

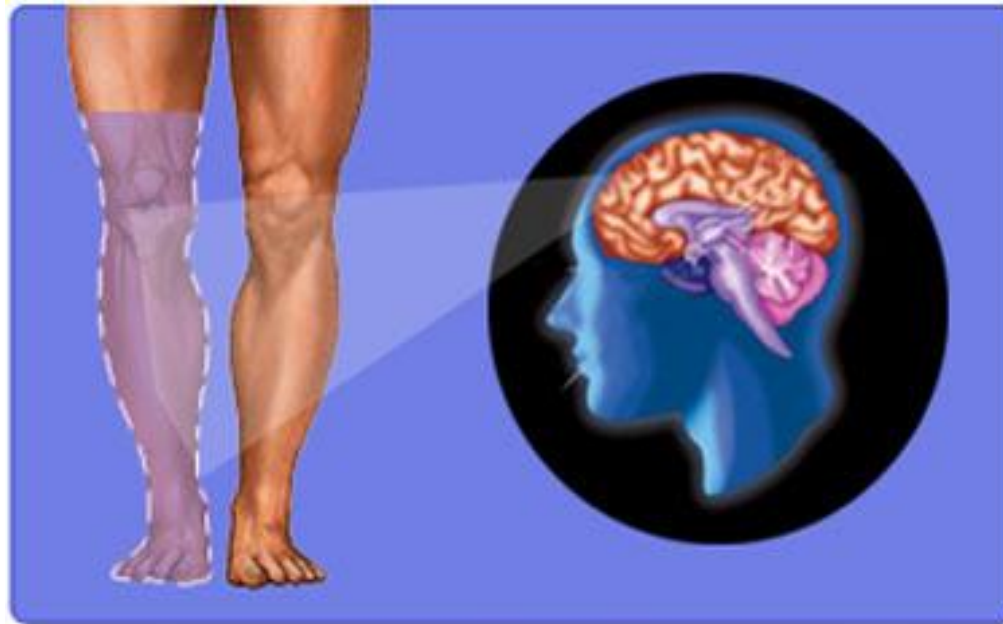


# Phantom Limb Syndrome

Mojtaba Kanani

# Phantom Limb

- A **phantom limb** is the sensation that an amputated or missing limb is still attached.



# History

**Ambroise Paré**



Posthumous, fantasy portrait by [William Holl](#)

**Born** 1510  
Bourg-Hersent near [Laval](#), France

**Died** 20 December 1590 (aged 80)  
Paris, France

**Nationality** French

**Citizenship** France

**Known for** His contributions to surgery

**Scientific career**

**Fields** Barber Surgery

**1551**

**Silas Weir Mitchell**



**Born** Silas Weir Mitchell  
February 15, 1829  
[Philadelphia, Pennsylvania](#)

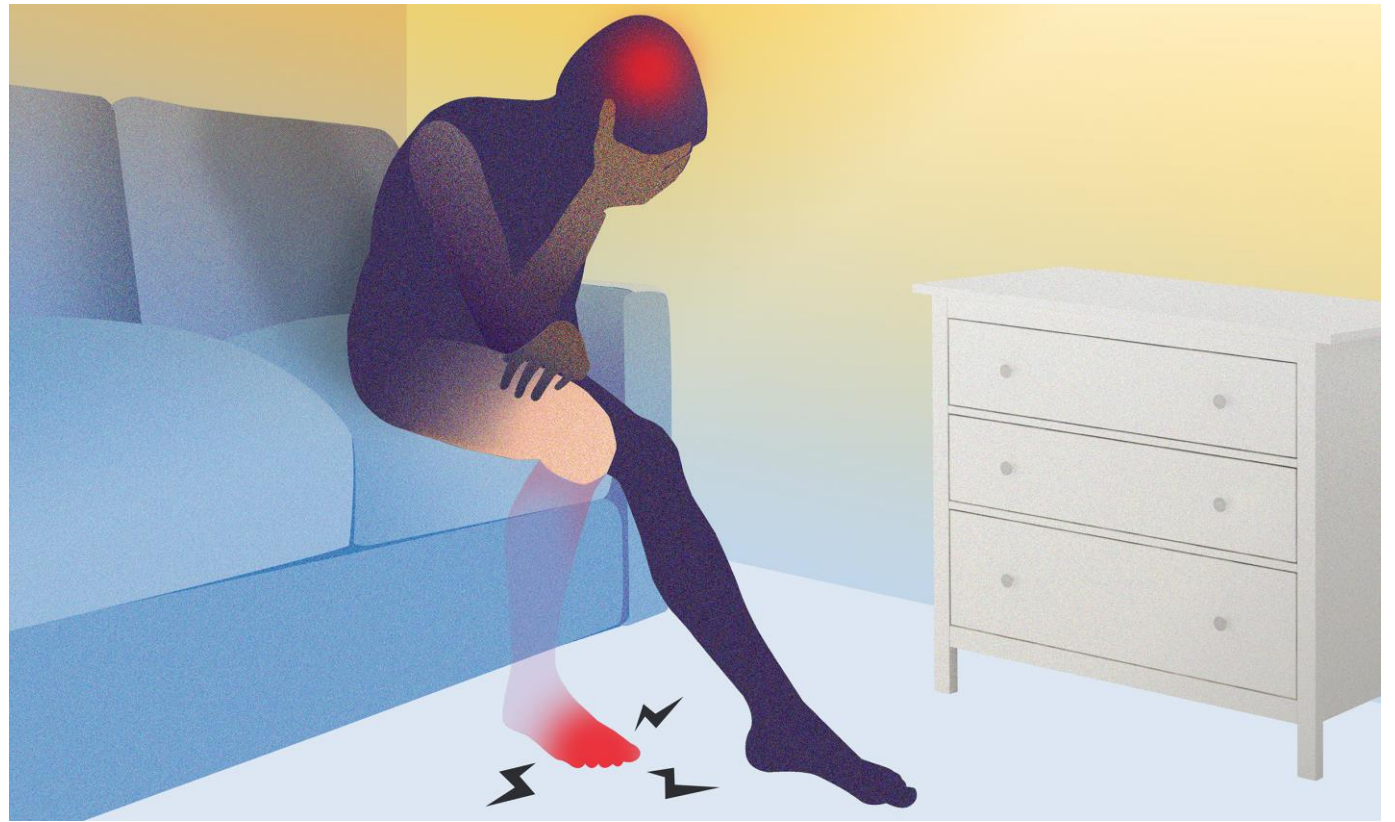
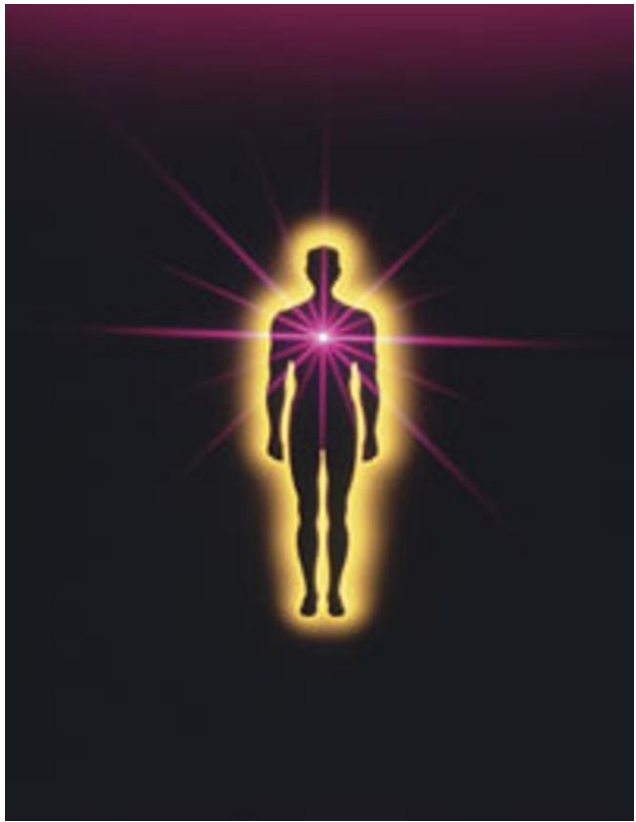
**Died** January 4, 1914 (aged 84)  
[Philadelphia, Pennsylvania](#)

