distinguish between the two forms.

Doodle tonguing aids in the development of one's tongue flexibility. "One other important key is to keep practising your single tonguing. As fast as you can single tongue, you can doodle tongue twice as fast."[12]

Arban, in his Cornet Method (a valuable brass resource held in high esteem - often referred to as the *"Trumpet Bible"*), advocates that triple tonguing should be studied before double tonguing. My supervisor, Mr. S.A. Kierman concurs. Mr Kierman also advocates the study of single tonguing, followed by triple tonguing. He has found that those who learn double tonguing first never truly learn the art of triple tonguing. They substitute "te-ke-te, ke-te-ke" in place of the conventional "te-te-ke" articulation. Initially the progress of triple-tonguing may be exceptionally slow, when compared to its double-tongue counterpart.

A player should ideally create an overlap in his single and multiple tonguing abilities, enabling "the player to negotiate all tongued passages from the slowest to the fastest." (Farkas, 1963: 50) The style or method of multiple tonguing is left to the discretion of the player and to quote an old adage *"If it ain't broke, don't fix it."*

Of prime consideration is to find a combination of syllables which are usable and are competitive with each other. In the instance of "te-te-ke", "te" is pronounced farther forward in the mouth than the "ke" and so an imbalance of sound results. This imbalance can be compared to a motor vehicle with a flat tyre - the car may limp along until grinding to a halt with a destroyed rim. In this instance, the tongue recoils a distance in order to produce the pharyngeal "ke" sound.

[12] http://www.trombone.org/articles/library/conradherwig-mc.asp; Op Cit

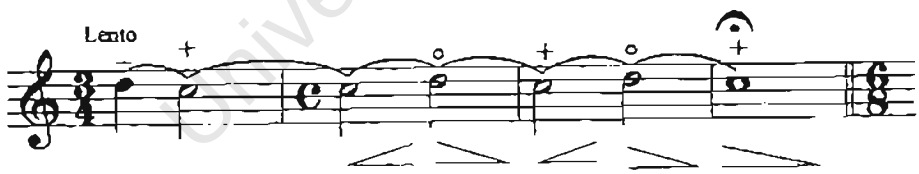
A better combination of syllables might be "du-du-ku." The "du" is not as explosive in nature as the "te." Owing to the softer release of the primary tonguing, the secondary tonguing ("ku") is more on a par with it and can match the sound more competitively ("ku" is more strident than its softer counterpart "gu"). The very nature of this subject is rather subjective and is best left to the discretion of the individual player.

5.3. SPECIAL EFFECTS / CONTEMPORARY CONCEPTS

During the twentieth century, a trend to incorporate the softer articulations of jazz and modern percussive effects into mainstream brass-playing occurred. Brass players are often called upon by contemporary composers to produce specialized sound effects, resulting in "ever-increasing contrasts of timbre."[13]

These include:

- Rattling the valves;
- Use of various mutes; e.g. Harmon (wah-wah), cup, straight, plunger;
- Use of a bucket of water. The bell may be placed: (Dempster, 1979: 58)
  - ✓ Above the surface of the water, resulting in a shimmering effect;
  - ✓ Partially in the water giving a 'water gong' effect;
  - ✓ In water producing air bubbles on blowing.
- Use of hand in bell - raises/lowers the pitch of the note (French horn) (+ - closed/stopped; 0 - open); an example is seen in Excerpt 19:

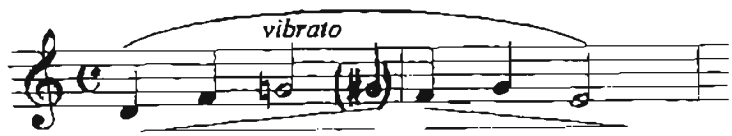


Excerpt 19: Seiber, *Notturno* for Horn and Strings

- Singing, speaking, whispering, shouting or hissing through the instrument;
- Playing with the water key open;
- Buzzing on the mouthpiece;
- Popping sound on the mouthpiece (hand slaps mouthpiece);
- Reverberation. e.g. playing a brass instrument into a piano (where the sustaining pedal is lowered), sympathetic vibrations of the piano strings occur resulting in the sounding of tones based on the harmonic series and/or microtonal harmonies;

[13] http://www.clubi.ie/amhiggins/effects.html

- Doppler Effect (Dempster, 1979: 28), created when a player stands still and twirls the instrument around. Another method would be for the player to rotate as a unit with his instrument;
- Pitch/note bending: here one alters the note pitch lower or higher by using the embouchure (not valves/slide) to create a scooping effect. This may be referred to as a 'bent tone' in the jazz idiom (Excerpt 20);



Excerpt 20: Hakim, *Sonata* for Trumpet and Organ (2nd Movement)

- Flutter tonguing (see 5.3.1);
- Multiphonics (see 5.3.2.);
- Trills, shakes and tremelos (see 5.3.3.);
- Glissandi and "Fall-off" effects (see 5.3.4.);
- Back tonguing (see 5.3.5.);
- Highest-note-in-line (see 5.3.6.).

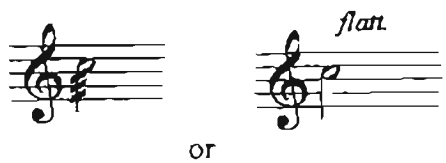
Of these Twentieth century developments, the following are relevant to this discourse.

5.3.1. Flutter Tonguing

Flutter tonguing is produced in two ways:

i. Tongue tip used against the alveolar ridge;
ii. Use of the uvula.

It is indicated in music by *Flatterzunge* (German) or *Frullato* (Italian), and is notated as in Example 26:



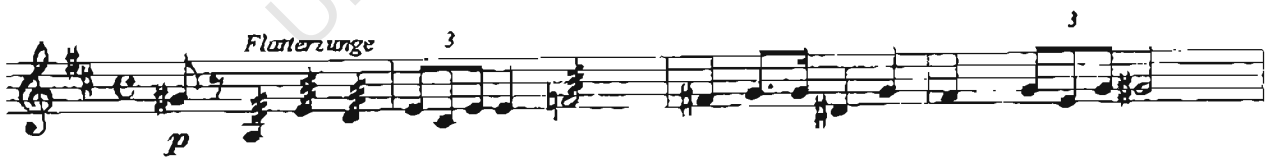
Example 26: Flutter Tonguing

In both instances, the tongue must be relaxed, resulting in a loose movement. A gentle/harsh trilling motion of the tip of the tongue against the alveolar ridge or of the uvula against the back of the tongue is the sought-after motion in progressing towards achieving the desired effect.

In the first instance, this special effect is achieved by rolling the syllable /r/ and "allowing the tongue tip to vibrate as the air passes into the instrument." (Whitener, 1990: 117) The tongue tip must remain relaxed, while the back (base) of the tongue is elevated. As the air stream passes over the tongue, the tip flutters in its wake (the tongue produces an Italian rolled /r/ after the note is begun with a /t/, pronounced 'trrrrrrrr').

If the flutter does not result, the air stream moving through the mouth should be increased. The player should practise rolling an /r/ without the aid of the instrument. Consistent practice will overcome any persisting problems. The tip of the tongue should strike the alveolar ridge and the hard palate. The speed and intensity of the flutter can be altered depending on where one rolls the /r/. If rolled forward in the mouth, the resultant sound is harsher and rougher than when one rolls the /r/ further back in one's mouth, where the resultant sound is softer and gentler.

In using the uvula, one achieves a more controlled and desirable sound, as one has the ability to alter the speed of the flutter. Flutter tonguing is most effective in the middle range of a brass instrument (Excerpts 21 and 22).



Excerpt 21: Hubeau *Sonata* for Trumpet and Piano (II: Intermede)

Excerpt 22: Martinu, *Sonatine*

> "The flutter tongue is easily used in most registers and dynamic ranges. The only real exception to this is in the pedal note range. The composer, in particular, should keep in mind that any pedal note is like a flutter tongue; that is, the vibrations per second are few enough that non-trombonists often perceive a plain pedal note as being flutter-tongued. Generally, a composer writes a flutter tongue to achieve a louder or more raucous sound. Neither of these things (occur) when the flutter tongue is used on pedal notes; indeed, the effect will be to actually reduce the very loudness and raucousness with which pedal notes are already blessed." (Dempster, 1979: 39)

Flutter tonguing may not come easily to those from certain population groups as mentioned in Appendix B. The use of the tongue is strongly related to speech and language. Clarity of articulation tends to reflect the conventions of one's mother tongue. In some of the world's language populations the rolled /r/ sound does not exist. For example:

- One of the southern dialects of German, *Sachsisch*, is characterised by slow and immobile tongues. School teachers in the area employed speech therapy techniques to 'correct' and discipline their pupils' tongues (Kierman, 1976).
- Similarly, in most, if not all South African Afrikaans-speaking communities, a slow and immobile tongue occurs. Some Afrikaans populaces cannot roll their "r's", and instead use a glottal /r/. A prime example is the Afrikaans-speaking community from Malmesbury, north of Cape Town, where the use of the glottal /r/ is dominant (Kierman, Personal Communication).
- The Japanese have difficulty in producing the rolled /r/, even in producing the Anglophone /r/, /l/ and even the /n/ sounds. This is due to these sounds being produced differently in oriental languages (primarily Japanese) (Kierman, Personal Communication).

Stylised Version of Flutter-Tonguing

Duke Ellington's 'Growling Brass' or 'Jungle Style' (Ayers, Coursework 2003)

The 'jungle' effect, which was to become a traditional Ellington trademark, was created by trumpeter *'Bubber'* Miley and his trombone-playing compatriot *'Tricky Sam'* Nanton. They created their own unique sounds by using a plunger mute and a glottal growl, which occurs in the throat. In using this "growling brass" technique, Ellington's band earned the reputation of being *'dirty'* players.

The growling brass or jungle style was achieved by combining three elements, as described by Duke Ellington's son Mercer Ellington, who was the band manager and a member of the trumpet section:

> "... the sound of the horn, a guttural gargling in the throat, and the actual note that is hummed. The mouth has to be shaped to make the different vowel sounds, and above the singing from the throat, manipulation of the plunger adds the wa-wa accents that give the horn a language. I should add that in the Ellington tradition a straight mute is used in the horn besides a plunger outside, and this results in more pressure. Some players use only the plunger, and then the sound is usually coarser, less piercing, and not as well articulated." [14]

Nanton went on to devise styles which have been strongly identified with him ever since, as seen in Table 30 below:

Table 30: 'Tricky Sam' Nanton's Plunger Techniques[15]

STYLE	*CREATED BY*
The *"Whinny"*	Resembles a horse's whinny. Created by a long ascending glissando which *"rips through the partials of the trombone, followed by a long, rippling, descending glissando."*
The *"ya"*	Most famous aspect of his plunger style. It is uncertain how he created the *"ya"* sound (possibly by *'dropping'* the tongue arch as he played a tone).

