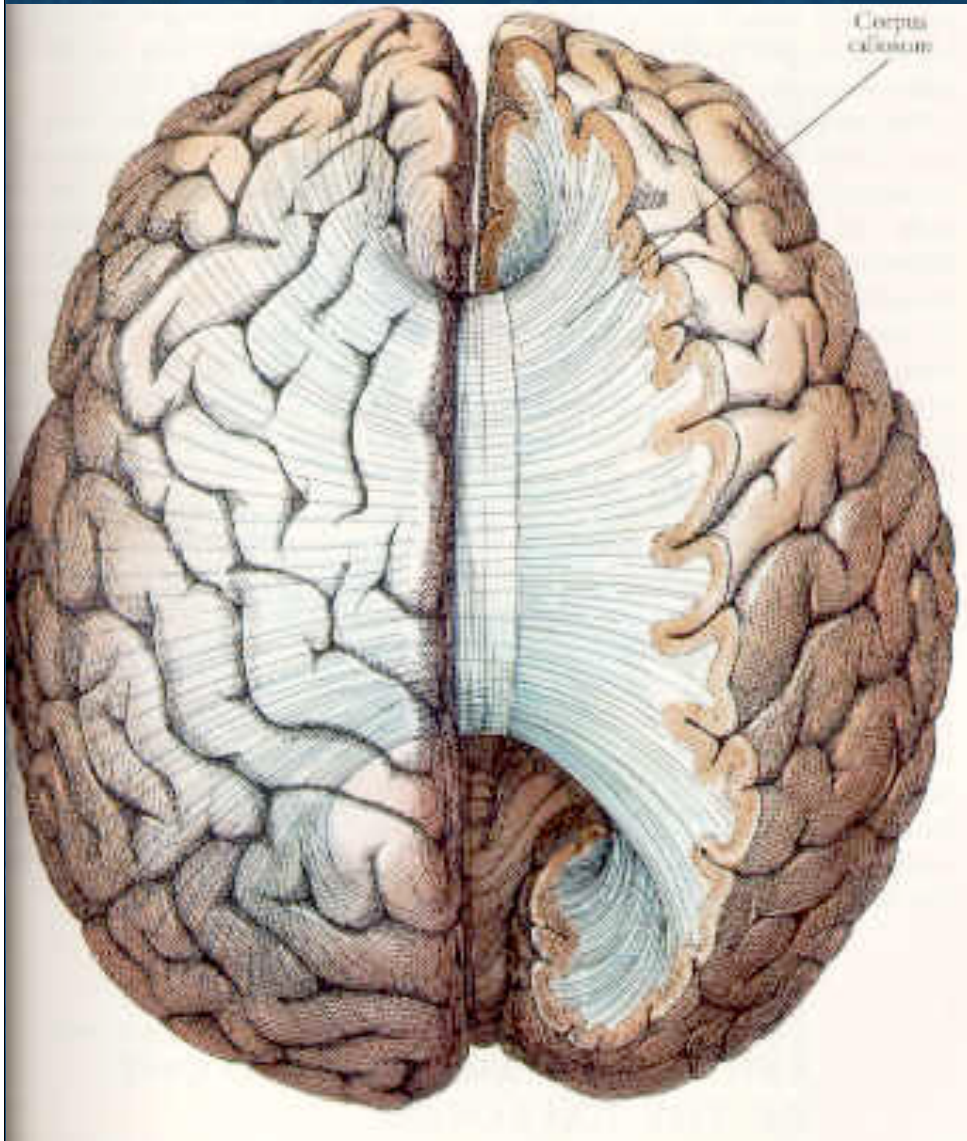


Cognitive Neuroscience
of Language:
6: Hemispheric specialization
for language

Richard Shillcock

Goals

Further explore the implications for language processing that stem from the hemispheric nature of the brain

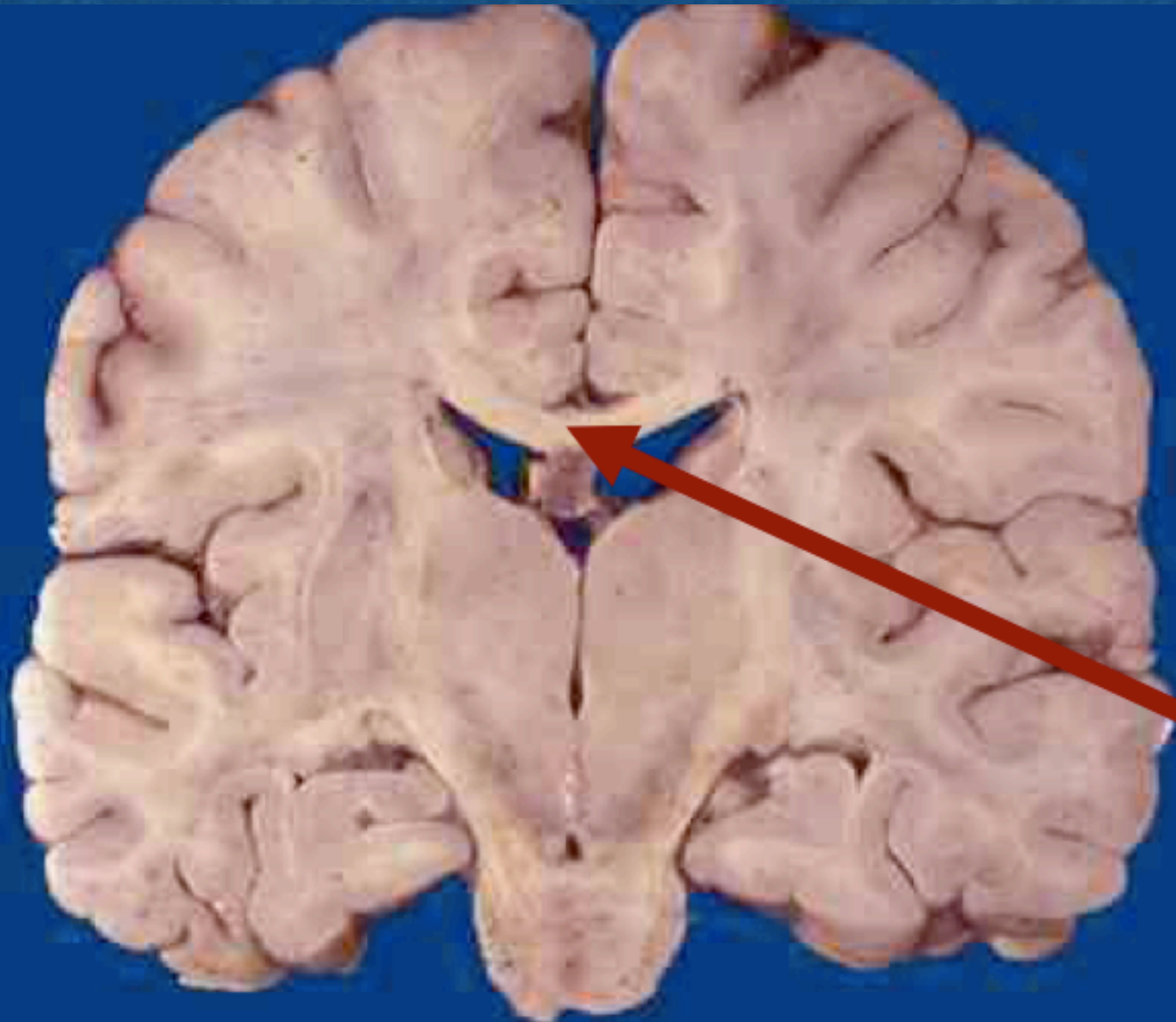


Reading for this lecture

Corballis, M.C., Corballis, P.M., & Fabri, M. (2004). Redundancy gain in simple reaction time following partial and complete callosotomy, *Neuropsychologia*, 42, 71–81.

