

# ILUSÕES MULTISSENSORIAIS

O ESPERADO E O INESPARADO NA INTEGRAÇÃO MULTISSENSORIAL

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UNIVERSITY OF COIMBRA

PORTUGAL

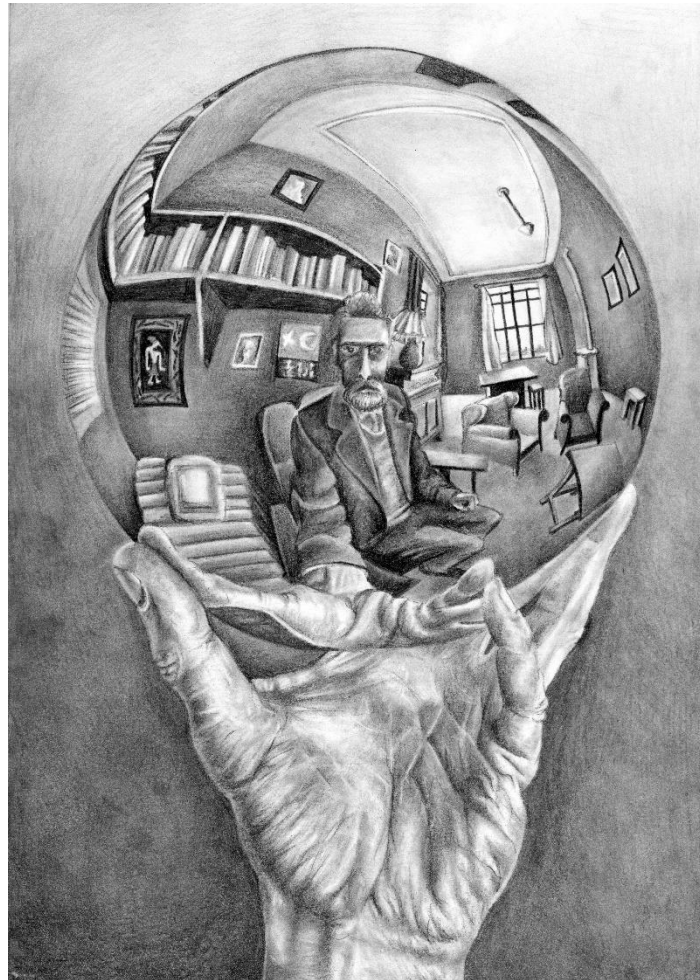
DEPARTAMENTO DE FÍSICA E ASTRONOMIA

FACULDADE DE CIÊNCIAS

UNIVERSIDADE DO PORTO

1 DE SETEMBRO DE 2015

# A UNICIDADE DA PERCEPÇÃO SENSORIAL

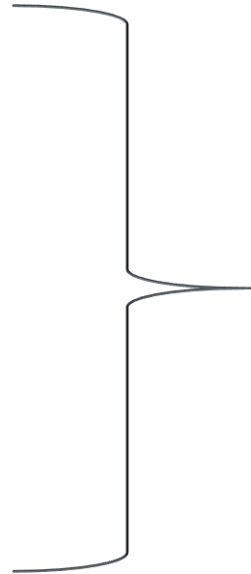


Maurits Elscher, 1935  
Hand with Reflecting Globe

# MULTISSENSORIAL?...

## ■ Unisensorial:

- Visão
- Audição
- Tato
- Olfacto
- Paladar



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# MULTISSENSORIAL?...

