

Looking at the Whole Person with Cerebral Palsy Related to Prematurity and Periventricular Leukomalacia

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OBJECTIVES

1. Understand the relationship of prematurity, MRI findings of periventricular leukomalacia, and the diagnosis of cerebral palsy.
2. Discuss how the white matter supports critical interconnection in the brain tissues
3. Review motor, sensory and cognitive function challenged by periventricular leukomalacia.

WHAT IS CEREBRAL PALSY?



Modern consensus definition:

- Group of disorders of movement and posture
- Non-progressive etiology
- Damage to the fetal or infant brain

- Often accompanied by co-occurring problems with sensation, perception, communication, and/or behavior and/or seizure disorder

Periventricular leukomalacia (PVL)

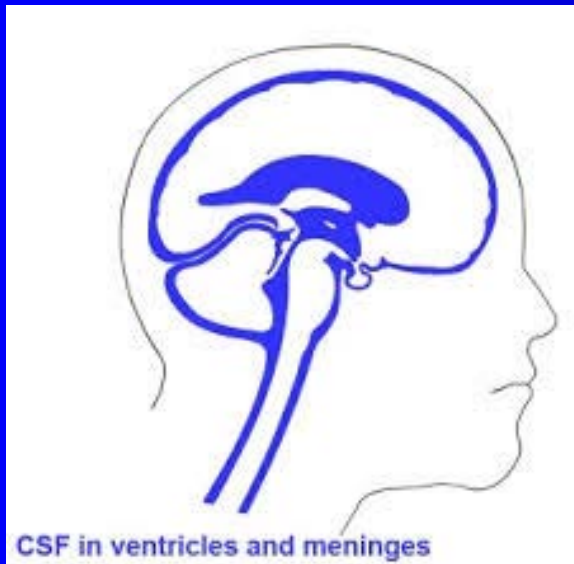
Cerebral palsy is caused by some abnormality in the brain.

PVL is the largest single etiology of cerebral palsy.

PVL is caused by a complex series of events in the brain set in motion after birth among newborns with prematurity and very low birth weight.

Periventricular leukomalacia (PVL)

Cerebral ventricles: Interconnected system of spaces that continue and circulate the cerebrospinal fluid



Periventricular leukomalacia (PVL)

Periventricular leukomalacia is

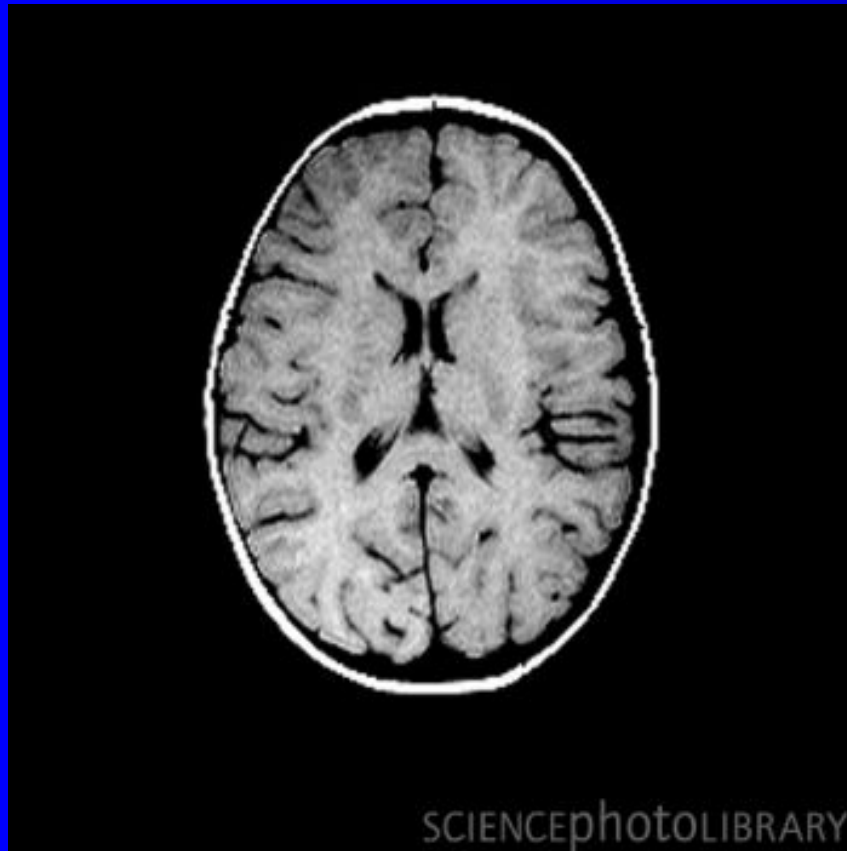
Peri	=	around
Ventricular	=	deep brain fluid spaces
Leuko	=	white matter
Malacia	=	thinning