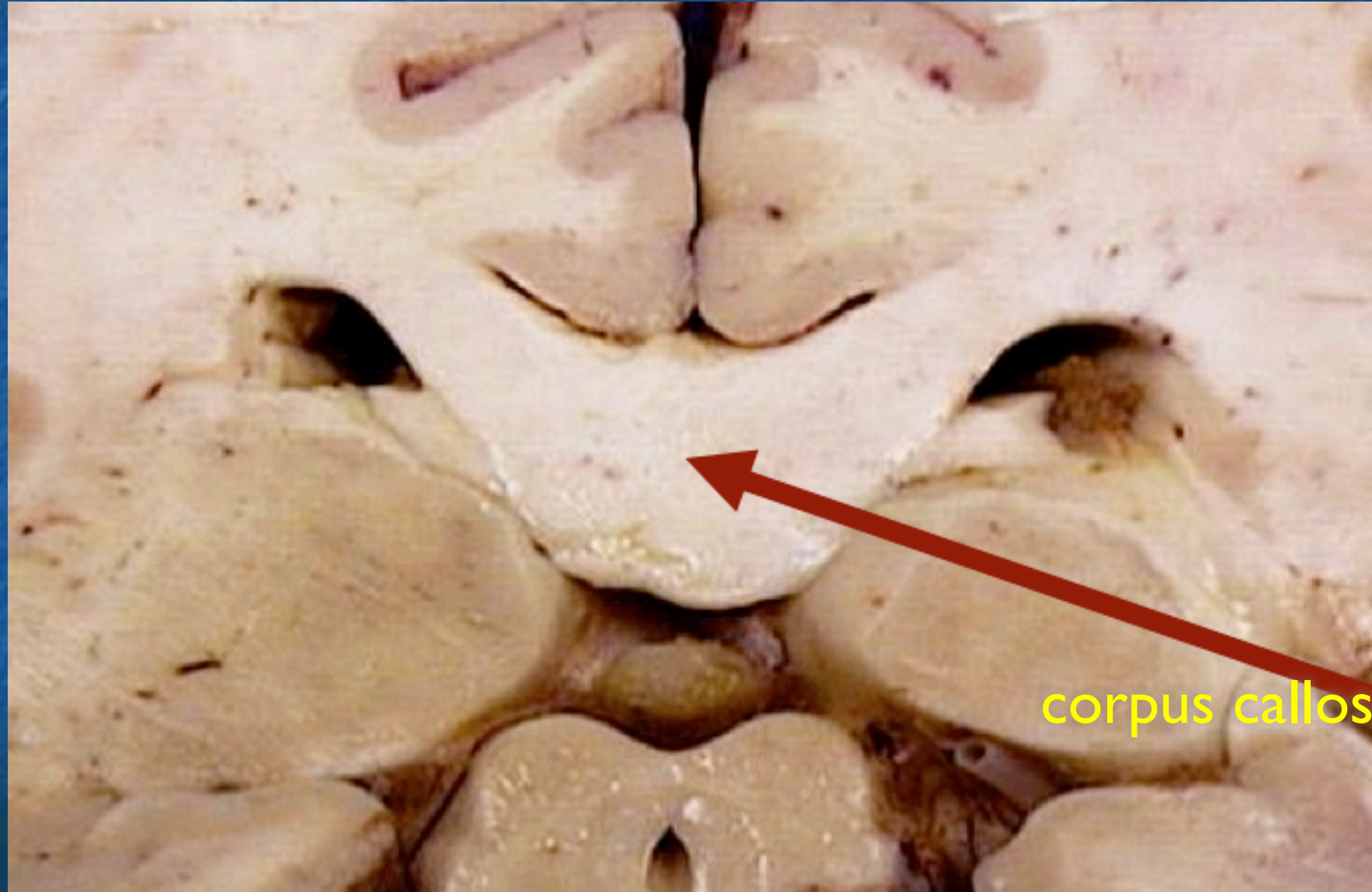
Levy, J., & Trevarthen, C. (1977). Perceptual, semantic, and phonetic aspects of elementary language processes in split-field patients. *Brain*, 100, 105–118.

