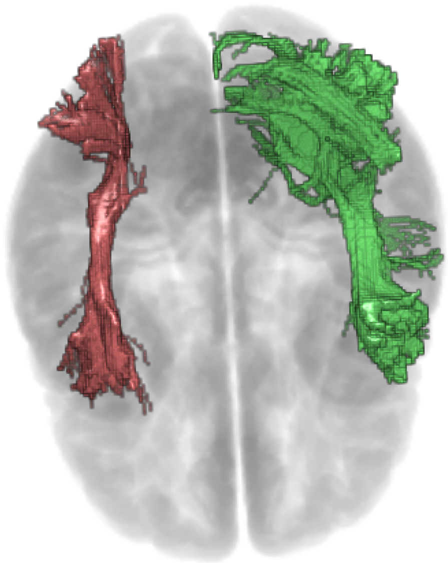
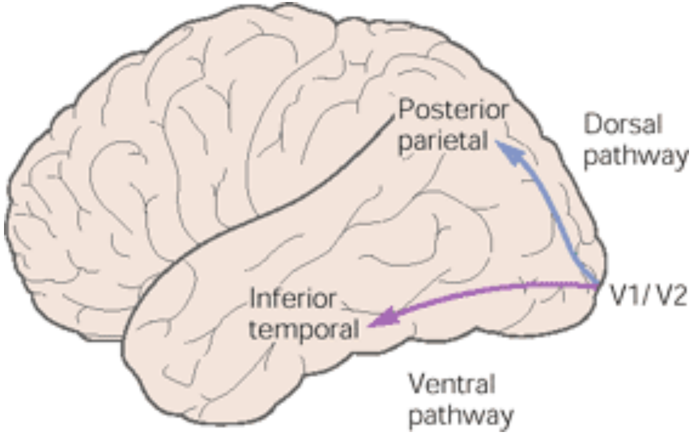
Inferior Longitudinal Fasciculus

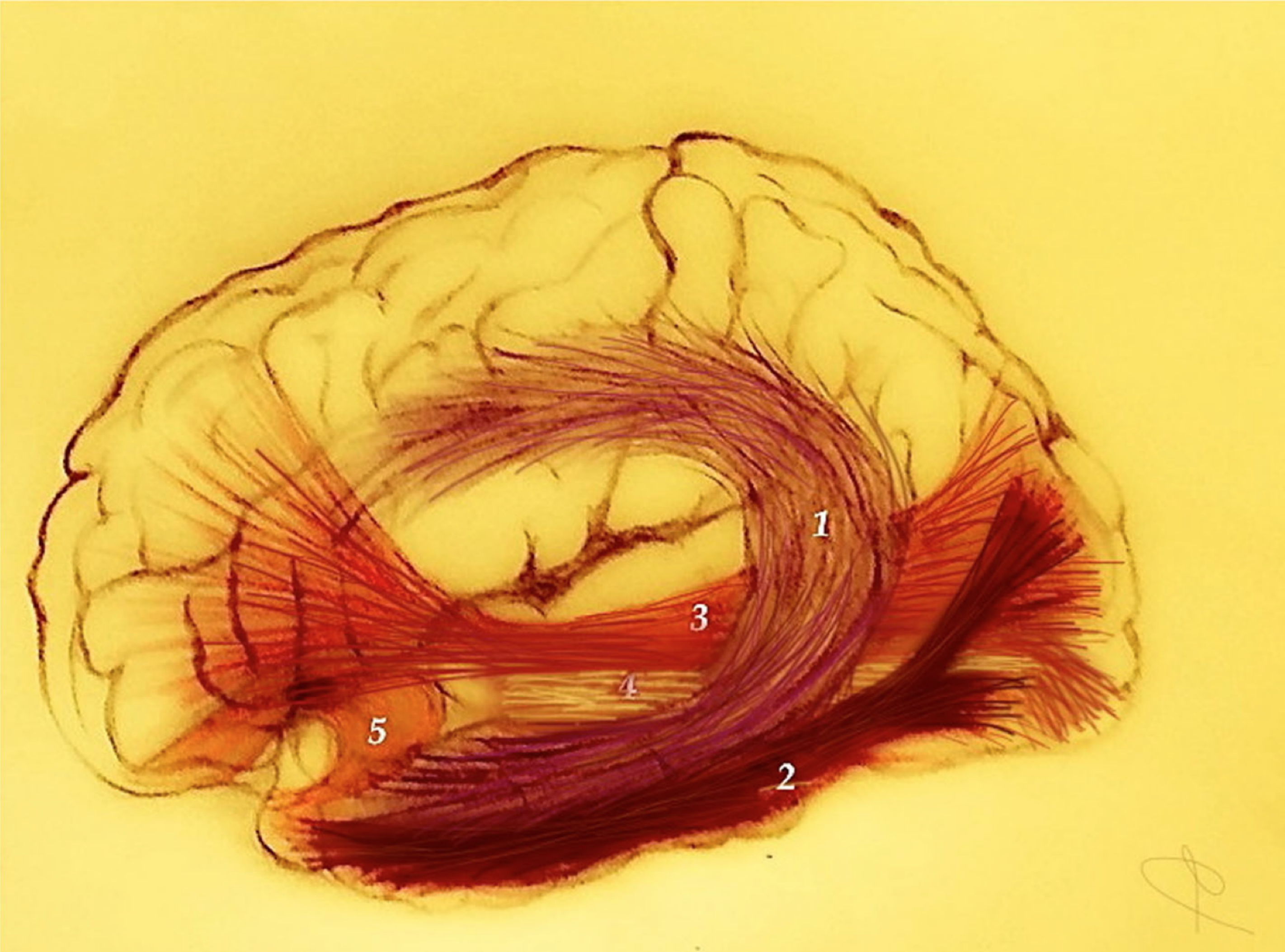




Charlie Burlingham
Virtual Neuroanatomy
Date: 11/20/2014

Overview

1. Background 2. Afferents & Efferents
3. Neurophysiology
4. Behavioral correlates
5. Physiological correlates
6. Neurochemical systems
7. Clinical Pathologies



Latini 2013

Background

ILF - Ventral Stream

What Pathway?