## ■ Unisensorial:

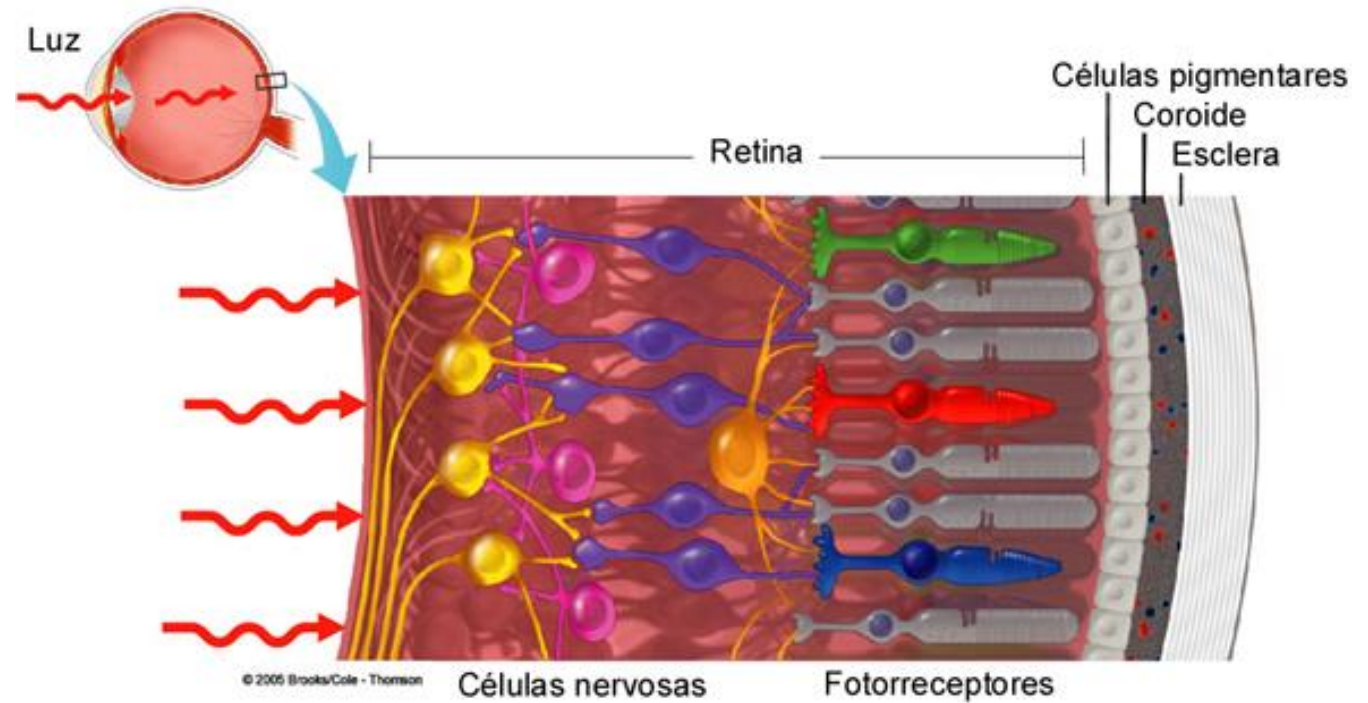
■ Visão

■ Audição

■ Tato

■ Olfacto

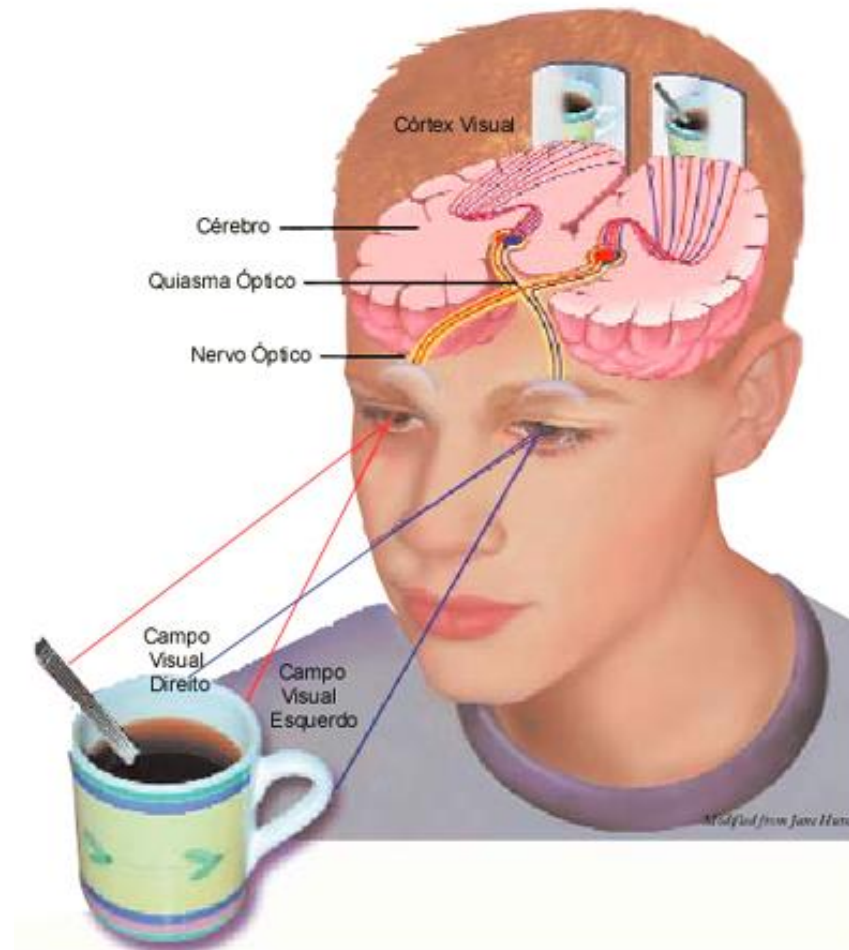
■ Paladar



# MULTISSENSORIAL?...

## ■ Unisensorial:

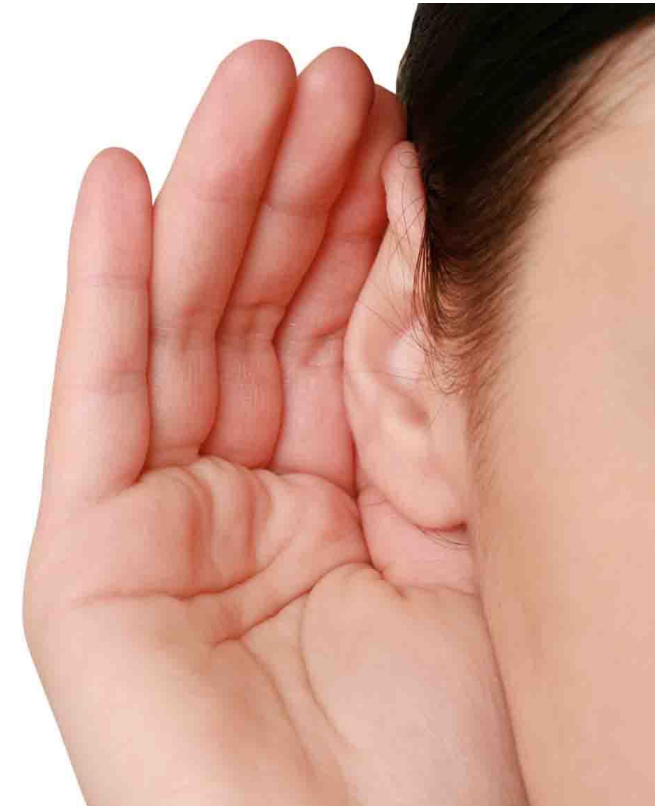
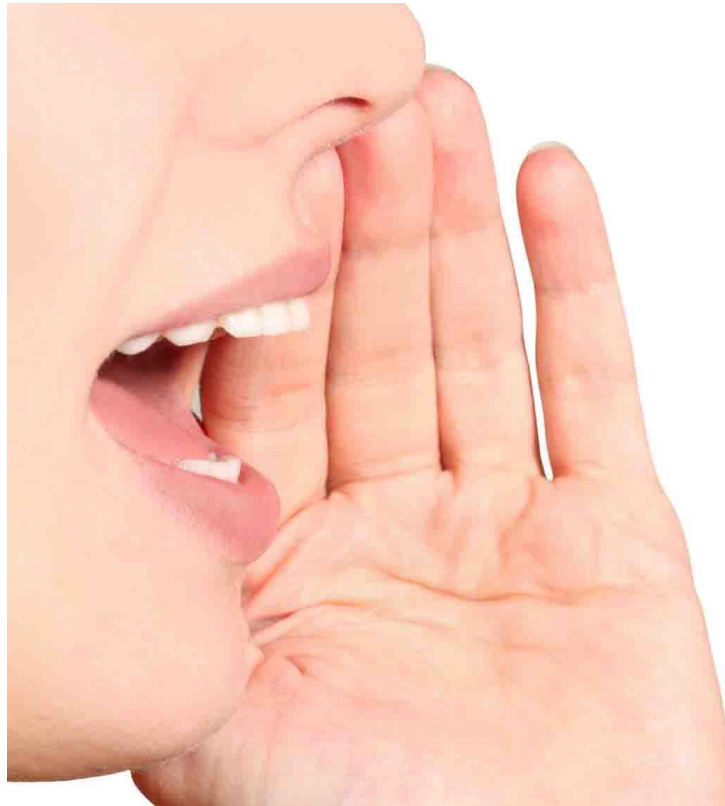
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# MULTISSENSORIAL?...

- Unisensorial:

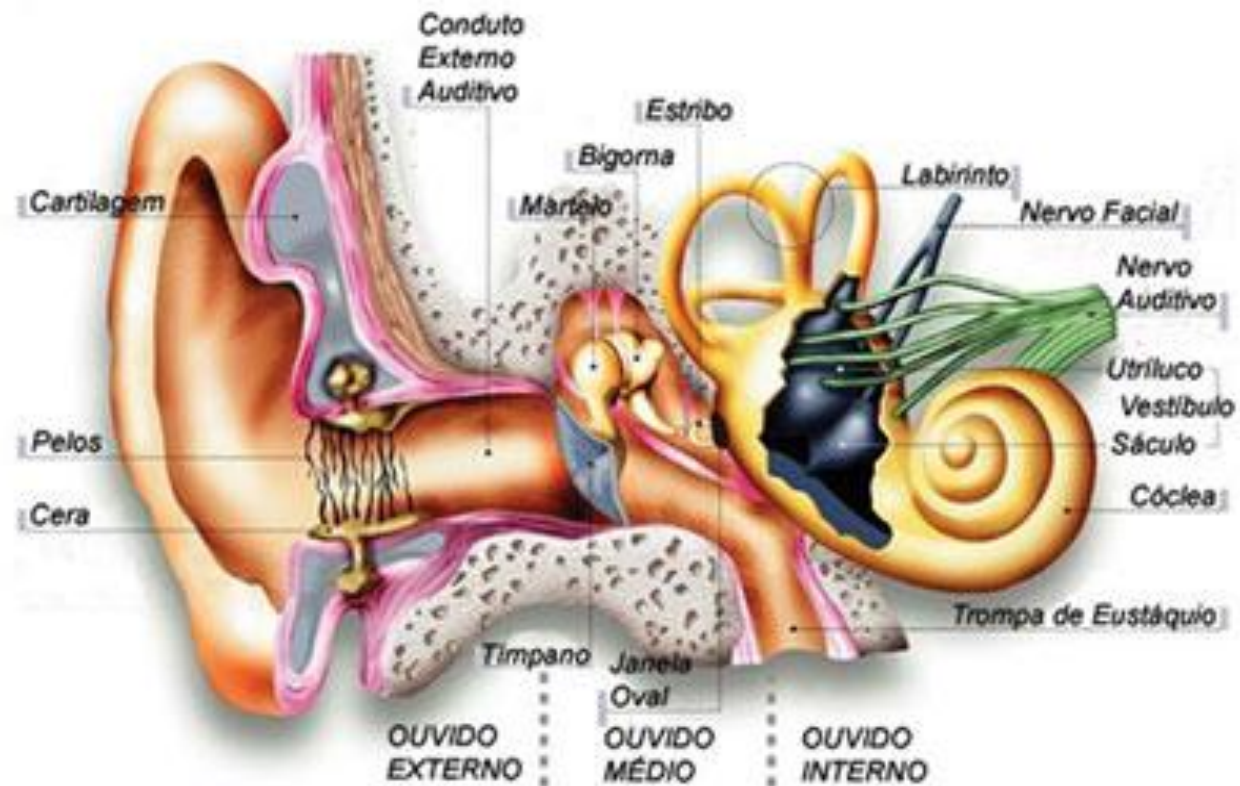
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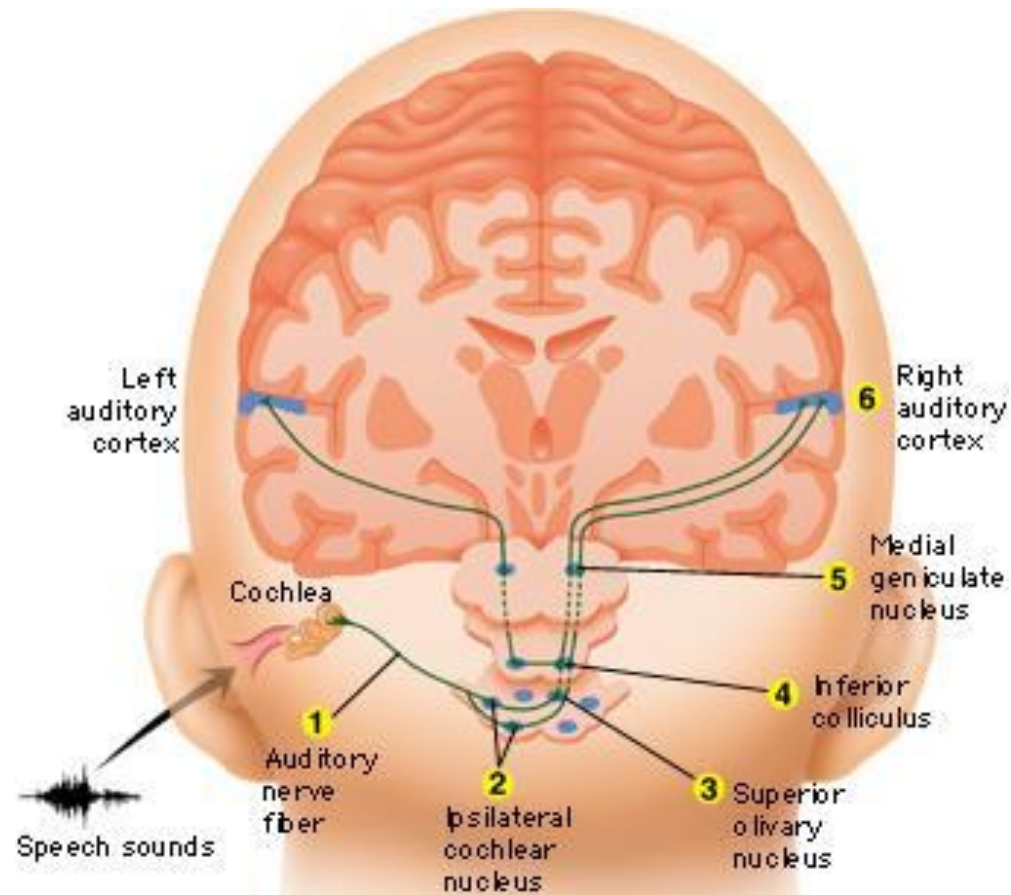




# MULTISSENSORIAL?...

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- Visão
- **Audição**
- Tato
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# MULTISSENSORIAL ?...