Coronal section



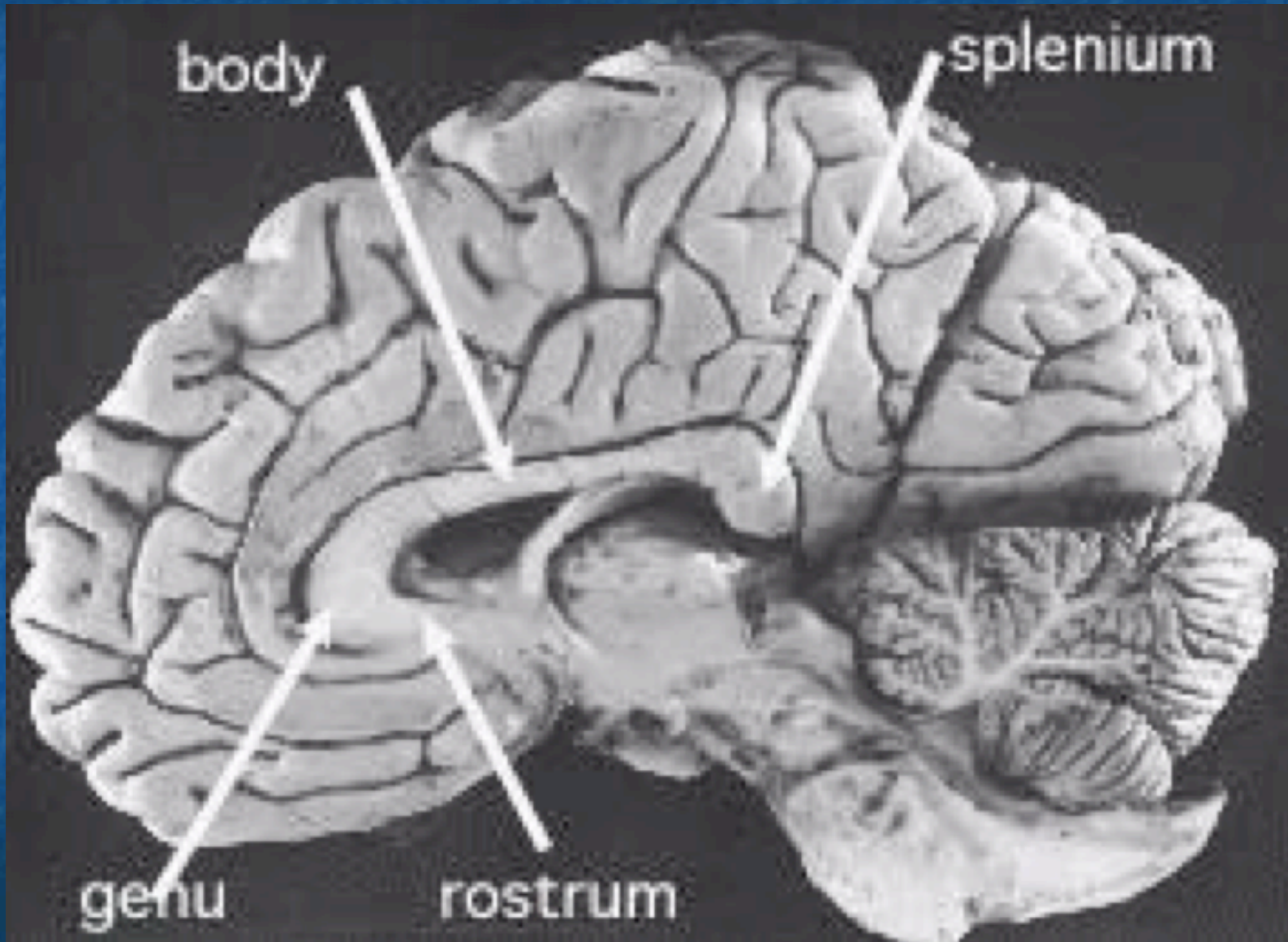
corpus callosum

Closer view of the corpus callosum

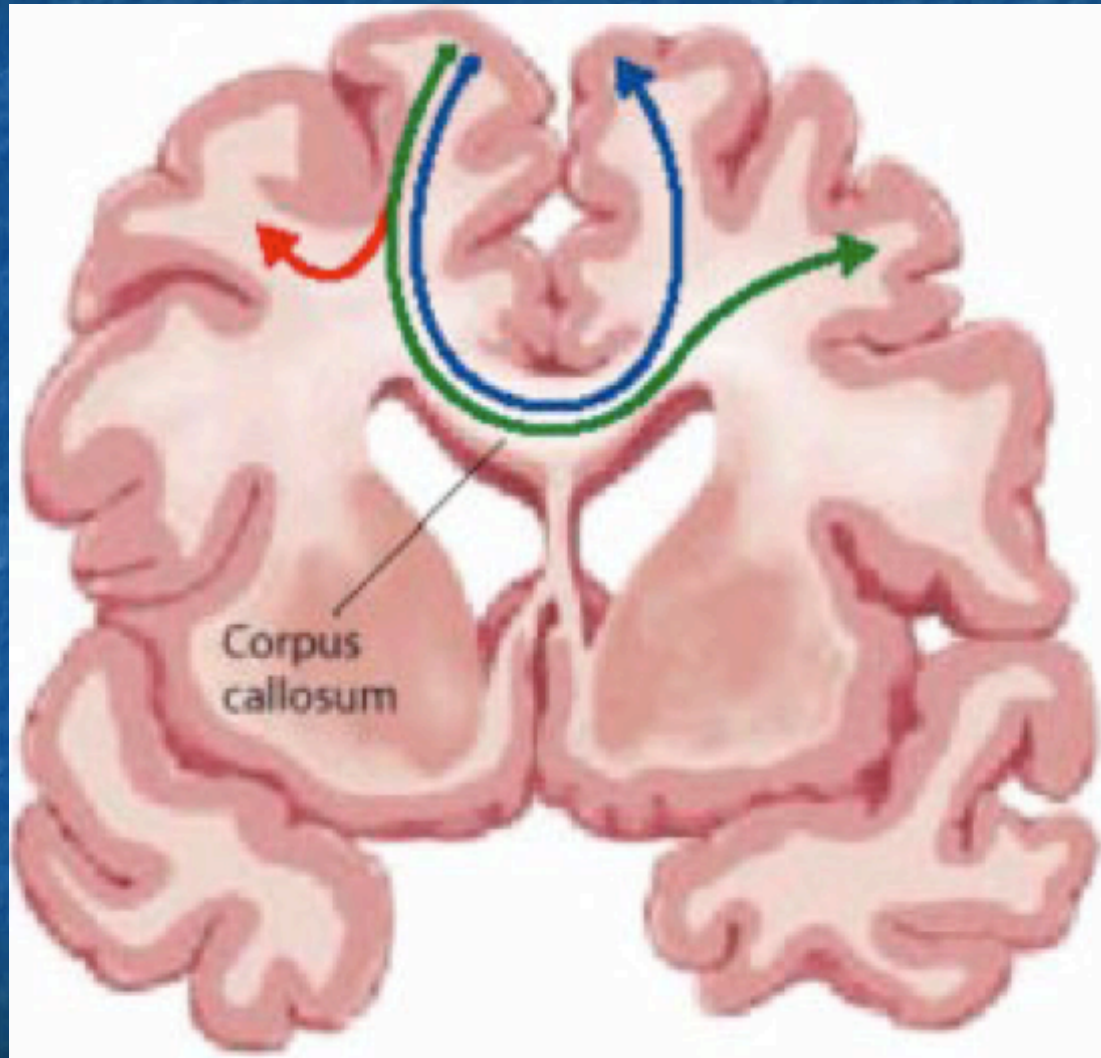


corpus callosum

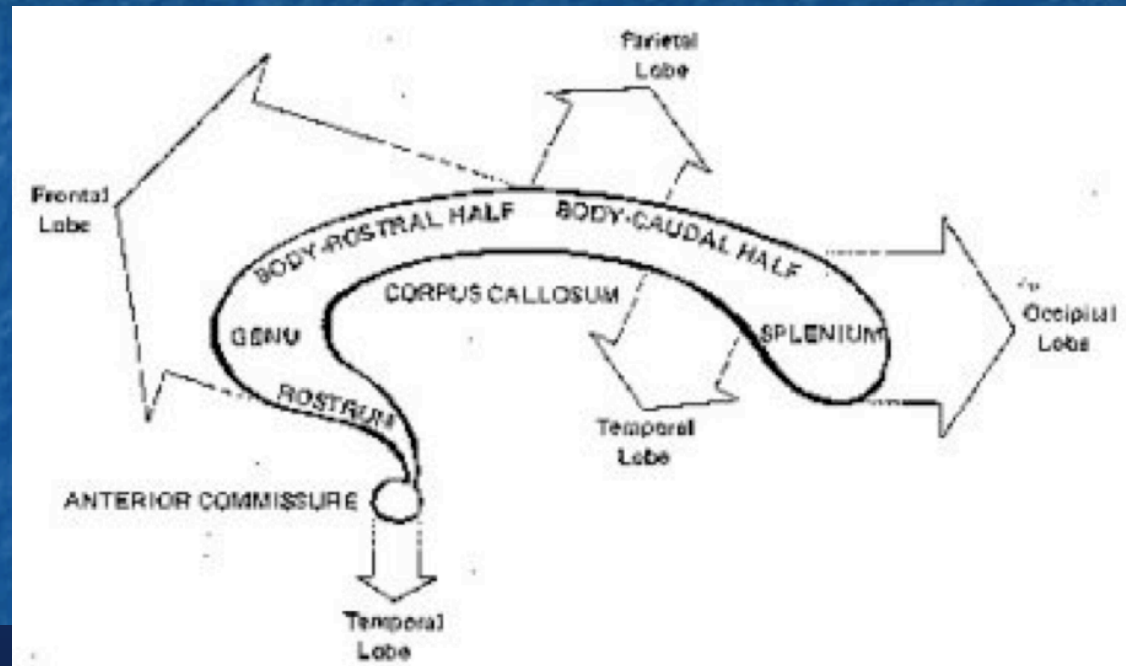
Anatomy of the corpus callosum



Callosal connectivity



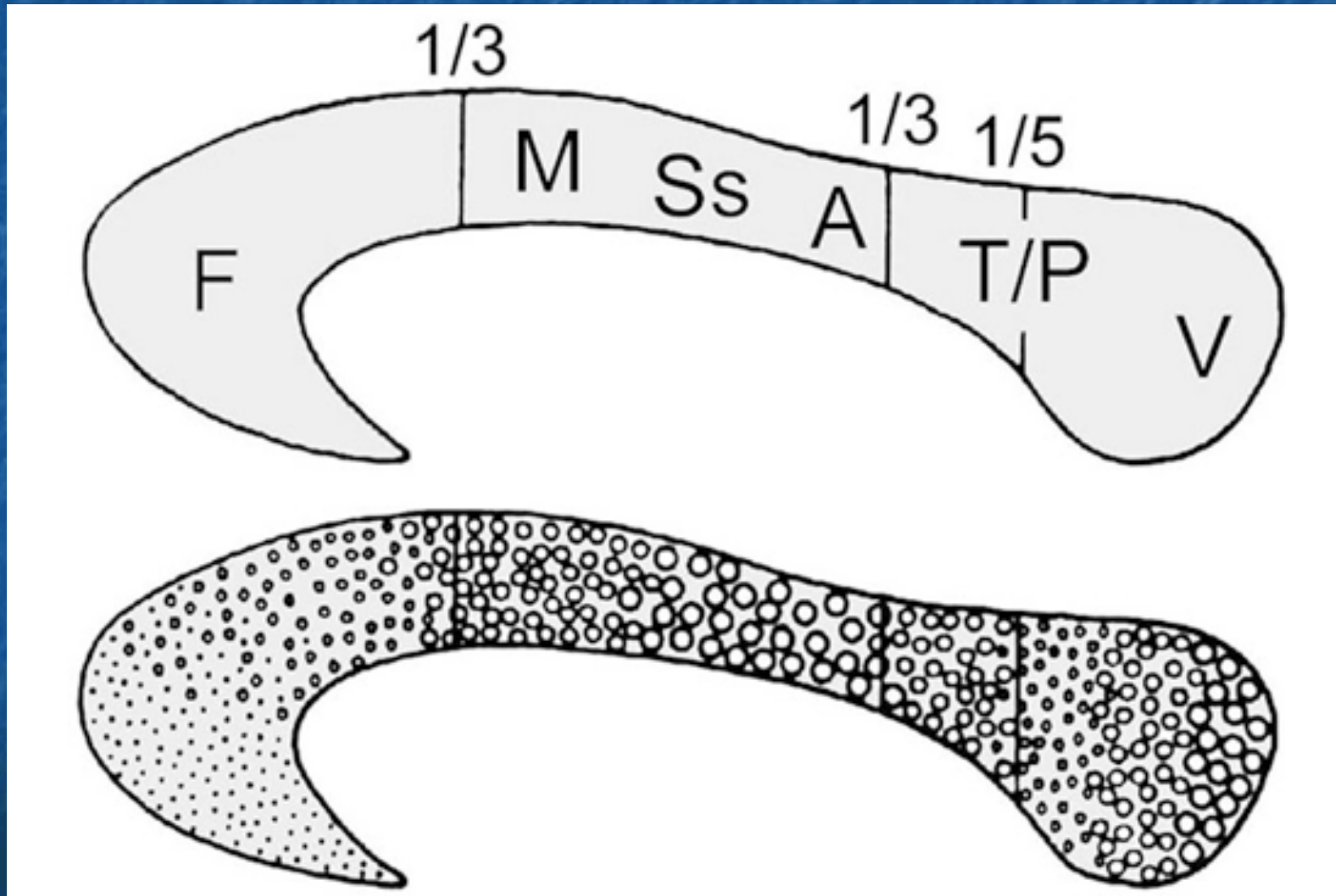
Connections *via* the corpus callosum



- Rostrum- prefrontal cortex
- Genu- prefrontal cortex
- Rostral Body- superior frontal and motor cortex
- Caudal Body- parietal/somatosensory & temporal/auditory