**Alma mater** [Jefferson Medical College](#)

**Known for** neurology research

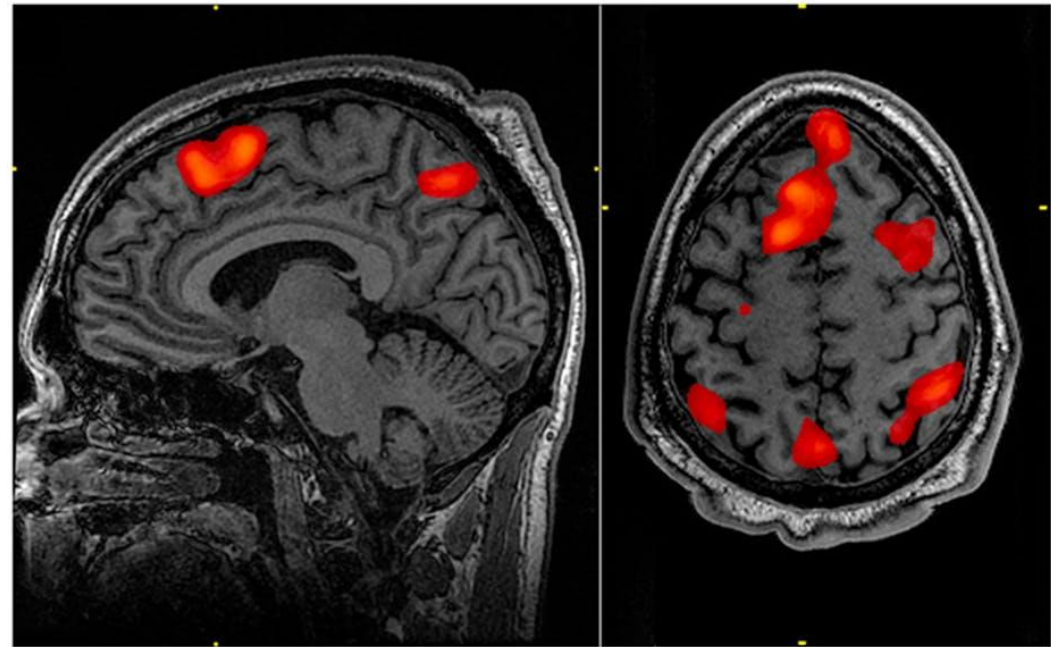
**1872**

# Reason



# FMRI

- **Functional magnetic resonance imaging**
- **1990**



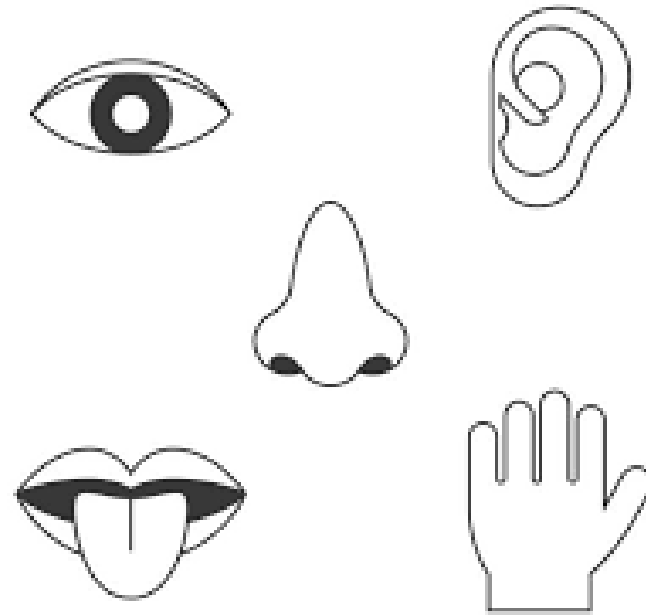
# Phantom Limb Syndrome

- **Phantom limb syndrome** is a condition in which patients experience sensations in a limb that does not exist.
- 80% - 100%

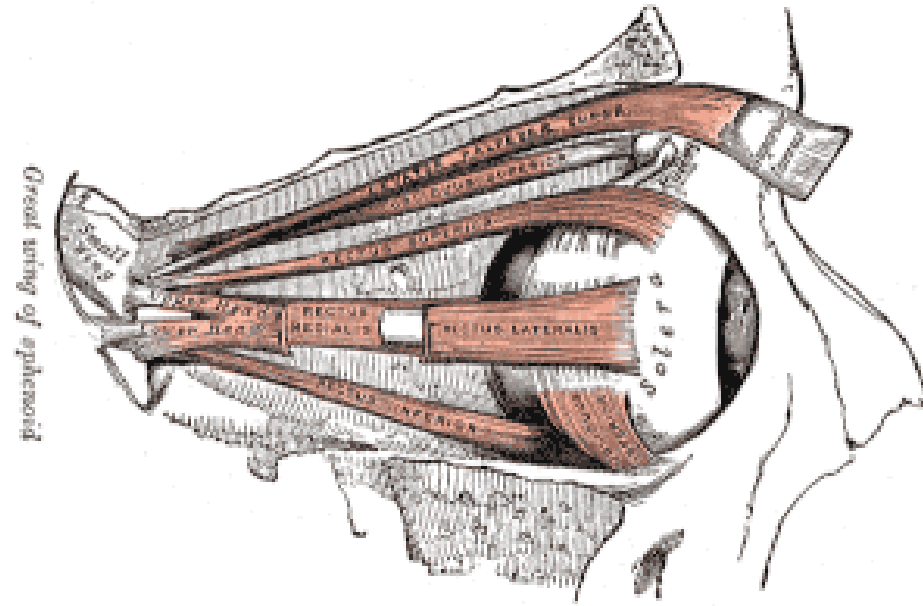


# Not just in Limbs

- Nose
- Internal Organs
- Eye
- ...



