

# Speech Physiology

Articulation and Resonance  
Electropalatography

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# Electropalatography (1)

- Electropalatography (EPG) uses an artificial palate (similar to a denture palate) that is covered with a number of electrodes. When the tongue contacts an electrode an electrical signal results.
- In this way we can examine the patterns of tongue contact with the roof of the mouth.

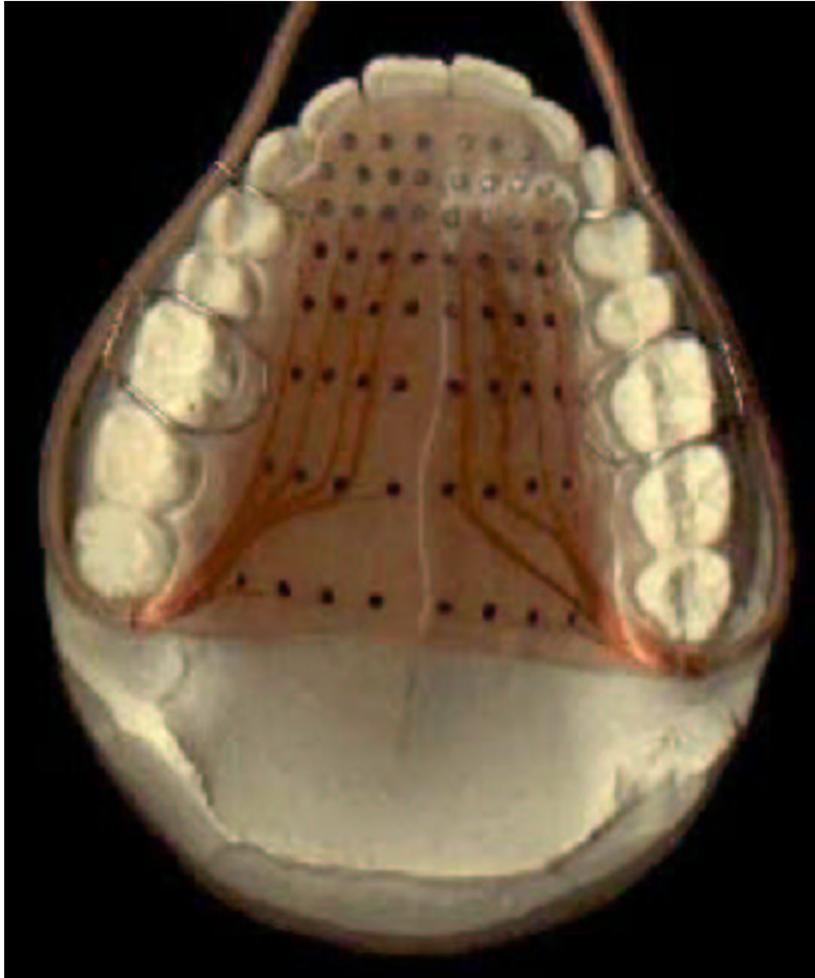
Many of the following EPG pages are based on notes by Jonathan Harrington (2001)

