Spatial memory and navigation

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Spatial navigation - definition

- A complex type of behaviour of moving organisms
- Process of determining and maintaining a route from one place to another

Gallistel, 1990

Spatial navigation

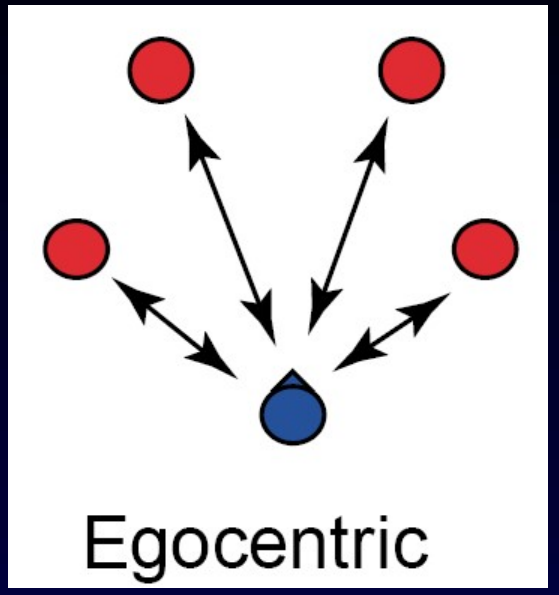
- Is divided into:

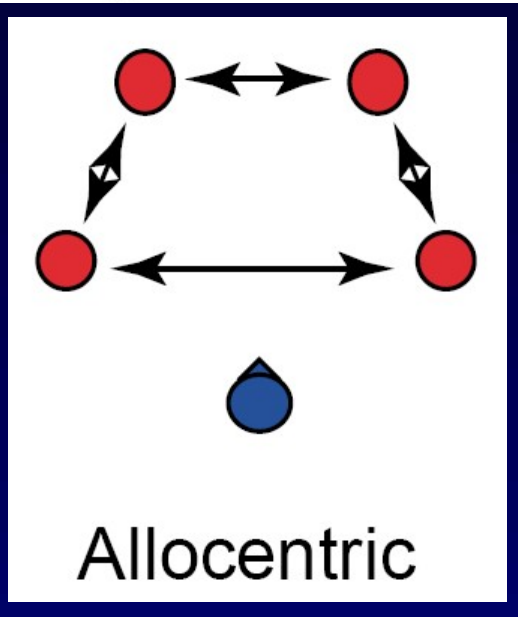
egocentric x allocentric

Klatzky, 1998

Navigation – egocentric x allocentric

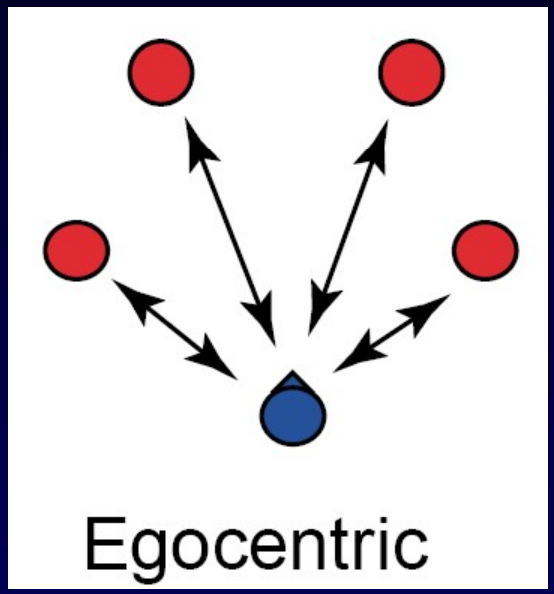
- Representation of objects‘ (or goals‘) positions:
  - **Egocentric** – subject (observer)-to-object relation
  - **Allocentric** – object-to-object relation





Egocentric navigation

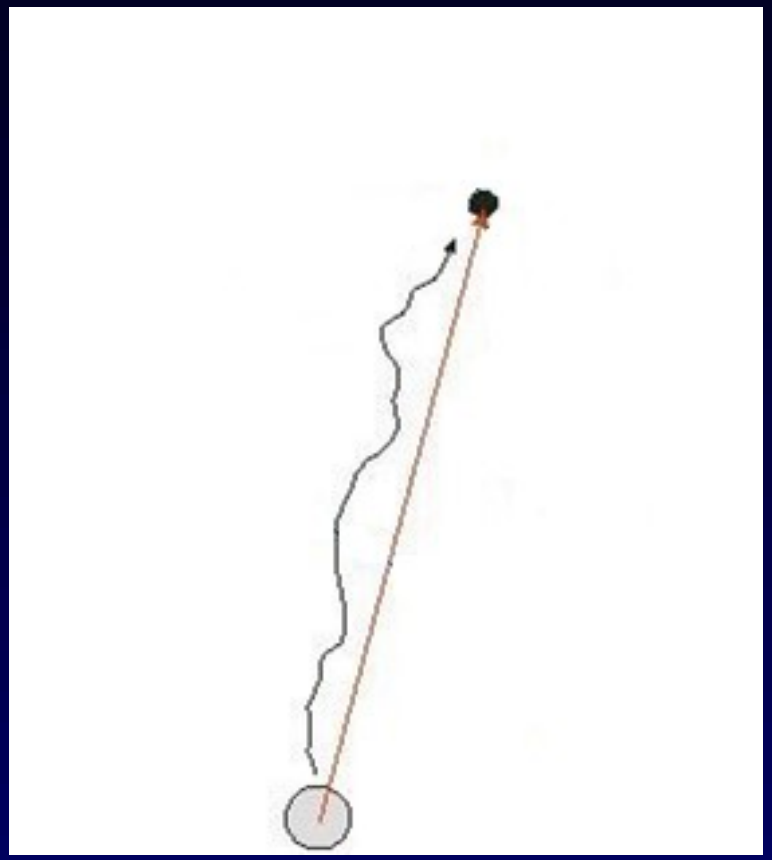
- Use spatial representation relative to the body
- Is subject (observer) dependent



