The Superior Colliculus and the Detection of Visual Stimuli


The Physiological Conditions of Attention:

These seem to be the following:

1. The appropriate cortical area must be excited ideationally as well as sensorially, before attention to an object can take place.
2. The sense-organ must then adapt itself to the reception of the object, by the adjustment of its muscular apparatus.
3. In all probability a certain afflux of blood to the cortical centre must ensue.

Of this third condition I will say no more, since we have no proof of it in detail...

(William James, Psychology: Briefer Course, 1892.)

Visuomotor Components of Attention

- Sensory information
  - visual
  - auditory
  - tactile
- Movements of
  - eyes
  - head
  - pinnae
  - vibrissae
- Sensory Integration

http://faculty.frostburg.edu/mbradley/psyography/james.gif


Wall, Walker & Smith (2009)
The Colliculus Makes It to the Small Screen!

Multisensory Integration Occurs in the Deep Layers of the Superior Colliculus

from King (2004)

Multisensory Integration Occurs in the Deep Layers of the Superior Colliculus

Recording Neuronal Activity in Awake Rats
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Multimodal Integration in the Superior Colliculus of Awake Rats

Sensory Processing Depends on the Behavioral Context

Neuronal Activity Related to Direction of Head Movements

Held in hand

On platform

Freely moving

Weldon & Best (1992)
Colliculus Units (45%) Show Reward-Related Activity in a T-Maze Task

Is SC Activity in the Goal Box Due to Motor Movements or Sensory Stimulation?

SC Activity during Reward Retrieval is Not Due to the Execution of the Movements

Responses of SC Neurons are Not Due to an Increase in Sensory Responsiveness
Some Superior Collicular Cells Code for Magnitude of Reward

Some SC Cells Show Activity That Is Correlated with Head Movement

Some SC Cells Are Inhibited During Food Retrieval

Some Neurons Code for Magnitude of Liquid Reward
The Superior Colliculus Participates with Other Brain Areas During Sensorimotor Integration

Connections from the Caudate Nucleus Disinhibit Collicular Cells to Elicit Saccadic Eye Movements

Striatal Cells Facilitate Collicular Sensory Responses

Collicular Connections to the Striatum Might Provide Short Latency Information Regarding Salient Stimuli
Conclusions

1. Neurons in the superior colliculus are dynamically involved in visuomotor orientation.
2. Collicular sensory responsiveness changes as a function of the behavioral context.
3. The presence and magnitude of reward affect collicular activity.
4. For some neurons, reward correlates are independent of specific movements or changes in sensory processing.
5. Thus, the superior colliculus is probably involved in processing of salient behavioral events, perhaps via connections with the striatum.

Collaborators

Philip J. Best
Sascha I. Arbouet
Erica A. Calligan
Jennifer A. Delgado
Robert R. Edwards
Tamara J. Green
Tamara L. Knoor
Christina L. Nemeth
Carly A. Patterson
Jennifer L. Perley
Kimberly M. Preucil
Avery A. Rizzo
Matthew R. Silver
Aliosa A. Thomas
Rebecca E. Wright