- Pain – 26%
- Charles Bonnet Syndrome (Visual hallucinations) – 30%





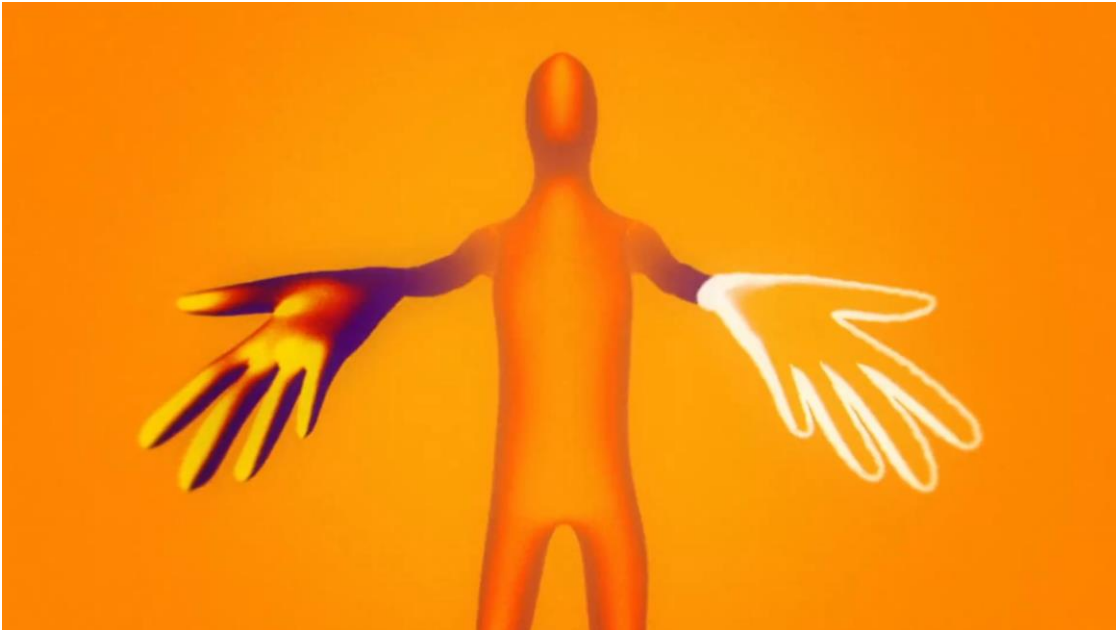


# Phantom Sensation Types

- Kinetic
- Kinesthetic
- Exteroceptive

# Kinetic

- Sensations Related to **Movement** of Phantom Limb
- Voluntarily / Involuntary

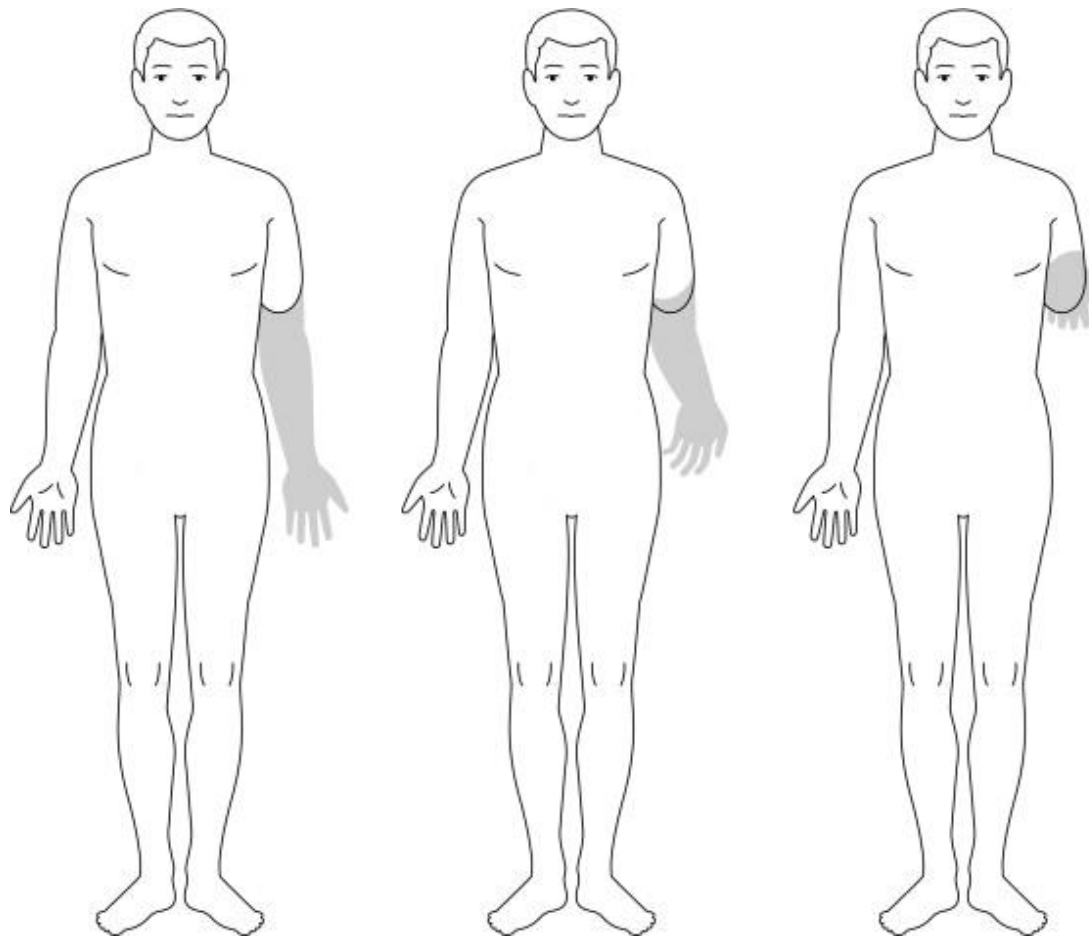




# Kinesthetic

- Sensations related to **Size** , **Shape** , **Position** of Phantom Limb.
- Bigger / Smaller / Same as real / Changing
- Unhurt / Injured
- Relax / Painful

# Telescoping



# Exteroceptive

- Sensations related to **Touch , Pressure , Temperature , Itch** of Phantom Limb.
- Also Feelings Related to External Objects being applied to Phantom Limb
- Wedding Ring , Watchband , Tight Shoelaces



# Phantom Limb Pain

- 60% - 80% feel **Phantom Limb Pain**
- 75% Early – 25% Late
- Sometimes Start even Years after amputation
- Duration



# Common Types of Phantom Limb Pain



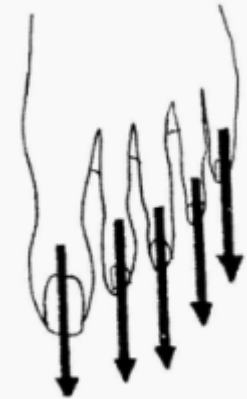
A rope burn sensation between the big and second toe.



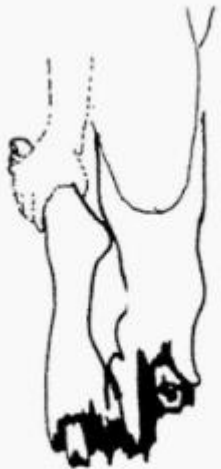
A hammer is smashing the big toe.



The fist is so tightly clenched that the finger nails are digging into the flesh in the palm of the non-existent hand.



Five toes are being stretched.



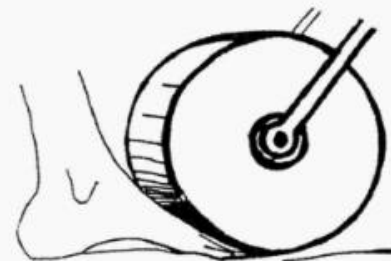
A feeling, for an above-knee amputee, that the fibula and tibia are being broken in half.



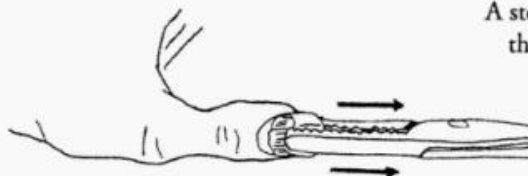
The bones of the non-existent arm are being shattered.



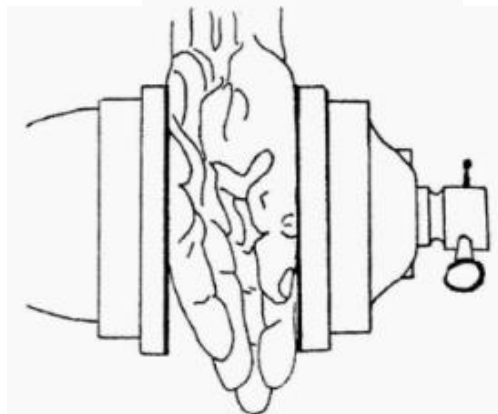
A red-hot poker is being thrust through the foot.