Object Vision

Mishkin & Ungleider

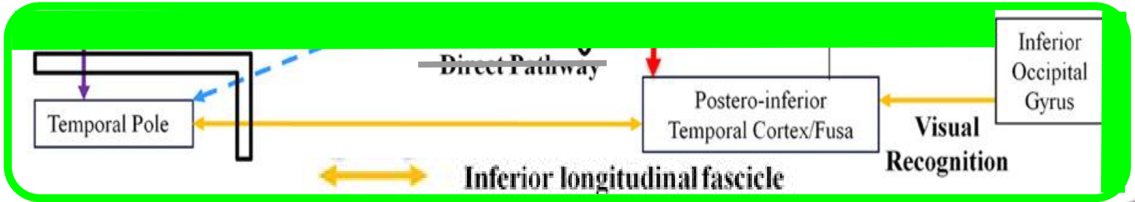
Direct or Indirect?

Occipital & Temporal endpoints

Relation to Uncinate and IFOF

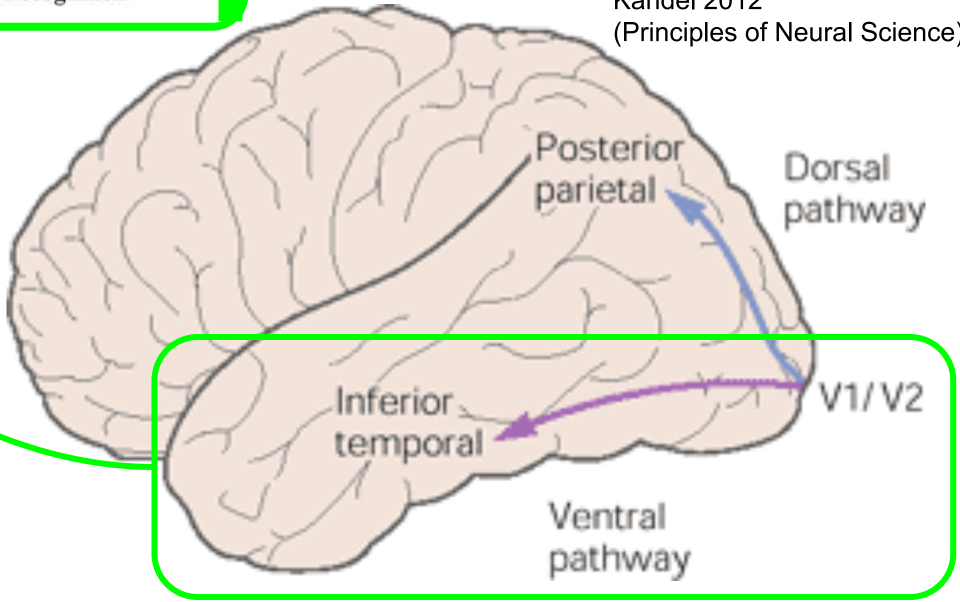
Background: The Inferior Longitudinal Fasciculus

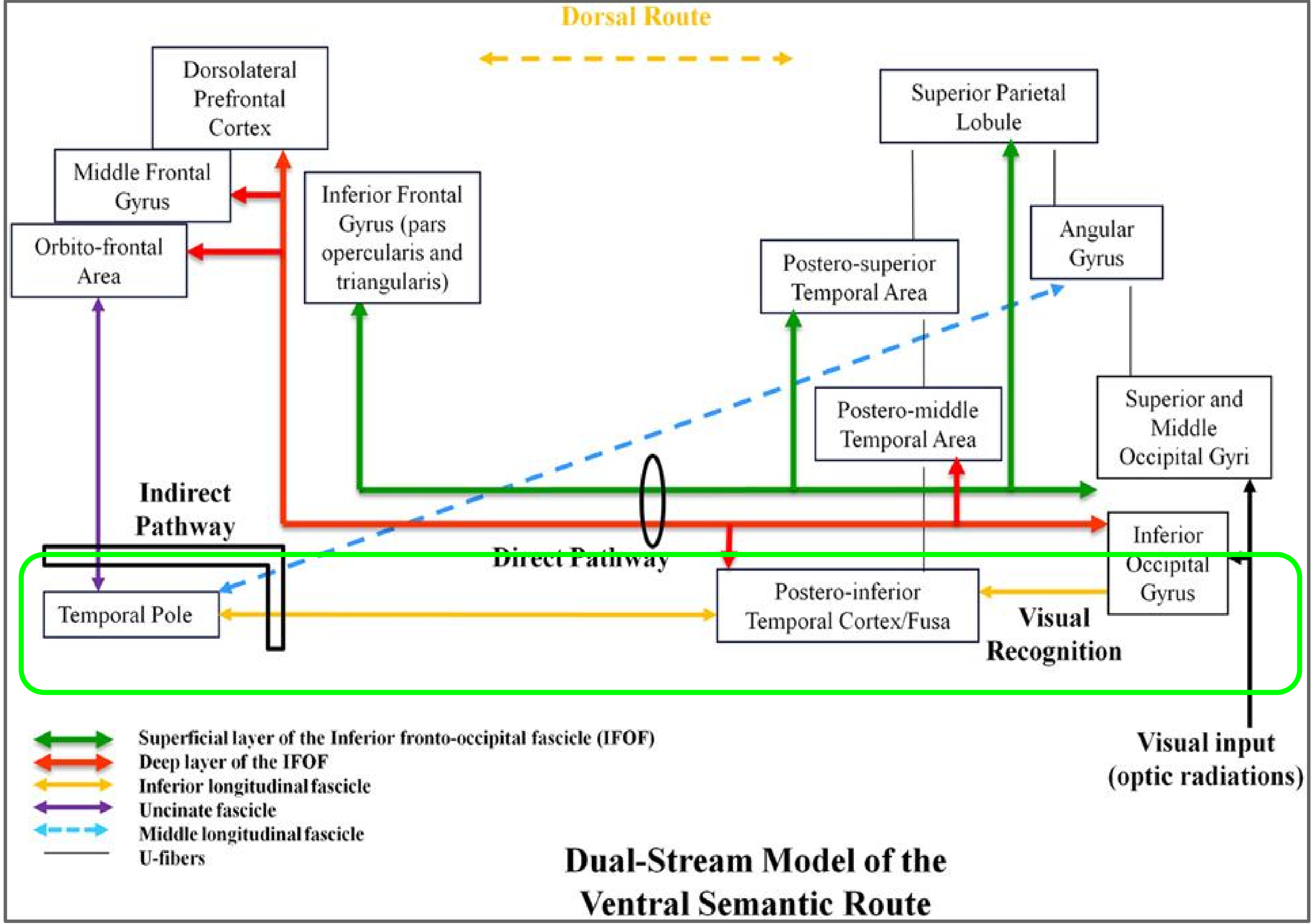
Visual Association Pathway | Ventral Stream | Recognition & Semantics



