The ventral visual pathway: an expanded neural framework for the processing of object quality (A review by D.J. Kravitz et. al)

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### Visual Pathways

Dorsal

- "Where" pathway
- Through the occipitoparietal cortex to the posterior part of the inferior parietal lobule (area PG)

#### Ventral

- "What" pathway
- Through the occipitotempora cortex to the anterior part of the inferior temporal (IT) cortex (area TE)



# Ventral pathway



#### • Anatomical Findings

### Intrinsic connectivity in ventral pathway





- Bypass connection
- Multiple connections
- Unidirectional and Bidirectional connections
- Parallel connections
- Weak and strong connections
- Neuroanatomical distinction between the inputs from visual fields.
- Afferent pathways

## Implications

#### • No serial hierarchy

- Multiple and parallel connections
- Although there is an increase in the complexity of representations from posterior to anterior region but not necessarily central pathway is involved.
- <u>Biasing</u>
  - Retinotopic biases : Extend to high-level object and pattern representations like identity of body parts
  - Eccentricity : functional eccentricity biases throughout the occipitotemporal network
- <u>Clustering</u>
  - Functional clustering in cortex with selectivity for particular object categories
  - Behaviorally significant
  - Emerging naturally from an interaction between large-scale connectivity and experience

#### <u>Recurrent processing</u>

• The dense bidirectional connections along the central route are likely to contribute to the complex interactions necessary to generate attentional effects.

### Retinotopic Bias and Eccentricity Bias





## Output Pathways

#### Cortico-subcortical

#### Occipitotemporo-neostriatal pathway

- visual discrimination learning based on the reinforcement versus extinction of stimulus-response associations; that is, habit formation or procedural learning
- <u>Occipitotemporo-ventral striatum</u> pathway
  - assignment of value (positive and negative) to particular stimuli.
- Occipitotemporo-amygdaloid pathway
  - visually-dependent emotional regulation

#### Cortico-cortical

- Occipitotemporo-medial temporal pathway
  - encoding of long-term memory of object quality. (Perirhinal)
  - selectivity for particular landmarks, places, and views of the environment (hippocampal)
- <u>Occipitotemporo-orbitofrontal</u> pathway
  - updating particular stimulus-reward associations.
- <u>Occipitotemporo-ventrolateral</u> <u>prefrontal pathway</u>
  - attention, working memory, switching task set of task-relevant information represented in the posterior cortices.
  - final stage of the putative processing hierarchy

## **Output Pathways**



### Summary

- Characterizing the occipitotemporal pathway as a recurrent network accounts for several of its functional properties, and specification of its output targets provides insight into the function not only of those targets but also of the pathway itself.
- the connectivity enables distinct areas to perform specialized processing of distinct aspects of stimuli.
- the functional properties of a region are ultimately related to its connectivity.

### References

- Mishkin, M. et al. (1983) Object vision and spatial vision: two cortical pathways. Trends Neuroscience
- de Haan, E.H. and Cowey, A. (2011) On the usefulness of 'what' and 'where' pathways in vision. Trends Cognitive Science.