<http://clas.mq.edu.au/speech/physiology/epg/epgnotes.html>

## Electropalatography (2)

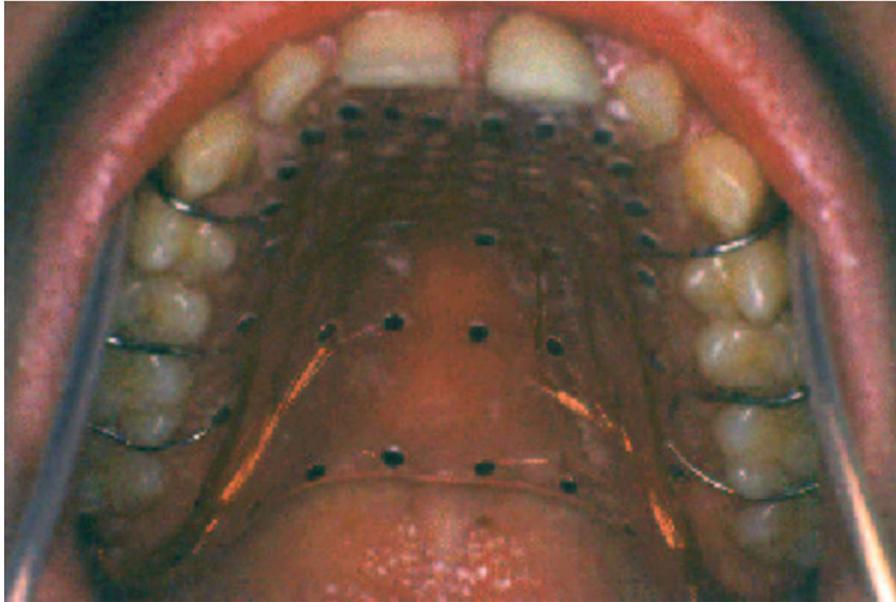
- Electropalatography allows tongue-palate contacts to be detected as a function of time from an artificial palate worn by the subject.
- In other words, we can see the changing patterns of tongue contact with the roof of the mouth by observing changing patterns of contact between the tongue and the electrodes on an EPG palate.

## Electropalatography (3)



- A palate and the dental/palate impression used in its manufacture.  
**Image source:**  
Department of  
Speech and  
Language Sciences,  
Queen Margaret  
College, Clerwood  
Terrace, Edinburgh

## Electropalatography (4)



- A palate in place in the mouth of the subject. This palate was made specifically for this person.
- **Image source:** University of Kent at Canterbury

Some manufacturers, instead, provide a range of flexible ready made palates and clinicians may chose the palate that best fits the client.

## **Electropalatography (5)**

- Whilst the wearing of such a palate can have a significant effect on the production of speech sounds (similar to the effect of wearing dentures for the first time) this technique can provide a lot of useful data on patterns of coarticulation.
- This effect is usually reduced by the subject wearing the palate for a while before the experiment in order to get used to it.

# Electropalatography (6)

- As this technique specifically measures patterns of tongue contact with the roof of the mouth its use is limited to measuring oral consonant contact patterns.
- Its of no use for labial consonants, /h/ and for some very retracted consonants (eg. pharyngeals). Its also of little use for vowels which are not characterised by significant tongue-palate contact.

# Electropalatography (7)

## Basic operation

- Electropalatography allows tongue-palate contacts to be detected as a function of time from an artificial palate worn by the subject.
- In most cases, especially for research, a palate has to be made separately for each subject

# Electropalatography (8)

## The Palate

- The 62 electrodes cover the region from behind the upper front teeth to the hard/soft palate junction.
- When the tongue touches an electrode in the palate, a cell is filled on the corresponding position on a palatogram. Palatograms are typically obtained once every 10 milliseconds.