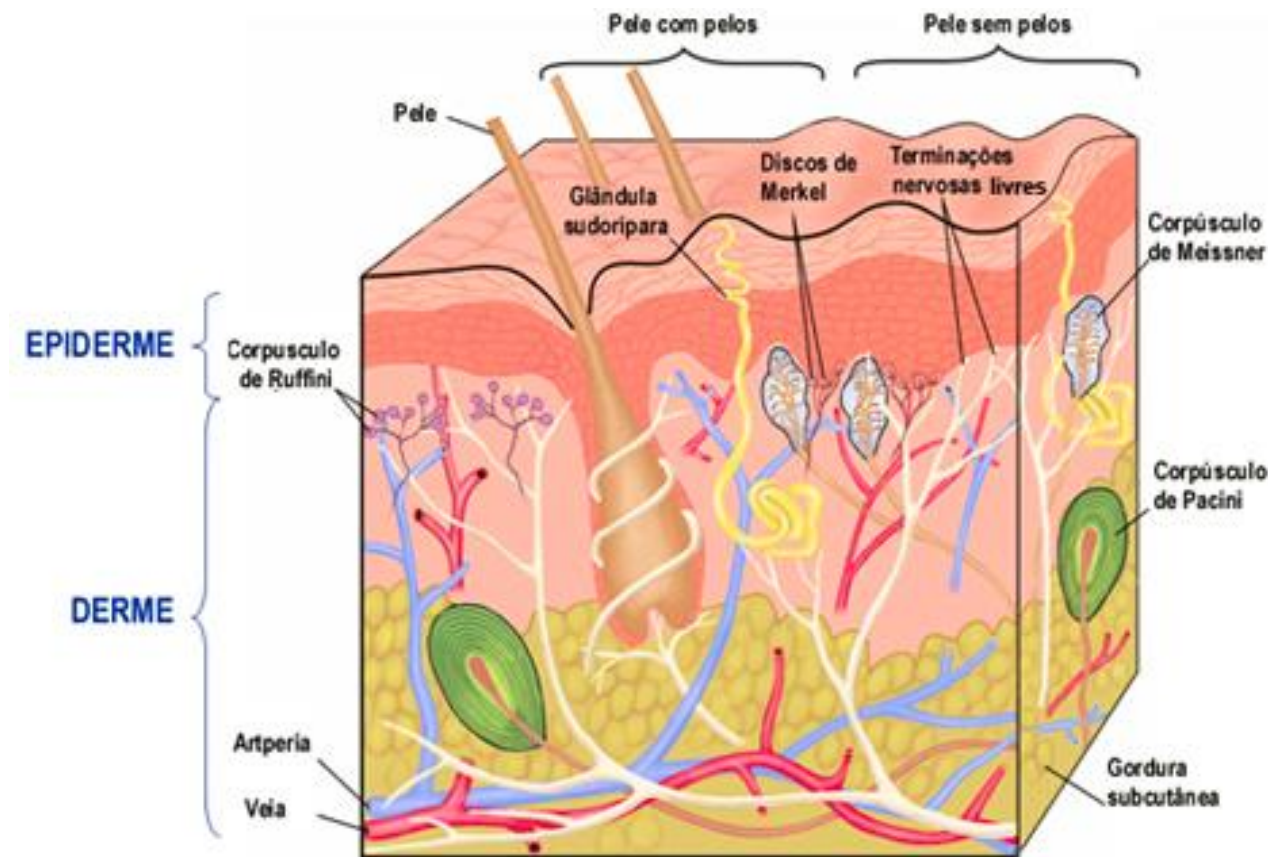
- Unisensorial:
  - Visão
  - Audição
  - Tato
  - Olfacto
  - Paladar



# MULTISSENSORIAL ?...

## ■ Unisensorial:

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## Mecanoreceptores

### Epiderme (small receptive field)

- Meissner (rápida adaptação)
- Merkel's (lenta adaptação)

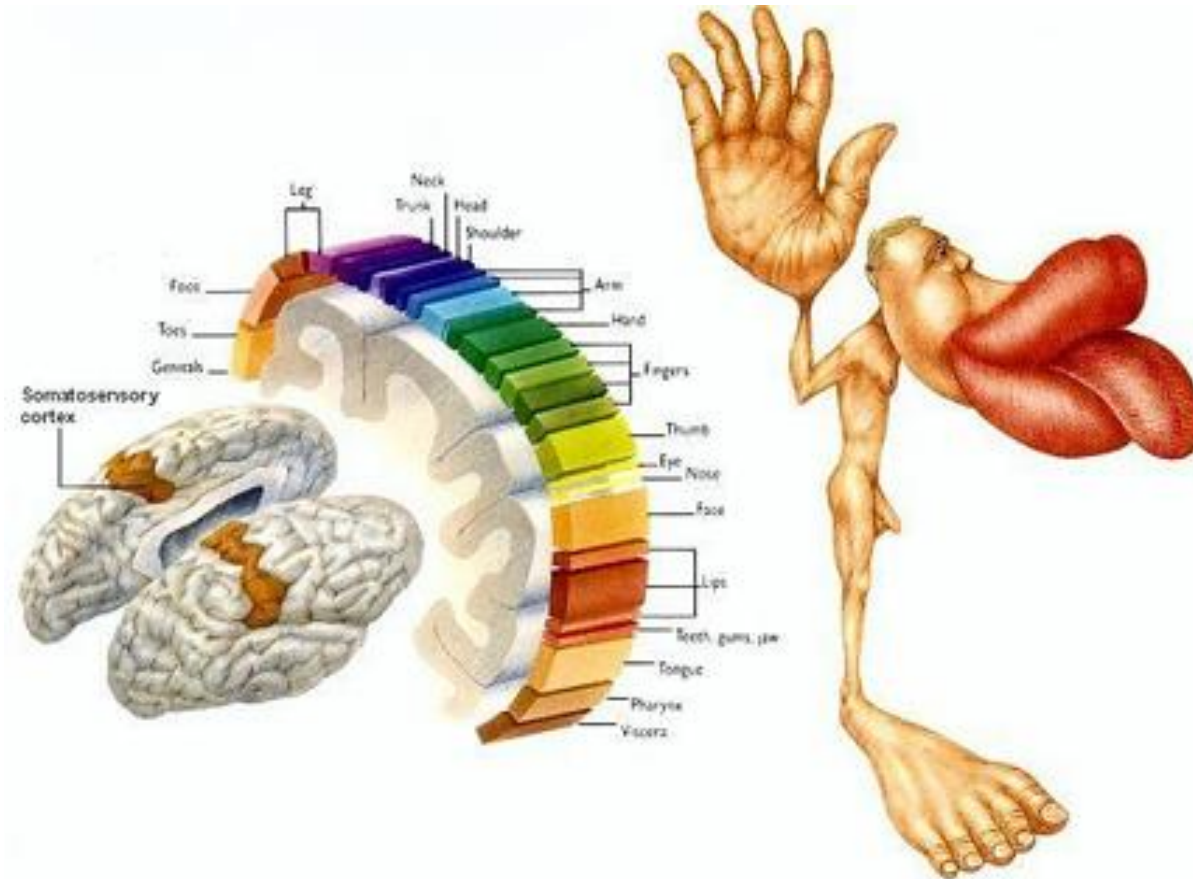
### Derme (large receptive field)

- Ruffini (lenta adaptação)
- Pacini (rápida adaptação)