Duffau et al 2013

Kandel 2012
(Principles of Neural Science)





Duffau et al 2013

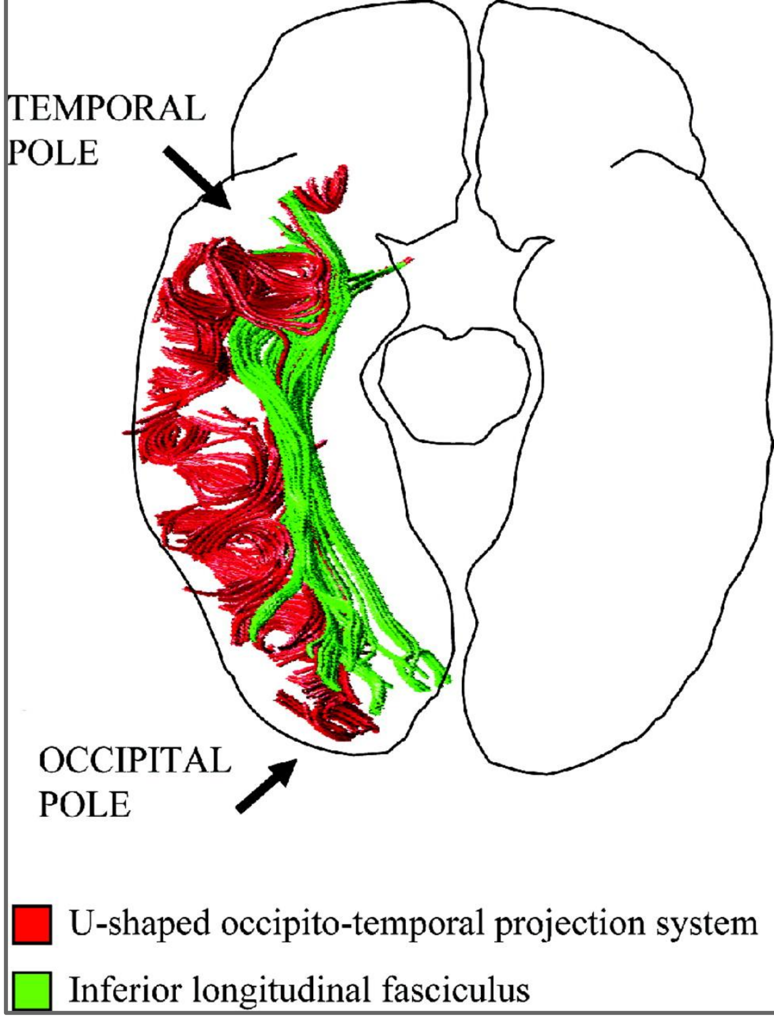
Does the ILF actually exist?

Controversy:
Unglerleider & Tusa (1985)