# **Electropalatography (9)**

## **The Electrodes in the Palate**

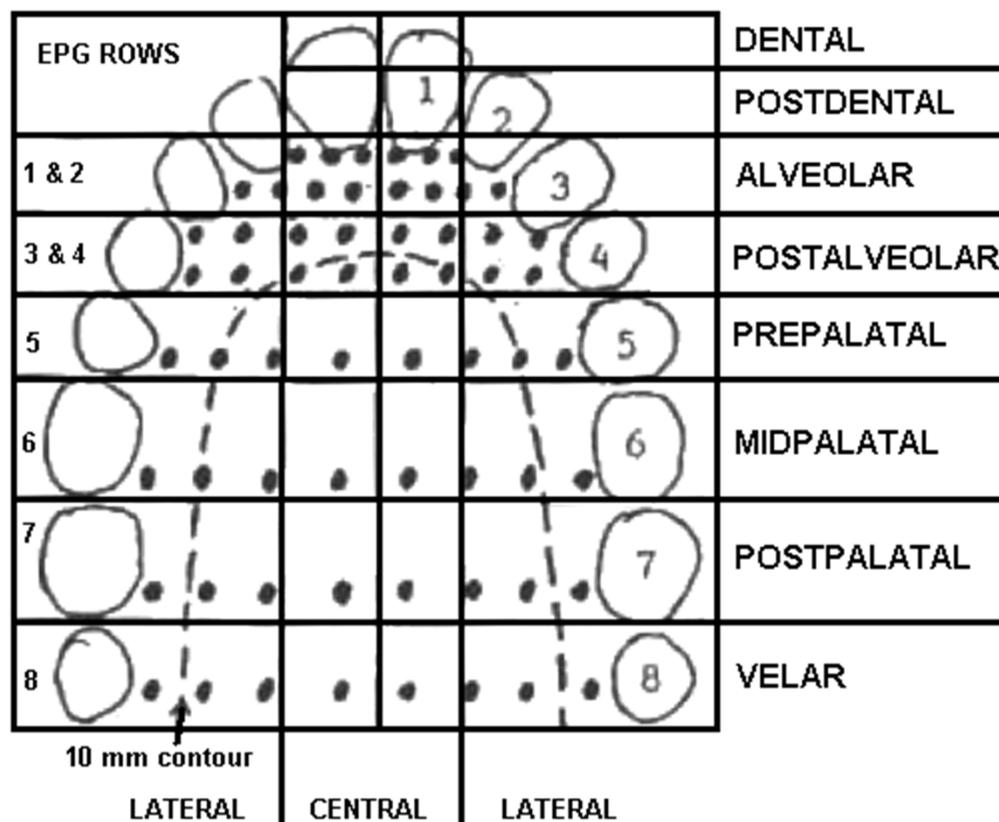
- The electrodes conduct an electrical current that is passed through the subject's body (via a hand-held electrode). When the tongue touches any electrode, the current passes from the tongue into the electrode.

# Electropalatography (10)

## The Computer Display

- When the tongue touches an electrode in the palate, a cell is filled on the corresponding position on a palatogram. Palatograms are typically obtained 1 per 10 milliseconds.

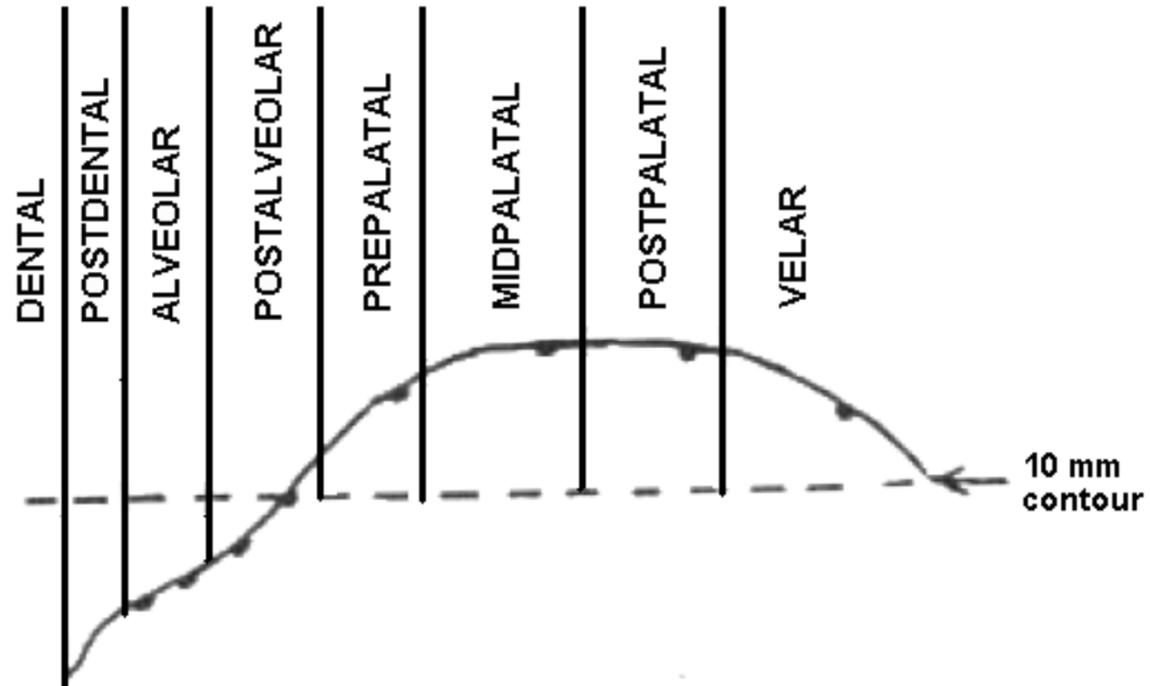
# Electropalatography (11)



Relationship between the palate and electrode placement.