- Splenium- visual areas in temporal/parietal and occipital cortices

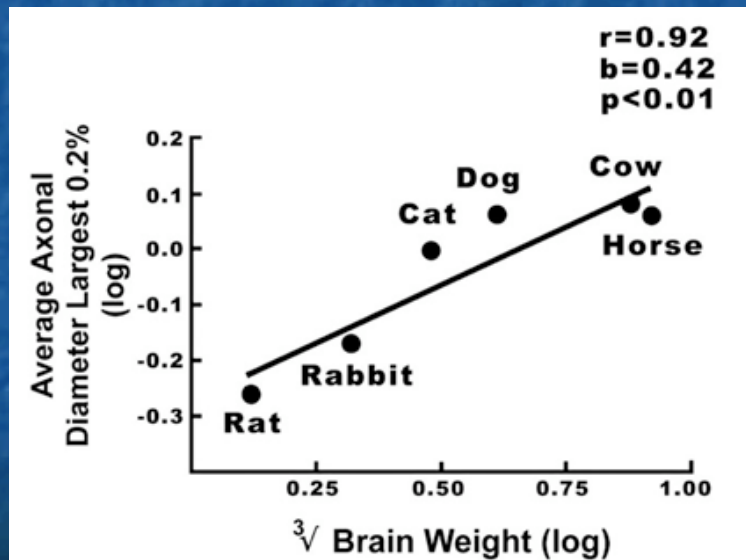
Connections *via* the corpus callosum

Aboitiz, Lopez & Montiel (2003)



Callosal transmission times

In humans, fibre diameter varies between .8 and 10 micrometers, corresponding to callosal delays of 13 msec and 3.25 msec. The larger fibers are much rarer. We can infer the roles of the larger fibres. We can see some of the motivation for lateralization.



Aboitiz, Lopez & Montiel
(2003)

Variation with sex

Jancke et al. (1997)