5.3.2. Multiphonics

Multiphonics result when a brass player sounds two or more tones at the same time (playing on one or more notes and singing at either the same or a different pitch through the instrument simultaneously, usually with the expectation of one or more resultant tones). It should be noted that the shape and position of the tongue plays an integral role in the production of multiphonics; e.g. the tongue is positioned differently in the mouth (high/middle/low) in order to produce vowel sounds at varying pitch levels (as discussed in 2.1. Vowels).

Richard W. Bowles' article on "Multiphonics on Low Brass Instruments" states that multiphonics is the sounding of "one tone in normal fashion by buzzing the lips, and at the same time humming a tone of higher pitch." (Bowles, 1979: 566) This is an

[14] http://search.eb.com/blackhistory/micro/727/46.html

inaccurate concept, as when one hums, the sound is produced through one's own nose. One needs to sing, using a bigger mouth space, similar to a yawn, while singing louder (than the instrument tone) to balance the instrument sound (Kierman, Personal Communication). "The played note will always sound louder than the sung note, so in order to get a good balance I learned to blow hard, sing loud, and play soft. If you play loud and sing soft you get a vague kind of sound - it's not as clear and the overtones won't ring."[16]

Multiphonics generally sound easier on an instrument with a larger bore, e.g. a tuba or bass trombone, as well as on a euphonium or a trombone. Lower instruments generally allow for greater freedom in the production of multiphonics. They can be produced with careful effort on a French horn, and with more difficulty on a trumpet or cornet (Kierman, Personal Communication).

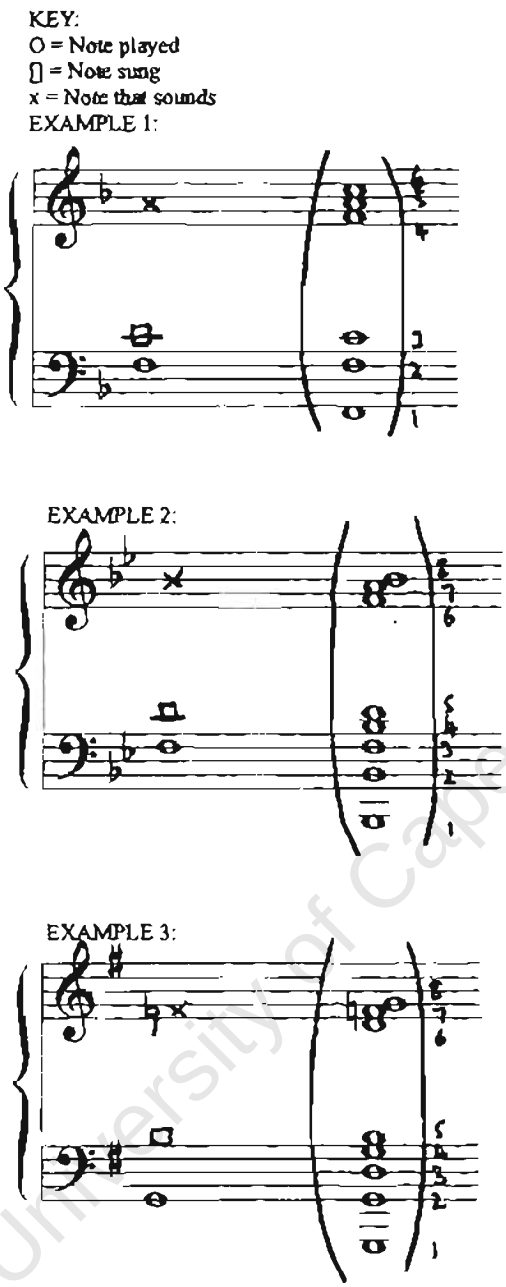
Brass players attempting to play compositions involving vocal technique may find that they are impaired by limitations in their vocal ranges. e.g. female trombonists and male trumpeters may find it difficult to sing below/above their natural voice range.

The basic principle behind this special effect is the overtone series (see Appendix I). An instrumentalist must be at ease with the overtone and harmonic series on his instrument before becoming familiar with multiphonics.

> "When multiphonics are produced the resultant third tone is predictable as the sum of the relationship between the tone played and the tone sung.....When these two tones have the proper relationship in the harmonic series, a third tone (and sometimes a fourth, or even a fifth) can result. Acousticians refer to these third tones as summation tones because their pitch is the result of the sum of the frequencies of the other tones." (Bowles, 1979: 566)

(See Example 27 below. In Example 27 - 1, one plays the note F3, sings the note C (middle C). The interval of a Perfect 5th is formed between overtone series 2 and 3. The resultant multiphonic will be the 5th partial of the overtone series. Similarly, for Examples 27 - 2 and 27 - 3 and other examples.)

[15] http://search.eb.com/blackhistory/micro/727/46.html, Op Cit.
[16] http://www.trombone.org/articles/library/dickgriffin-mc.asp



Example 27: Multiphonics [Renotated] (Bowles 1979:567)

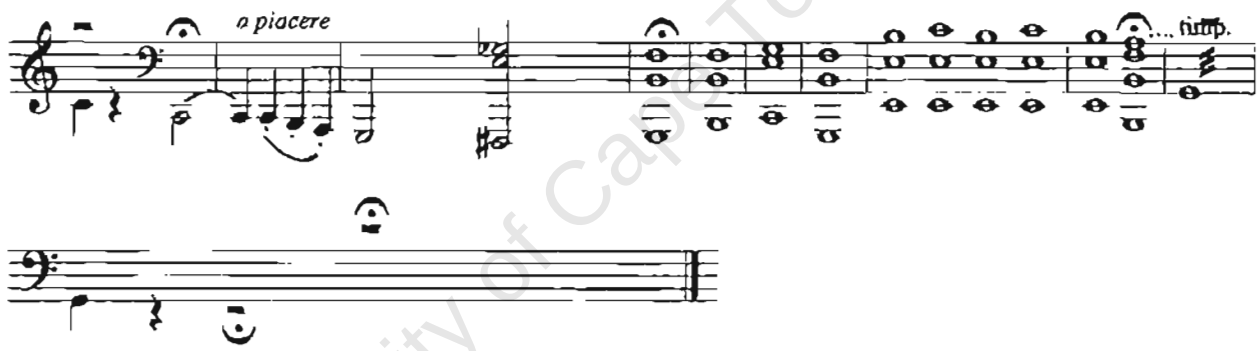
"According to Groves (Dictionary of Music and Musicians: Acoustics), the first published accounts of such things are in a text by the German organist Sorge, written in 1745. The Italian Violinist Tartini, discovered and used difference tones as a technique for tuning double stops as early perhaps as 1715." ~ Herman Helmholtz

Helmholtz (On the Sensations of Tone, Dove, N.Y.: 1889, ed. 1954 by Ellis and Margenau), acoustician and theorist, in 1885 referred to summation and difference tones as combinational tones, and reasoned that the tones were produced in the human ear, rather than being a physical fact." (Bowles, 1979: 568)

It has been proven that summation tones are a physical reality and actually occur; i.e. they are not just produced in the ear of the listener. If one were deaf, the resultant tone would be non-existent. A brass player can also produce multiphonics on the mouthpiece alone, without the aid of a large bore or small bore instrument (Kierman, Personal Communication).

> "Multiphonics today (has) moved out of the theoretical closet into an increasingly prominent place in low brass performance. Today's player should be aware of the acoustical principles involved in their production, and should add this dimension to the other elements of well-rounded performance technique." (Bowles, 1979: 568)

The first notation of the use of multiphonics occurs in Carl Maria von Weber's *Concertino in E* for French Horn, Opus. 45 (Excerpt 23).

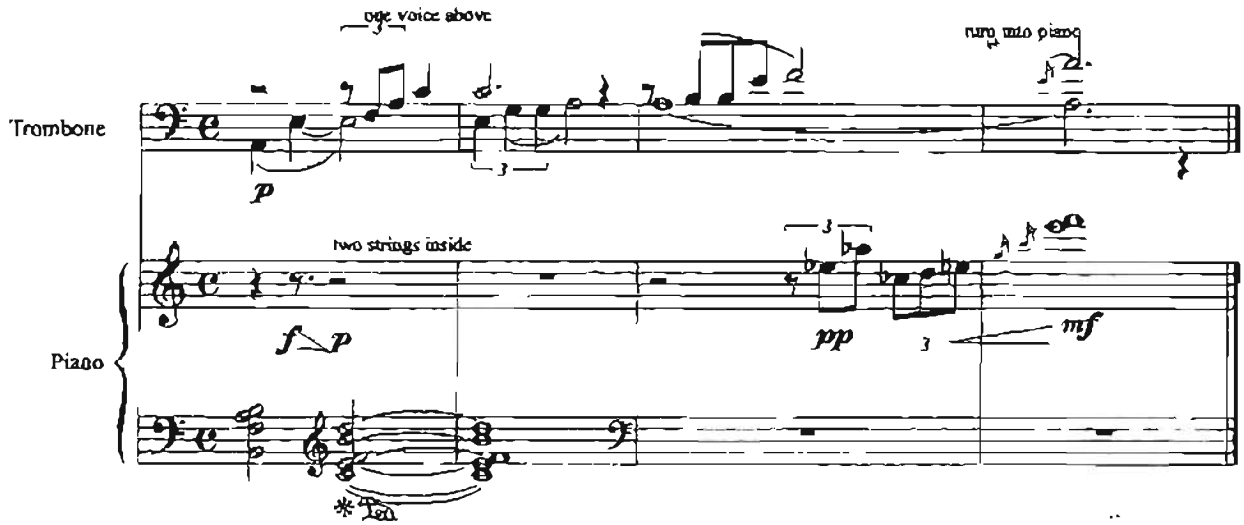


Excerpt 23: Weber, Concertino in E for French Horn, Opus 45

"One can teach oneself the art of multiphonics by practising away from the instrument:

- Alternately buzzing a pitch with the lips and then singing the same pitch.
- Sustaining the pitch with either the voice or the lips. Add the one function to the other.
- Once the rudiments of vibrating the vocal chords and lips are accomplished, the player can apply these to his instrument, expanding the range above and below the middle register.
- The player, once this has been achieved, can then sustain a pitch with one function, while moving the other in stepwise motion, descending/ascending away from the first." (Stevens, 1974: 448)

A further example of multiphonics is seen in Excerpt 24.



Excerpt 24: Krenek, Five Pieces for Trombone and Piano

5.3.3. Trills, 'Shakes', and Tremolos

Trills, 'shakes' and tremelos are frequency variable ornamentations.

Trills

A trill is created by slurring rapidly with the lip between two notes on adjacent harmonic series. On brass instruments, two types of trills are attainable:

i. Valved trills;

ii. Lip-trills.

Valved trills:

In the case of valved trills, the player oscillates between different valve combinations, oscillating between tones located in close proximity to each other (generally limited to a minor or major second). The styles of trills are era specific, baroque trills differ from their classical counterparts and similarly differ to the handling of twentieth-century trills. For further documentation on ornamentation performance practises, consult other sources.

Lip trills:

A lip trill is generally viewed as the rapid movement between two notes. The speed of the trill is individual-specific, being attained by different facial musculature "tension" and varying air pressure (Tuckwell, 1981: 17).