A steam roller is running over the front part of the foot.



Pliers pulling out nails.



The hand is being crushed in a press.



# Difference

- Phantom Limb Syndrome
- Phantom Pain
- Stump Pain – 50%



# Why Pain?

- Pain and Injury



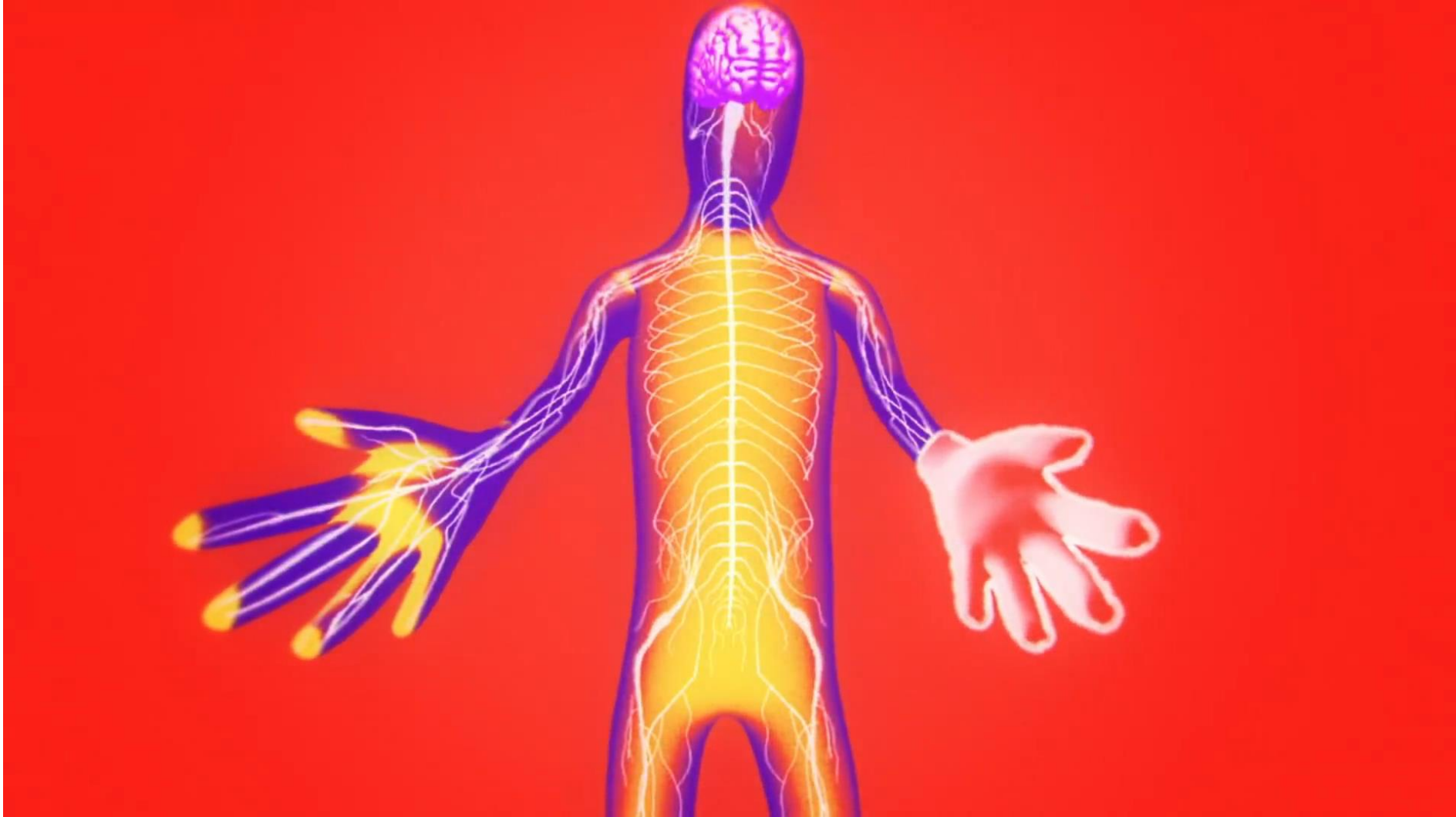
**What causes  
Phantom Limb  
Sensations?**



# Theories

- Peripheral mechanisms
- Central mechanisms
- The Neuromatrix
- Psychological Theory
- ...

# Peripheral mechanisms



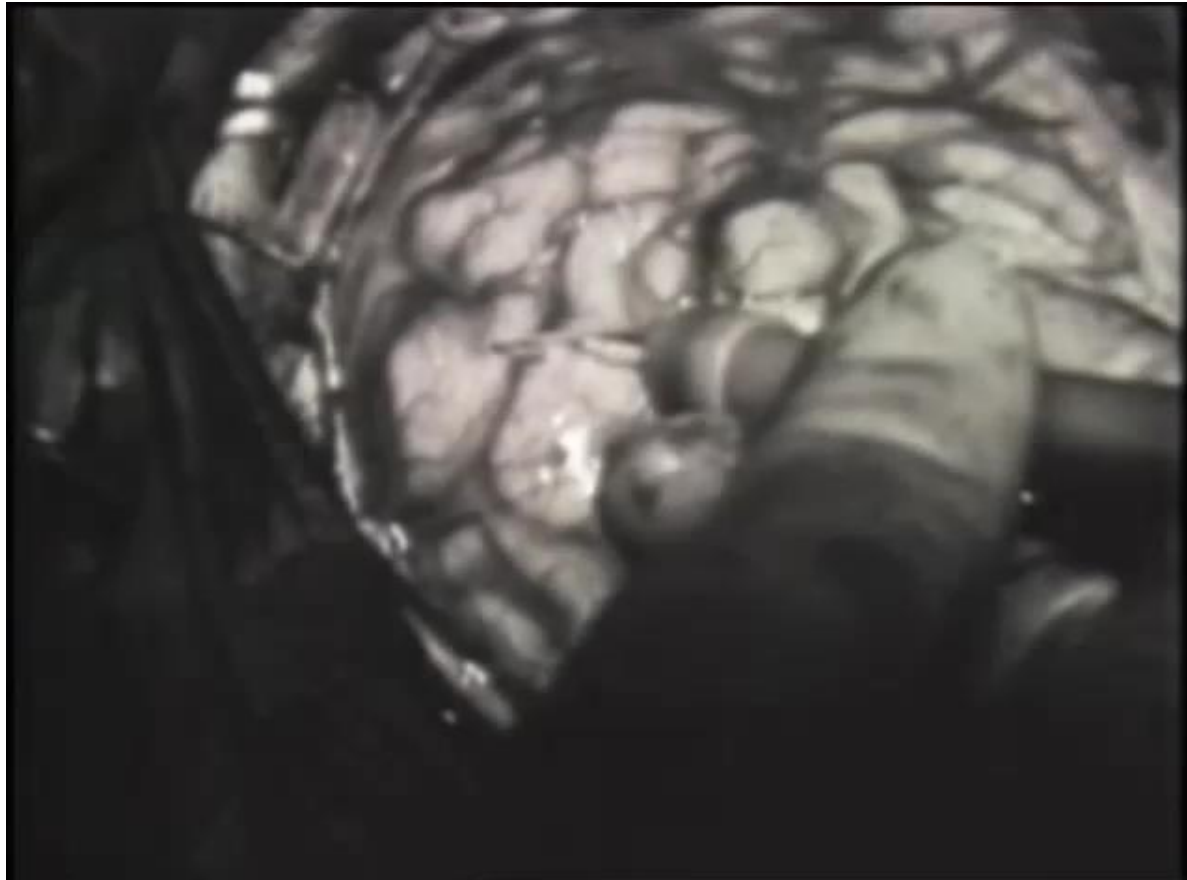


# Problems

- Even **removing neuromas** doesn't cure phantom pain.
- Cant explain phantom pain in people with **congenital limb deficiency**.

