

# Acoustic features of Hadza clicks

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## INTRODUCTION

Hadza (isolate) has clicks in its phonological inventory.

A precise articulatory and acoustic description is necessary to characterize and formalize these consonants in terms of articulatory gestures and distinctive features.

The challenge is to understand the mechanisms of the production of these segments.

Sands, Maddieson & Ladefoged [1] and Sands [2] describe Hadza with 9 clicks while Miller [3] suggests that there are 12.

Recent data show that the language has 13 : [ʘ, ǀ, ǃ, ǂ, ǁ, ǁ̥, ǁ̥̥, ǁ̥̥̥, ǁ̥̥̥̥, ǁ̥̥̥̥̥, ǁ̥̥̥̥̥̥, ǁ̥̥̥̥̥̥̥].

Clicks have 4 types and various accompaniments [k, g, q, b, ʔ, ʰ, ŋ, ŋ].

The 4 types of Hadza clicks [ʘ, ǀ, ǃ, ǂ] bilabial, dental, alveolar and lateral can be accompanied, in a contrastive way, by aspirated, glottal and nasal features, that can sometimes be combined.

## REFERENCES

[1] Miller, K. (2008). *Hadza grammar notes*. Ms Riezlern.  
 [2] Sands, B. (2013). Phonetics and Phonology: Hadza. In R. Vössen (Ed.). *The Khoesan languages*. London. Routledge.  
 [3] Sands, B. (2020). In Click consonants: An Introduction. In Sands, B. (ed.). *Click consonants*. Leiden, Brill.  
 [4] Traill, A. (1994). The perception of clicks in !xoo. *Journal of African Languages and Linguistics*. 15. 161-174.

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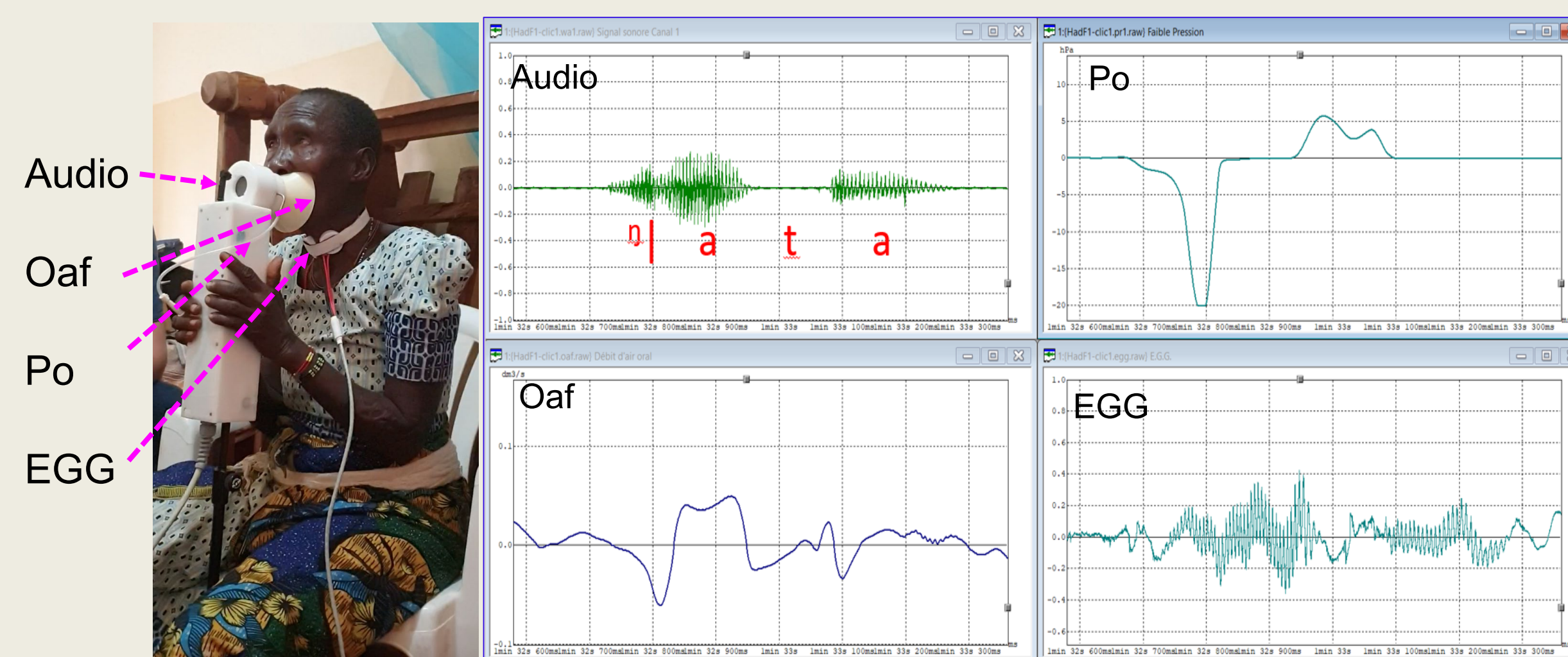
## Material and method