The technique of lip-trilling applies predominantly to the French horn and the trombone. The lip-trill is often considered a physical 'trick'; it "is not only an essential artistic technique but also an invaluable check on the health of the embouchure." (Kierman, UCT c.) Below is a three-step approach to the development of the lip-trill:

1. Whole tone oscillation, first using crotchets, then increasing the speed to quavers, triplets, etc. e.g. F-Horn G/A using 1-3.

2. Development of a "crass" vibrato. Use tongue to trill or warble "yayayayaya".

3. Concentrate on physical mechanisms (movement of mechanical nature of mouth and tongue).

The tongue plays an important role in the execution of a lip trill. A pronounced "oo-oe" tongue motion from the lower to higher note is essential (Farkas, 1956: 77). According to Tuckwell (1981: 17) "the time-honoured lip trill exercises hold good today, and there is no alternative but to practise them labouriously and conscientiously."

As stated by Kleinhammer (1963: 29), a lip trill can only be achieved "correctly" with a well-functioning embouchure which is free from sympathetic tensions of the throat, tongue and palate. Trills initially require slow, diligent practice, increasing speed gradually. A trombonist should aim for an even sound quality similar to those made by players of valved instruments. The lip-trill should not be confused with the "shake."

"Shakes"

A "shake" is a jazz articulation style used in jazz trumpet and trombone playing. The shake "usually involves actually moving the whole instrument against the cushion of the embouchure." (Kierman, UCT c.) A 'shake' can be achieved by either shaking the head or shaking the instrument, or both (Dempster, 1979: 34). From personal

experience, the hand shake is the more viable option as it does not disturb the highly sensitive embouchure.

Tremolos

Tremolos are "rarely designated for wind instruments, but the equivalent effect can be produced by harmonic trills, by a very close trill, or by flutter tonguing."[17] Jazz trumpeters make use of false-fingered tremolo, using rapid valve movement on the same pitch, similarly achieved on the trombone, where the slide is rapidly moved. "When the valve slide is taken off, the valve movement produces a stark timbre change even on a unison." (Dempster, 1979: 35)

Other forms of tremolo which are possible on the trombone (and other brass instruments) are: (Dempster, 1979: 35)

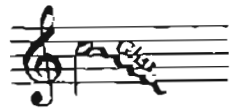
- Doodle tonguing tremolo, where the effect produced resembles that of tremolo produced on a string instrument - fast action (see 5.2.3. Doodle Tonguing).
- Diaphragm vibrato tremolo, where uneven dynamics result. The throat becomes involved in the sound production.
- *'wa-wa'* mute tremolos, where the hand alternates on-and-off the mute stem quickly.

According to Walter Piston, one of the most authorative writers on orchestration, 'a trill with a harmonic interval larger than a major second is a fingered tremolo."[18] This effect is also possible on brass instruments. Trills or tremolos of a third or more are possible on brass instruments and are most often used in jazz.

5.3.4. Glissandi and 'Fall-Off' Effects

Glissandi and 'Fall-off' effects are used in the contemporary music genres (jazz and popular music), and extended techniques in the classical genre. Both can be created on brass instruments by either lowering the valves halfway and sliding/smearing upward or downward for the desired effect (playing chromatic or scalar notes (actual pitches) in the case of valved instruments), or using the slide to alter the pitch, in the case of trombones.

1. Glissandi

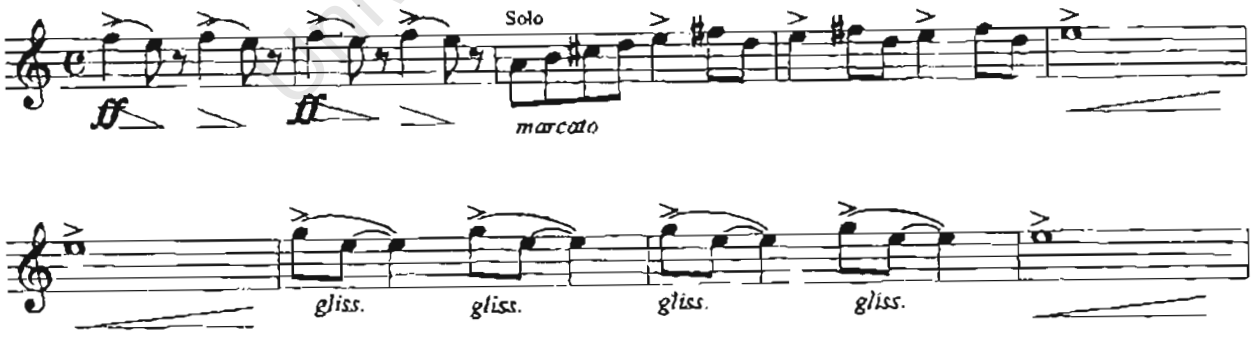


Example 28: Glissando

A *glissando (gliss.)* is a method of approaching or leaving a note, generally landing on another tone. A *glissando* is achieved by playing notes in between the pitches (may also be referred to as a 'rip', a 'smear' and/or even a 'scoop' within the jazz idiom - notated as per Example 28). "Expressive glissandi of shorter duration can be rendered by elongating a slur, or, if a less subtle effect is desired, by allowing the valves to come up with a deliberately slow action." (Whitener, 1990: 117)

i. Upward glissando - notated as is executed like a fall-off, with tightening of lip pressure. The note on which the glissando lands may be articulated.

ii. Downward glissando - notated as The notes on which the glissando starts may be articulated, while the finishing note is not articulated with the tongue. The notes in-between are "smudged", similar to the fall-off.



Excerpt 25: Example of glissandi - Khachaturian, *Sabre Dance*

For a discussion on the glissando relating specifically to the trombone, see 5.3.7. g.)

[17] http://www.grovemusic.com/shared/components/search_results/hh_article?section=m. .
[18] Op cit.

2. "Fall-offs"

Example 29: Fall-off

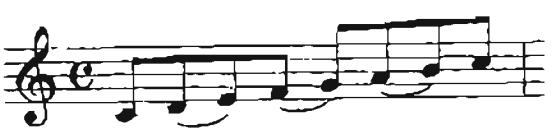
In contrast, a fall-off (Example 29) leaves a note and does not land on another tone. It is usually accompanied by a decrescendo, giving the illusion that the note continues to fall (Example 29). A fall-off is indicated by B the resultant effect is similar to that of a downward glissando. It is achieved by using ½ valves and slackening the embouchure muscles. The duration of the fall-off is indicated by the duration of the note, for example: a dotted minim = three beat duration (occasionally an upward directed 'fall-off' is requested; may be indicated by C).

Both the glissandi and fall-offs are "methods of releasing a note and are usually executed fast with a slight diminuendo. Occasionally a big band will do a long, slow drop with the entire sections of trombones and trumpets together; these often are combinations of bent tones, half valve...and glissandos." (Dempster, 1979: 20)

During the execution of glissandi and fall-offs, and similarly in trills, the linking mechanisms are the tongue and the jaw. During the execution of both, the height of the tongue is lowered is the oral cavity, as in a "yawn". Owing to traits specific to each individual, it is difficult to state precisely what occurs during these physical gestures (Kierman, Personal Communication).

5.3.5. Back Tonguing

Back tonguing, or Bebop-tonguing, is the articulation of notes in a non-classical manner (Example 30).



Example 30: Ascending C Major Scale - Back or Bebop-tonguing

Approaches to achieve Bebop-tonguing may be as follows: (Davidson, 2001: 59)

- An ascending C major scale is played, with only the 1st, 2nd, 4th, 6th and 8th notes being articulated - the 3rd, 5th and 7th notes are slurred.
- Legato tonguing is used, playing even eighth notes (Non-swing quaver notes)
- Three or more notes in a row are not tongued.

5.3.6. Highest-Note-In-Line

This technique involves the player articulating the first note and the notes on the 'highest part of the line'. Articulation markings in jazz compositions are rarely included, leaving it to the player's discretion to develop his individual articulation patterns.

This can be demonstrated by the following (Davidson, 2001: 59):

- Tracing paper or transparent paper is placed over a jazz composition.
- Using a pencil the player connects all the notes of a melodic line.
- The contour of the line is examined.
- The first note and only those notes that fall on the highest parts of the line contour are articulated, so that over-articulation of the melodic line is prevented.

The tongue's function is to articulate individual tones and slur others. The essence of this method is that the player is individually responsible for creating a fluid line which is not over-articulated.

5.3.7. The Trombone Slide and its "Special Effects" (pertaining to the role the tongue plays)

The Trombone is the only brass instrument which is essentially valveless (excluding the 7th position valve). Trombone players rely entirely on the movement of a versatile slide to achieve what other brass players achieve with piston or rotary valves. The trombone has seven basic slide positions, each with its own fundamental harmonic series (see Appendix I). Like a string player, a trombonist is capable of extreme finesse when it comes to tuning - each note can be placed and altered until optimal resonance is attained.

As mentioned earlier the position of one's tongue is register-based, e.g. in the low register the tongue is positioned low in one's mouth, while in the high register, the tongue tends to take up a raised position in a similar way to when one sings.

In order to ensure a more comprehensive section on the "valveless" or slide trombone, aspects of different playing techniques in which the tongue is not directly the main focus have been included. Without these, the full range of musical nuances available to a trombonist would not be apparent. For obvious reasons where the tongue is not involved, these technical aspects have been briefly outlined.

a. Legato Tonguing and Natural Slurs

Trombone *legato* tonguing imitates slurring on a valved instrument and is occasionally called *portamento*. *Legato* articulation (see 5.1.1.), as defined by The Harvard Dictionary of Music, should be "performed without any perceptible interruption between notes" (Graham, 1965: 257). Legato, by definition, indicates that "each note of the phrase is connected...the air must 'flow through the horn'...with a constant force until the end of the phrase... essential factors in legato performance are articulation and slide movement." (Fote, 1974: 450)

Natural slurs are produced "when the note goes up and the slide goes out or when the note goes down and the slide comes in." (Heath, 1973: 641) Lip slurs and trills are also natural slurs.

Legato articulation is considerably "more complex for the trombonist than it is for any other instrumentalist." (Ross, 1976: 477) This style of articulation affords the trombone-player with "a means of beautiful musical expression which, when executed in good musical style, is seldom equalled on any other instrument...in the hands of a capable player it is closer to the human voice in character than is any other brass instrument." (Kleinhammer, 1963: 69) Legato articulation is formed by the close co-ordination of breath and tongue (as explained below).

b. Function of Breath in Legato Articulation

Air needs to be blown evenly and steadily in legato playing. Visual evidence of breath control is obtained by buzzing "on the mouthpiece alone, (whilst) holding a mirror or a piece of glass near the stem of the mouthpiece. The circle of condensation produced on the mirror or glass will be in proportion to the fluctuations of the air being expended." (Kleinhammer, 1963: 71)

The concept of a "steady-air-stream" can be demonstrated by "turning on a water faucet and displacing the water with your hand several times." (Kleinhammer, 1963: 71) The flow of one's air stream is essential in brass playing, as without it, there would be no articulation. Articulation 'floats' on air (Blake, Personal Communication).

c. Tongue's Role in Legato Articulation

The tongue is responsible for initiating a legato phrase, as with the execution of any tongue-initiated note. It functions simultaneously with the slide and embouchure in slurred passages. In legato articulation, the tongue should be used to prevent unwanted glissandi, which may result if the tongue were not used. In some cases of slurring, the tongue is not used.