Thinning of the white matter surrounding the ventricles

DIAGNOSIS:

MRI with Periventricular leukomalacia

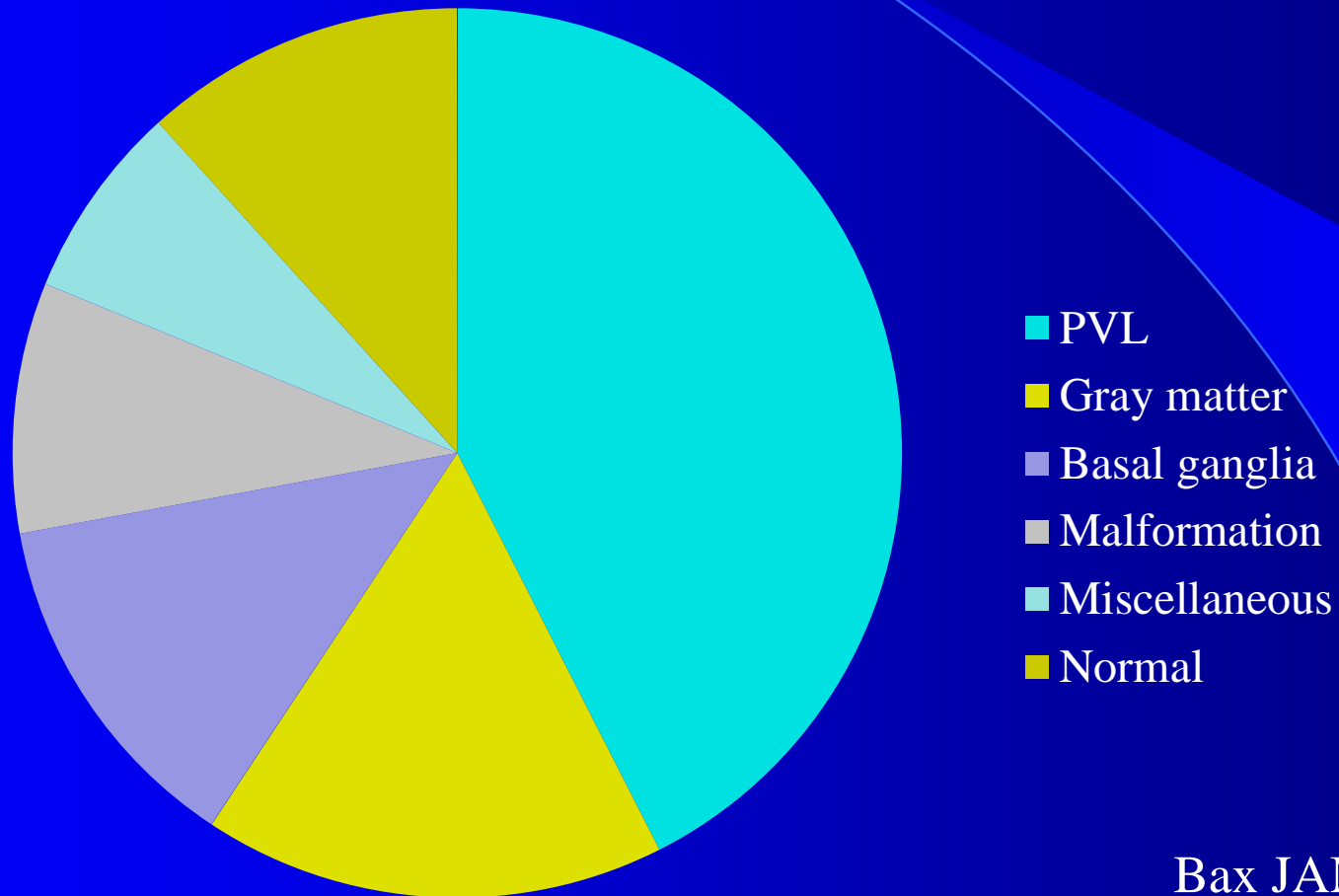