**Method:** 5 male and 4 female native speakers

Words including all Hadza consonants were recorded. Each word was repeated 3 times

**Material:**

EVA2 workstation that can record simultaneously sound, oral airflow (Oaf), intra oral pressure (Po) and electroglottography (EGG) (only acoustic data are presented here).



## Objectives of the study

Describe Hadza clicks in terms of gestures (with a measure of time) and distinctive features.

Check and establish the accompaniments of the different clicks.

Similarities and differences with the clicks of the southern Khoesan languages?

Are there aspirated clicks in Hadza?

Evaluate the acoustic similarity between clicks and ejectives.

## Click acoustics

Clicks are consonants that have a unique source, namely a suction caused by a velaric air flow.

The result can be a type of impulse source and/or noise of a certain duration. These parameters are filtered by the shapes of the oral cavity which are associated with each click.

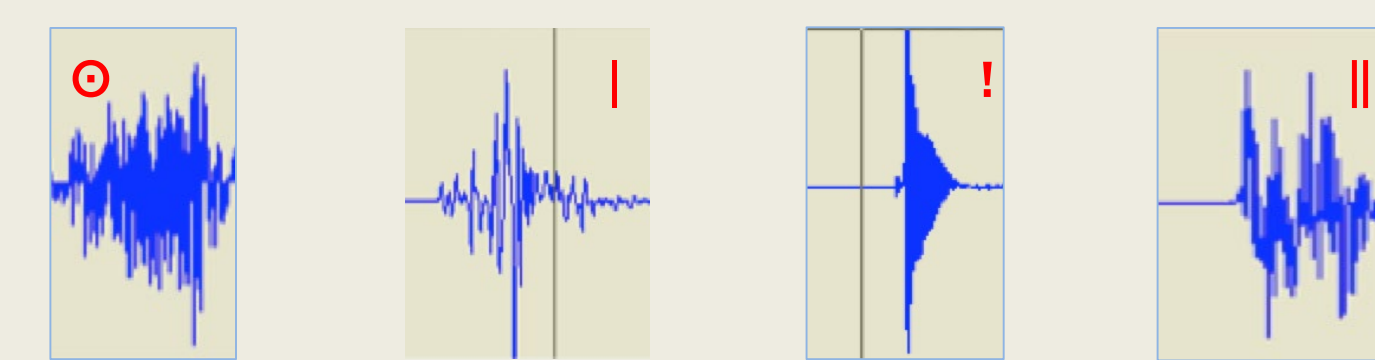
The acoustic signatures encode the dimensions of the vocal tract as for the consonants where the acoustic signature particularly encodes those which are in front of the constriction.

In the case of some clicks, the cavity posterior to the constriction is also excited.

Clicks have acoustically two components : an **attack transient** and an **extinction transient**

