Inferior Longitudinal Fasciculus

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Virtual Neuroanatomy
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Overview

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2. Afferents & Efferents
3. Neurophysiology
4. Behavioral correlates
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6. Neurochemical systems
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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

Kandel 2012 (Principles of Neural Science)

Duffau et al 2013
Dual-Stream Model of the Ventral Semantic Route

Dorsolateral Prefrontal Cortex
- Middle Frontal Gyrus
- Orbito-frontal Area

Indirect Pathway
- Temporal Pole

Dorsal Route
- Superior Parietal Lobule
- Angular Gyrus
- Superior and Middle Occipital Gyri

Direct Pathway
- Postero-inferior Temporal Cortex/Fusa
- Postero-superior Temporal Area
- Postero-middle Temporal Area

Visual Recognition

Visual input (optic radiations)

Superficial layer of the Inferior fronto-occipital fascicle (IFOF)
- Deep layer of the IFOF
- Inferior longitudinal fascicle
- Uncinate fascicle
- Middle longitudinal fascicle
- U-fibers

Duffau et al 2013
Does the ILF actually exist?

Controversy: Unglerleider & Tusa (1985)

Autoradiography

‘occipito temporal projection system’

ILF == optic radiation
Afferents & Efferents

Anterior portion of dILF:
- Posterior occipito-temporal region / junction
  - (Fusiform gyrus in RH / Visual word form area \{VWFA\} in LH) \rightarrow
  - Temporal Pole

Posterior portion of dILF:
- Inferior occipital gyrus / OFA \rightarrow
  - Fusiform gyrus / VWFA

Duffau et al 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

Duffau et al. 2013
Image from Latini 2013
vILF: Afferents & Efferents

Extends from: posterior portion of the fusiform gyrus to: temporal pole
Along: infero-lateral wall of lateral ventricle
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)
Behavioral Correlates

-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
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).
● 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-dependent 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)
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.
Faces and words: Homologous brain activation

**Prospagnosia**
- 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
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