Normal brain



PVL



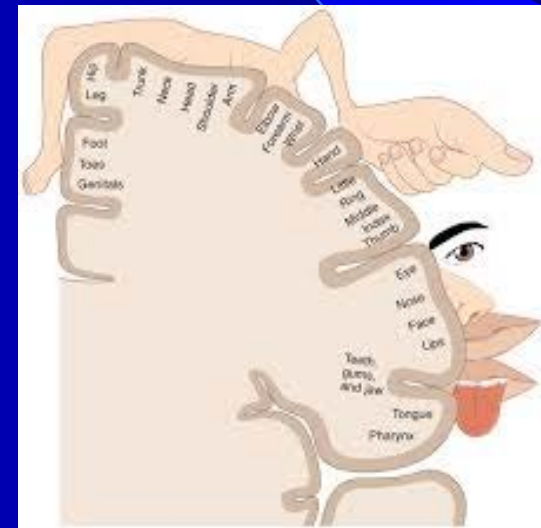
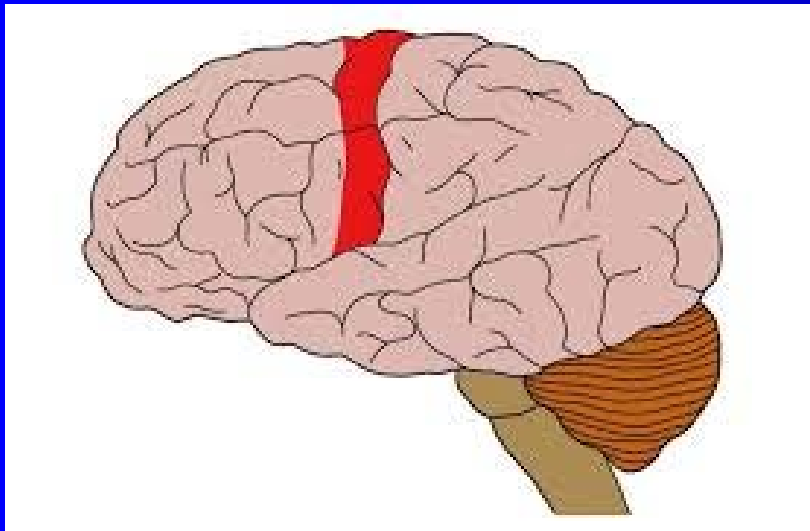
Cerebral Palsy: Cranial imaging findings