The concept of "du" tonguing is ideal for legato style articulation. "By using a soft "du" or "thu" in co-ordination with a fast movement of the slide and a steady, unpulsating air column, a smooth melting of one tone into another is possible. Slow scale practice is an excellent means of improving tongue technique for legato." (Mathews, 1978: 799) Another useful syllable is the single tap /r/ (as in Spanish pronunciation).

Whitener has noted that trombonists often leave too much space between notes to facilitate the change of slide position. This results in the execution of notes in a staccato-like fashion, with a consequent reduction in note value (1990: 115).

d. The Slide

Movement between different slide positions requires a "uniform amount of time to manoeuvre between any two positions." (Kleinhammer, 1963: 72) Slide movement needs to be co-ordinated with the tongue. It is considered bad musical taste to allow even the slightest of glissandi to enter into a slur. This fault may be attributed to:

- Weak tongue movement in syllable pronunciation;
- Too slow a slide movement;
- Unco-ordinated tongue and slide movement (see 4. Motor Learning).

e. The Role of the Embouchure

In slurring, the embouchure should adjust in as smooth a manner as possible, thereby avoiding abrupt movements. "In practising lip slurs, the player will begin to get the feel of the function of the lips in producing a "rolling" from one tone to another. This feeling should then be co-ordinated with the tongue in interval exercises and scale patterns, always seeking the ultimate in smoothness." (Kleinhammer, 1963: 72) The throat, palate, mouth, tongue, and jaws must remain relaxed, flexible and tension-free.

f. Vibrato

"The ability to make a beautiful controlled vibrato is a very necessary part of the trombonist's technique. Vibrato, the undulation of the sound a fraction of a semitone above and/or below the written pitch." (Wick, 1971: 50)

"The broader definition of what a vibrato is (or must be) must be considered; it is simply a motion or variation of one of three functions in music: frequency, amplitude, and timbre." (Dempster, 1979: 34)

As indicated in the beginning of this section, the tongue plays a secondary role in a number of aspects. On the trombone, vibrato, which is controlled by varying mechanisms (namely the lips, jaw, tongue and diaphragm mechanisms) can be achieved in several ways:

i.) Slide

During slide vibrato, the hand moves the slide in a controlled manner. Slide vibrato is customarily used by jazz trombone players, e.g. Tommy Dorsey, slide vibrato's greatest exponent, made use of this frequency-variable style of vibrato playing. It should be noted that slide vibrato is virtually impossible in 1st position. The tongue's function in slide vibrato, is based on the area of the harmonic series the player is using; i.e. the tongue rises and falls at regular intervals (individual specific).

ii.) Lip/Jaw

Lip or jaw vibrato are similar to lip trills. It is a variable timbre vibrato which is "accomplished by changing tongue shapes or by movements of the

jaw." (Dempster, 1979: 29) As mentioned previously, the mechanisms of the tongue are individual-specific and will not be examined in detail here.

iii.) Diaphragm

Some players advise against using this form of vibrato as it may obtrude with phrasing and breath control. This type of amplitude vibrato may be considered 'dangerous' as it may become so habitual that the player may be unable to maintain an even tone. The tongue muscles may become tense, owing to the use of one's diaphragm, thereby disturbing musical phrases as well as causing excessive muscular tension (in brass playing a free, unhindered tongue is sought-after).

iv.) Tongue

Tongue vibrato (a form of the timbre variable vibrato style), is achieved by a change in the vowel sounds created with the tongue; e.g. "a-i-a-i" (sounded as "ah-ee-[y]ah-ee"). "This vibrato is not only easy to do, it can also be varied easily. e.g. variable speed and/or width." (Dempster, 1979: 32)

v.) Throat

Throat vibrato is achieved by interrupting the flow of air at the glottis and is thus not to be encouraged. It was popular in bygone years, but is no longer fashionable. This style of vibrato will result in possible sympathetic tongue muscular tension. As previously mentioned, this is ideally to be avoided in brass playing

vi.) Head

Head vibrato is generally not encouraged. It is achieved by a vertical shaking of the head and may be used due to its 'showy effect'. In brass playing one aims to limit unnecessary movement. Shaking one's head may result in undesirable tension in areas of the body required for brass playing; e.g. the tongue and neck.

> "One caution to keep in mind is that the use of three or more simultaneous vibratos can cancel one another out; that is, the texture becomes so cluttered as to be pointless. This is especially true if such other sounds as multiphonics are also being employed." (Dempster, 1979: 34)

g. Glissandi (See Section 5.3.4. Glissandi and "Fall-off" effects)

"With its infinitely variable tube-length it is not surprising that the trombone is probably the chief source of the glissando in the orchestra, equalled perhaps only by stringed instruments." (Wick, 1963: 62) The slide travels slowly and continuously without breaks, and there has to be continuity of sound between the notes, the only exception being legato-style articulation.

On the trombone a true glissando cannot be created over an interval greater "than an augmented fourth, that being the relation of the harmonic series of the first and seventh positions." (Bate, 1978: 217) Several examples "violating" the augmented fourth limitation may be found in twentieth century music.

"The harsh loud glissando is an outworn cliché which should be used very rarely indeed. Very few composers however seem to have considered the rather wistful pp glissando, which is rather beautiful and by no means outworked." (Wick, 1963: 65)

The level of the tongue alters to aid in the production of a glissando. In the case of an ascending glissando, the level of the tongue will rise. Similarly in a descending glissando, the level (height) of the tongue will fall. This movement of the tongue, in addition to the movement of the slide (and/or valves), aids in creating a glissando effect.

6. SPECIFIC ARTICULATION FOR CERTAIN BRASS INSTRUMENTS

This section gives a brief survey of past and present articulation styles for certain brass instruments, namely the trumpet, the French horn and the trombone. Focus will only be put on those specific articulation styles which are influenced by the role that the tongue plays in achieving them. The styles relate to varying music genres (Baroque, Classical, Romantic, 20th Century, and Contemporary).

6.1. THE TRUMPET

Historical Articulation Styles

The stylistic distinction between the principale and clarino styles is:

> "(To) some degree inherent in the long-tubed natural trumpet itself, and is one of the hardest things to do justice to with valved substitutes, on which the registers are colourfully and technically much less sharply differentiated. True, in France and England the distinction was stressed less than in the German lands, yet the natural registers inevitably possessed the same inherent differences in sound-quality and (in) player's approach." (Baines, 1976: 134)

Principale

The baroque Quint or Principale is rooted in the old trumpet-corps Quint or Sonata. "Tonguings formed an important ingredient. The cavalry calls had been learnt with speech-like syllables whereby to aid the memory, though also so that they might be expressed with an eloquence as close to verbal command as an instrument is capable." (Baines, 1976: 133) These used syllables such as "ta-ran-ta-raa", but much more extended.

Stylisation of the various tonguing styles occurred. In Germany the *Doppelzunge* evolved. It was a stylised semi-quaver triplet, in current day terminology, namely triple tonguing. Interestingly it frequently appeared as a duplet in manuscripts, but "Altenburg (p.92) and Frohlich both show how it should be executed as a triplet." (Baines, 1976: 133) *Doppelzunge* was often "delivered with the famous schmetternd effect which made the metal vibrate." (Baines, 1976: 133) The term *Schmetternd* literally means brassy.

On historical instruments one has to keep the air stream continuous despite articulation. If one does not, the result will be that the tone will split, ruining the musical phrase. On the current modern-day horn this effect still occurs. Breaks in the air stream can cause the

player to lose his pitching and musical accuracy. e.g. the use of "te-ghe" as opposed to our modern "tu-ku" (similar to "du-ku" mentioned in 5.2. Multiple Tonguing).

The historical time-line is not precise. Frohlich's treatise 'Von der Trompete' (pp. 22-3)(cited in Baines, 1976: 133) illustrates ways in which "a principalist should add tonguings to a plain written part - but not on a strong beat - and evidently with reference to the 2nd Trumpet of an orchestra." (Baines, 1976: 133) (1st trumpeter was often a clarinist (see Clarino below), while the 2nd trumpeter was often a principalist, (borrowed from the trumpet corps in small establishments) thus having the ability to overpower the 1st trumpeter.)

In his treatise, Altenburg (pg. 93.)[19] makes brief mention of another form of tonguing, that of the *Haue*: "to-ho-to". In this the first two differing tones would be slurred (Baines, 1976: 134).

Clarino

Clarino is considered in our modern era as baroque trumpet playing, where "clear, singing and without double-tonguing" playing is in strict contrast to principale, which is considered to be "robust, schmetternd and commanding". (Baines, 1976: 134)

Interestingly, the developments in wind instruments have occurred during or after "times severely marred by wars, and it is the period after 1650 that witnessed both the beginning of the obsolescence of cornett and trombone in every country and the rise of the clarino trumpet as a major and idiomatic voice of the baroque orchestra." (Baines, 1976: 134)

Trills

> "On the modern trumpet trills are usually performed with the valves, though a few between adjacent notes in the high register must at least partly be produced by the lips, tongue and jaw - the so-called 'lip-trill'. The only problem with valve trills arises from the purely mechanical difficulty of certain fingerings." (Bate, 1978: 217)

Some examples of troublesome trills on the modern trumpet may be:

i. High G to high A (0 - 1&2)
ii. High E to high F-sharp (0 - 2)
iii. High F-sharp to high G (2 - 2&3)

6.2. THE FRENCH HORN

> "Strange metal instrument controlled not so much by the arms as by those mysterious and secretive means, somewhat damp and yet so agile, of lips, tongue and mouth." (Tuckwell, 1983: xiii)

The French horn is an omni-directional instrument. With its bell directed away from the audience, a French horn player may use a stronger style of articulation than other brass instruments with the overall result sounding less harsh than its brass counterparts, whose bells are also directional - this time facing the audience (Kierman, Personal Communication).

6.3. THE TROMBONE

> "The ability to rattle off passages is usually very much admired, perhaps more so on the trombone than on other brass instruments. After all, trombonists have the relatively clumsy slide to contend with, rather than the agile piston valves, which with a tiny finger-tip movement can alter the length of the tube at the player's will." (Wick, 1971: 43)

In the production of all note values, from the shortest to the longest, the tongue makes a hermetic seal which temporarily breaks the air stream before the sound is initiated. The trombone has a directional bell (see 5.3.7. The Trombone Slide and its "Special Effects").

[19] See ALTENBURG, Johann Ernst *Trumpeter's and Kettledrummers Art* (Nashville: The Brass Press, 1974 (English translation by TARR, Edward H.)

7. CONCLUSION

The hallmark of a schooled brass player is clean tonguing. Well controlled double and triple tonguing on brass instruments require diligent practice.