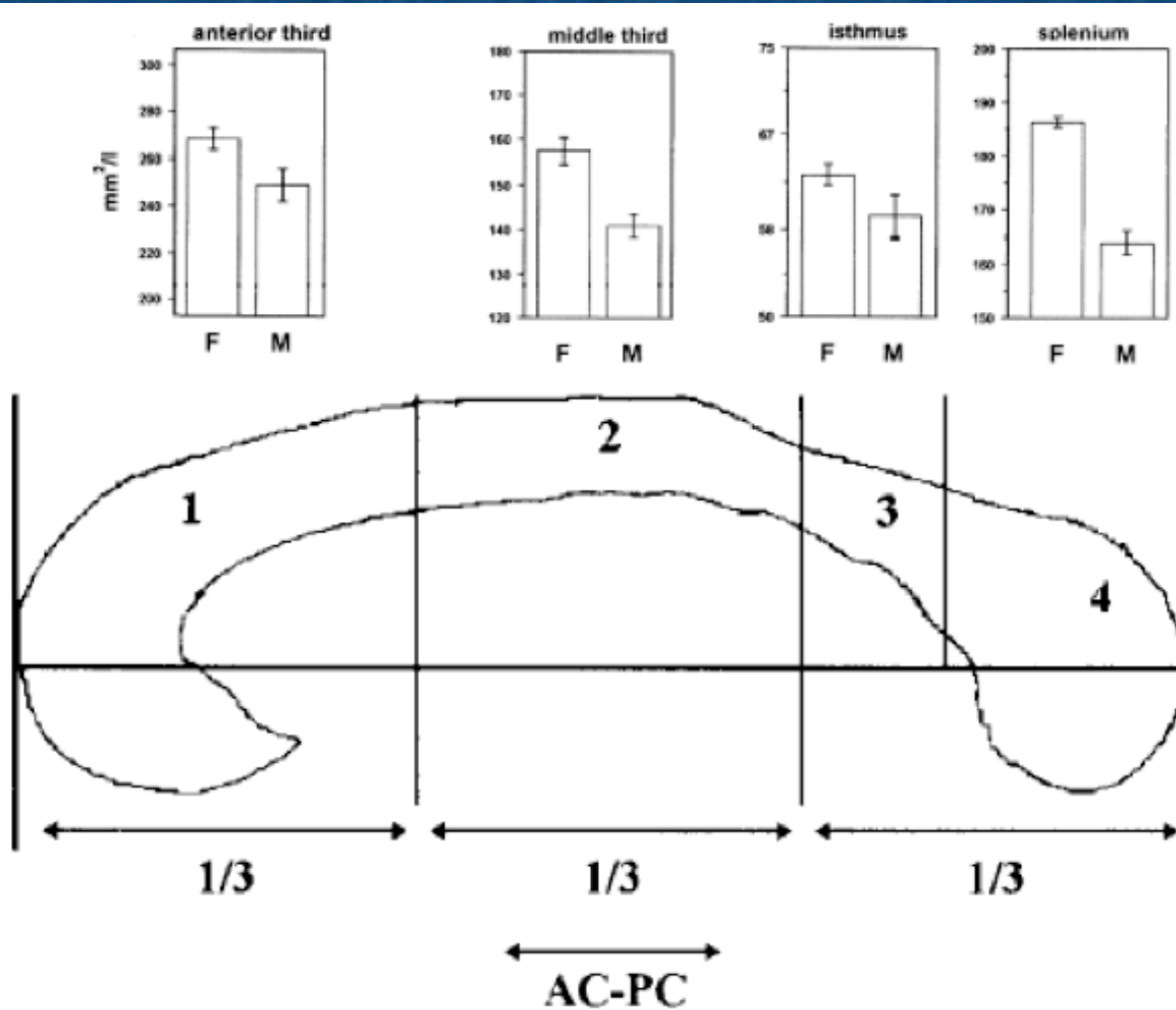


Figure 1. the CC is determined and divided into four subareas as demonstrated (1, anterior third; 2, middle third; 3, isthmus; 4, splenium).

Lateralization of abilities

Left Hemisphere

Linguistic material

Local

Language sounds

Fine motor skills

Grammar, phonology

Interpretative center (language, maths)

Verbal Memory

Full lexicon

Right hemisphere

Complex forms, spatial relations, faces

Holistic

Music

Movements in spatial patterns

Prosody, emotional content

Spatial visualization and analysis

Non-verbal memory (episodic)

Limited lexicon (\approx 10 y. old)

Hypothesis formation in the LH

Wolford, Miller & Gazzaniga (2000)

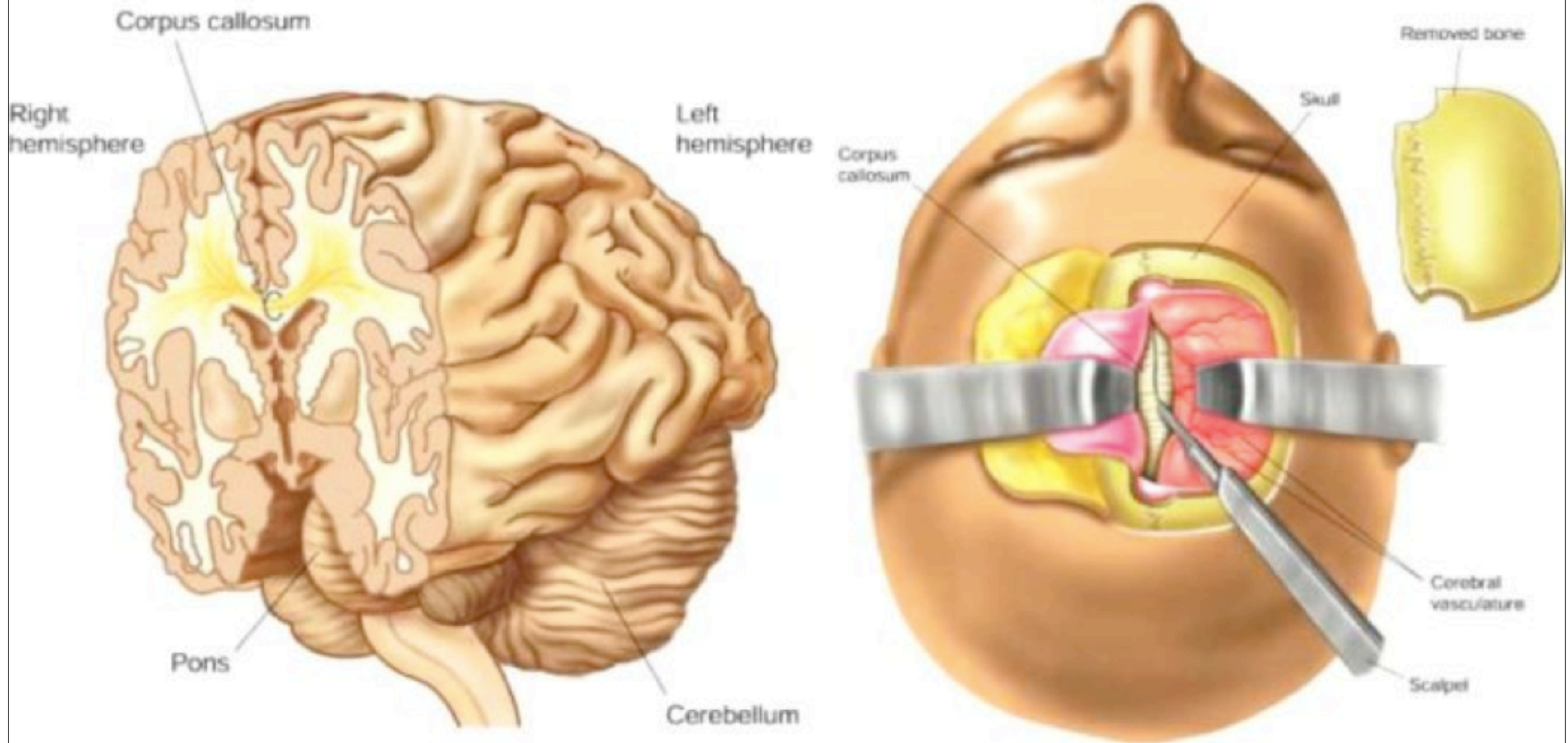
In a guessing experiment with split-brain patients, the LH behaved according to *frequency*, the RH behaved in a *maximizing* way.

The LH may house pattern-searching and hypothesis formation.