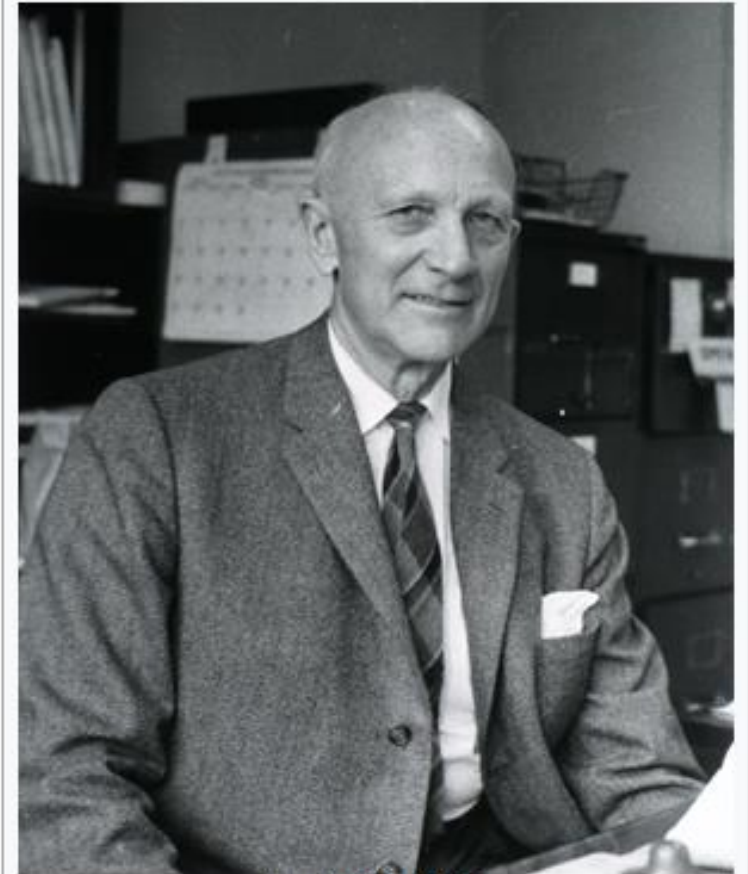
# Central mechanisms

- Brain Mapping



**Wilder Penfield**

OM CC CMG FRS

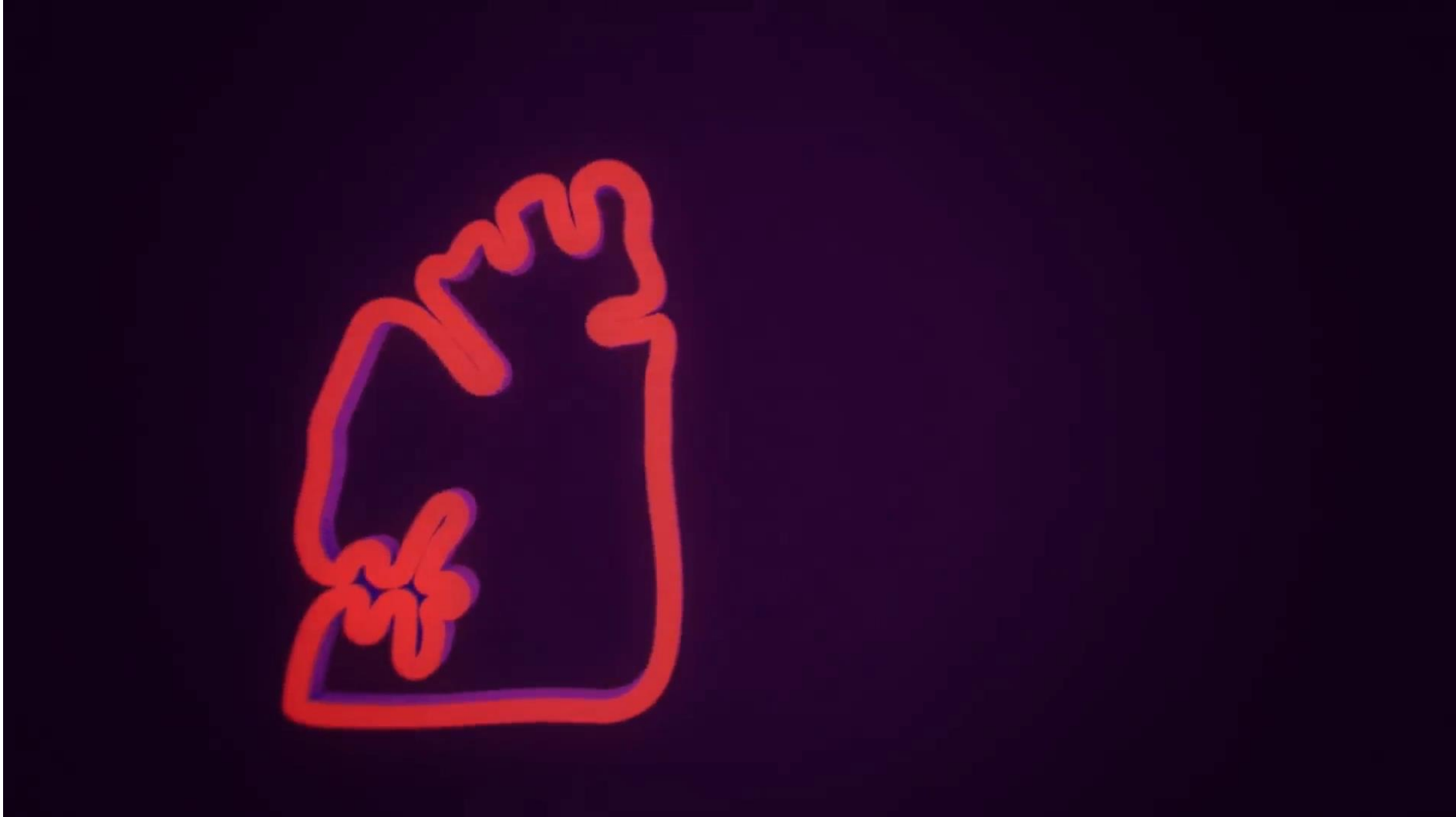


Penfield in 1958

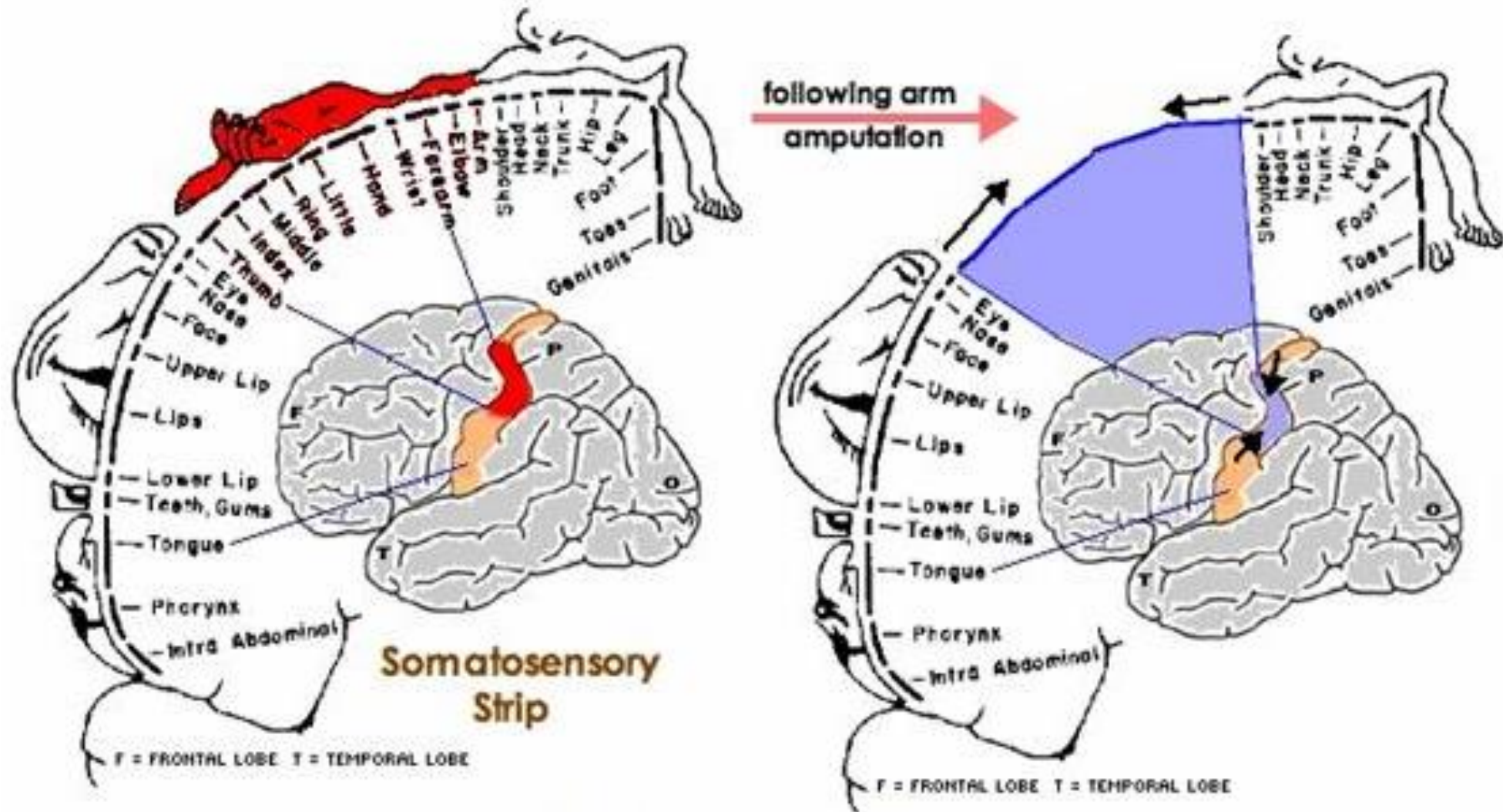
<b>Born</b>	Wilder Graves Penfield January 26, 1891 Spokane, Washington, United States