# MULTISSENSORIAL ?...

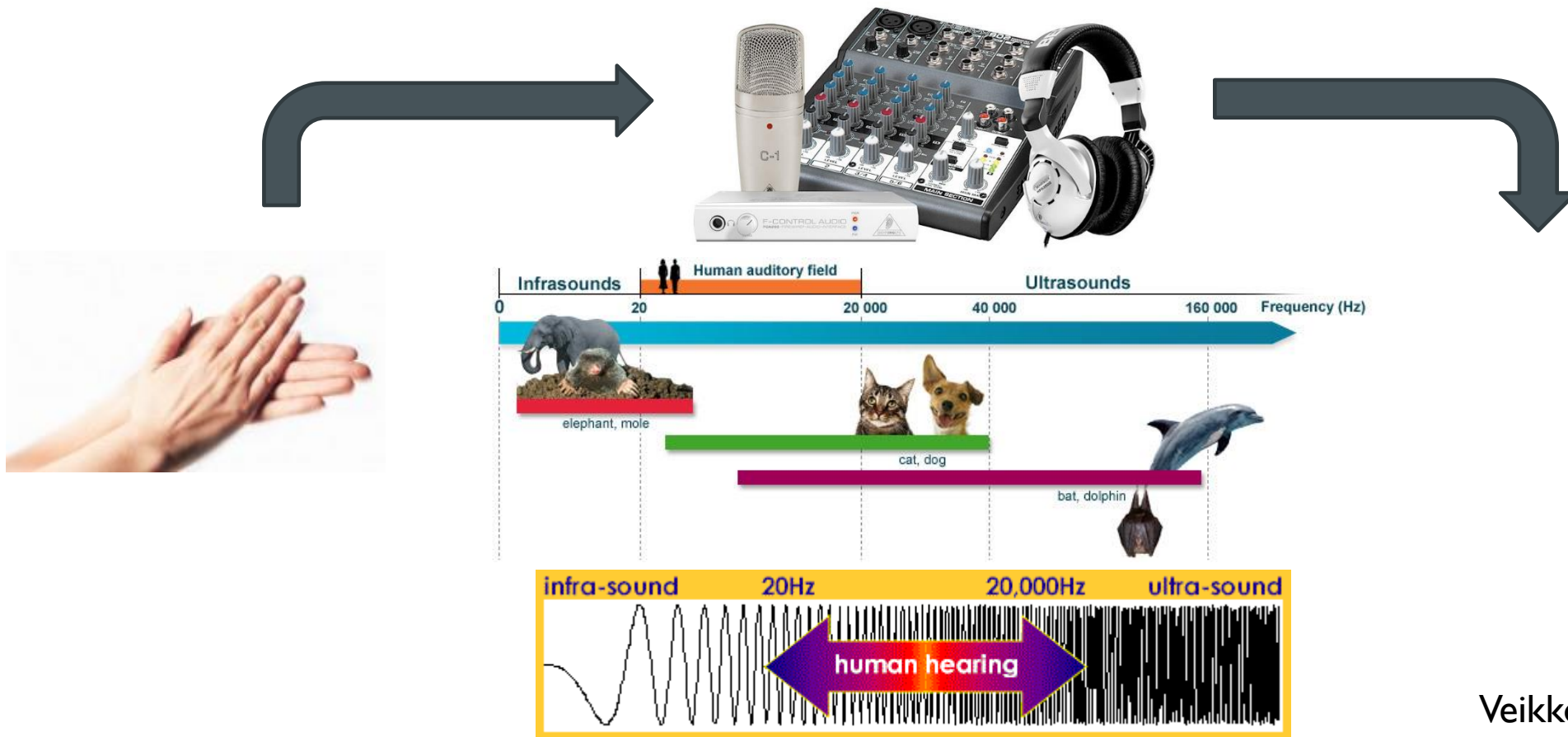
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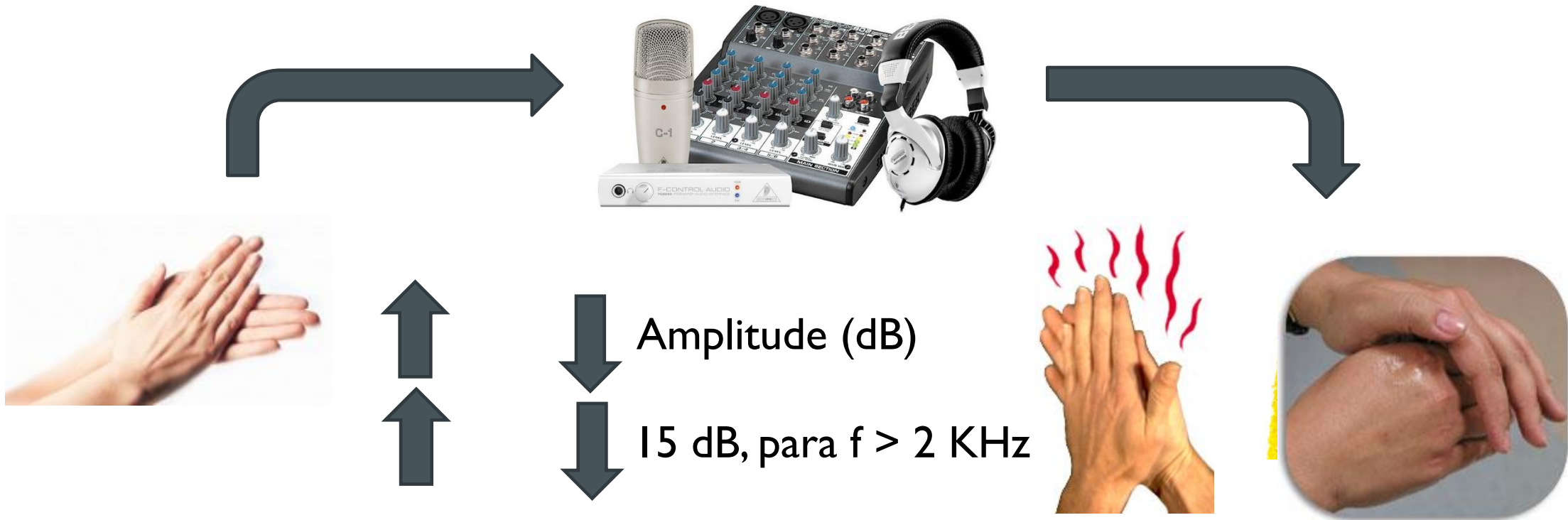
# PARCHMENT SKIN ILLUSION