> "The tongue can be a brass instrument performer's best friend or his worst enemy. When it is behaving properly, the tongue responds to the player's efforts as if it were charmed. When it misbehaves, it seems as if the devil himself has control of it and the performer has a deviled tongue." (Stoutamire, 1972: 406)

The main reason why I embarked on this dissertation ***"Articulation in Brass Playing: The Tongue- Friend or Foe"*** is because as a young child learning to speak, I too seemed to have a 'deviled' tongue. I had major problems pronouncing certain consonants, particularly the /l/ and /r/ sound. Thanks to the help of a speech therapist, my mispronunciation of certain words *'disappeared'* by age eight. Of interest is the fact that I only learned to roll my "r's" at the 'grand old' age of seventeen.

It is only now, years later, as a serious student and teacher of the trumpet (my sixth year) that I have started to look at the link between speech and articulation in brass playing. As my dissertation has shown, there is a very strong link between the two aspects, and the tongue plays a major role. Motor learning and Proprioception play a large role in the development of mankind, especially in the development of mankind as musicians.

In this age of computerisation, a possible area of research would involve the establishment of a database of the world's best brass players (jazz or classical) and, by comparing their playing, try to link their success at multiple tonguing (5.2.), special effects (5.3.), and specific articulation styles (5.1.) to any speech difficulties that they may have experienced as young children.

Another avenue for research is one which could possibly revolutionise the teaching of future brass teachers. The use of *'electropalatography'* (where an artificial plate is fitted over the palate and with which it is possible to record the number of times a given palatal electrode is touched) would make it possible to record the precise tongue contact of the brass student when trying to multiple tongue. A computer print-out could then be given to the student, comparing his tongue contacts with those of his teacher or esteemed players. The palatograms could be filed and stored over a period of time and comparisons can be made to see if the *'contact'* points have changed or improved. Having seen these visual cues (computer printouts) the pupil would possibly respond better kinaesthetically with his tongue contacts.

Even more exciting, but still quite *'new,'* is the EMA machine. This electro-magnetic articulograph can analyse articulatory phonetics. Small coils are placed on the subject's tongue and by measuring the disruptions in the magnetic field, each coil's position can be accurately measured, thereby precisely measuring the tongue's movement. Time may yet show how using a *'state-of-the-art'* electro-magnetic articulograph could be put to use in the teaching of brass instrument playing.

A brass player should heed the English playwright William Shakespeare (1564-1616) - "While thou livest keep a good tongue in thy head" ~ without this weapon at their disposal, a brass player's clarity of articulation suffers.

Meanwhile, as my life continues as a brass teacher, my aim is to encourage my young pupils to harness the power of the tongue to become their *'best friend'*, rather than their *'foe'* in music-making!

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APPENDIX

A. THE TEETH AND THE IMPACT OF BRACES[20]:

Of interest is the question of how the impact of braces on teeth impact on brass playing (influence). In the olden days plates could be removed so that one could still play a brass instrument with ease. Nowadays, with modern technology, the teeth are wired together permanently often for a period of 18 months to 2 years, occasionally longer. Some teachers who teach high brass instruments, namely the trumpet and the French horn, insist on their pupils taking a leave of absence during this procedure. This is based on the size of the mouthpiece. Interestingly enough, players of lower brass instruments find it easier to play with braces, as the mouthpiece rim does not sit on the metal braces, thus not causing cuts and abrasions on the inner lips.

It should be understood that trumpet teachers who encourage their students to stop playing for this period are not being awkward or difficult. These teachers have the interest of their pupils at heart. The abrasions lead to scar tissue which does not vibrate in the same manner as unscarred or 'untarnished' tissue. Some players may use a mouth guard, or a strip of plastic which covers the metal tracks, thus avoiding the abrasions whilst still being able to play. Despite this preventative measure against damage to the delicate embouchure tissues, the player may find that his range and overall sound production is diminished.

There are currently various forms of braces available:

i. Labial Orthodontics
ii. Lingual Orthodontics
iii. Invisalign

i. *Labial Orthodontics*

The traditional method, *Labial orthodontics*, is where the brackets are placed on the front of the teeth of the upper and lower arches. In the context of brass playing, a mouth-guard ideally should be used to protect the delicate mucous membranous tissues of the oral cavity (similar to mouth-guards used in contact sports, such as rugby. The guard used in brass playing would be thinner and yet still function as a protective barrier).

ii. ***Lingual Orthodontics***

In *Lingual orthodontics* the brackets are placed internally on the upper arch, and externally on the lower arch, usually placed as per *Labial* method, owing to limited availability of space and reduced access. Consideration should be given to the fact that the tongue is already confined within the constraints of the oral cavity. By placing brackets internally on both the upper and lower arches, reduction in space occurs, resulting in further constraints being placed on the tongue. In the process of articulation a brass player's tongue is placed behind the upper teeth/arch. Due to the internally placed orthodontic mechanics, the tongue is in danger of being damage by the braces. The tongue may be cut by or caught in the internal brackets leading to the development of scar tissues.

This method is more expensive than the traditional one and here computer graphics aid in the ideal placement of the brackets. It should be noted that if repairs are necessary, brackets on the internal upper arch are less accessible than in the traditional method. Cosmetically, the 'railway tracks' on the upper arch may be 'invisible' (internal placement). A bracket may occasionally be placed externally, as per the *Labial* method, to achieve optimal orthodontic results. This would however destroy the cosmetic 'image' the patient may desire. The lower arch, if labial placement occurs, would still be visible.

iii. ***Invisalign***

Invisalign is a relatively new method of orthodontic correction. In this procedure an impression of the patient's current teeth is taken and sent to Invisalign where plaster models are cast. The incorrectly aligned model teeth are cut and placed accordingly. Computer graphics are used in the creation of an accurate 3-D digital image of the patient's teeth, from which a desired result model is created. Models of the gradual stages of treatment are created, indicating the gradual repositioning of the teeth.

In the *Invisalign* process a series of clear removable aligners or retainers are manufactured according to the individual's needs. The aligners should be removed while eating, as well as while brushing or flossing teeth. Aligners are replaced every two weeks or so resulting in the gradual corrective movement of the teeth. This method is more expensive than the previous two - sometimes as much as one-and-a-half times the cost of traditional *labial* braces. It is however well-suited to brass playing, due to its *non-invasive* nature. The delicate mucous tissues of the oral cavity and the tongue are not damaged, as they can be in the other procedure. This method may thus be considered more 'brass user-friendly'.

[20] DR. R. GINSBERG, Personal Interview, 21 August 2003.

It should be noted that the success rate of *Invisalign* is less than that of its traditional metallic counterparts. In playing a brass or wind instrument, it should be remembered that pressure to some degree from the mouthpiece does occur. Thus despite these corrective measures the pressure of a mouthpiece on the lips as in the case of brass playing, or in between the lips as in the case of wind reed-playing can cause the teeth to become misaligned.

B. FRENULUMS AND ANKYLOGLOSSIA

If the upper labial frenulum is short, tight, restricted movement of the lip may occur. This sort of frenulum may also contribute to excessive tissue between the upper central incisors, creating a *diastema* (a space), which may promote a frontal lisp. This shortened frenulum does not seem to affect brass playing (Hanson, 1983: 9).

Ankyloglossia (tongue-tie) is caused by a restricted lingual frenulum, owing to a consolidation of tissue extending further than usual towards the tip of the tongue, usually leading to reduced mobility of the tongue. A 'normal' frenulum may be 15mm long. If less, pronunciation difficulties may result. A tongue-tie or Ankyloglossia (which is often hereditary) results in limitations of the forward and upward mobility of the tongue.

Ankyloglossia may:

- Inhibit movement or elevation of the tongue;
- Affect the lingua-alveolar sounds; /t/, /d/, /l/, /th/ and /s/;
- Cause dental problems;
- Cause articulation problems in playing a wind/brass instrument.

The treatment of *Ankyloglossia* is a controversy dating back many centuries. In the nineteenth century, midwives "slashed the membrane under the tongue of all newborn babies" [21] with a fingernail. The present-day treatment for this tongue-tie is a frenotomy - the clipping of the frenulum. Factors needing assessment prior to surgery include the influence of the shortened frenulum on:

- Speech development;
- Dental, periodontic and oral health/hygiene;
- Eating and digestion;
- Physical or "cosmetic" appearance, which plays a major role in self-esteem;
- Oral mobility (control and flexibility of the tongue).

A *frenectomy* is considered, in some cases, to be a relatively simple surgical procedure. Generally pre-operative exercises, as well as post-operative exercises are recommended, to increase muscle strength and flexibility. Other outcomes are:

[21] http://www.gp.org.au/cls/TONGUETIE.html

- Development of new muscle movements, particularly those involving tongue tip elevation and protrusion inside and outside the mouth;
- Increase a kinaesthetic awareness of the full range of movements which the tongue and lips can perform;
- Encouragement of tongue movements related to cleaning the oral cavity.

Some medical practitioners refuse to consider doing a frenotomy, owing to the possibility of infection, uncontrolled bleeding and the possibility of muscular injury. It should be noted that a restricted lingual frenulum does not necessarily impair speech.

i. **Article 1: Korean Children have Tongues Snipped to help them Speak English Better**

(Sourced from page 2 of the Cape Times - World News on the 9/04/2002. Author PARRY, Richard Lloyd (Independent Foreign Service)

Korean children have tongues snipped to help them speak English better

RICHARD LLOYD PARRY

[illegible]

HIROSHIMA, Japan: The Koreans, the Japanese and the Chinese are among the world's most dedicated learners of English, but they have always shared a common weakness: the inability of many of them to distinguish between the sounds "l" and "r".

Now, after decades of cruel jokes about "rice" and "lice", Korean doctors claim to have found a cure: a surgical operation to improve pronunciation.

Korean parents are paying up to £255 for an operation on their children's tongues, in the belief that it will improve their English almost before they can speak their own language.

The operation, called a lingual frenectomy, involves splitting the frenulum, the web of stringy tissue below the tongue.

If children are born with a frenulum that is too long or too tight, it inhibits the tongue from touching the roof of the mouth. This, in turn, hampers the production of certain sounds, including "l" and "r". Cutting the frenulum lengthens the tongue by a millimetre or two, theoretically opening up a new world of lingual dexterity.

"Parents are eager to have their children speak English so that they want them to have the operation," says Nam Il Woo, who performs about 10 frenectomies a month, most of them on children under five. "It's not cosmetic surgery. In some cases, it's really essential to speak English properly."

The problem is that, in their eagerness to give them the best start in life, parents are putting children with perfectly healthy tongues under Nam's scalpel.

Article 2: **Shock OverTongue Surgery to make Toddlers Speak**

(Sourced from http://breaking.tom.ie/2004/01/02/story127726.html as at the 2/01/2004)

"The South Korean government has produced a disturbing film in a bid to scare upwardly-mobile parents out of giving their children tongue surgery to help them speak English. In the past, South Korean parents have played their children nursery rhymes in the womb, hired pricey tutors for toddlers and sent pre-school children to America to pick up the accent. But now they are even turning to surgery to sort out misplaced L and R sounds, underscoring the dark side of the crushing social pressures involved in getting a highly competitive society in shape for a globalised world. The surgery involves snipping the thin tissue under the tongue to make it longer and supposedly nimbler.