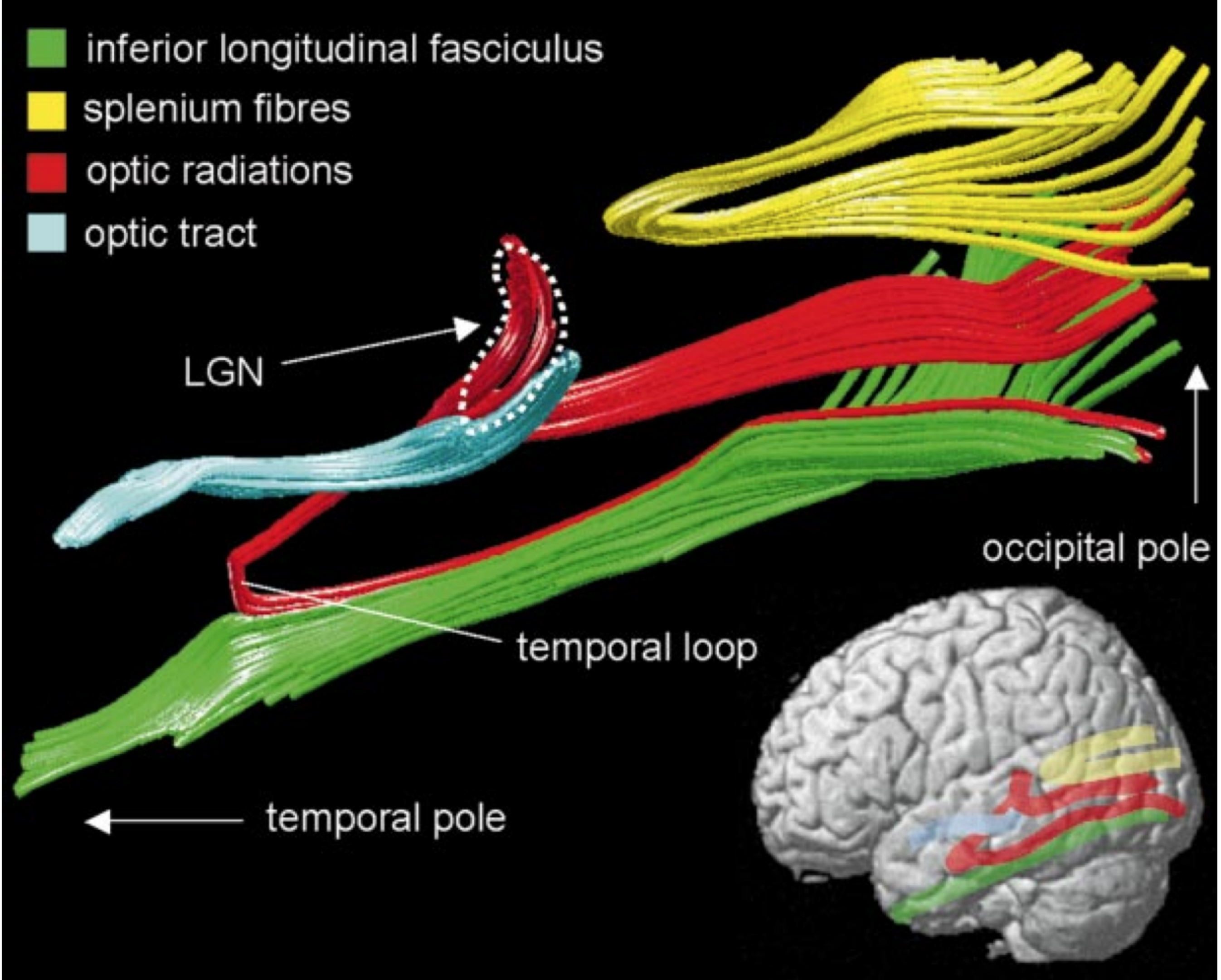
Autoradiography

‘occipito temporal projection system’

ILF == optic radiation

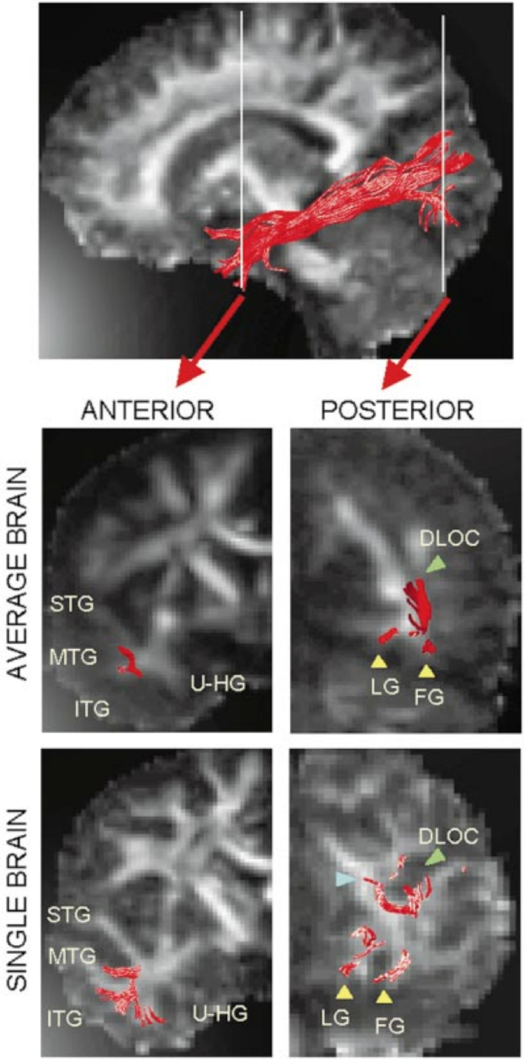


Catani & ffytche 2005



inferior longitudinal fasciculus
splenium fibres
optic radiations
optic tract
LGN
occipital pole
temporal loop
temporal pole