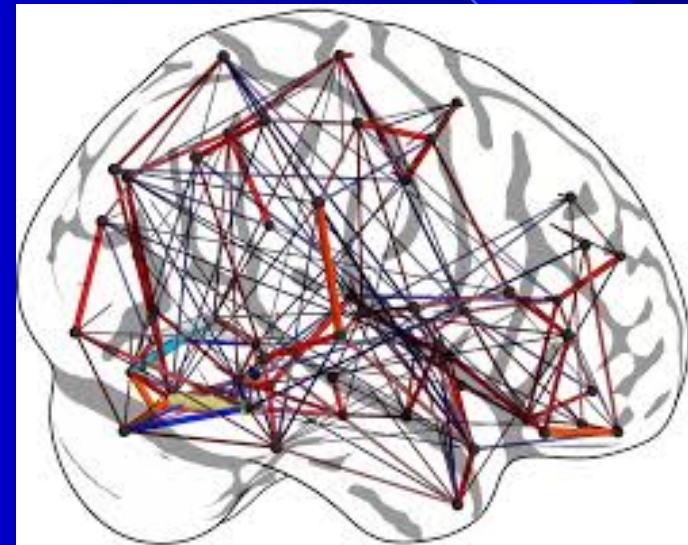
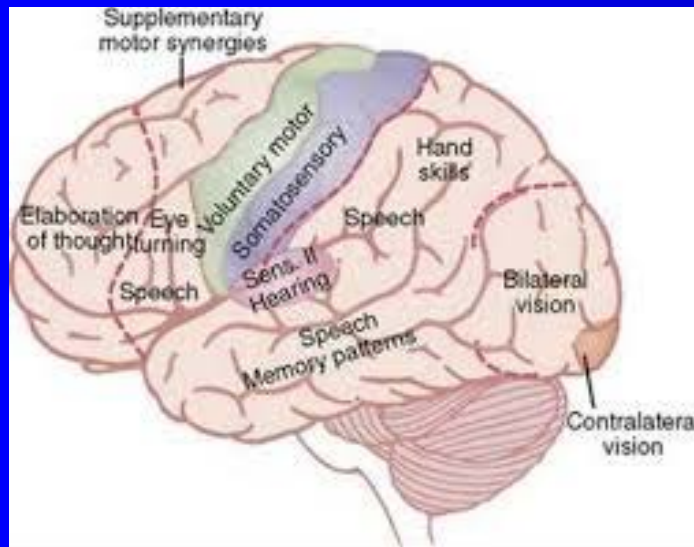
Bax JAMA 2006

Motor impairments with CP are related to the cortical anatomy

Precentral gyrus and motor homunculus



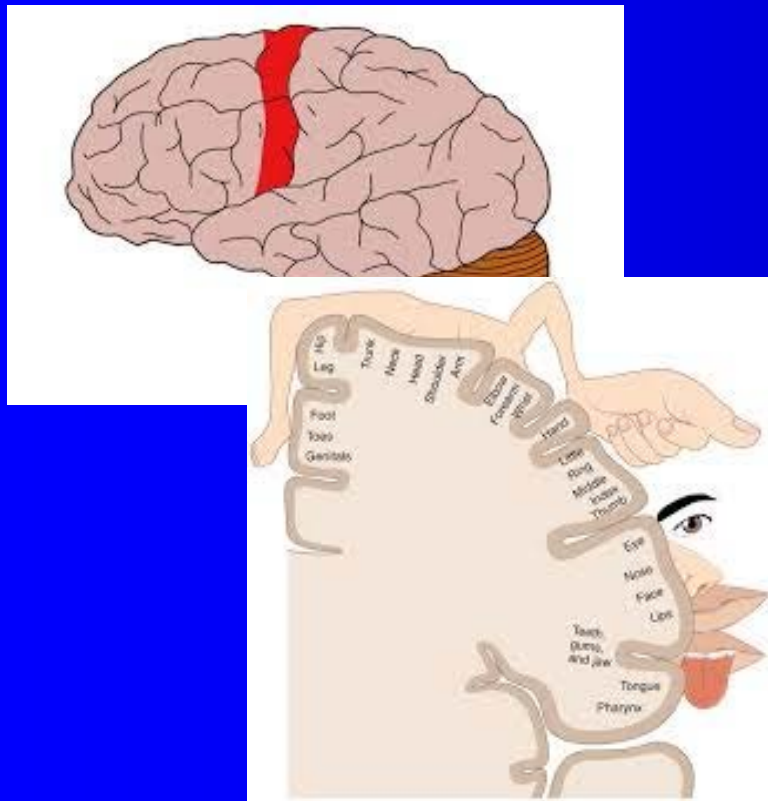
Cortical anatomy combine with connectivity