Trullier et al, 1997

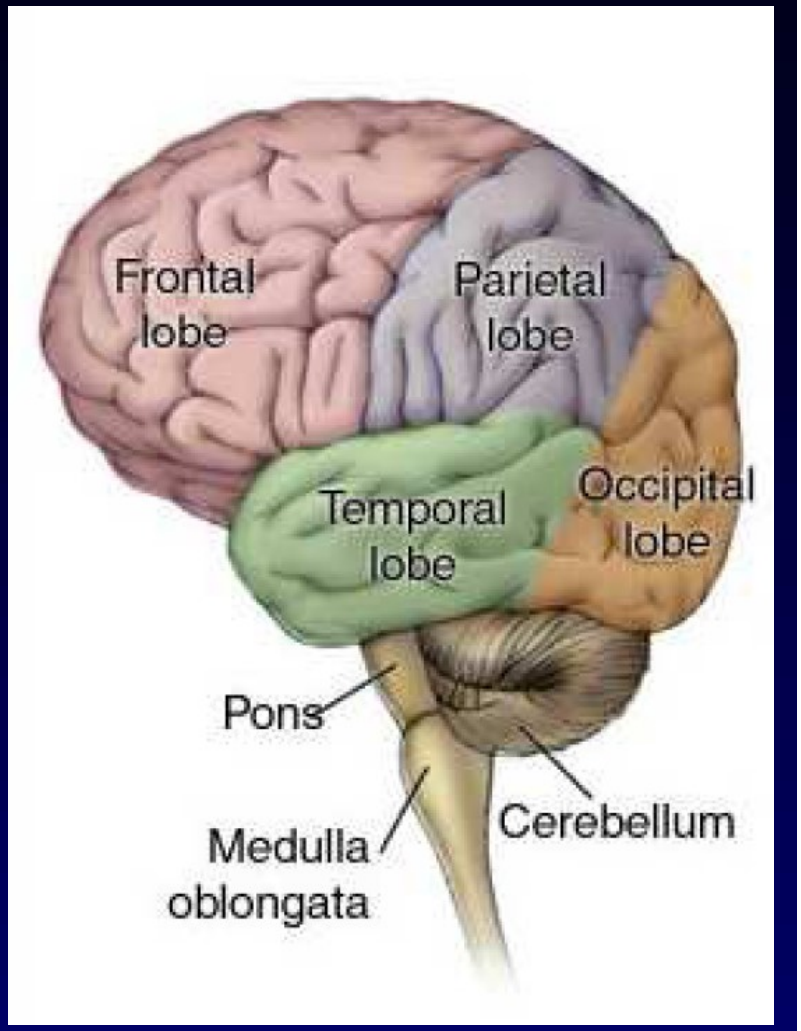
Egocentric navigation

- Goal is defined by distance and direction from the observer



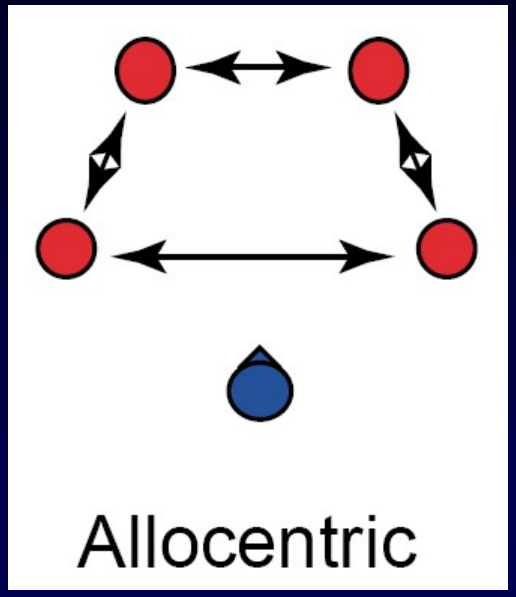
Localisation of egocentric navigation

- Parietal cortex
- Caudate nucleus



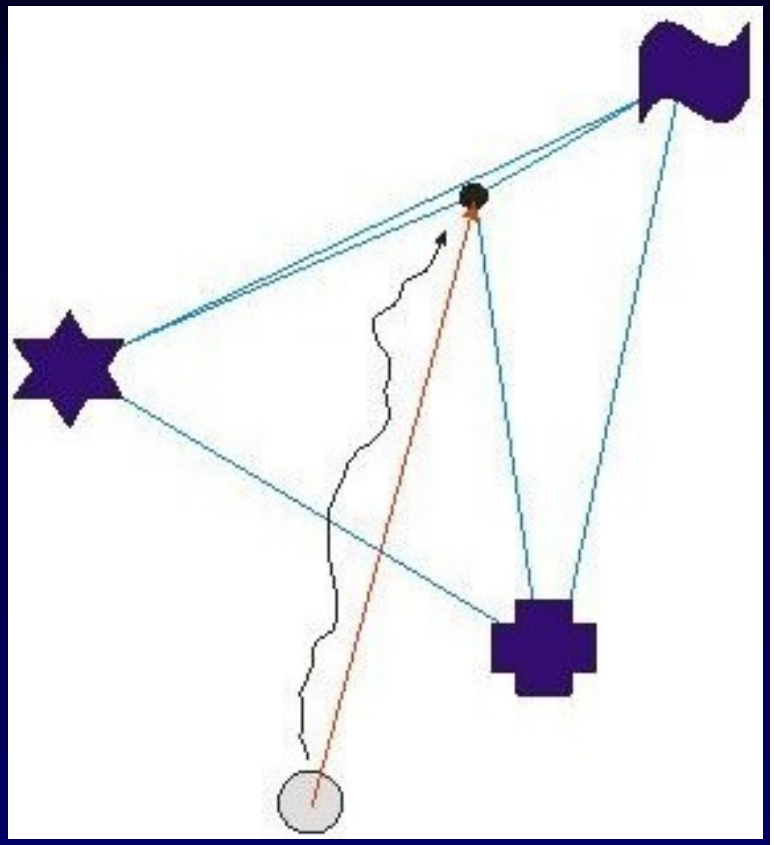
Allocentric navigation