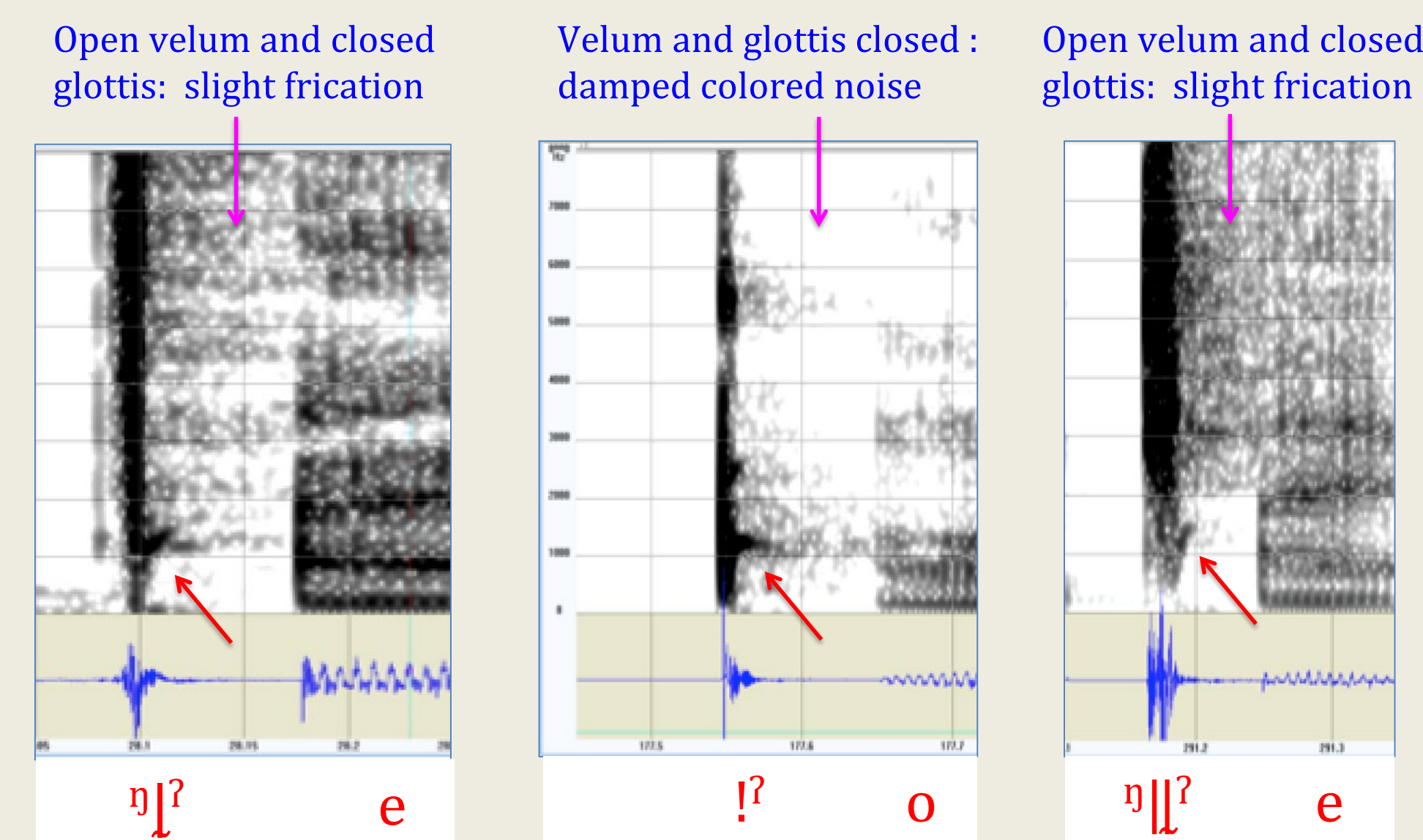
The attack transient is the explosion noise (sometimes called a burst) which is the impulse response to a change in the shape of the vocal tract.

The extinction transient is the noise associated with the turbulent release.



## Role of the posterior cavity

The rising resonance - the partial - [between 1 and 2 kHz] following the posterior release, results from the lowering of the back of the tongue and the reduction in the volume of the pharyngeal cavity.