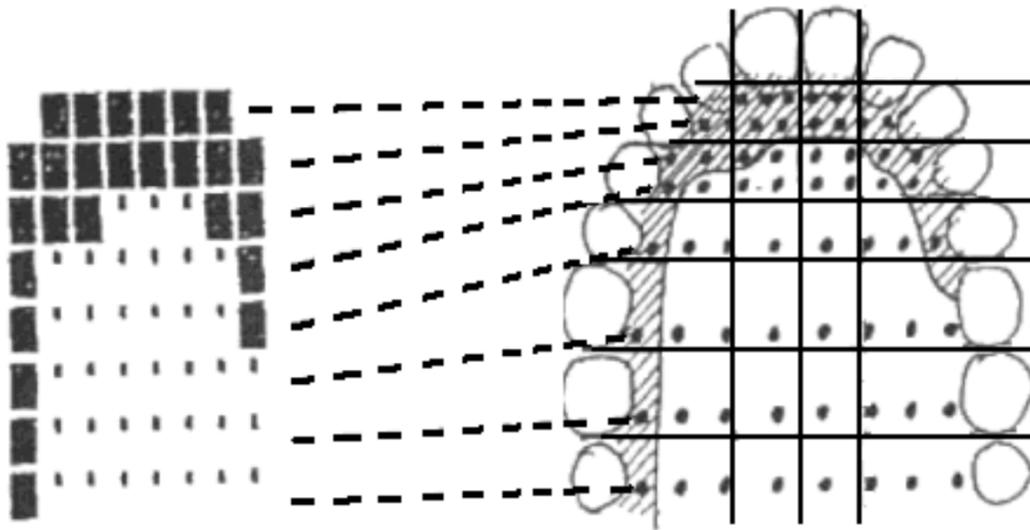
Electrodes are indicated by black dots.

# Electropalatography (12)



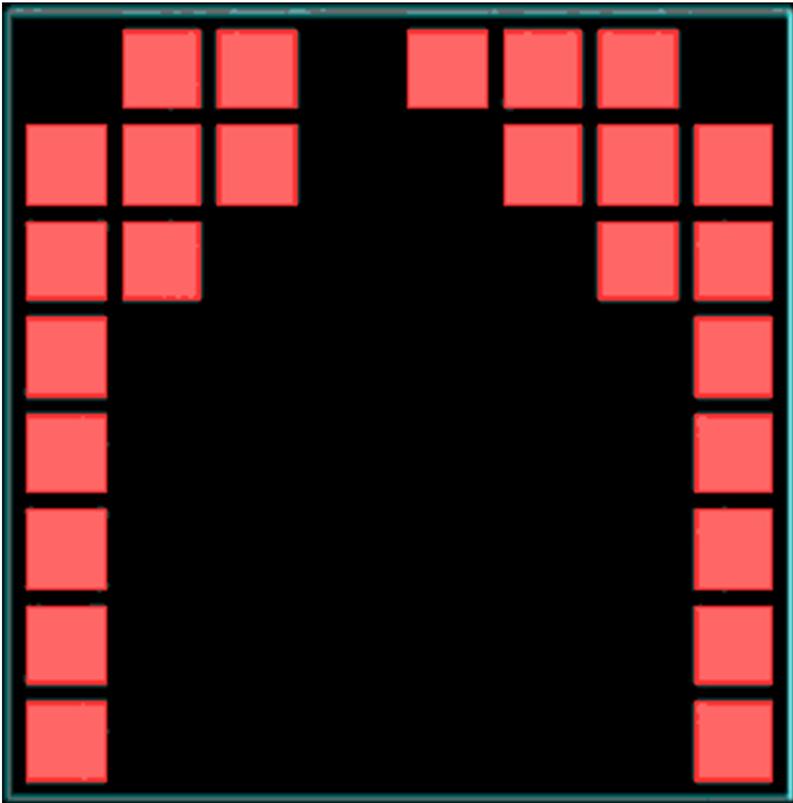
The division of the palate into articulatory zones

# Electropalatography (13)



The relationship between electrode placement and the palate

# Electropalatography (14)



A typical computer readout, an "electropalatogram".