IMAGES OF CONNECTIVITY: The Connectome



BRAIN SURFACE: Cortical anatomy

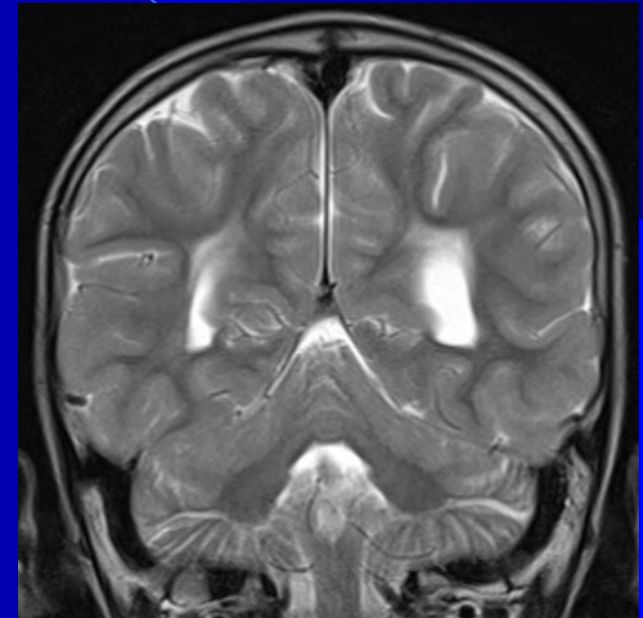
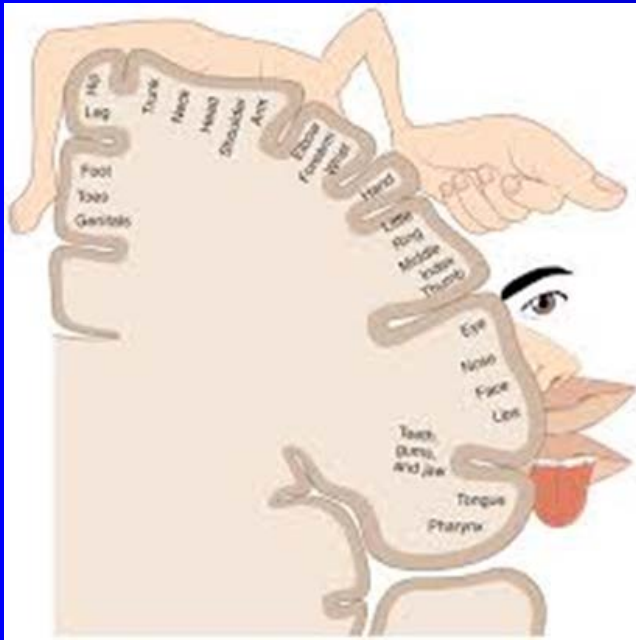


If the periventricular leukomalacia (PVL) disrupts connections under the motor area, there would be motor manifestations of cerebral palsy

PVL and spastic diplegic CP

Motor homunculus

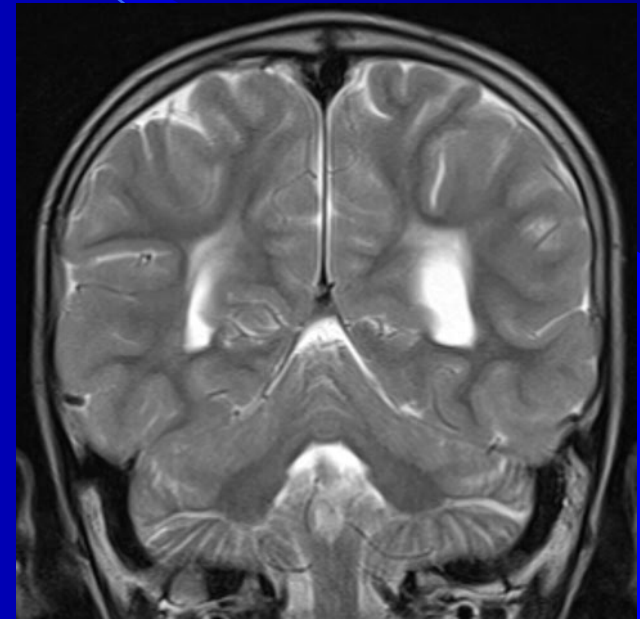
PVL



Leg fiber connections are more affected than hand fibers related to more central location

PVL and CP

Spastic diplegia most frequent pattern: more leg than arm involvement



PVL and CP

More widespread PVL may cause additional hand impairment, or spastic quadriplegia