Now the government's National Human Rights Commission has made a film to shock parents into stopping the practice.It shows a young mother, obsessed with her son's pronunciation at the nursery school's all English Christmas play, rushing him to the clinic for a quick fix. The boy screams as the mother and nurses hold him down, the mother insisting: "It's all for his future."

"Many viewers close their eyes at the surgery scenes," said director Park Jin-pyo, who used footage from a real operation. "I wanted them to see how our society tramples our children's human rights in the name of their future."

The English craze among pre-school children took off four years ago when the government made English classes mandatory from third grade. Flawless English was once riddiculed as snobbish and even unpatriotic. Now it's a status symbol and prized by business and colleges.

"Many parents have an illusion that good English could change their children's lives," said Song Young-hye, who runs Wonderland, one of the thousands of English language schools that have mushroomed in South Korea's multibillion English-teaching industry.

The procedure, called a frenulotomy, is used in the West in cases where the tissue under the tongue is abnormal and causes a speech impediment. No statistics exist on how many Korean children undergo it. Reports say it is widespread in Seoul's wealthier districts, but doctors say that is exaggerated.

"Tongue-Tie" struck an immediate chord when it was seen in "If You Were Me", a compendium of six short films about human rights in Korea released in cinemas to enthusiastic reviews in November.

Doctors scoff at the notion that the Korean tongue is too short or too inflexible for proper English, noticing the thousands of Korean-Americans who speak unaccented English without surgery. Experts say practice, not surgery, is the key.

"Doing the surgery on a normal kid just for English pronunciation doesn't make anatomical sense at all," says Park Bom-chung at Seoul's Kangnam Sacred Heart Hospital The operation takes 20 to 30 minutes under local anaesthetic.

Noh Kyung-sun, a child psychologist at Seoul's Kangbuk Samsung Hospital, calls the surgery "crazy" and cites the case of a three and a-half-year-old to illustrate the parental zeal that disrupts children's lives.

"That child came to my office and saw a big Jackson Pollock poster on the wall and could read each letter of the artist's name at the bottom - J.A.C.K.S.O.N - but could speak neither English nor Korean," he said.

The government has tried to absorb some of the overheated private English-instruction industry into the public school system, hiring more teachers including native speakers. But there is no sign that the craze is losing steam.

The mania has even induced changes in the Korean language itself, like "goose fathers." These are dads who work in South Korea and fly to the United States for seasonal reunions with their kids who have been transplanted to America just to learn English."

C. TONGUE FLEXIBILITY EXERCISES (BRASS AND SPEECH)

i. **Flexibility exercises:**

- Stretch tongue up towards nose, then down towards chin.
- Open mouth wide. Touch front teeth with tongue while mouth remains wide open.
- Look in a mirror. Still with a wide, open mouth say "dar-dar-dar", "nar-nar-nar" and "tar-tar-tar".
- Lick top lip from one side to the other side. Reverse direction.
- Lick bottom lip, as above.
- Lick tongue all the way round lips, repeat.
- Poke tongue far out of mouth.
- Shut mouth and poke tongue into the left hand side cheek then into the right cheek..
- Play word games.

ii. **Tongue Gymnastics** ***(Kierman, 1998b)***

Exercises which aid in increasing the flexibility of the tongue:

- Stretch tongue slowly out and in of the mouth (x1 repetition).
- Stretch tongue quickly out and in (x3) (resembles a lizard or snake's tongue which probes in and out to sense the air).
- Stretch tongue up towards one's nose and then down towards one's chin (x3).
- Move tongue in a circular motion, stretching as far as possible (x3 in one direction, then reverse the motion x3).
- Create an infinity sign (∞) with the tongue, again stretching as far as one can reach with the tongue.
- Swing the tongue from left to right and right to left, following the contour of the bottom lip.

Once this cycle of exercises has been completed, one can now move onto *'tongue-scales,'* where one makes use of different consonant and vowel sounds.

"tay - day - en - ell - ell - en - day - tay"

- Repeat the scale three times in a row, e.g. "tay - tay - tay - day - day - day...." etc.
- Repeat the scale cycle four times.
- Repeat the scale cycle five times.
- Repeat the scale cycle six times.

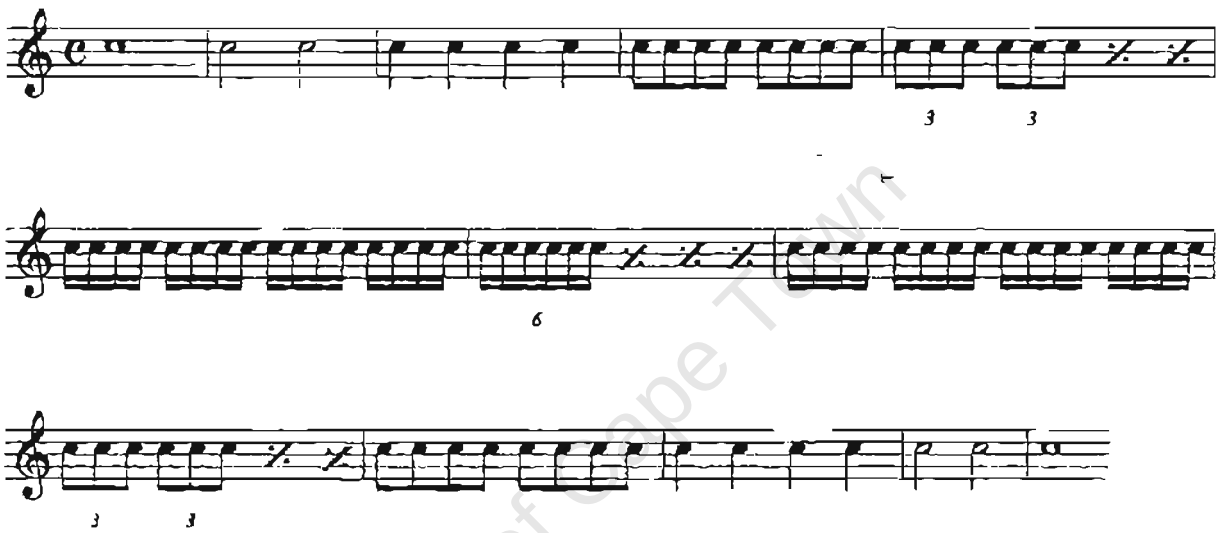
- Repeat the scale cycle eight times.
- Say tongue scale as fast as possible: "tay - day - en - ell - ell - en - day - tay".

In each part which links together to form the tongue scale, the tongue is in a different position. i.e. forward in the mouth, low tongue; further back in oral cavity, higher tongue.

D. TONGUING EXERCISES

What follows is an exercise which may aid in the development of single and multiple tonguing, and also specific tonguing styles, namely legato, staccato, staccatissimo, accents, etc.

Rhythmic example from Drum Rudiments:



Example 31: Drum Rudiments

E. THE VALSALVA MANOEUVRE / MECHANISM[22]

The Valsalva Manoeuvre is named after Anton Maria Valsalva, an Italian anatomist (1666 - 1723). Of special interest is the fact that it is largely ignored by speech pathologists.

i. The Purpose of the Valsalva Manoeuvre

When this manoeuvre takes place, the neurologically programmed larynx closes tightly like a fist, blocking the passage of air into the lungs completely (effort closure by the larynx).This results in raising the air pressure in the lungs, thereby enabling one to exert extra physical effort to force things out of the body. e.g. in the actions of urination, defecation, child birth (see Figure 9 below).

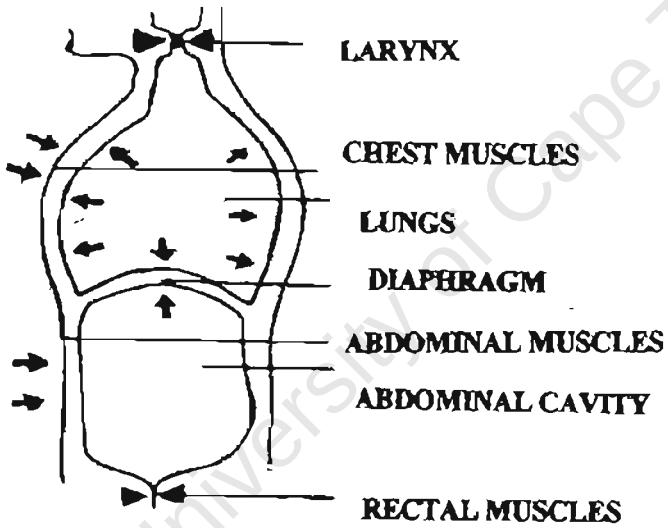


Figure 9: Depicting a Valsalva Manoeuvre

(Sourced and redrawn by the author from http://members.aol.com/wdparry/valsalva.htm)

The weight lifter who 'holds his breath' when he lifts a heavy bell bar above his head, increases the support to his arm, by keeping the chest and ribs rigid and having increased the air pressure in the lungs.

The medical world makes use of the manoeuvre as a diagnostic tool, to evaluate suspected heart abnormalities or as a treatment to correct abnormal heart rhythms.

[22] http://members.aol.com/wdparry/valsalva.htm, 1. Article by W. D. Parry. Presented at the World Congress for People who Stutter, in Linkoping, Sweden, July 29, 1995.

ii. The Valsalva Manoeuvre - and the Stuttering Child or Adult

Firstly, it must be noted that not all childhood's earliest speech disfluencies are caused by the Valsalva manoeuvre. Many factors come into play when dealing with the causes of stuttering in a child. e.g. emotional stress, excessively high expectations by those adults around the child, or delays in the neurological development of the child's speaking skills.

However, should the valsalva manoeuvre develop as the older child attempts to speak, then stuttering may take on a whole new dimension. The child gets caught up in a vicious cycle which can result in a perpetuation of his stuttering even after the causes of his original disfluency have disappeared, namely 'The Valsalva-Stuttering Cycle'. Its stages are depicted below.

As stutterers go round and round in this cycle, so they become trapped in the Valsalva trap. Constant repetition of the Valsalva-Stuttering Cycle could cause strong nerve pathways to be formed in the child's brain linking the Valsalva manoeuvre to speech. Meanwhile, the child's pathway for fluent speech might remain undeveloped.