- Sensação de tato alterada pelas propriedades do som



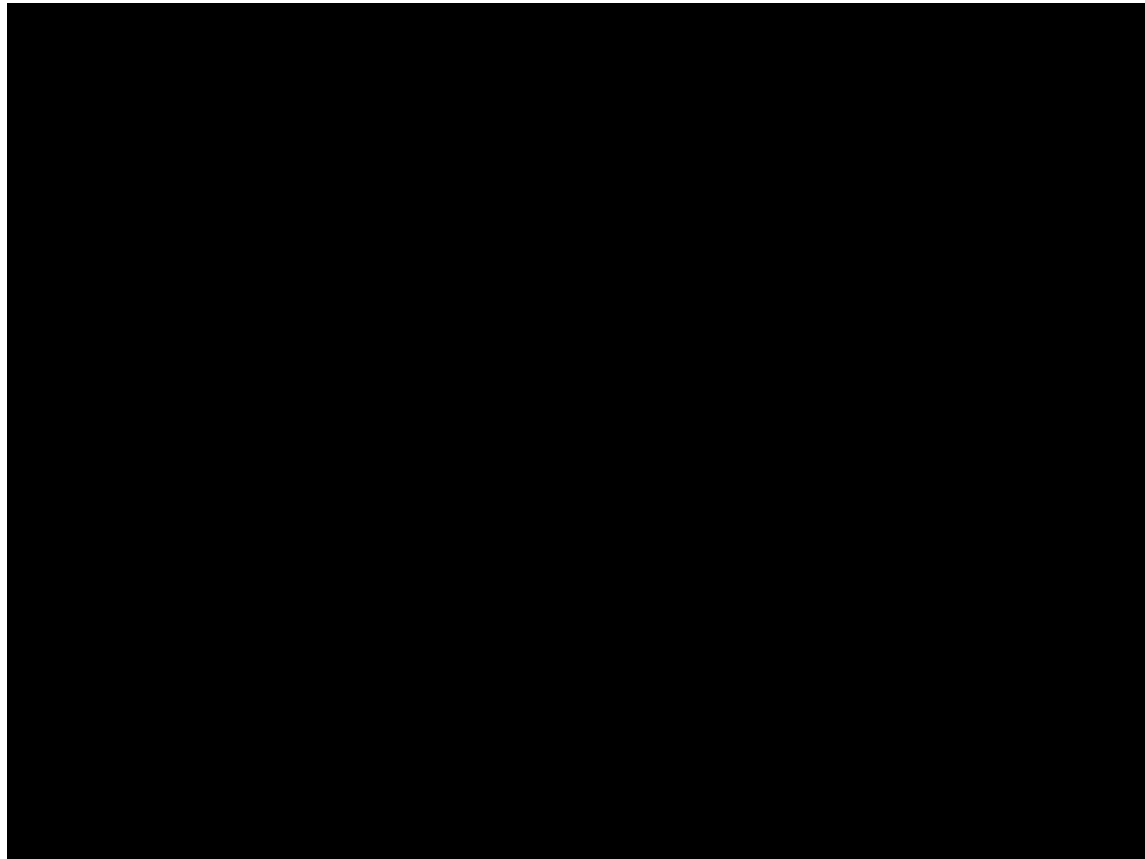
# PARCHMENT SKIN ILLUSION

- Sensação de tato alterada pelas propriedades do som



# MCGURK EFFECT

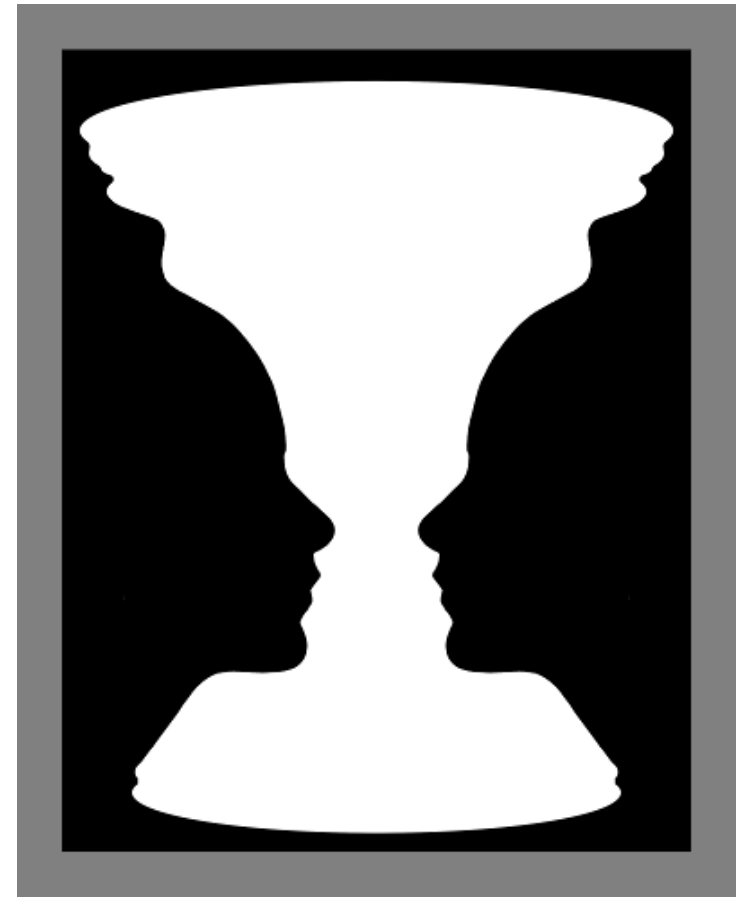
- Incongruência na informação Audio-Visual: nova percepção



*Hearing Lips Seeing Voices*  
McGurk & MacDonald  
Nature 1976

# QUE PARÂMETROS SÃO DECISIVOS ?

- Janela Temporal
- Congruência/Incongruência
- Atenção
- Dominância de modalidade sensorial



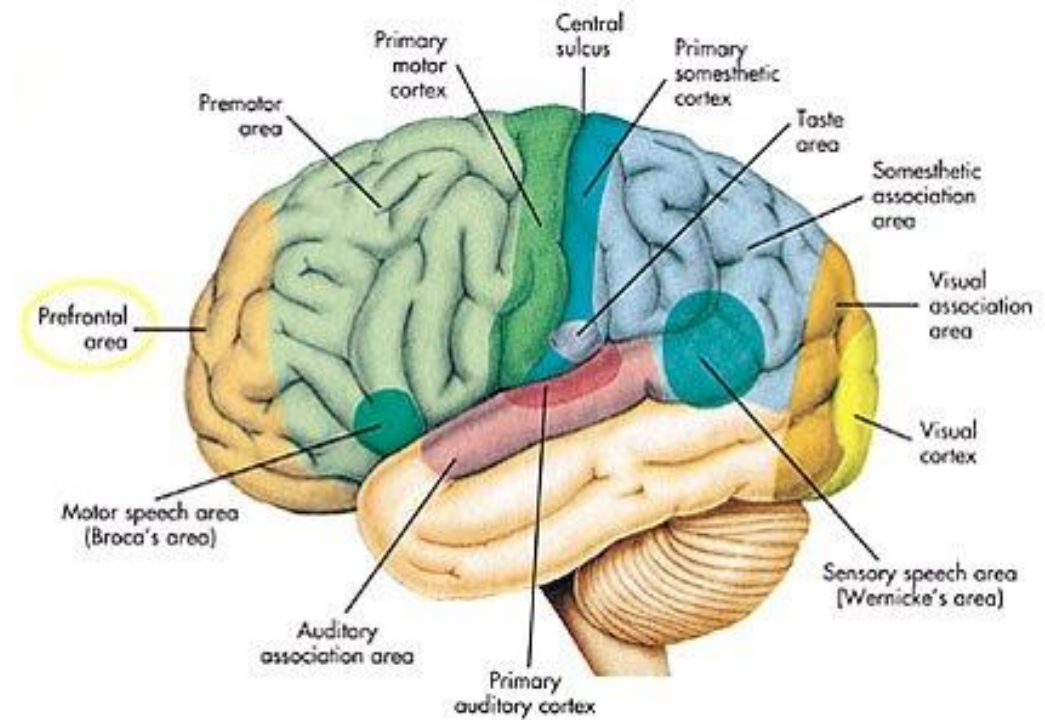
Rubin Face-Vase



# COMO SE INTERPRETAVA A INTEGRAÇÃO

1º Processamento em áreas  
UNISSENSORIAIS

2º Processamento em áreas  
de ASSOCIAÇÃO

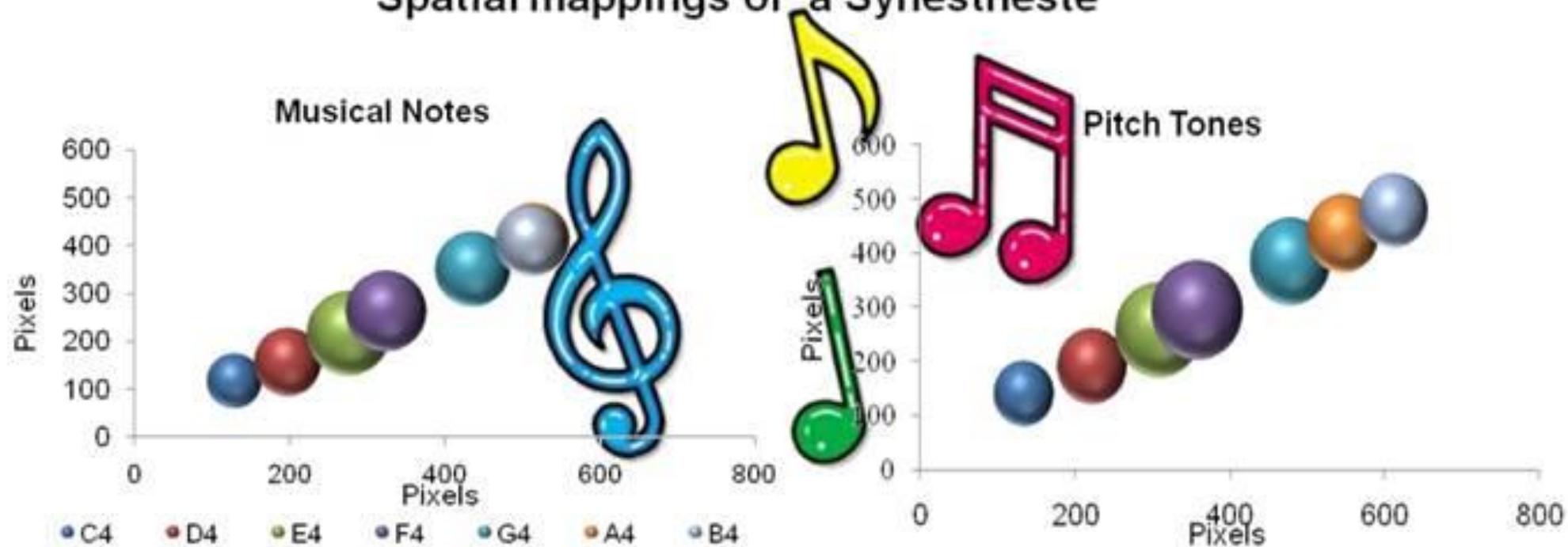


# AS NOVAS HIPÓTESES

- Existem neurónios multissensoriais
- Estes existem em zonas do cérebro, onde o processamento de informação ocorre antes de chegar ao córtex (zonas sensoriais primárias)
- Integração multissensorial também ocorre nas zonas classicamente definidas como puramente unissensoriais