Catani 2003


ANTERIOR
POSTERIOR
AVERAGE BRAIN
SINGLE BRAIN
STG
MTG
ITG
U-HG
DLOC
LG
FG
STG
MTG
ITG
U-HG
DLOC
LG
FG

Catani 2003

Afferents & Efferents

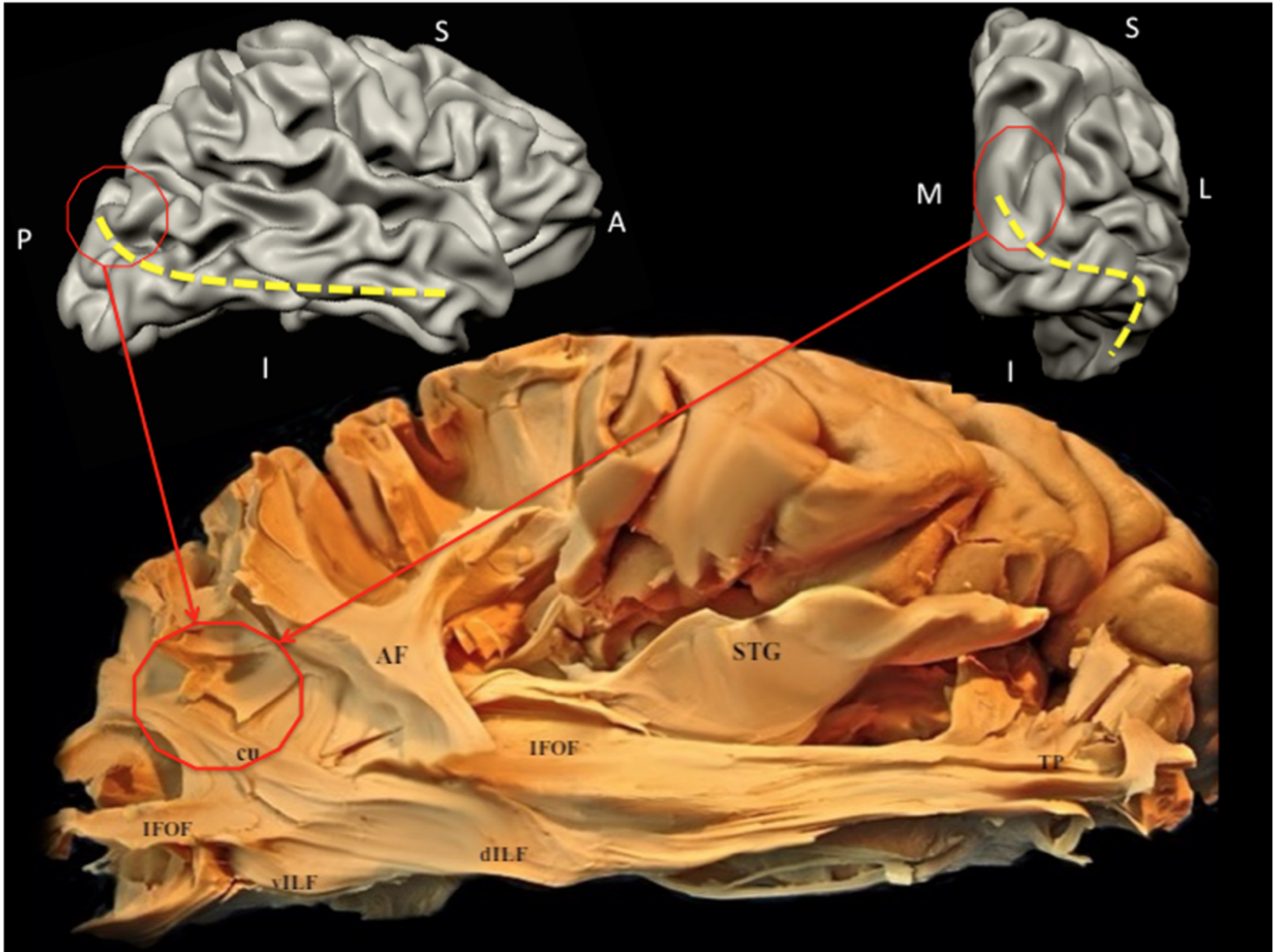
Anterior portion of dILF:

Posterior occipito-temporal region / junction (Fusiform gyrus in RH / Visual word form area {VWFA} in LH) → Temporal Pole

Posterior portion of dILF:

Inferior occipital gyrus / OFA → Fusiform gyrus / VWFA

Duffau et al 2013



Latini 2013

dILF: Afferents & Efferents

Includes fibers originating in:

- superior temporal gyrus
- middle temporal gyrus
- inferior temporal gyrus
- fusiform gyrus

these project to:

- lingual gyrus
- cuneus
- lateral occipital cortex
- occipital pole

Image from Latini 2013

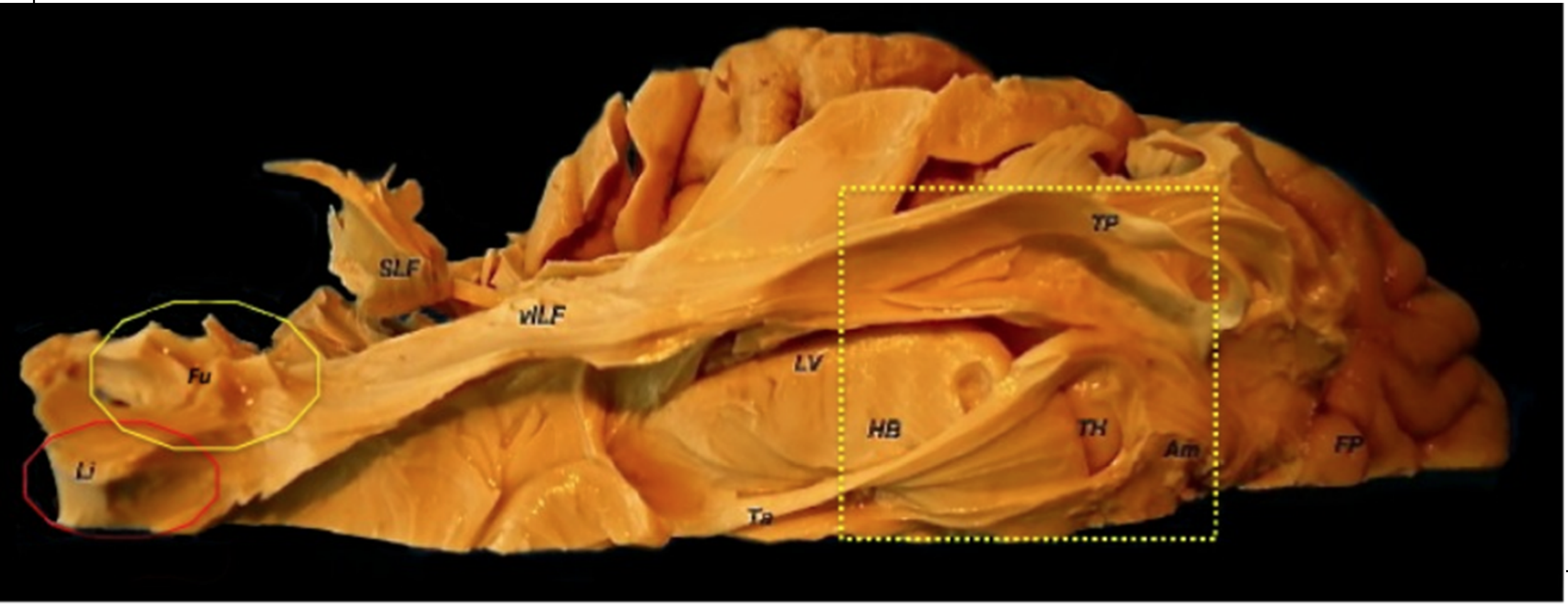
Duffau et al 2013

vILF: Afferents & Efferents

Extends from: posterior portion of the fusiform gyrus

to: temporal pole

Along: infero-lateral wall of lateral ventricle



Latini 2013

Afferents & Efferents

Difficult to delineate FFA and OFA in post-mortem brains because they are primarily defined by function.