<b>Died</b>	April 5, 1976 (aged 85) Montreal, Quebec, Canada



# Cortical Homunculus



# Brain Remapping

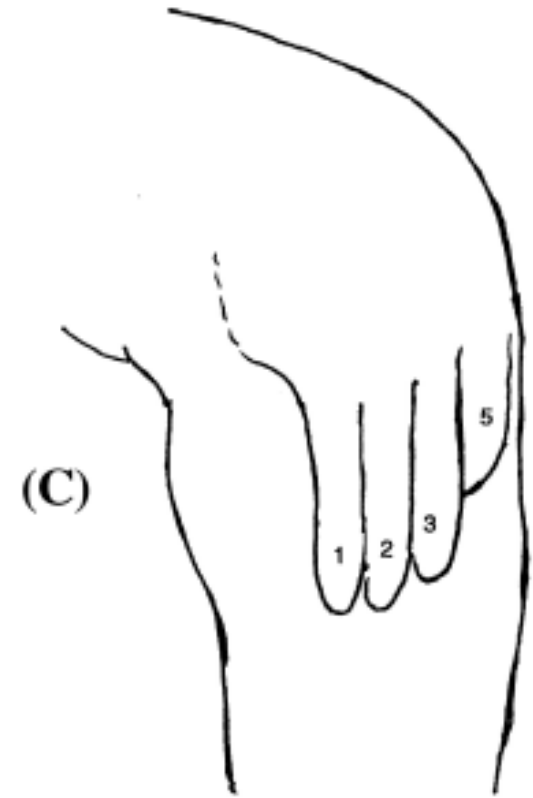
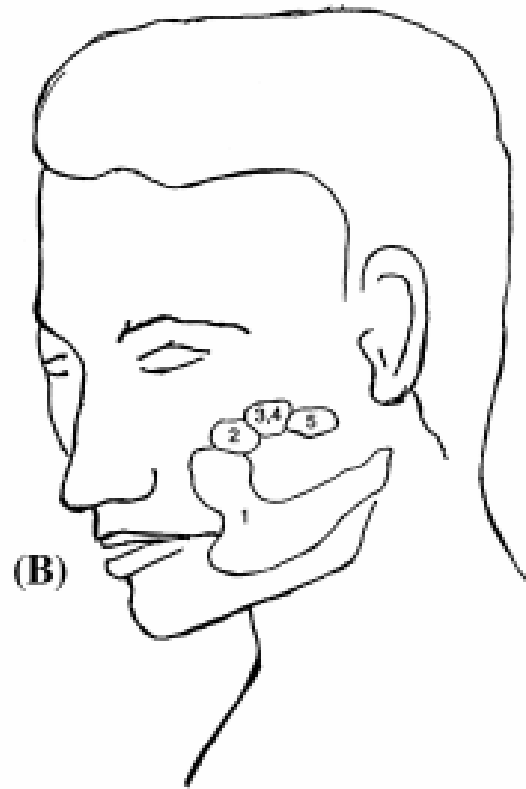
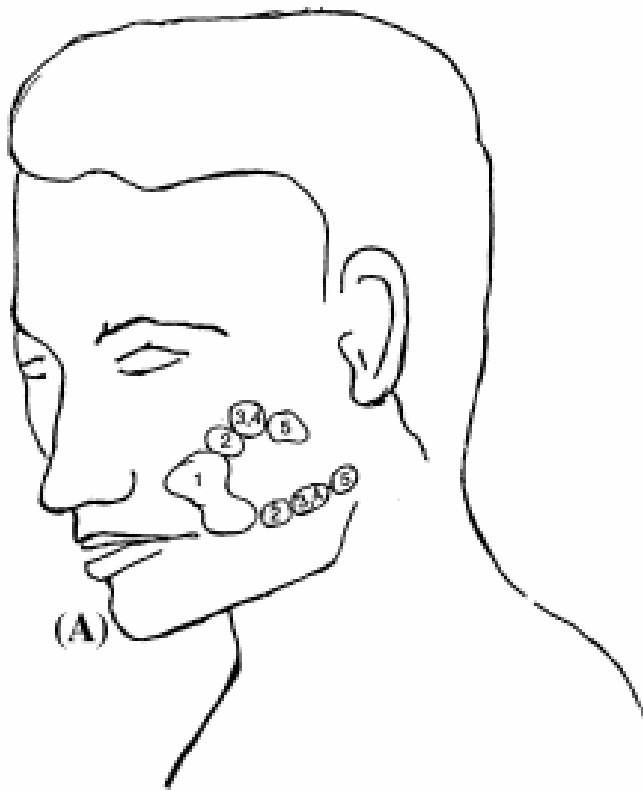