# SINESTISIA ... UM EXEMPLO EXTREMO

Spatial mappings of a Synestheste



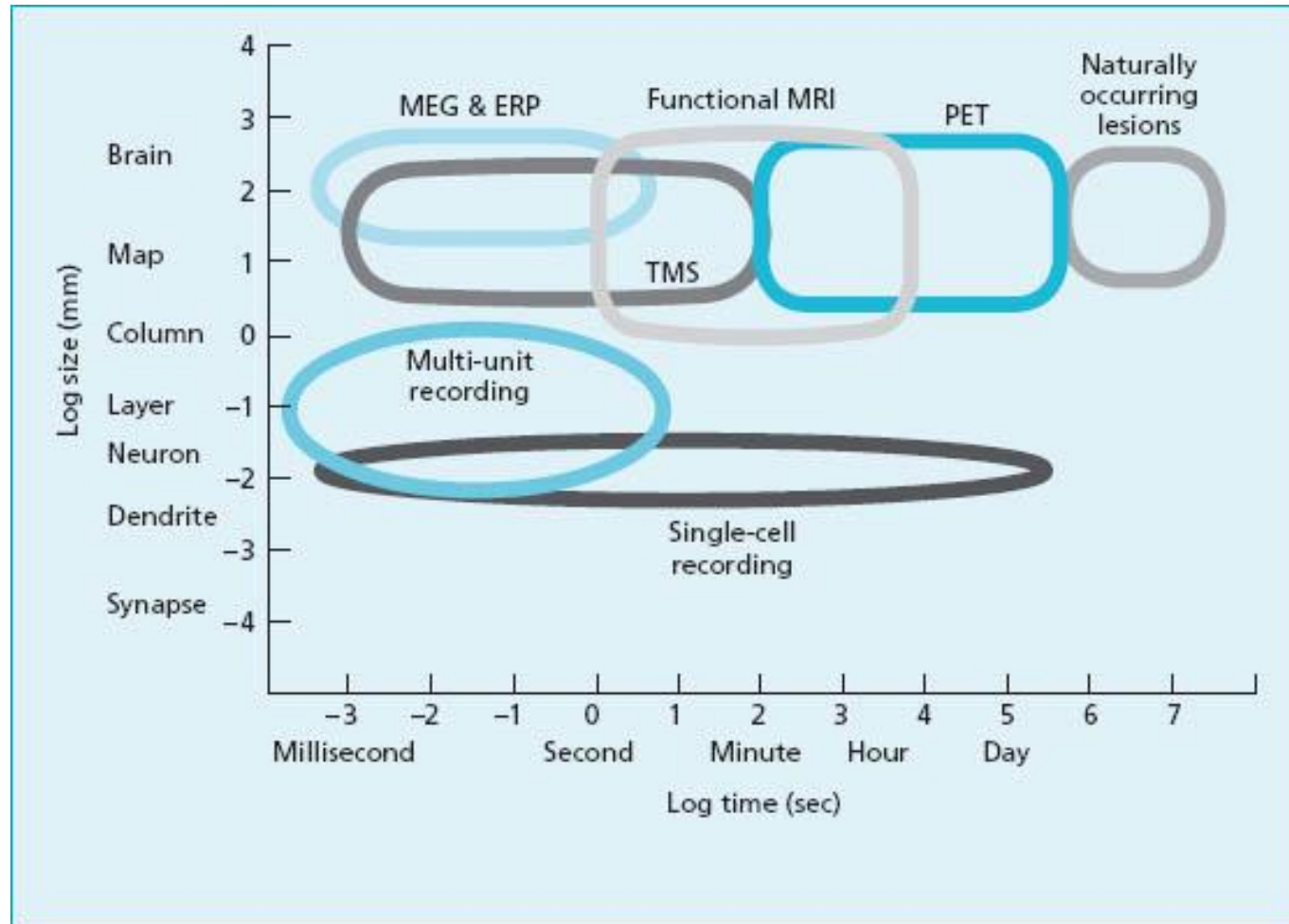
# SINESTISIA ... UM EXEMPLO EXTREMO

A B C D E F G H  
I J K L Ł M N O  
P Q R S T U V  
W X Y Z  
1 2 3 4 5 6 7 8 9 0

# SINESTISIA ... UM EXEMPLO EXTREMO



# COMO VER O QUE SE PASSA NO CÉREBRO?



# COMO VER O QUE SE PASSA NO CÉREBRO?

Magnetoencefalografia



Electroencefalografia

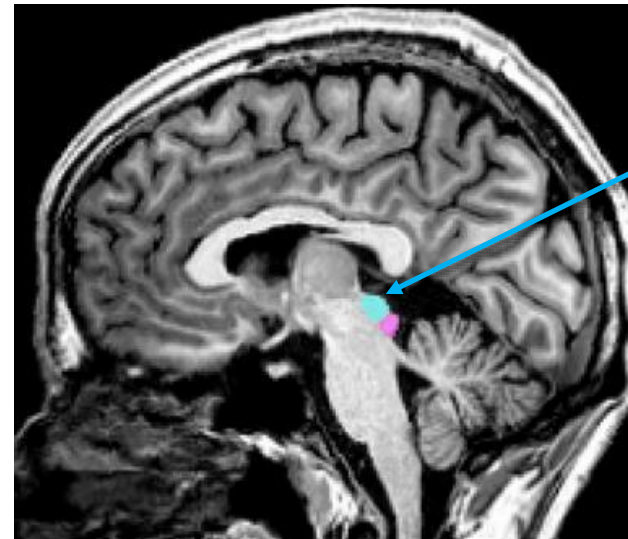


Ressonância Magnética



# ESTUDOS EM MODELOS ANIMAIS

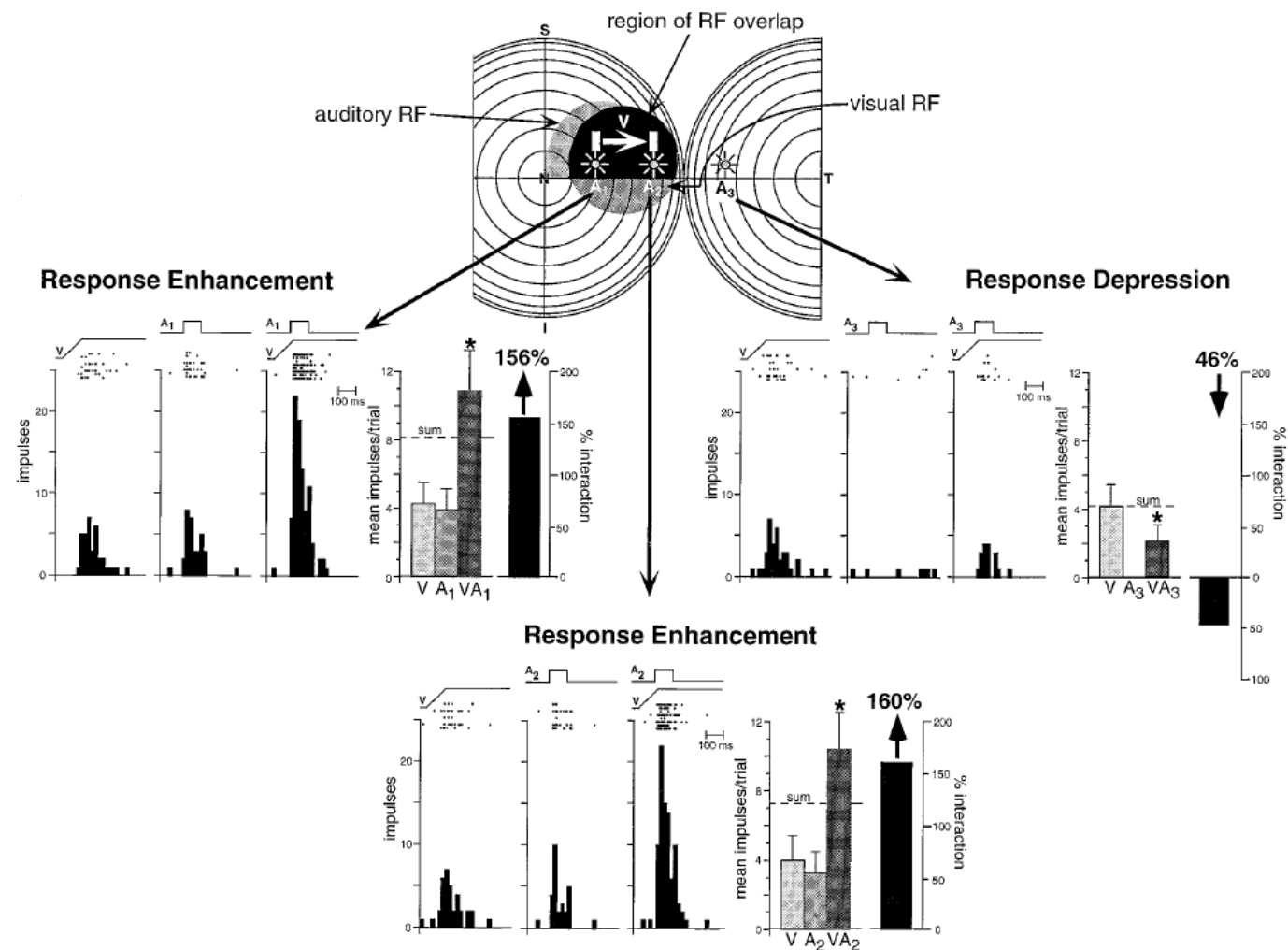
- Wallace and Stein (1997) - *‘Multisensory neurons receive convergente input from two or more senses, and they show enhanced activity when stimuli are spatially concordant and synchronized’*