Data from primate studies do not map well onto human brain anatomy.

Experience-dependant plasticity.

Strong individual differences in left OFA (Gshwind et al 2012)

Duffau et al 2013

Behavioral Correlates

Gratton et al. 2014

-Different tuning properties in neurons in the anterior and posterior portions of the face processing network

-occipital face area (OFC), fusiform face area (FFA), face-selective superior temporal sulcus (fSTS), and frontal anterior temporal lobe (fAT).

- reveal a posterior to anterior topography among face-selective occiptotemporal regions where posterior regions differentiated faces at an individual level and anterior regions differentiated at a more categorical level

Gratton et al. 2014

Behavioral Correlates

“We found that posterior visual areas were sensitive to small changes in stimulus properties (i.e., differences between individual faces along the morph continuum), whereas anterior areas responded to larger categorical changes.”

Gratton et al. 2014

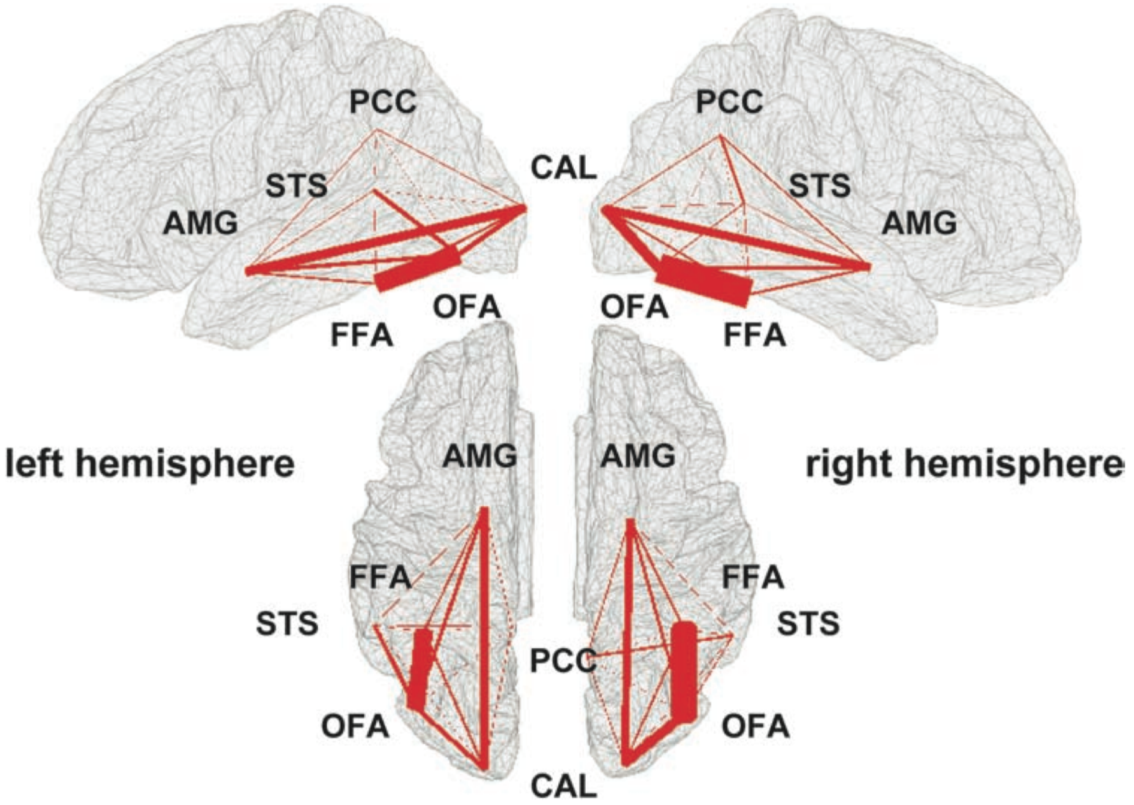
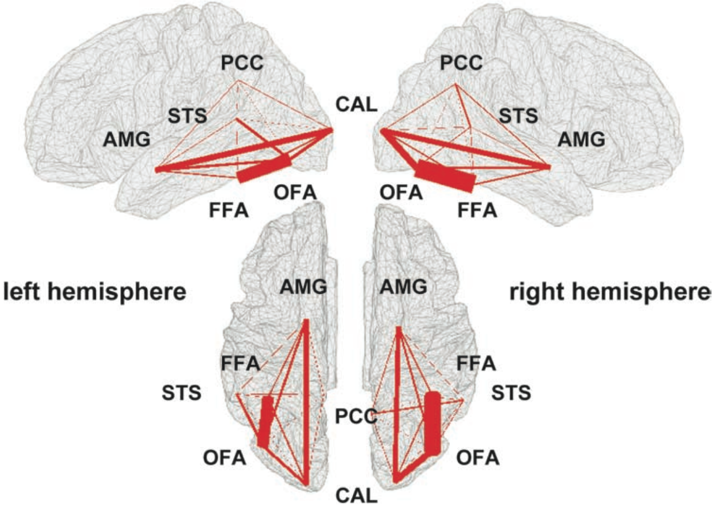


Figure 7. Summary of the main white-matter connectivity results. Connectivity results are shown for both hemispheres, averaged across 22 participants. The width of each connection path reflects their relative connectivity probability (averaged for streamlines to and from each ROI in each pair). A proportional contrast weight is applied to the path width for illustration purposes (linear = 4, gamma = 0.5).

Gschwind et al 2014

- Tractography: high connectivity between FFA and OFA with a right hemisphere predominance
- Consistent with imaging and neuropsychological studies
- ILF, along with the IFOF, constitutes a major portion of the face processing network.