# Brain Remapping



# Brain Remapping



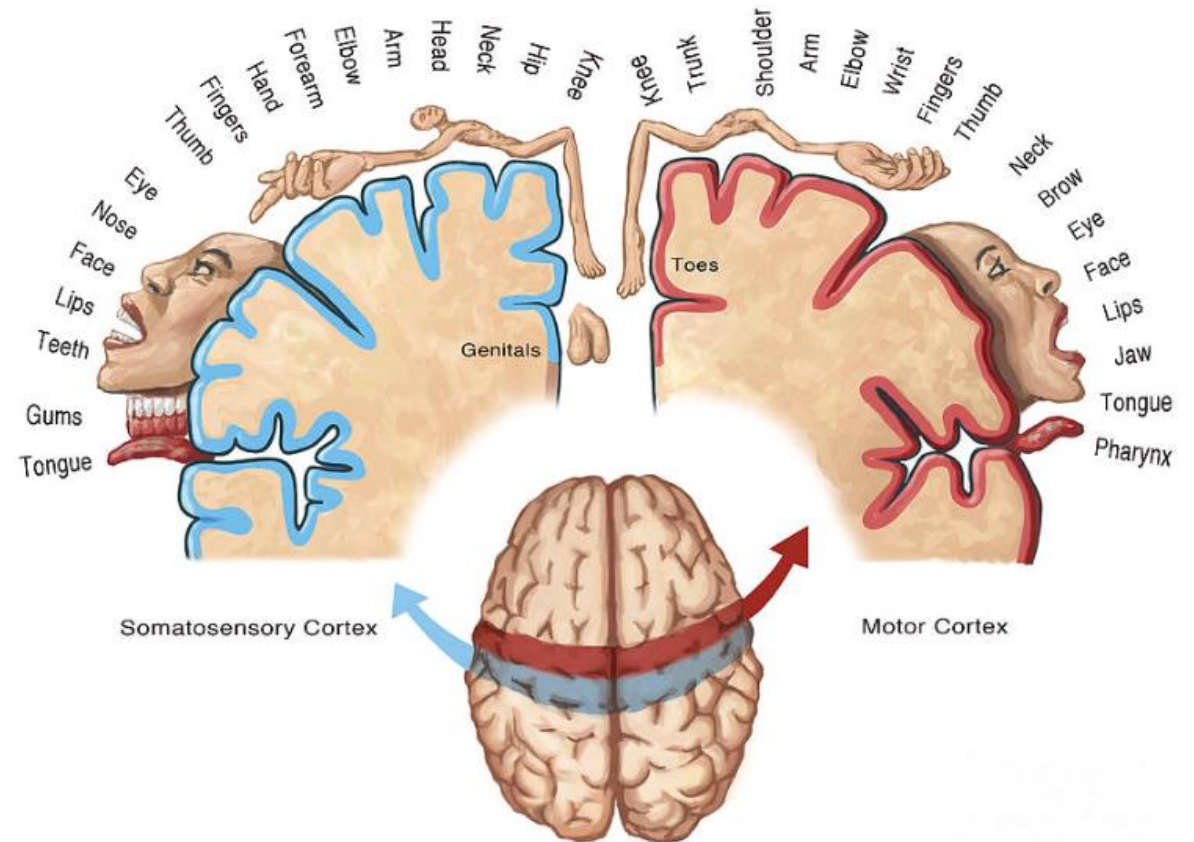


# Problem

- **Not everyone** feel phantom limb and phantom pain.

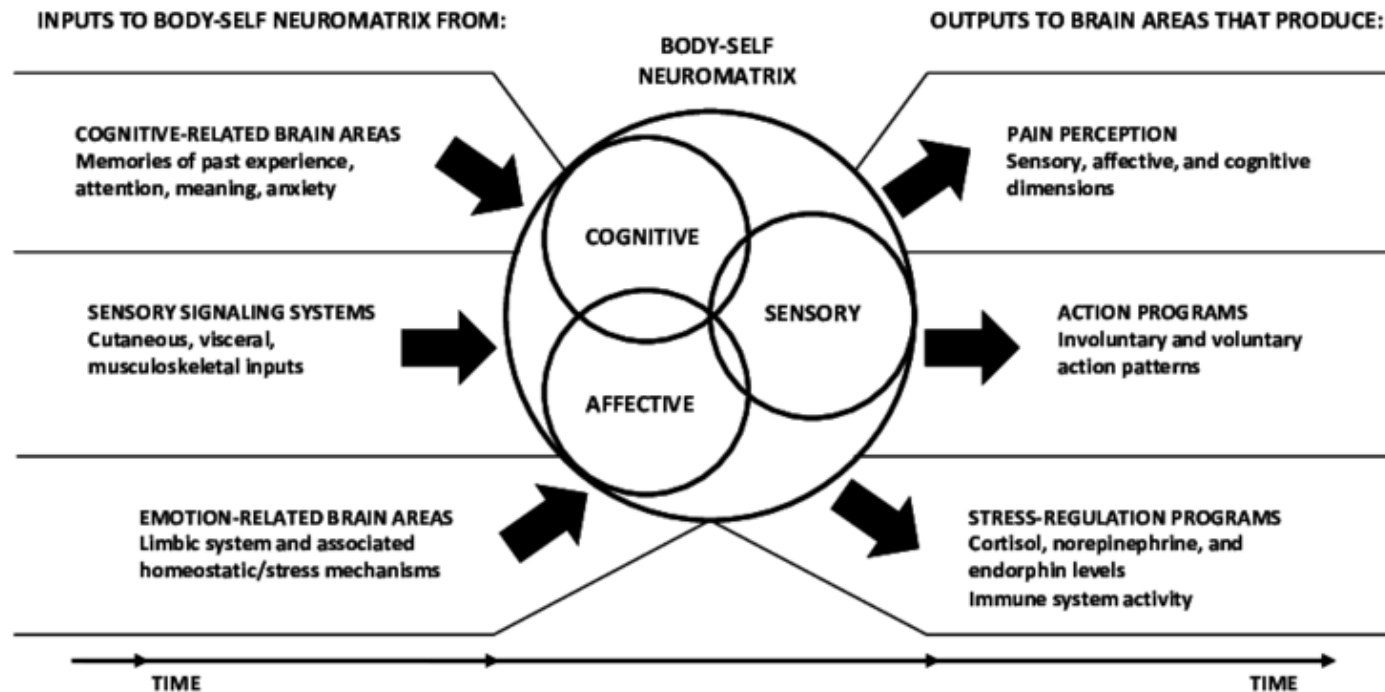
# Phantom Limb and Age

- Age < 2 20%
- 2 < Age < 4 25%
- 4 < Age < 6 61%
- 6 < Age < 8 75%
- Age > 8 100%



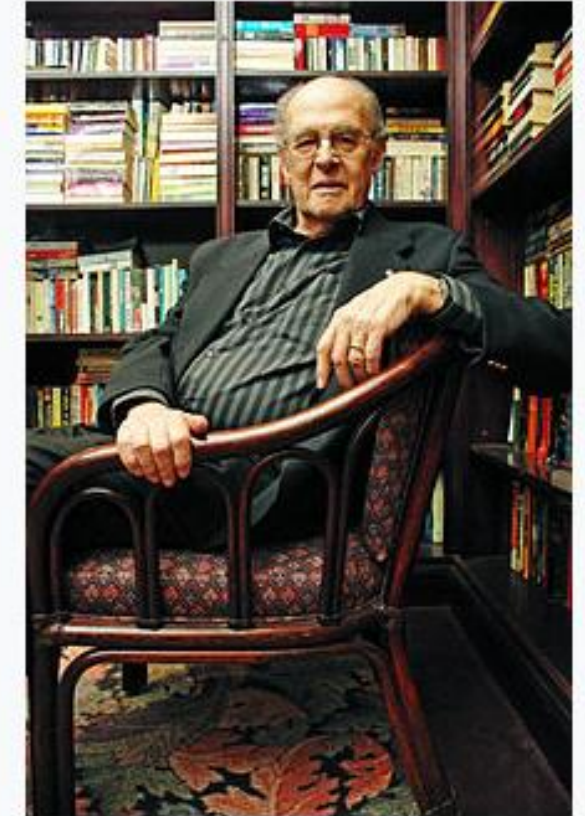
# The Neuromatrix

- Self
- NeuroSignature



**Ronald Melzack**

OC OQ FRSC



Born	July 19, 1929 Montreal, Quebec, Canada
Died	December 22, 2019 (aged 90) Montreal, Quebec, Canada
Nationality	Canadian
Alma mater	McGill University
Occupation	Psychologist, Professor



# Problems

- does not address how sensations can **spontaneously end**.
- **Not everyone** feel phantom limb and phantom pain.
- **can not be tested empirically**.