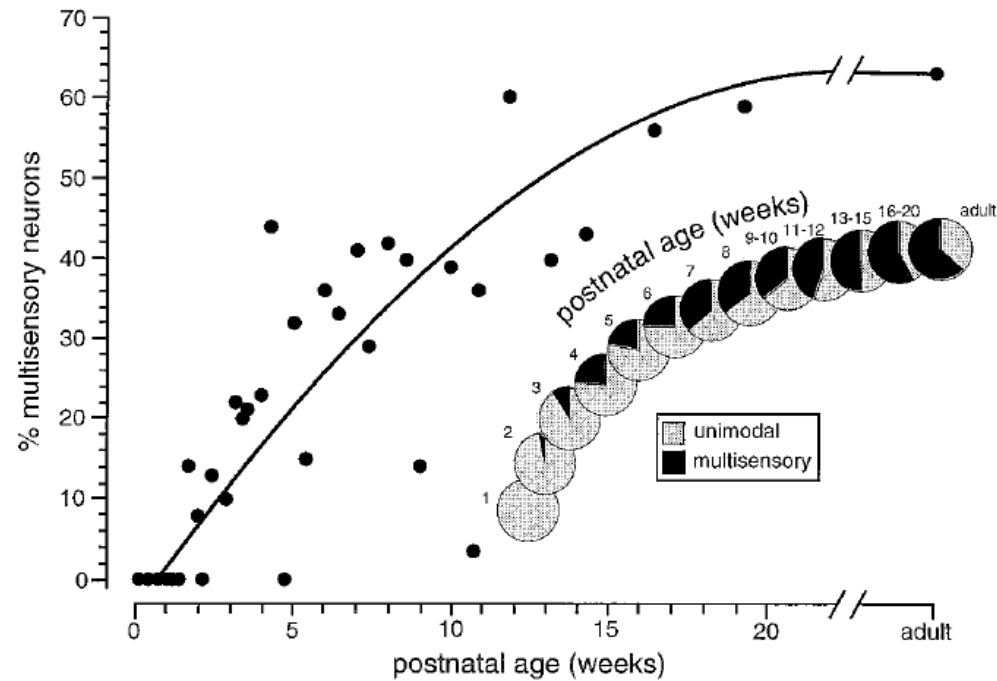
Colículo Superior



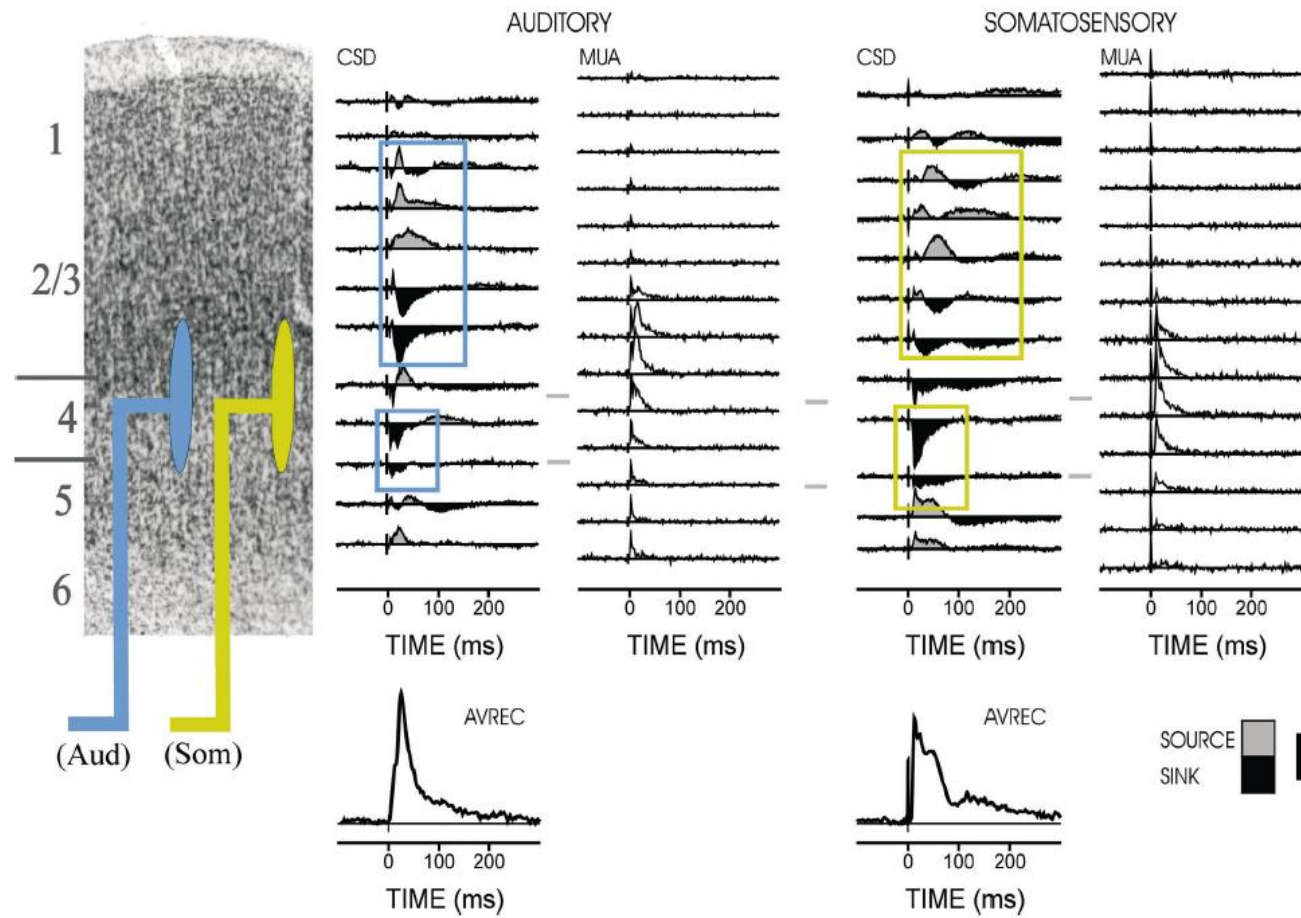
# ESTUDOS EM MODELOS ANIMAIS



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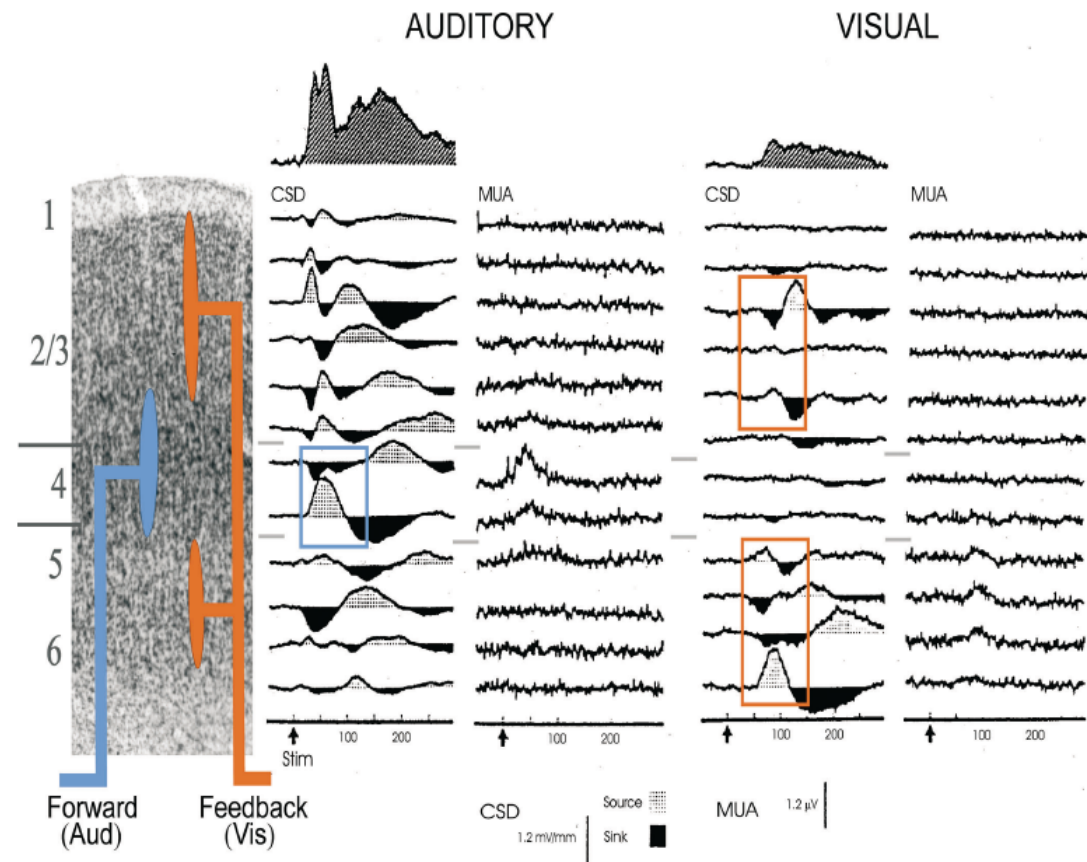


Fig. 3. Laminar CSD and MUA profiles evoked by auditory (left) and visual stimuli (right) and recorded from one site in auditory association cortex, poster lateral to A1 cortex. Intercontact spacing on the multielectrode was 150  $\mu\text{m}$ . Each tracing represents an average of 100 stimulus-evoked responses. Those on the left represent the averaged responses to binaural 65 dB clicks. Those on the right were elicited by intense binocular light flashes (10  $\mu\text{s}$  duration,  $7.8 \times 10^5$  lux intensity). The boxes circumscribe CSD configurations that reflect the initial excitatory response at the depth of lamina 4 (blue—auditory profile), as opposed to, above and below lamina 4 (red—visual profile). At the extreme left is a diagram depicting the laminar pattern of termination for feedforward inputs from auditory (blue) and feedback visual (red) systems.