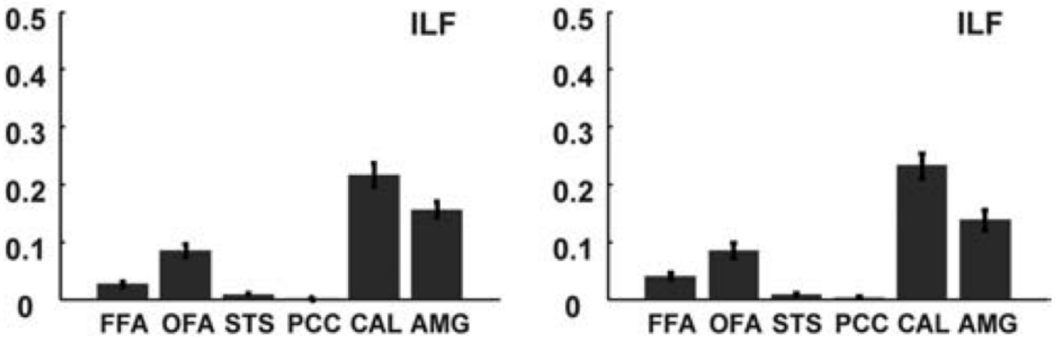


Figure 6. Connectivity probabilities between major white-matter bundles and face-responsive regions (analysis 3). Each panel represents the connectivity probability from the AF and the ILF toward each of the face-responsive ROIs (F = FFA, O = OFA, S = STS, P = PCC, A = AMG, C = CAL). The connectivity probability is expressed as a proportion of all connections in both hemispheres, thus permitting comparison across hemisphere. The error bar indicates the standard error.

Gschwind et al 2014

Behavioral Correlates

VWFA

- reading
- processes visual shape of letters and produces percept of word

Dehaene & Cohen 2011

Hemispheric Specialization

Left hemisphere : language

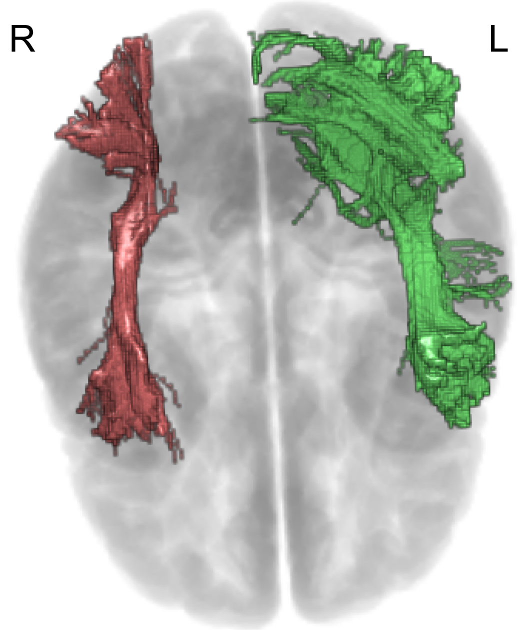
Right hemisphere : face processing

VWFA and FFA

- homologues
- strong lateralization of function
- experience-dependant plasticity
- response to invariant visual info

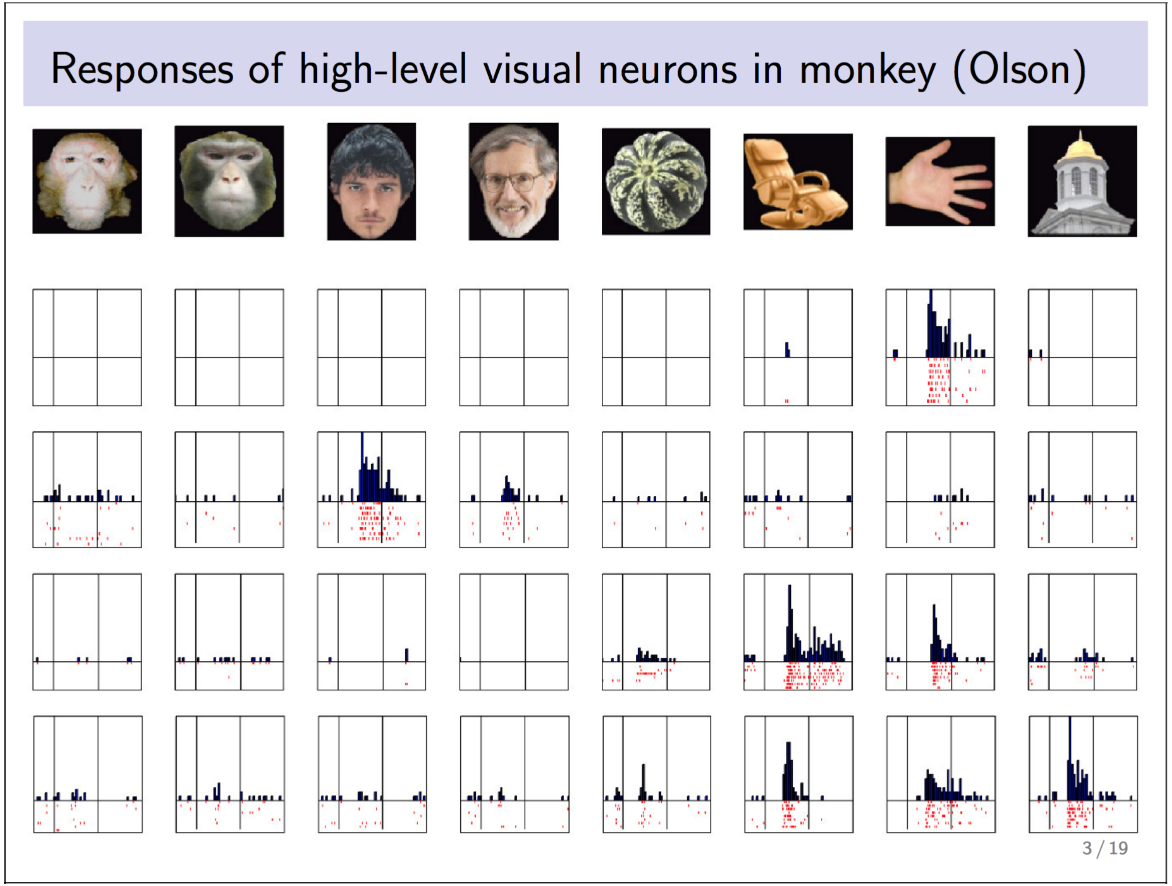
Plaut & Behrmann 2013

Hemispheric Specialization



From Connectopedia (Denis DUCREUX

Neurophysiology



Neurons in IT show category selectivity in response to images of objects

Slide: David Plaut

Clinical Pathologies

Associative visual agnosia

Prosopagnosia

Pure Alexia

Visual amnesia

Visual hypo-emotionality (but may be amygdalar pathways, not FFA)

Schizophrenia (Kikinis et al 2013)

Latini 2013

Clinical Pathologies

The transection or reduction of fractional anisotropy (FA) of the pathways between “visual” areas, “emotional” and “memory” areas result in a visually specific semantic [66] emotional or memory deficit.