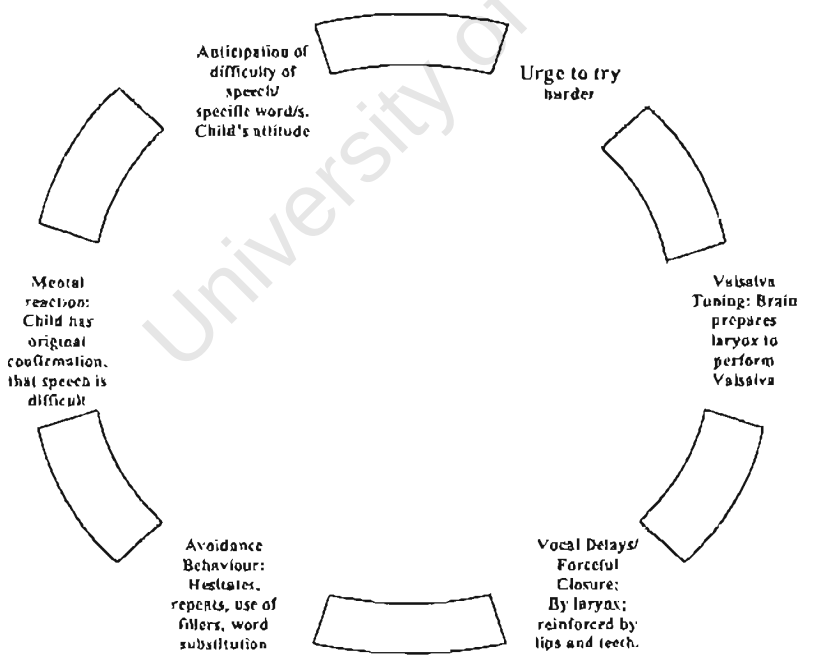


Figure 10: The Valsalva - Stuttering Cycle[23]

(Illustration by the author).

[23] http://members.aol.com/wdparry/valsalva.htm, Op Cit, 7.

iii. Role of the Valsalva Mechanism in Brass Playing

The Valsalva mechanism is known to interfere with the playing of brass instruments.

> "A study of trumpet players shows that tooting and marching can be a heart-stopping performance in more ways than one. By hooking trumpet players to electrocardiographs, Texas researchers Leigh Anne Hunsaker of Hardin-Simmons University in Abilene and Darhyl Ramsey of the University of North Texas in Denton, have shown that the heart goes through all sorts of odd contractions and arrhythmia in trumpet players. The results of their study are in the current issue of the journal Medical Problems in the Performing Arts. One action in particular, the Valsalva manoeuvre, actually causes the heart to stop momentarily, Hunsaker says. The manoeuvre is done by closing the airways and then trying to blow out air."[24]

Making a Valsalva manoeuvre while playing a brass instrument involves substantial muscle movement which does not contribute to the playing. It interferes with breath control. A description of the Valsalva manoeuvre may be found in "Arnold Jacob: The Legacy of a Master." (1987)

> "Basically, the brass player takes a breath, but before playing begins there is a momentary hesitation while the tongue moves up and locks in an upper position, causing a build-up of air pressure in the mouth. The sensation of air pressure triggers a response, which involves tightening the stomach muscles at the same time the diaphragm contracts. Now there are two sets of opposing muscles working against each other."[25]

iv. Ways to Counteract the Valsalva Cycle

The stutterer needs to short-circuit his stuttering block by learning to relax his abdominal muscles. This leads to less air pressure in the lungs. The larynx is now less likely to go into its 'effort closure' mode. The larynx also needs to be given exercises to strengthen its 'phonation function.' These exercises could include learning to relax and to intone on each of the twenty-one vowel sounds. One could concentrate on perfecting one a week, e.g. "ah"- as in 'father'. The tongue lies perfectly relaxed in the lower jaw. The tongue tip touches the lower teeth. One should drop one's jaw as far as possible and intone on "ah", until all the breath is exhausted. In breathing, it is important to use abdominal muscles to release the diaphragm back to its natural relaxed dome-shape.

An interesting observation is that when stutterers sing they are fluent. Their mind is focused on the melody and not on trying to 'force' the words out. Due to the singing process, the larynx is constantly tuned for phonation.

[24] http://www.woodwind.org/Databases/Logs/1998/08/000351.txt
[25] http://www.musicforbrass.com/articles.php?artnum=38

> "Based on my research, I developed my own experimental, self-help therapy program, which I call 'Valsalva Control." Its objective is to control the Valsalva mechanism through both psychological and physical means to reduce the likelihood that it will interfere with our natural speaking ability. I developed or adapted a number of relaxation, breathing, and speaking exercises designed to relax or 'tune down' the Valsalva mechanism."[26]

Various concepts, methods and ideas on how to avoid the Valsalva Manoeuvre.

- Use breathing devices, e.g. "Windsong."
- Visualise - in one's mind's eye see oneself executing perfect articulation.
- Think of 'blowing' through the instrument.
- Use breathing extension exercises.
- Create a rhythmic context - articulate on specified beat.

[26] http://members.aol.com/wdparry/valsalva.htm, Op Cit. See W.D. Parry's "Understanding and Controlling Stuttering: A Comprehensive New Approach Based on the Valsalva Mechanism"

F. CIRCULAR BREATHING

The aim is to breathe through one's nose while continuing to expel air through the mouth, allowing for a continuous tone while inhaling. It is a technique employed in wind performance when a breath is necessary, but the breaking of continuity in the musical phrase would not be desired. This technique allows the performer to take the necessary breath without stopping the sound, thus continuing the phrase far beyond normal breathing limits (Kynaston:1). Circular breathing can be well explained through the following quote:

> "Circular breathing is the ability to sustain the tone and breathe at the same time. It requires filling the cheeks with air while playing a note. Then, as the cheek air is used to continue the sound without any break, more air is inhaled by sniffing through the nose. The trick is to match the main air stream with the cheek air and to avoid any changes in the sound (no 'surges' or 'bumps'). It takes a certain knack to breathe through the nose while squeezing air into the trombone with the cheeks. A certain amount of practice is required before the proper feeling takes hold." (Watrous & Raph, 1983: 34)

Australian aborigines used circular breathing in the performance practices of the *didgeridoo*, a unique and ancient instrument often referred to as a kind of straight trumpet. A *didgeridoo* is a straight open pipe which has been hollowed out by termites. The sound achieved on a *didgeridoo* is a low guttural, *'earthy'*/primeval sound. *Didgeridoo* players use mouth-sound mnemonics (along with the use of multiphonics) combined with circular breathing to sustain a continuous sound. The importance of traditional items such as the *Didgeridoo* has not gone completely unnoticed by Western society. This can be emphasized by the extract written by Stuart Dempster in his book *The Modern Trombone: A Definition of Its Idioms*, below:

> "The aboriginal people have a great deal to teach the Western world about wind playing in general and lip reeds in particular. The trombone may seem old when compared to Western orchestral instruments, but it is only a five-hundred-year old baby when compared to the possible two - to four-thousand-year old tradition of the didjeridu. The time has come to examine the didjeridu in depth, for the aboriginals hold answers to questions that trombonists and other brass players are just beginning to learn how to ask." (Dempster, 1979: 95)

The ability to use circular breathing requires specific technique development. In order to achieve correct circular breathing a brass player needs to:

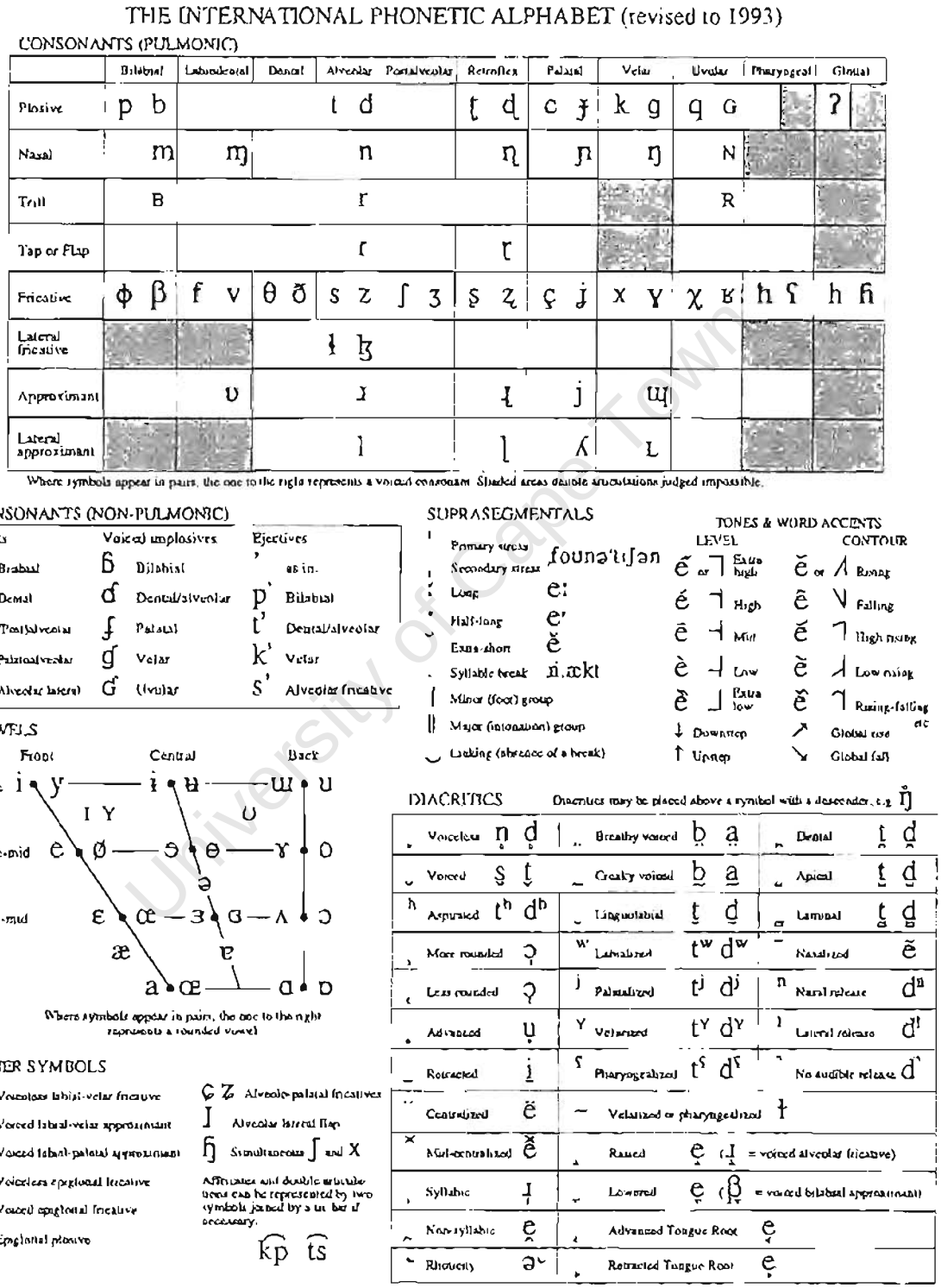
- Learn how to expel air between the lips with the aid of the cheek muscles instead of the lungs.
- Combine a quick breath through the nose while expelling air out with one's cheeks.
- Create a smooth transition between the air being expelled by the cheeks and the air being expelled by the lungs.