# O QUE VEMOS NO CÉREBRO HUMANO?

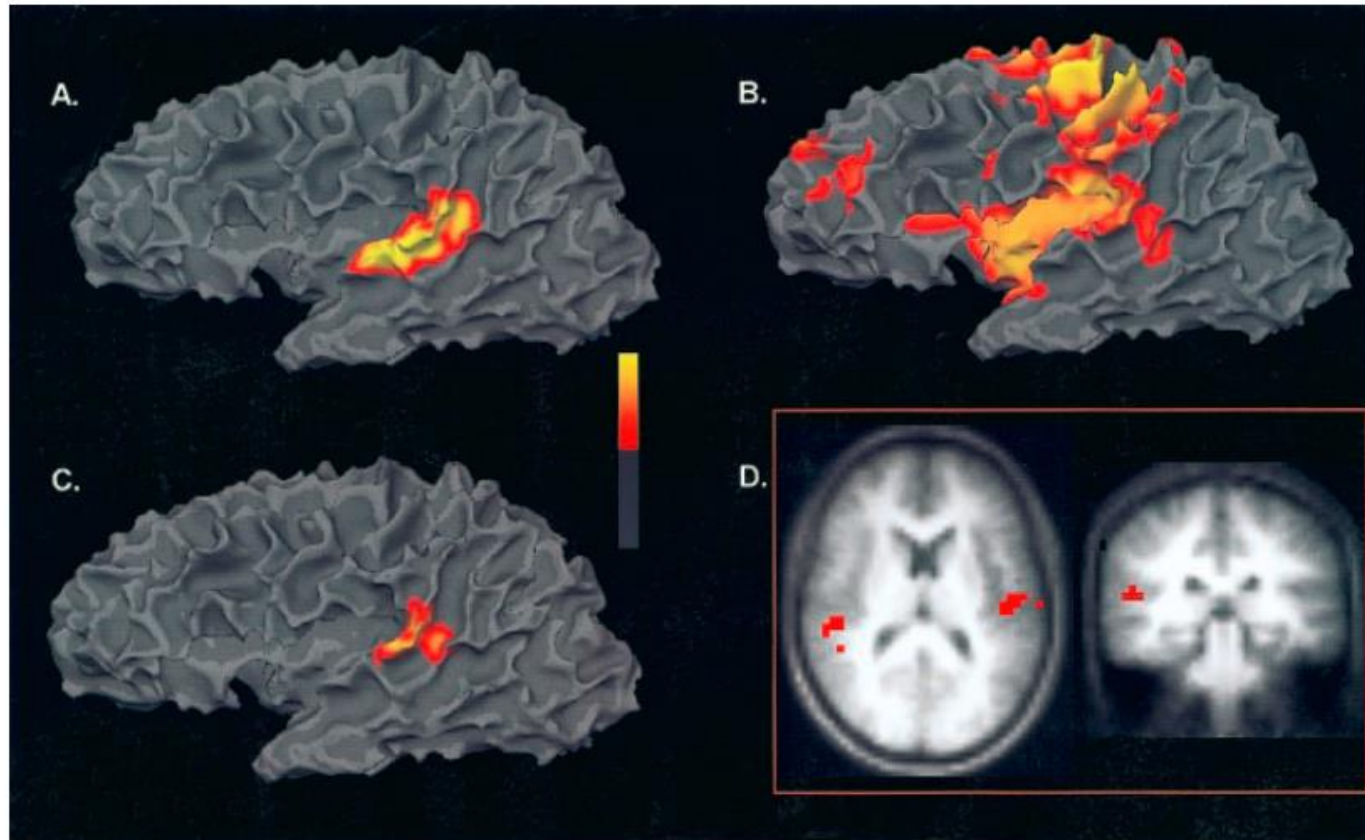


FIG. 1. Group ( $n = 12$ ) activation maps for auditory (A) and somatosensory (B) stimulation, projected onto a 3-dimensional rendering of the left hemisphere, which was derived from one representative subject's anatomic magnetic resonance imaging scan. The color scale indicates significance values from  $P < 0.05$  (red) to  $P < 0.001$  (yellow). The region of significant overlap between these 2 activation maps ( $\text{Aud} \cap \text{Soma}$ ) is shown projected onto the same rendered surface (C). D: the overlap fields in both an axial slice ( $z = 12$ ), which shows overlap fields in both hemispheres, and in a coronal slice ( $y = -32$ ), which shows the overlap field in the posterior portion of the left auditory cortex. These slices were derived from of a group-averaged brain, obtained by averaging the anatomic scans of the 12 subjects who participated in the study.

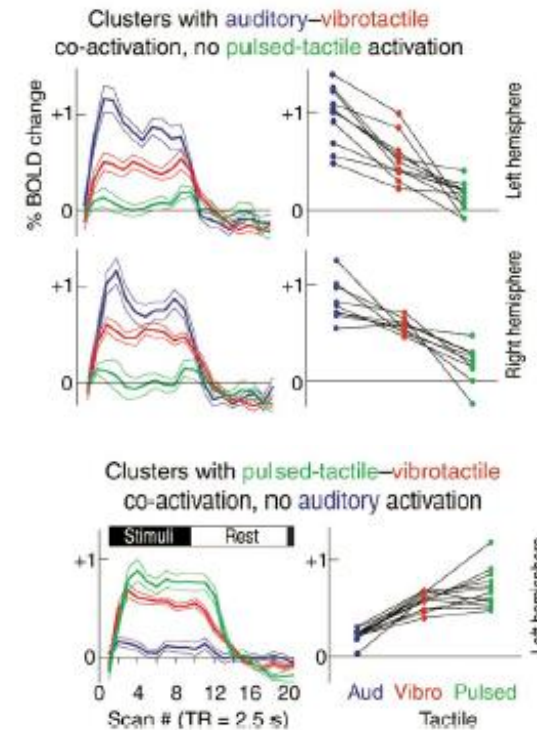
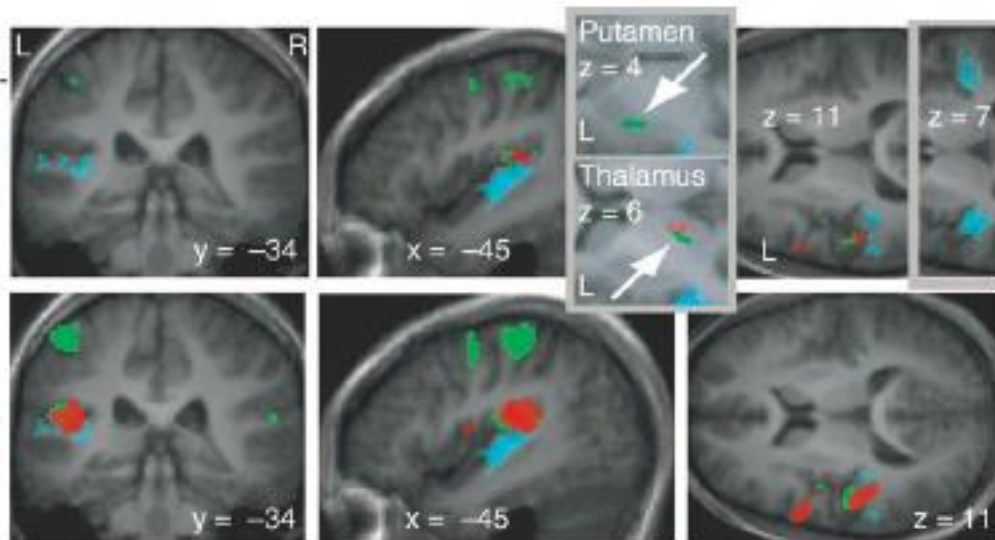
# O QUE VEMOS NO CÉREBRO HUMANO?

**A** Stimulus-related activation (*random-effects analysis, N = 13*)

*minimal smoothing*

■ Vibrotactile  
■ Pulsed-tactile  
■ Auditory

*liberal smoothing*



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OBRIGADA 😊