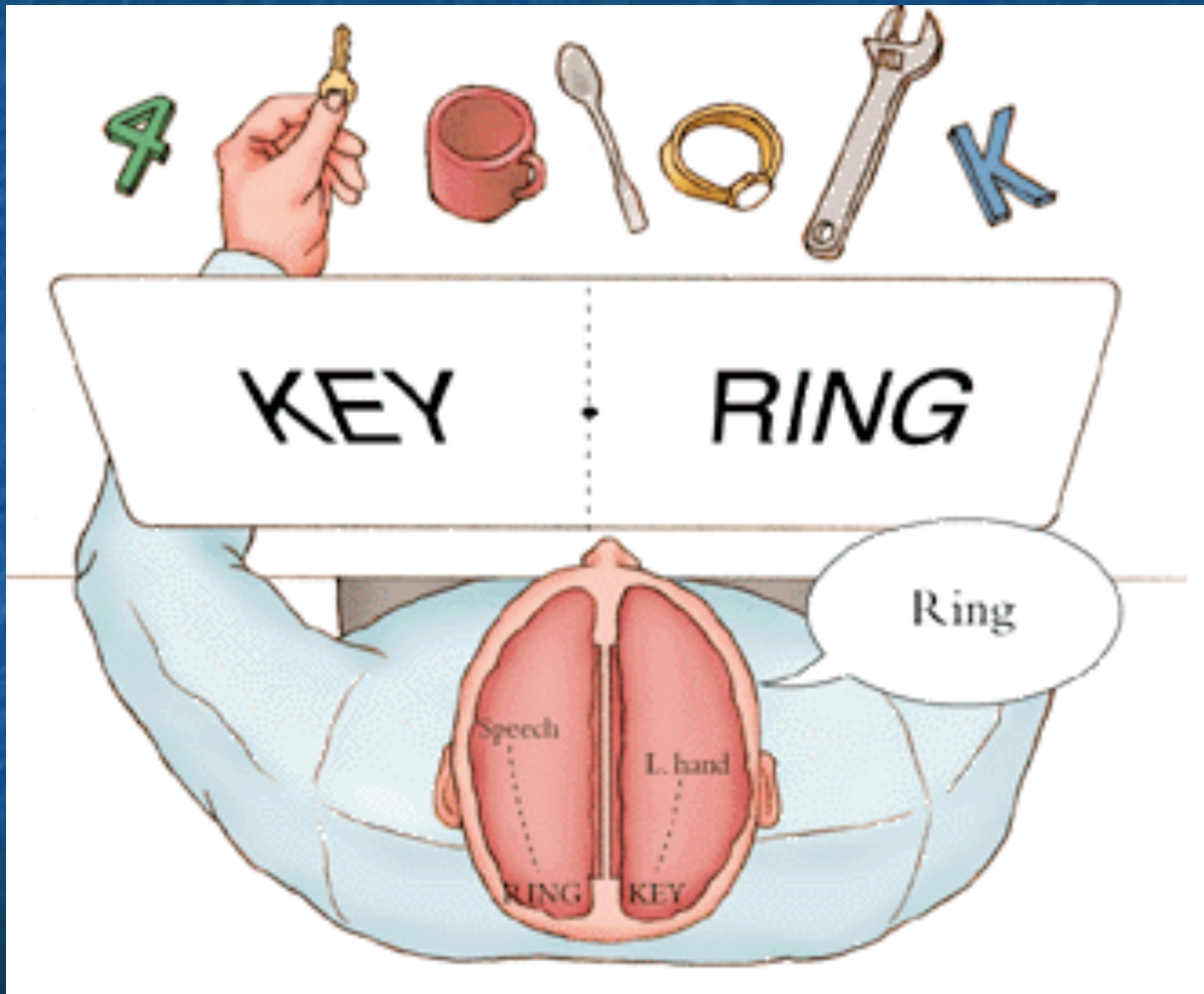
Gazzaniga



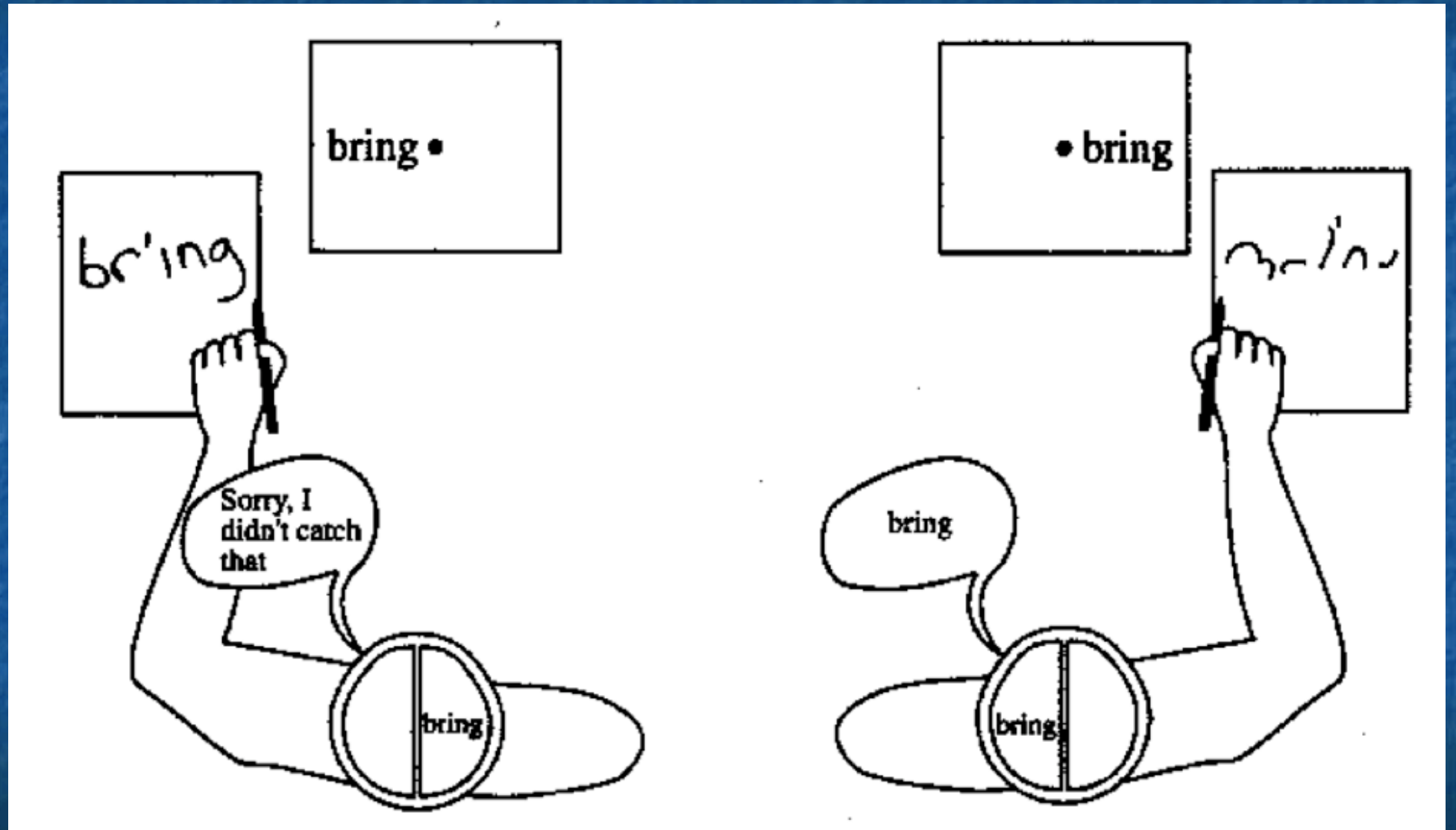
Commissurotomy



Experiments with split brains

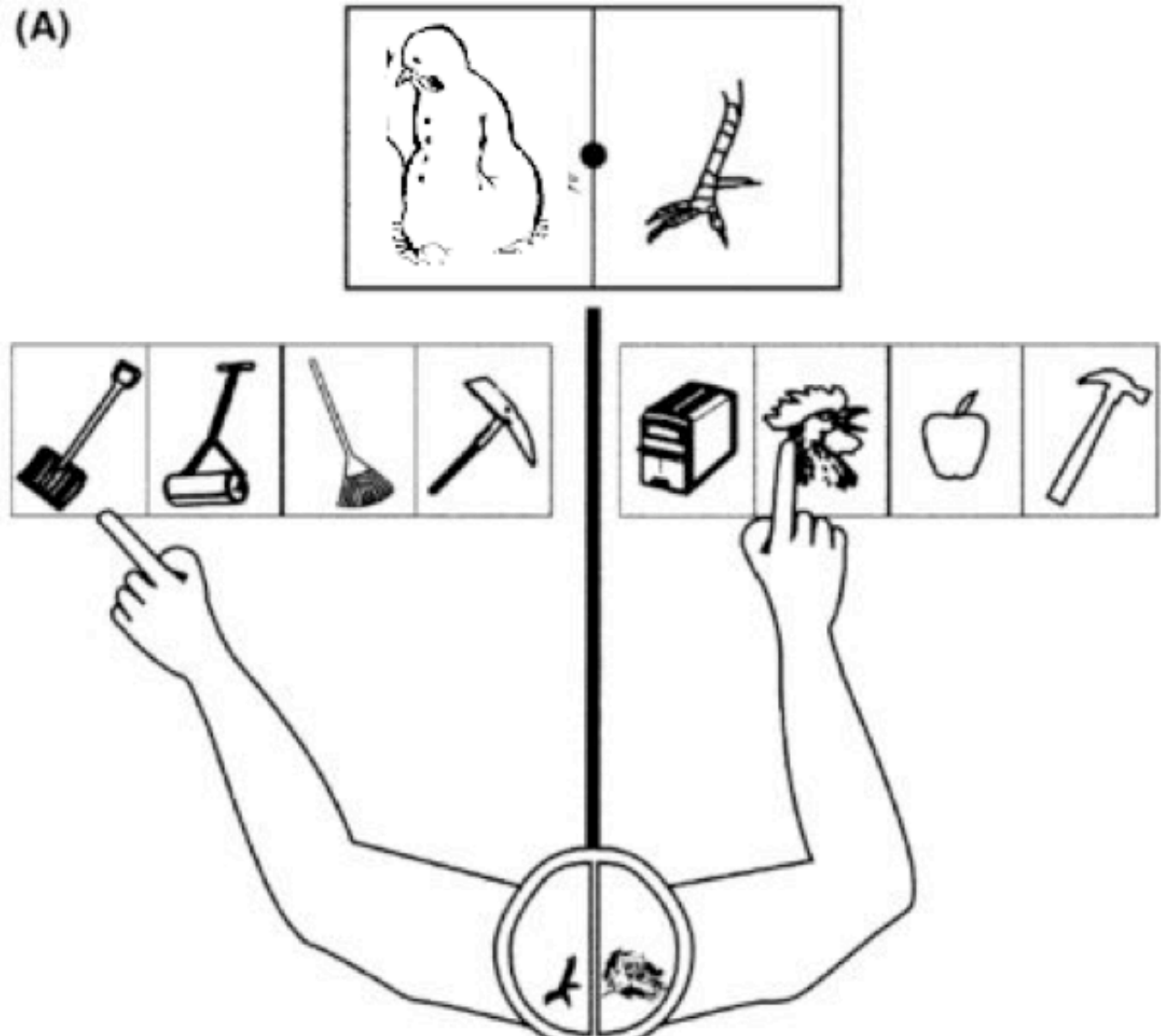


Vj: left-handed for writing



Interpretation by the LH

(A)



Patient PS: “the chicken claw goes with the chicken, and you need a shovel to clean out the chicken shed...”

VP: single words from the RH



An athlete -
a basketball guy?