Circular breathing should be considered as an extension of the development of normal breathing techniques. Unfortunately it is often viewed as a gimmick. The merits of circular breathing have been recognized by numerous leading trumpet players; e.g. Wynton Marsalis and Rafael Mendez. Dempster once again illustrates its merits with a quote from once-leading brass/trombone specialist Edward Kleinhammer:

> "Used judiciously, both 'sniff' and circular breathing became useful tools in our breathing toolbox that can help us confront and overcome obstacles that composers often put in our way." (Dempster, 1979: 95)

G. THE INTERNATIONAL PHONETIC APHABET

Reproduction of The International Phonetic Alphabet (Revised to 1993, Updated 1996)



H. INFLUENCE OF THE MOTHER TONGUE ON ARTICULATION

i. **FITZGERALD, Bernard "Articulation" Brass Anthology(November-December,1946 pg 3)**

"Racial speech characteristics and speech habits indicate a close relationship to articulation of brass instruments. Herbert Clarke believed that the Latin Race possessed the best control over all types of attack and suggested that perhaps their language may help them to be more decisive, besides guiding them with greater certainty as to the attack for the different varieties of tonguing." This opinion is well founded, since the Latin language and those closely related to it employ a much greater variety of vowel sounds than the average American uses in his speech and requires both extreme flexibility and velocity in lingual movement, particularly in the use of the tip of the tongue. Speech correction techniques may prove to be of considerable value in teaching wind instruments, since students having poor articulation in speaking frequently encounter a similar difficulty in articulation in wind instruments."

ii. **I.T.G. (January, 2000) MOORE, Christopher: Trumpet Playing in Bulgaria is Alive and Well: A Summer 1999 Residency, 32.**

The author describes his belief that one's ability to multiple tongue is influenced by one's mother tongue - which may grant early success in some languages. In this instance, the brass players tended to have fast multiple tonguing, owing to the fact that the Bulgarian language makes use of the back of the tongue.

iii. **Vincent Cichowicz**

The world-renowned Chicago trumpeter and pedagogue, Vincent Cichowicz, relies on the natural resonance of his language, rather than the complex analysis of tongue placement. He believes that every individual has his own natural 'striking' point (due to his mother tongue) which will produce the proper effect, namely "tu". In the case of multiple tonguing, the /k/ should ideally remain as far forward in the mouth as possible.

I. PITCH ESTABLISHMENT

Increasing Accuracy in Pitch Production

To increase accuracy in pitching, one can buzz with the lips or on the mouthpiece alone (buzzing can be achieved by pursing the lips together and expelling air through the lips). Buzzing with the mouthpiece improves intonation on all brass instruments (Whitener, 1990: 111) (use of B.E.R.P. [27]).

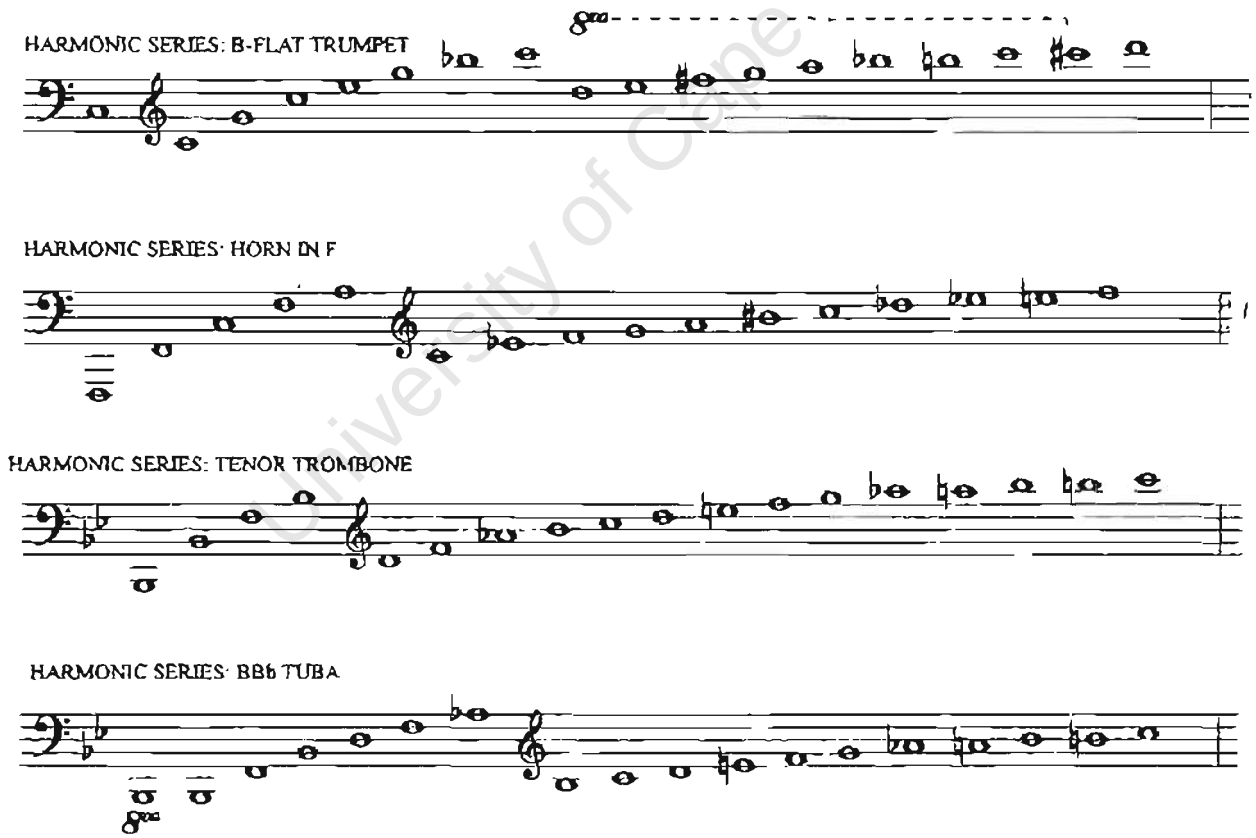
Good intonation occurs when one's lip vibration is *'set'* or honed in on the pitch one desires to play. Note accuracy increases, while one can now create a tone with better sound quality: "beautiful tone can only result from well-centred placement of pitch on each note." (Farkas, 1962: 46) The chances are that if one cannot buzz a 'problem' phrase on the mouthpiece, one will be unable to play it on the instrument. Similarly, if one cannot sing, hum or whistle specific pitches, the chances are one cannot pitch them accurately. There are a few very good players who are exceptions to the "rule" in that they do not willingly sing, hum or whistle.

[27] Buzz Extension and Resistance Piece, *"approximates the same resistance as that offered by the instrument...the unit fits into the instrument's leadpipe so that it may be used in playing position while employing the appropriate fingering or slide position "* (Whitener 1990: 111)

J. TONE PRODUCTION

Sound is a sensation. Since there is scientific proof that sound is produced through vibrations and that the breath blown into a brass instrument does not carry tone with it, simple logic compels the conclusion that the tone must be produced by vibrations of the air column within the instrument. On the trumpet, or on any three-valved brass instrument, there are seven fundamental air columns. Six are formed by adding tubing to the first or open fundamental length, the additions being selected by depressing the valves.

By fingering from low C down to low F-sharp and tapping the palm of the hand against the mouthpiece in every position, each of the seven fundamental tones can be heard distinctly (Example 32 below). This is still further proof that the tone is produced by vibration of the air column within the instrument.



Example 32: Harmonic Series of the Trumpet, French Horn, Tenor Trombone and Tuba

With the lips vibrating properly and with correct fingering, each of the seven fundamental tones of the three/four-valve or slide brass instruments can be produced. The reason that these instruments are capable of playing other notes to form a two and one-half octave, or greater, chromatic scale is that an overtone series exists for each of the fundamental tones. The

overtones or harmonics can be sounded without changing the fingering by properly adjusting the lips to cause subdivisions of the fundamental length as it vibrates (Malek, 1954: 121). It should be noted that almost every technical aspect of brass performance, (range, note accuracy as well as musical expressive control) is dependent on proper tone production - a basic foundation of brass playing.

K. TERMINATION /RELEASE OF TONES

In *'The Art of Brass Playing'* by Philip Farkas (1962), the author states that the way a singer terminates a note is what brass players should strive to achieve, that is where the air flow is stopped but the throat remains open, all the while maintaining constant support. The clarinet release, as well as its smooth supple sound, is the model for most brass players. This is frequently quoted in brass literature as well as technique reference materials. For example, in H.L. Clarke's *Technical Studies*, the sixth study advises that a trumpeter should practise these exercises with a clarinettist to gain an impression of the sound which one should strive to achieve - a smooth, flowing, supple sound which is maintained throughout all registers, as well as the correct beginning and terminating of tones. Good clarinet players prove to be worthy role models for brass players.

i. **Correct Termination of Tones/Good Releases Tapered:**

The tapering of notes results in a 'ring' at the end of a note. The term 'tapering' does not imply a gradual diminuendo of the tone.

ii. **Incorrect Termination of Tones/Poor Releases Closure of the glottis:**

The closure of the glottis results in a tense throat. This is not ideal in brass playing. The note ending will sound abrupt, creating an undesirable effect. The closure of the glottis results in restricted tones with successive articulations having an explosive nature due to excess build-up of air in the throat (Sherman, 1990: 25).

iii. **Incorrect Usage of Tongue/Faulty Releases**

Tone quality diminishes resulting in a poor sound when releases are flawed or faulty. A rigid jaw or tongue limits the embouchure's movement and causes a reduction in one's range and lip flexibility.

To achieve the desired results, one needs proficient tongue action, combined with proper breathing and a well-formed embouchure. One of the most common fallacies concerning articulation is the frequent reference to the striking action of the tongue. Actually, the tongue acts as a valve and the breath is released when the tongue is drawn backward and down toward the floor of the mouth.

Indefinite/unclear release may be attributed to some of the following:

- Movement of the tongue is excessively forward and backward, instead of up and down.
- Excessive force in tongue motion.
- Inadequate breath support, leading to an inability to produce or sustain tones.
- Misplacement of tongue i.e. placed too far forward/back.
- Tongue articulates between the lips.
- Stoppage of air stream with tongue, resulting in a clipped and abrupt tone ending in a "tut" articulation.
- Note released with an abrupt closing of the throat, similar to a cut-off. Identified by a guttural sound.

iv. Test for Clean Release

Repeat a note several times. If the initial release is blurred and the succeeding releases become clearer and lighter, "the ear, the lips and the instinct begin to co-operate too late in focusing or 'zeroing in' on the exact pitch of the note." (Farkas, 1962: 45) (see Appendix H: Pitch Establishment).

The practice of breath releases ("ha" as in 'handy'), without the aid of the tongue, will aid in the correction of many 'articulation problems.' This method of release was uniformly used by the Chicago Symphony Orchestra brass section to create a seamless sound, which has since been emulated by other brass sections throughout the world. The use of breath 'attacks' (releases) helped form the unique 'Chicago sound' which started when Reiner was the principal conductor, and has been used ever since (see 5.1.4. Breath Releases).

After developing this form of articulation even the lightest touch of the tongue should be sufficient to create a clean release, as the instrument and lips are now vibrating in sympathy (Farkas, 1962: 45). It is important to develop the ability to focus the lips before each tone is sounded.

Faulty tone production which is primarily based on air stream flow may be linked to articulation deficiencies. Fundamentally, the function of the tongue in the act of articulation is that of a valve which releases the breath, thus allowing the air to pass between the lips resulting in a vibration, which is amplified and reinforced by the instrument acting as a resonator (Fitzgerald, 1949: 22).