

# Airstream Mechanisms

In order to generate sound, it is necessary to have air pressure. Speech sounds can be classified according to the source of air pressure used to produce them.

There are three sources of air pressure:

- (1) The air pressure for **pulmonic** sounds is generated by the lungs. If the lungs are fairly full, elastic recoil compresses them and generates air pressure. Otherwise, we may use the intercostal muscles and the diaphragm to compress the lungs, producing positive pressure, or to expand them, producing negative pressure.
- (2) The air pressure for **velaric** sounds is generated by closing the oral tract at the back by raising the back of the tongue against the velum, closing it at the front with the tongue tip or blade or the lips, pulling down the centre of the tongue, thereby expanding the volume of the enclosed region and generating a vacuum. The closure at the front is then released.
- (3) The air pressure for **glottalic** sounds is generated by closing the oral tract at the glottis by jamming the vocal folds together. When a closure is made somewhere farther forward, the result is a sealed tube. If the larynx is then raised, the air is compressed. If the larynx is lowered, the air is rarefied (a vacuum is produced).

What makes air flow is a difference in air pressure between two places. Therefore, air may flow in either of two directions, depending on where the air pressure is higher. In the case of speech this means that air may flow in two directions:

- (A) When the air pressure inside the mouth is greater than the air pressure outside the mouth, air flows out of the mouth and the airstream is said to be **egressive**.
- (B) When the air pressure inside the mouth is lower than the air pressure outside the mouth, air flows into the mouth and the airstream is said to be **ingressive**.

There are therefore six logically possible combinations:

Location/Direction	Egressive	Ingressive
Pulmonic	Usual	Only paralinguistic?
Velaric	Impossible	Clicks
Glottalic	Ejectives	Implosives

**Pulmonic egressive** sounds are found in all human languages. In many languages, such as English, all of the sounds are pulmonic egressive.

**Pulmonic ingressive** sounds are physically possible but seem not to be used in human languages. Some languages use them *paralinguistically*, that is, for communication outside of the normal linguistic system. For example, Japanese has an ingressive [s] sound. When a Japanese person is told something that upsets him, he will produce this sound. It is not considered a true Japanese speech sound because it cannot be part of ordinary words of the Japanese language. It is unclear whether pulmonic egressives occur as normal speech sounds. One speaker of Tsou, an Austronesian language of Taiwan, was recorded using pulmonic ingressive fricatives in word-initial position by Fuller (1990), but other investigators (Ladefoged and Zeitoun 1993) were unable to replicate this with

other speakers from the same village. The only other known case of pulmonic egressives as normal speech sounds is by Hill and Zepeda (1999) who report that in Tohono O’odham (Papago) pulmonic ingressive airstream is used by women with other women in some situations.

**Velaric egressive** sounds are physically impossible because there is no way to compress the portion of the oral tract between the velar closure and the anterior closure.

**Velaric ingressive** sounds are called *clicks*. Many English speakers have some clicks used paralinguistically. For example, the kissing sound that many people make at babies is a bilabial click. The sound that some people use to call to horses is an alveolar click. The only languages that use clicks as regular speech sounds are found in Southern Africa. These are the Khoi and San languages, the languages of the native people of the southern part of Africa, and some of the southern Bantu languages, such as Zulu, which have borrowed these sounds from the Khoi and San languages.

**Glottalic egressive** sounds are called *ejectives*. Sometimes they are called “glottalized” sounds, but the sounds called “glottalized” are not all ejectives. Ejectives do not occur in European languages, except in the Caucasus region, at the border of Europe and Asia, but they are quite common in the languages of the world. They are especially common in the native languages of North America, particularly in the Pacific Northwest.

**Glottalic ingressive** sounds are called implosives. They are not as common as ejectives, but are found in various languages around the world. They are especially common in Africa. Some Mayan languages (Central America) have a single glottalic series of consonants, with labial implosives but ejectives at other points of articulation.

## References

- Fuller, Michael (1990) ”Pulmonic ingressive fricatives in Tsou,” *Journal of the International Phonetic Association* 20.2.9-14
- Hill, Jane H. and Ofelia Zepeda (1999) ”Language, Gender, and Biology: Pulmonic Ingressive Airstream in Women’s Speech in Tohono O’odham,” *Southwest Journal of Linguistics* 18.1.15-40.
- Ladefoged, Peter and Elizabeth Zeitoun (1993) “Pulmonic Ingressive Phones Do. Not Occur in Tsou,” *Journal of the International Phonetic Association* 23.1.13-15.