## Hadza clicks

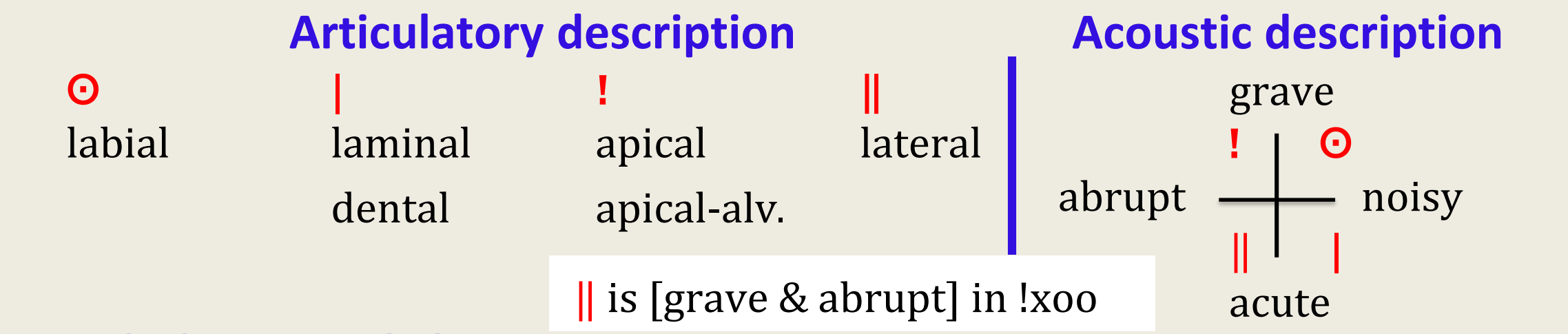
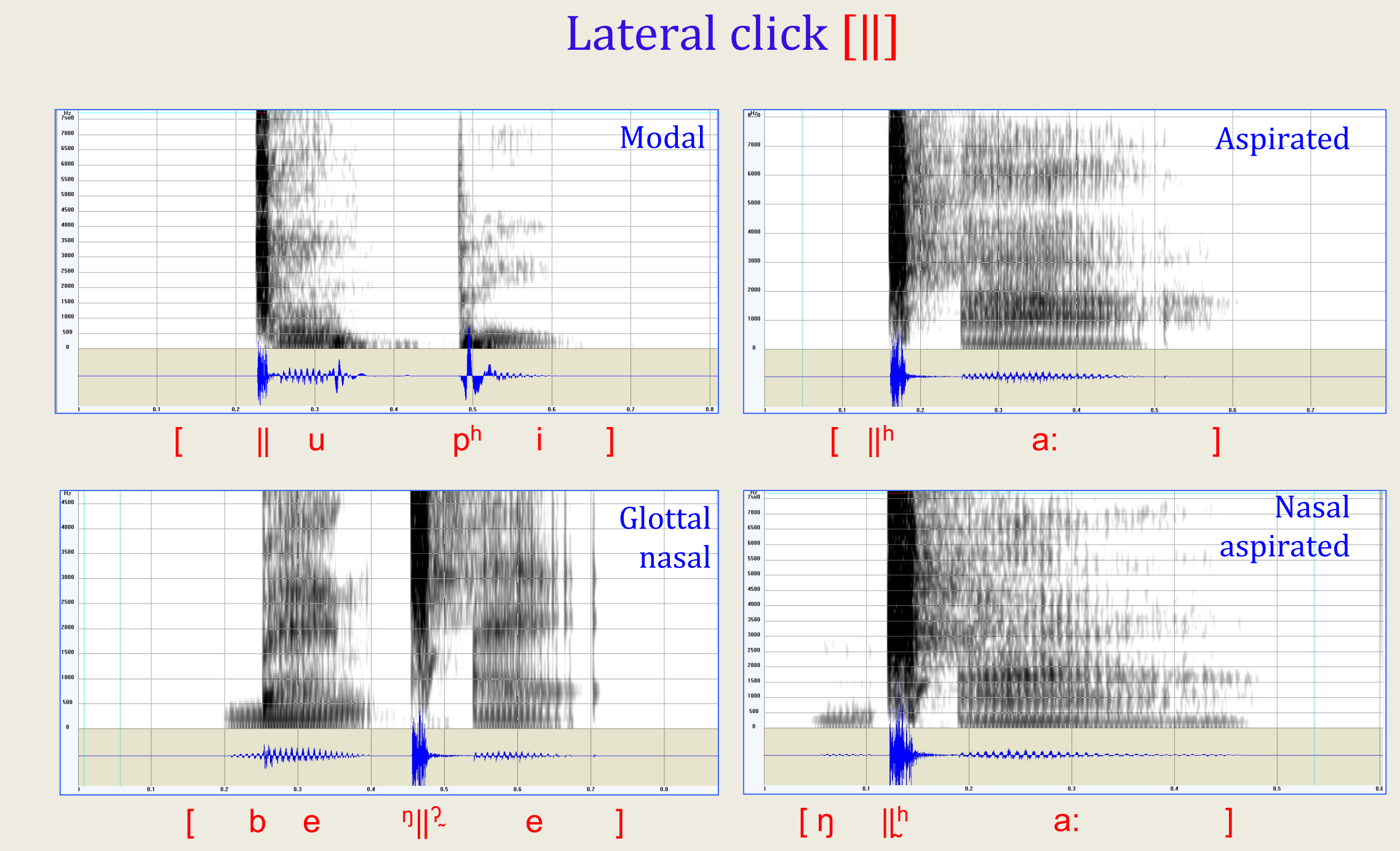
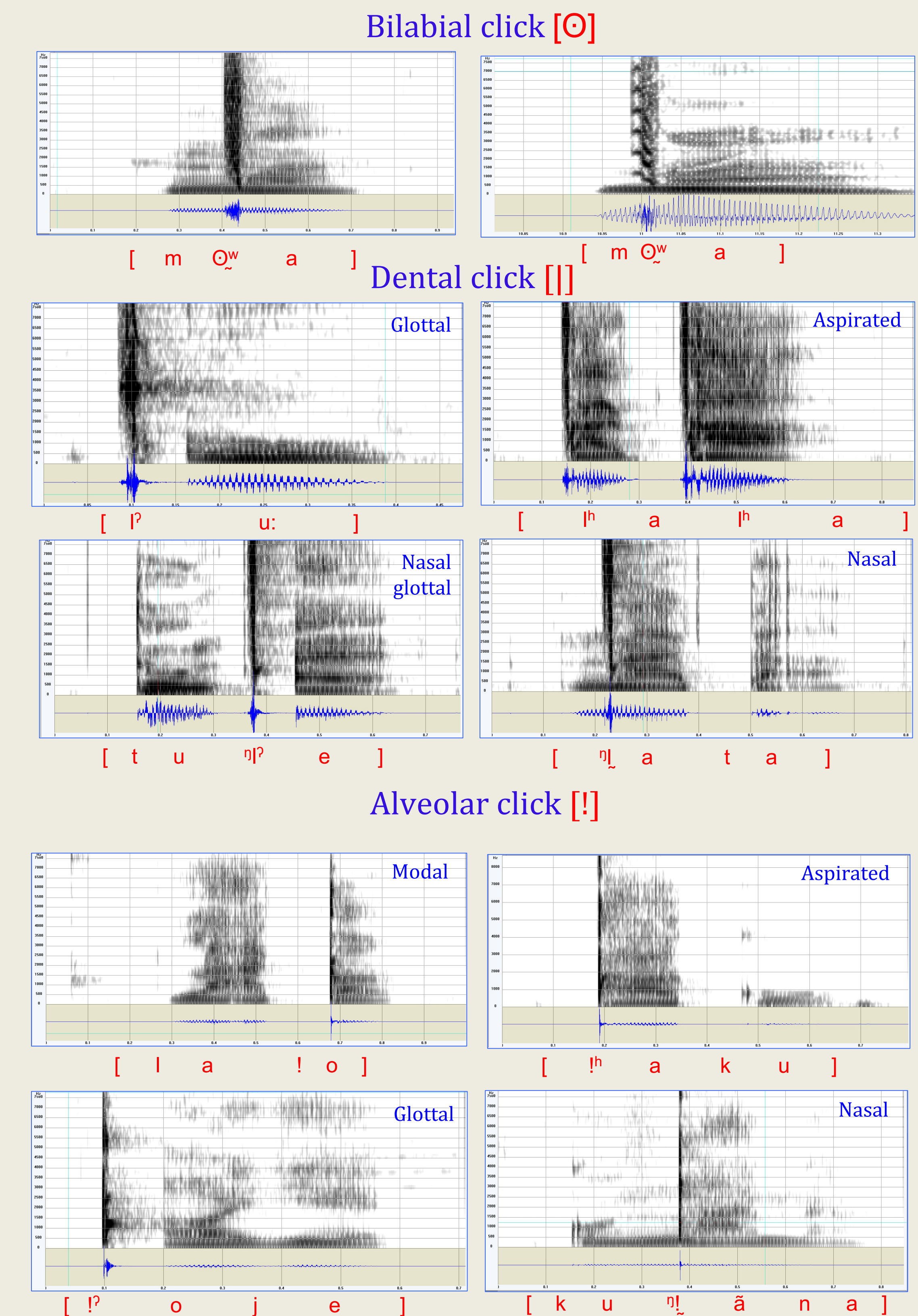
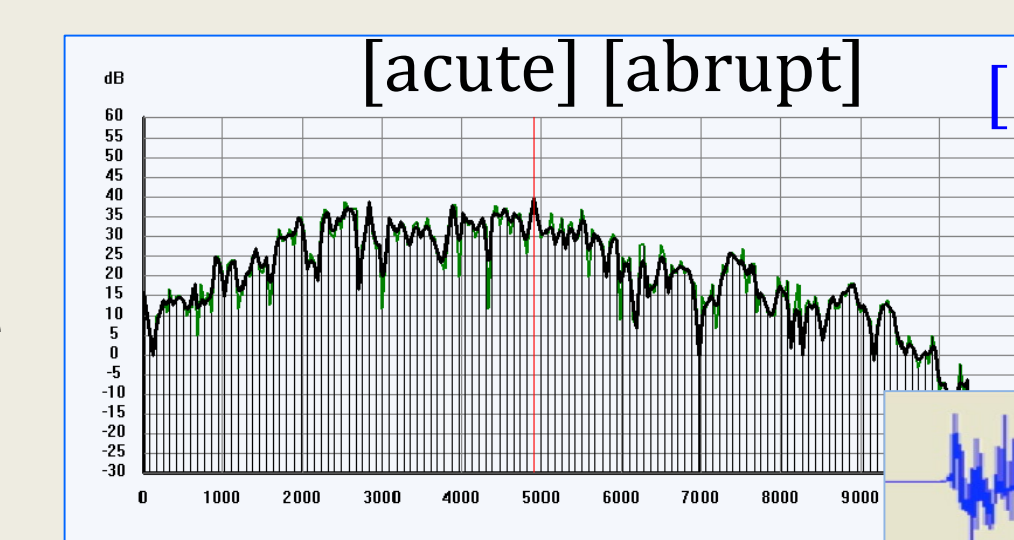