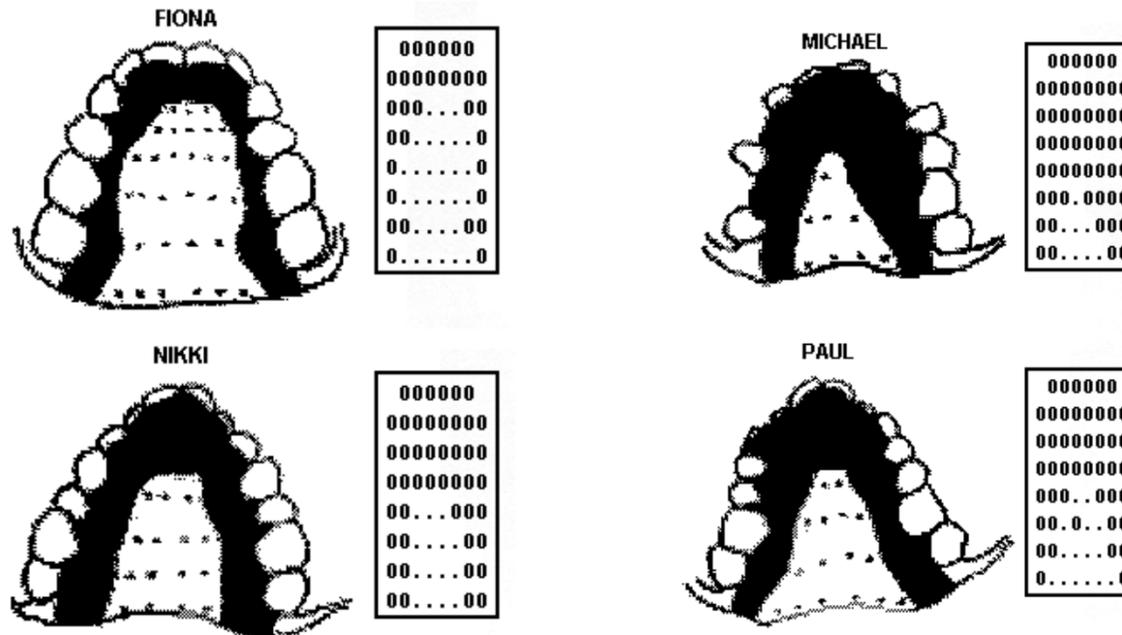
Image source:  
University of Kent at  
Canterbury