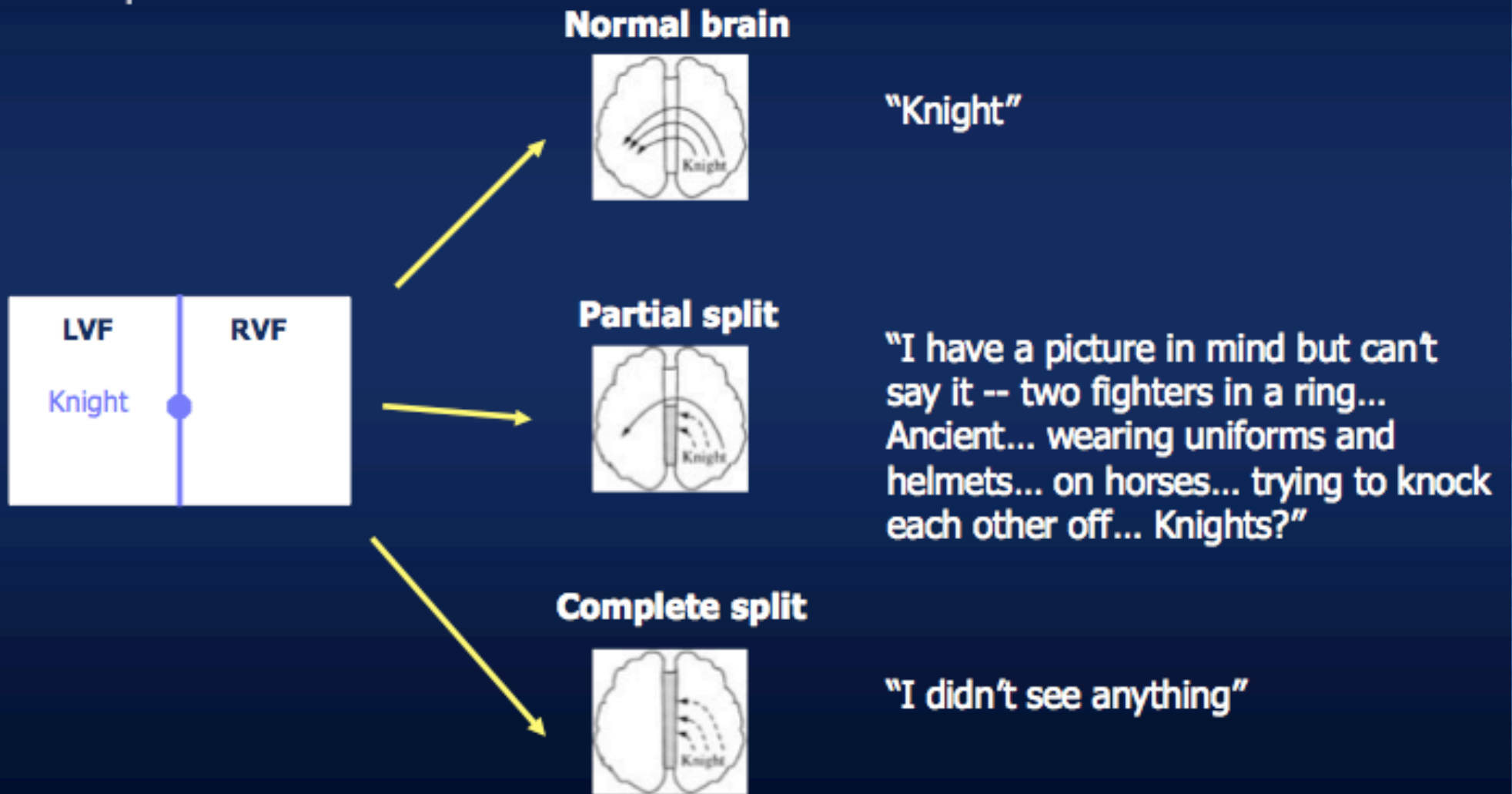
A man running
over hurdles



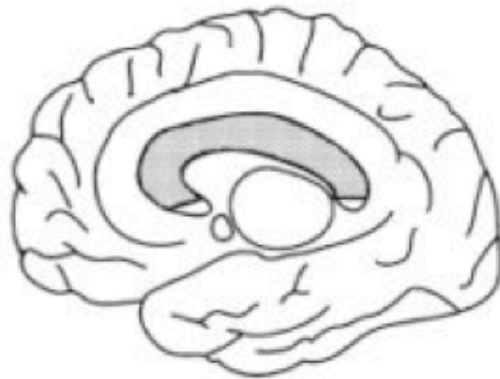
RH

LH

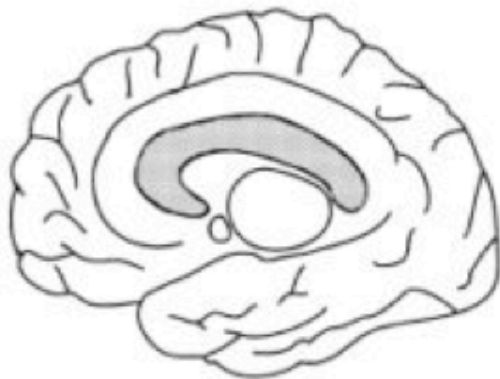
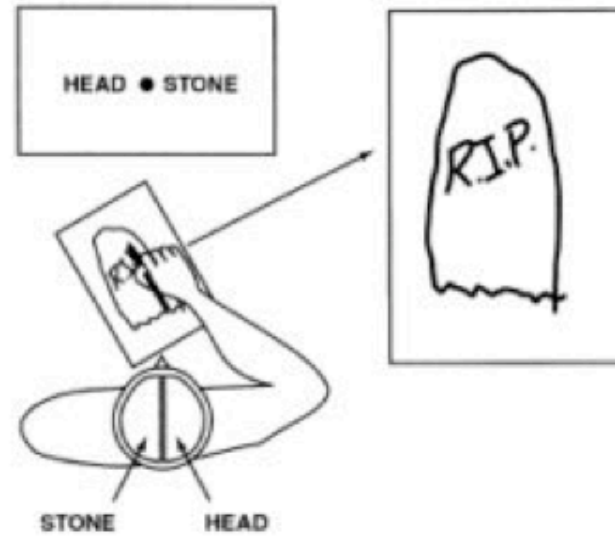
JW's staged callosal section



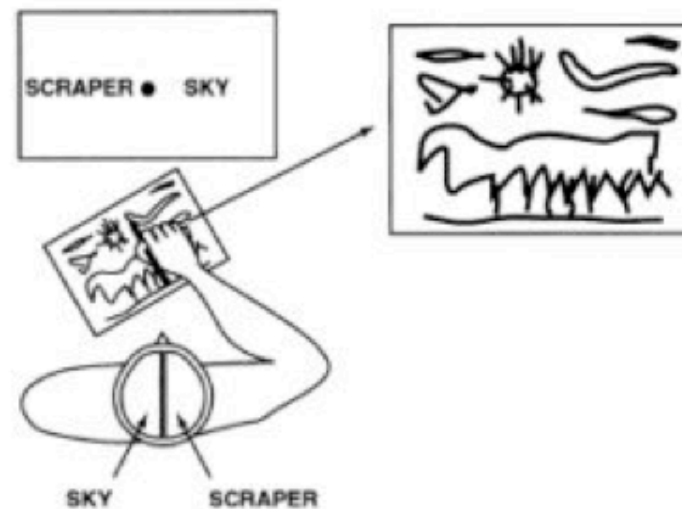
Integration in VP but not in JW



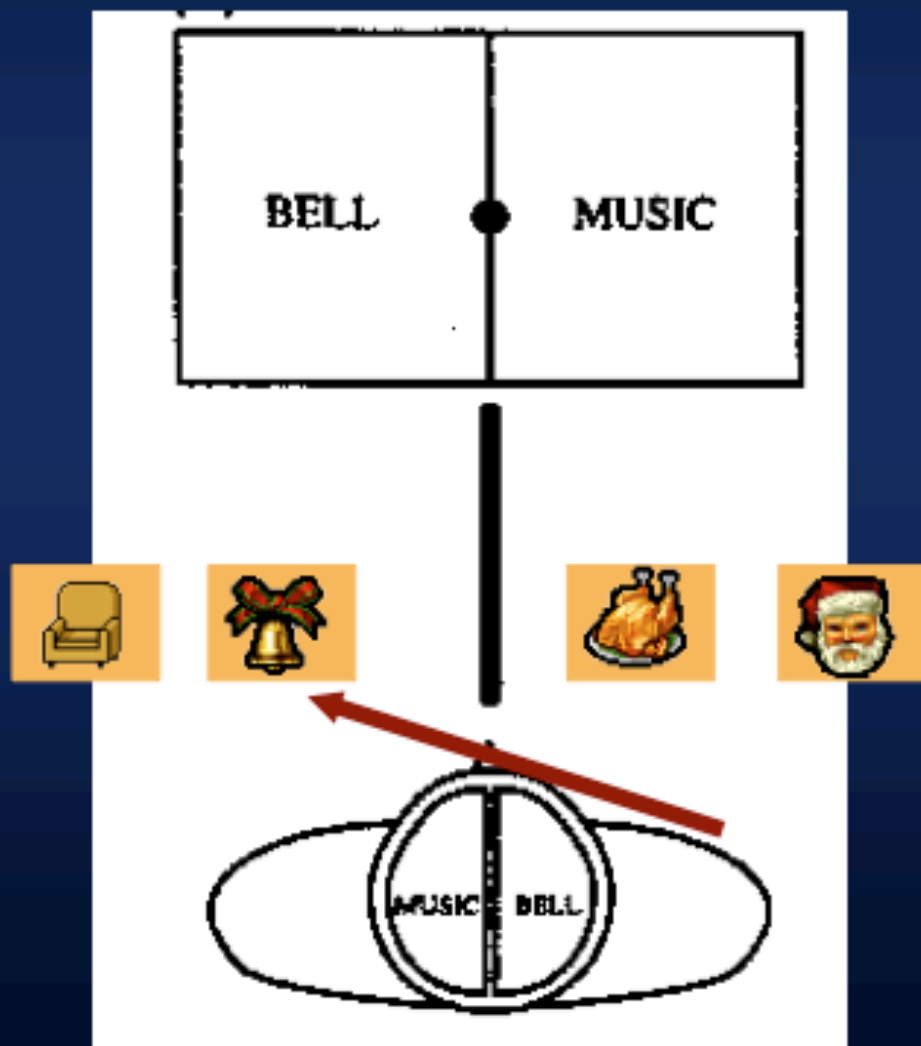
Case V.P. spared fibres



Case J.W. full split



JW: matching pictures and words



Patient J.W.

Point to a bell.

“Last time I heard any music it was from bells outside here, banging away”

Caveats

The brains were not initially normal

A few cases are intensively studied

All of the patients have some commissures intact

There may also be variable lateralization (e.g. handedness)

Summary

Hemispheric division and coordination has deep implications for language-related brain function

There are profound challenges for theorizing about processing and representation