Latini 2013

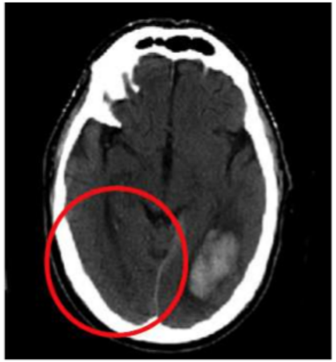
Faces and words: Homologous brain activation

Prosopagnosia

- Visual recognition much poorer for faces vs. other objects
- Can be bilateral but right lesion suffices
- Rely on other cues for recognition

Pure alexia

- Impairment in word recognition in premorbidly literate adults
- Left occipitotemporal lesion
- No general language impairment
- Rely on sequential "letter-by-letter" strategy



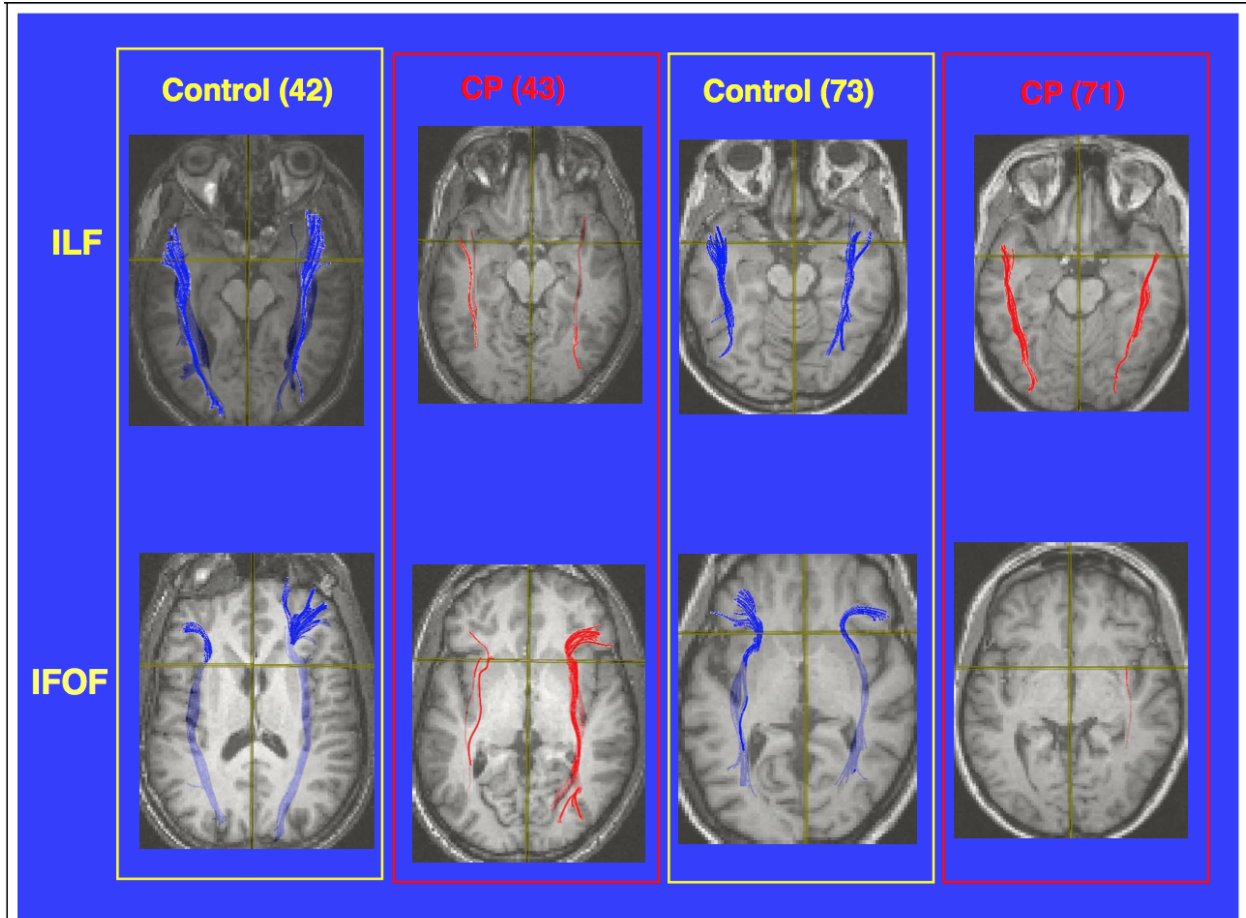
Dehaene & Cohen 2011

Slide from Plaut & Behrmann

Congenital Prosopagnosia

Inconsistent structural connectivity between OFA and FFA

Compromised structure of ILF or IFOF



Visual Amnesia

Patients cannot encode novel visual experiences to short-term memory, but are able to encode novel, non-visual experiences.

"For example, in one of the visual amnesia cases described by Ross (1980), occipito-temporal cortex and U-shaped fibres were largely unaffected, the critical lesion being a small infarct, posterior and inferior to the occipital horn of the left lateral ventricle, the classical location of the ILF."

Catani 2003