# **Electropalatography (15)**

## **Some applications of electropalatography**

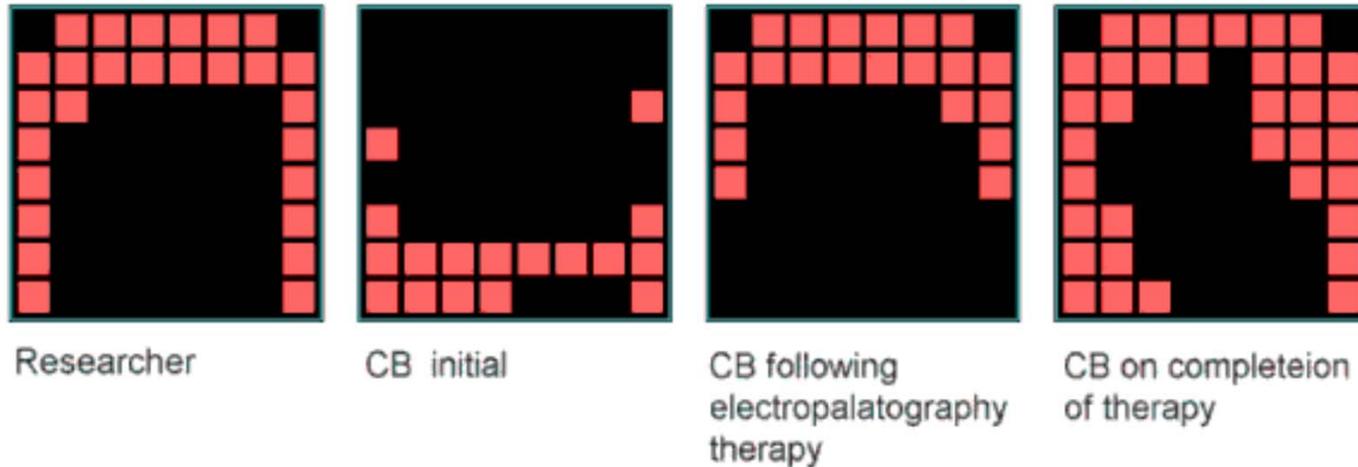
- Basic speech research - e.g., coarticulation, fast speech effects
- Assessing and describing certain kinds of speech disorders
- As a speech therapy tool - The EPG system allows information to be given to the subject about tongue-palate misarticulations.

# Electropalatography (16)



- Contact pattern for /l/ in a normal subject (top) and three subjects with down syndrome (lower three panels). **Image Source:** Christine Hamilton

# Electropalatography (17)



Severe Ataxic Dysarthria: A single case study.

**Image Source:** Alison Main, Steve Kelly and Graham Manley

“CB”, the client, initially has a very different pattern of contact compared to the researcher but after therapy CB’s contact pattern is much more like that of the researcher.

# Electropalatography (18)

Ataxic Dysarthria is a "... condition where a person finds it difficult to speak clearly because of weak oral muscles, damage to the brain, or lack of coordination of the involved muscles... . If the cerebellum... is damaged then the type is called Ataxic Dysarthria. ... the voice suddenly becomes harsh, speech breaks down, articulation is poor and the pauses while speaking are prolonged."

<http://speechtherapy.ygoy.com/2011/07/14/what-is-ataxic-dysarthria-%E2%80%93-causes-and-symptoms/>

# Electropalatography (19)

## Electropalatography Workshop Movie

Choose one of the following depending upon the speed of your internet connection:-

File sizes:        CDVersions (17 Mb)    slowest download, best quality  
                      webVersionHi (4.5 Mb)  
                      webVersionLow (2.5 Mb)    quick download, poor  
quality

[http://clas.mq.edu.au/speech/physiology\\_movies/main/index.html](http://clas.mq.edu.au/speech/physiology_movies/main/index.html)

Make sure you select the relevant electropalatography movie when you reach the download directory.

# Electropalatography (20)

To work out where you are when examining the data you will need to take into account the following three sources of information:-

1. In the webpage wheteron.html are the waveforms for each word. Aligned with the waveforms are the EPG frame numbers as well as the time in milliseconds (ms).

# Electropalatography (21)

2. The main EPG web page “Electropalatography (EPG)” (file index.html) has a table that shows the following for each word:-
  - pstart: word start in terms of palatogram number
  - pend: word end in terms of palatogram number
  - start: word start time in terms of milliseconds
  - end: word end time in terms of milliseconds

## Electropalatography (22)

3. The file epg.pdf provides the frame number for each odd-numbered EPG frame. Palatograms are 5 ms apart so the odd numbered ones are 10 ms apart (e.g. EPG 3 occurs 10 ms after EPG 1). In this file you can see each palatogram and under each one is the frame number (odd numbered frames only).

# EPG Reading

The following reference is provided for your interest. It illustrates the use of EPG in clinical studies (in this case, studies of Down Syndrome)

- Christine Hamilton, "Investigation of the articulatory patterns of young adults with Down's syndrome using electropalatography", The Down Syndrome Educational Trust, Down Syndrome Research and Practice, 1993, 1 (1) 15-28

[http://clas.mq.edu.au/speech/physiology/epg/epg\\_downs.pdf](http://clas.mq.edu.au/speech/physiology/epg/epg_downs.pdf)