More PVL on one side as compared to the other may cause spastic hemiplegia with same side arm and leg involved

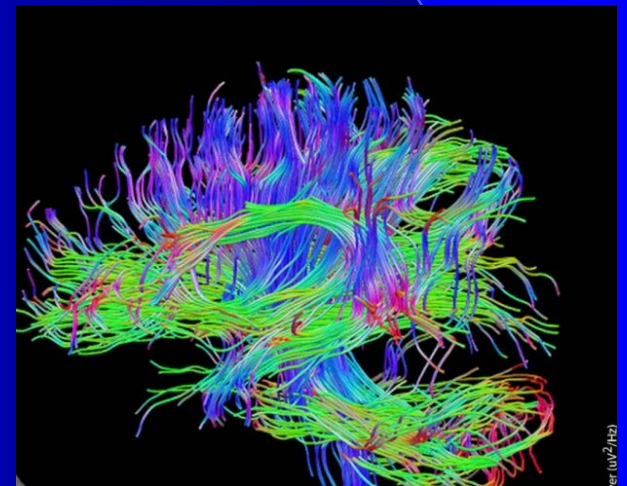
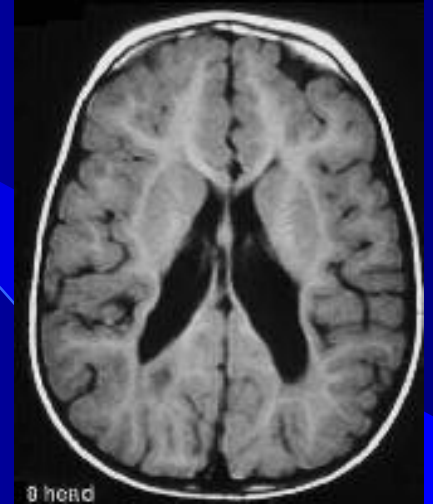


Periventricular leukomalacia

PVL is not limited to the region under the motor fibers.

If it involves tissue forward of the motor area, this may affect self regulation and attention

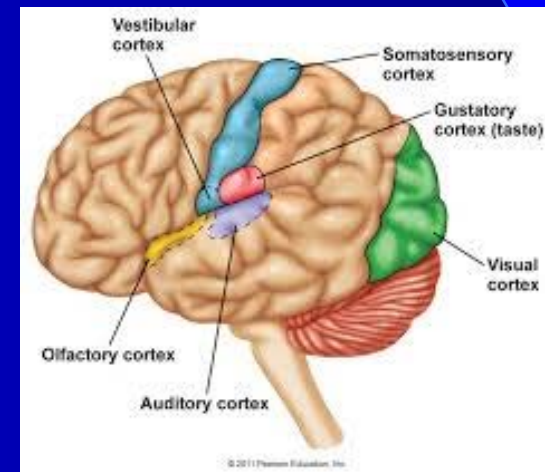
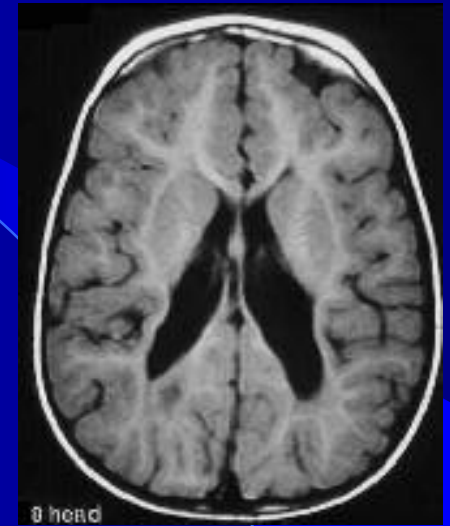
ADD is also commonly associated with prematurity and/or PVL



Periventricular leukomalacia

...and if it involves tissue behind the motor area, this will affect sensory processing

MRI scan in children with CP frequently demonstrate abnormalities in the sensory areas



CEREBRAL PALSY

Sensory concerns are common

- Hearing loss 7-12%
- Visual impairment overall 80%
- Tactile impairment 50-75%
- Visual-perceptual skill development and sensory processing are very frequently different for people with CP.