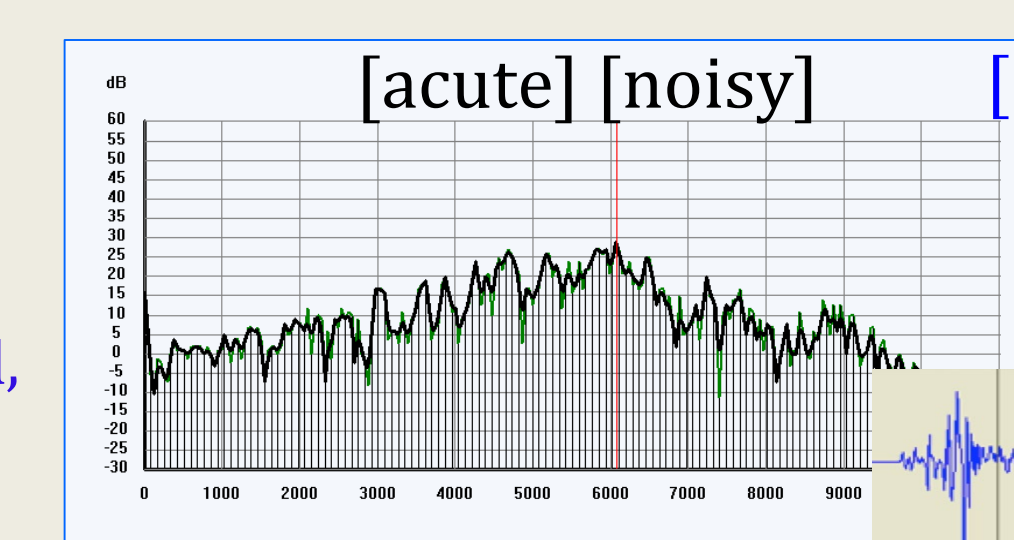
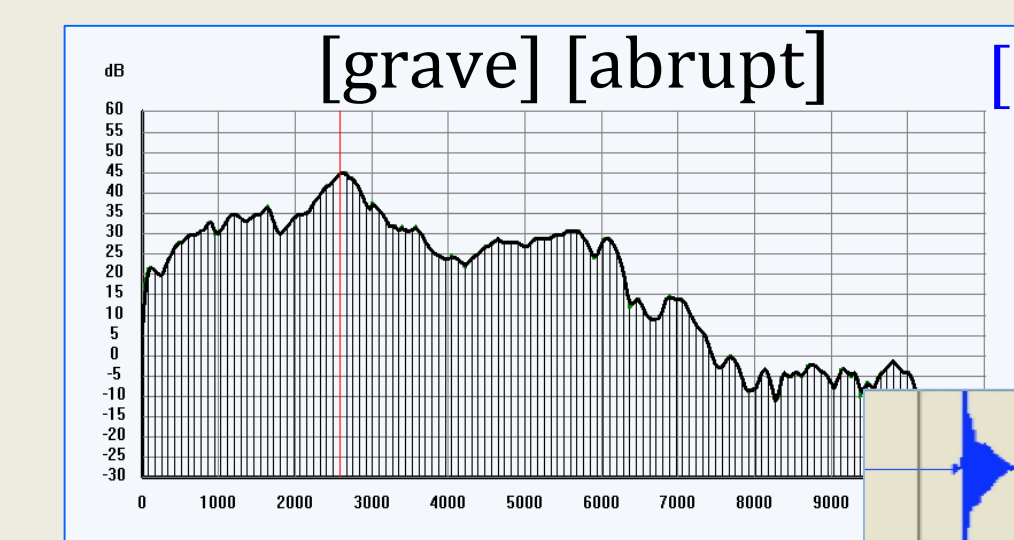
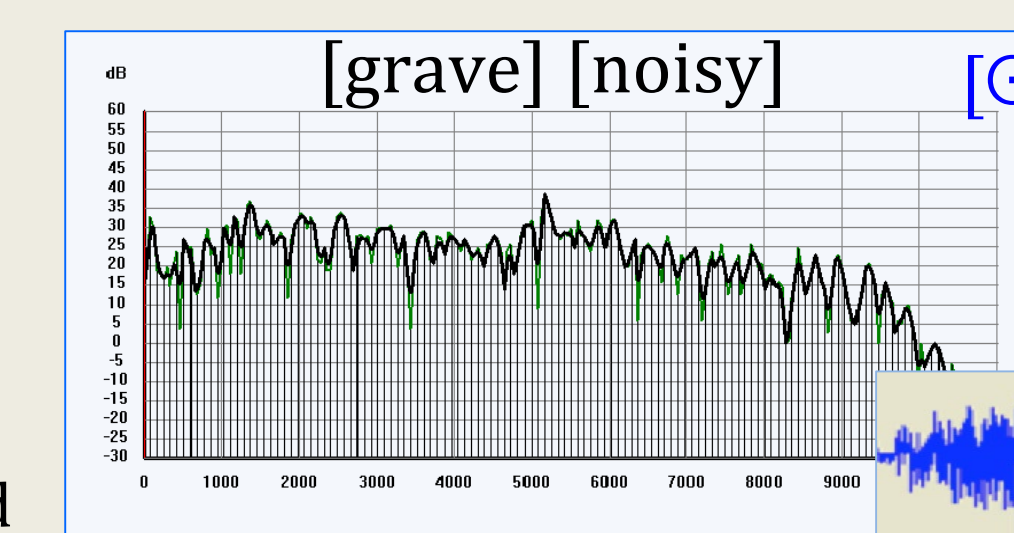
[ʘ] Bilabial click  
 [mʘᵂa] Thank God

[ǀ] Dental click (glottal, aspirated, nasal, glottal nasal)

[ǃ] Alveolar click (simple, nasal, aspirated, glottal)

[ǂ] Lateral click (simple, aspirated, glottal nasal, nasal)

[ǁ] Lateral click (simple, aspirated, glottal nasal, nasal)



**Links between clicks and ejectives**

ǁ has a similar articulation and acoustic signature to that of the palatal lateral ejective cʰ in Hadza