# Psychological Theory

- wish fulfillment
- denial of the loss of a part
- "Just as the widow finds it hard to believe that her husband is dead and often has a strong sense of his presence, so the amputee has difficulty in accepting the loss of his limb and he continues to feel it is present "



# Problems

- **FMRI** shows that the pain is really there.

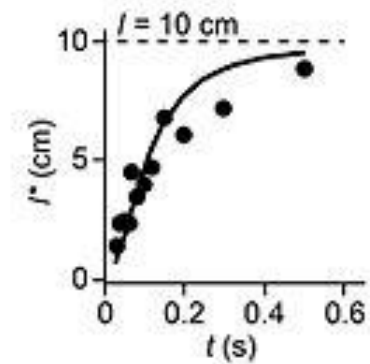
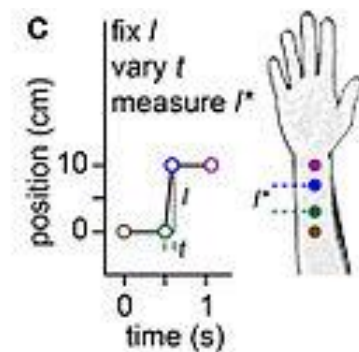
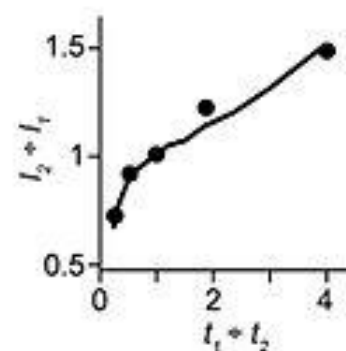
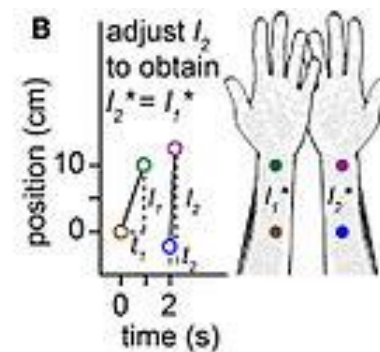
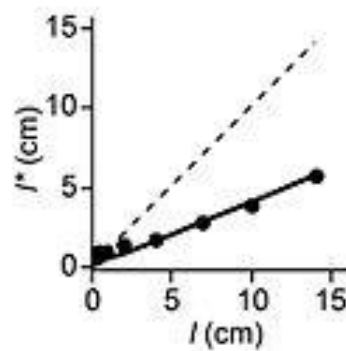
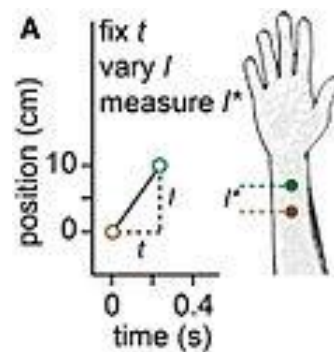
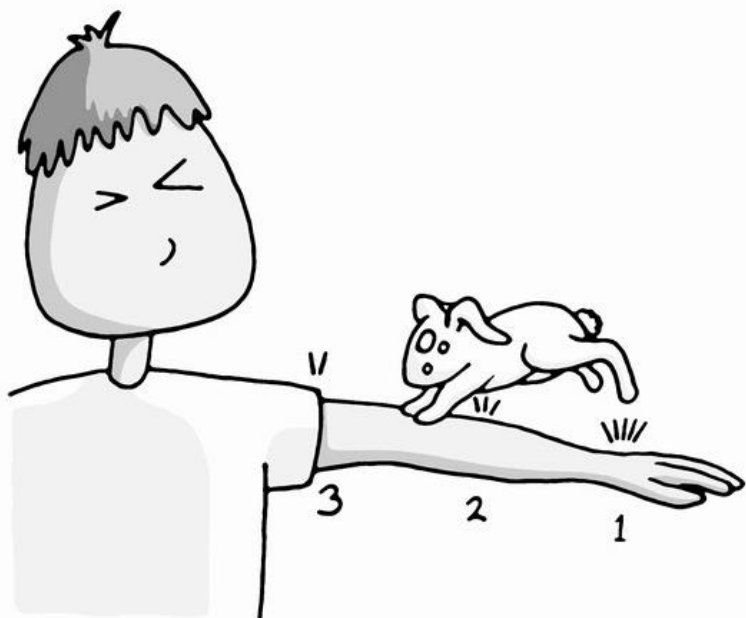




# Why Pain?

- Our Brain is **not just Reporting Everything**

# Cutaneous Rabbit Illusion





# What is the Truth?

- Is it illusion?
- Is pain illusion?



# Risk Factors

- Upper Limb or Lower Limb
- Traumatic limb loss or Surgical amputation
- Preamputation History
- Stump Condition
- Mechanical or electrical Stimulation
- Stress
- ...

# Treatment

Pharmacotherapy	Surgical/invasive procedures	Adjuvant therapy
Opioids	Stump revision	Transcutaneous nerve stimulation
Morphine	Nerve block	Mirror therapy
Tramadol	Neurectomy	Biofeedback
Tricyclic Antidepressants	Rhizotomy	Temperature biofeedback
Amitriptyline	Cordotomy	Electro myographic biofeedback
Nortriptyline	Lobectomy	Massage
Imipramine	Sympathectomy	Ultrasound
Desipramine	CNS stimulation	Physiotherapy
AntiConvulsants	Spinal cord stimulation	Sensory discrimination training
Carbamazepine	Deep brain/thalamus stimulation	Prosthesis training

# Mirror Box Therapy



V. S. Ramachandran



Ramachandran at the 2011 *Time* 100 gala

<b>Born</b>	Vilayanur Subramanian Ramachandran 10 August 1951 (age 68) <a href="#">Tamil Nadu, India</a>
<b>Alma mater</b>	<a href="#">Stanley Medical College (MBBS)</a> <a href="#">University of Cambridge (PhD)</a>
<b>Known for</b>	Research in <a href="#">neurology</a> , <a href="#">visual perception</a> , <a href="#">phantom limbs</a> , <a href="#">synesthesia</a> , <a href="#">autism</a> , <a href="#">body integrity identity disorder</a> , <a href="#">mirror therapy</a>
	<b>Scientific career</b>
<b>Fields</b>	<a href="#">Neurology</a> · <a href="#">Psychology</a> · <a href="#">Phantom Limb</a>
<b>Institutions</b>	<a href="#">University of California, San Diego</a>

# Virtual Reality



# Prosthetics







# Questions





Thanks for your attention