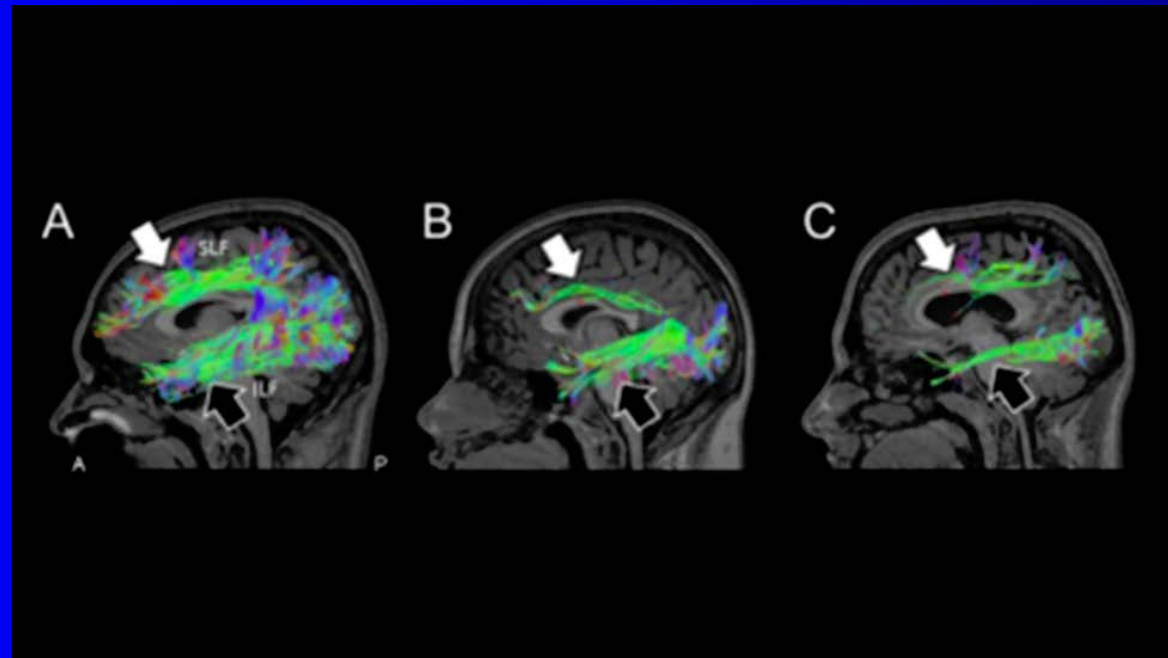
CORTICAL CONNECTIVITY:

Ventral stream: Connects vision to lower temporal lobe to recognize the name of the object



CORTICAL CONNECTIVITY:

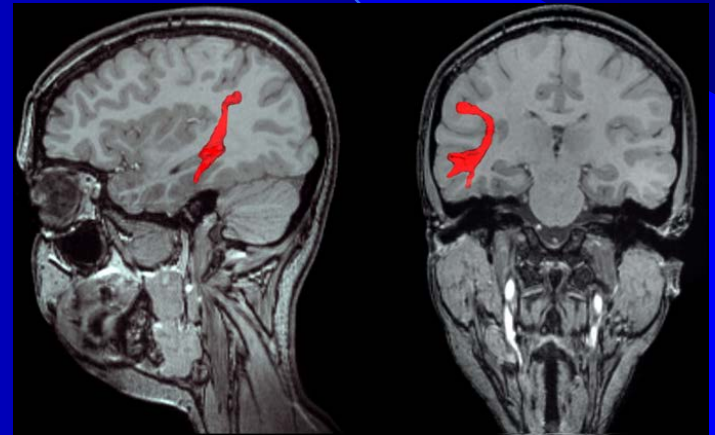
Dorsal Stream: Connects vision to the sensory area of the arm for eye-hand coordination



CORTICAL CONNECTIVITY:

Angular gyrus: Important connection in left brain

- Wernicke's area- sensory speech
- Broca's area- motor speech



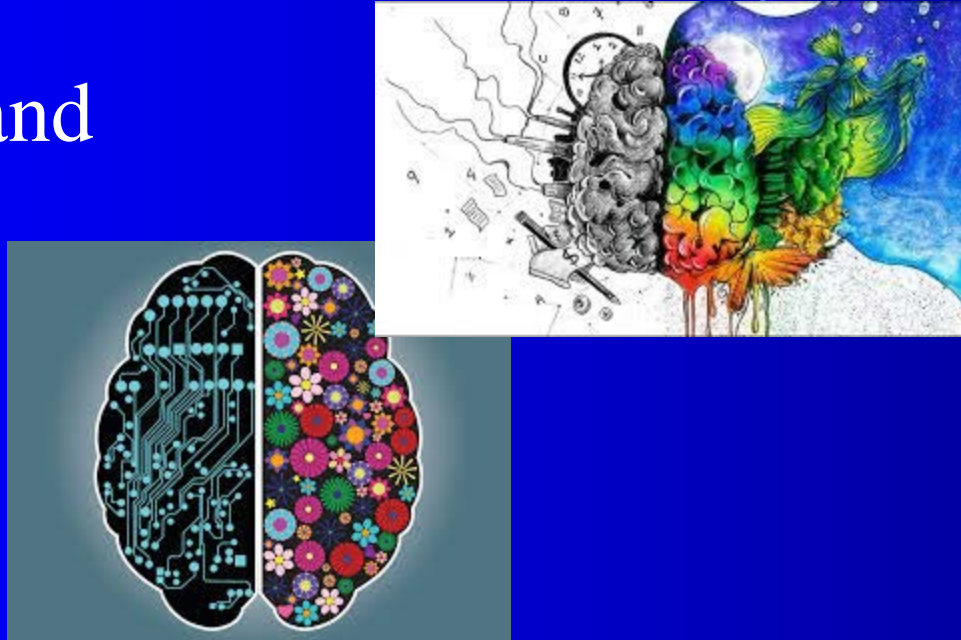
These are short tracts, using less white matter.

PVL has a relatively low impact on verbal abilities.

CORTICAL CONNECTIVITY:

Left brain and

right brain



have differences in the patterns of connectivity.
PVL is poses more difficulty on the function of the
right hemisphere.

CORTICAL CONNECTIVITY:

Functions of the right brain, particularly the specialized functions of processing complex visual and spatial material, are VERY dependent on rich connectivity,



particularly the right parietal lobe

Functions of the parietal lobe: RELATIONAL

How are my body parts related to each other?

How is my body connected to my clothes?

Where is my body related to the shape of a seat?

Where is my moving body going related to gravity?

Where is my body related to what I am seeing?

What is my relationship to this group of people?

How is my behavior connected to my core values?

Functions of the parietal lobe: RELATIONAL

Possible manifestations of loss of parietal connectivity:

- Sensory integration concerns

- Clumsiness

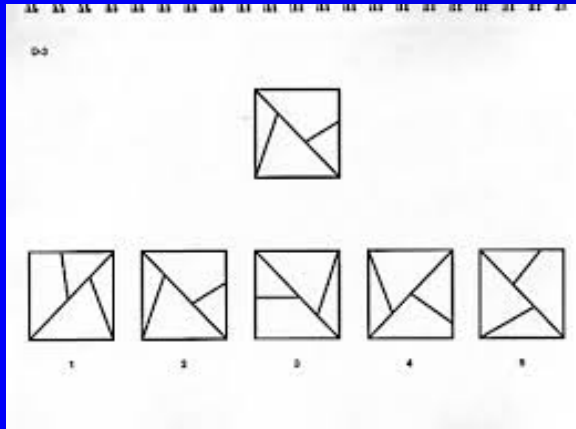
- Social awkwardness

- Good vocabulary, challenged communication

- Feeling disorganized and overwhelmed

Functions of the parietal lobe: RELATIONAL

These perceptions are essential to function in daily life.
They are also hard to understand and measure.



SUMMARY

Differential treatment for different areas?



IMAGES OF CONNECTIVITY