- Use spatial representation relative to the distant orienting cues
- Subject (observer) independent



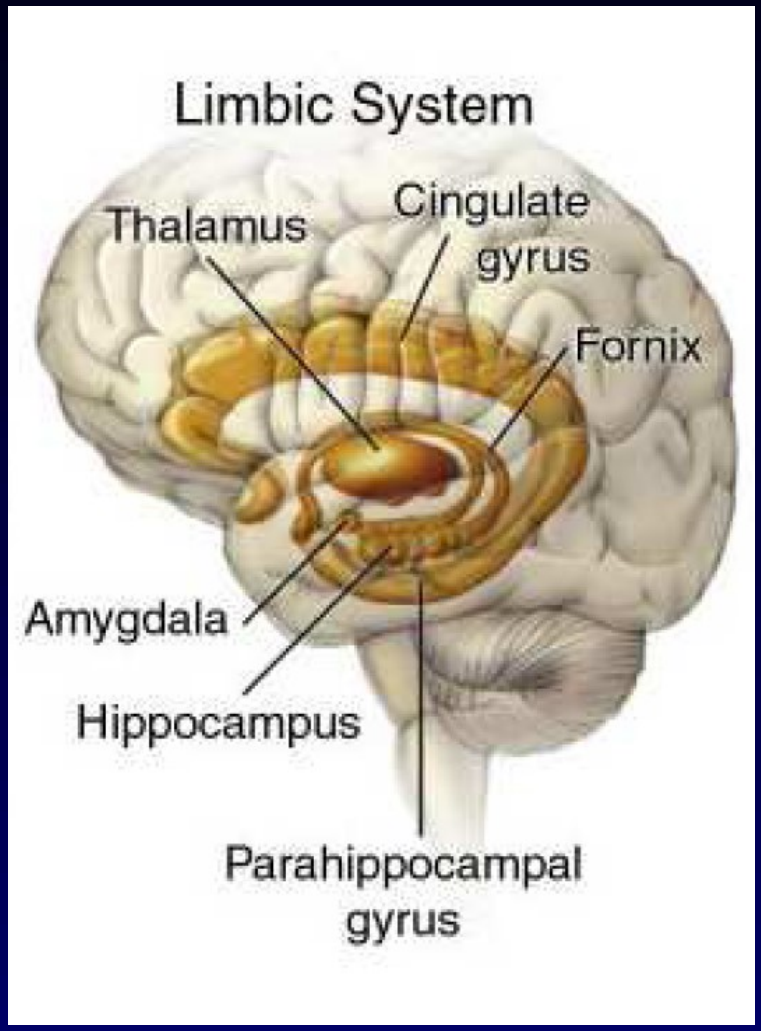
Allocentric navigation

- Flexible – enable to find a goal from any place (using a never transferred route)
- Enabe shortcuts and detours
- Stored as an internal map
  = **cognitive map**



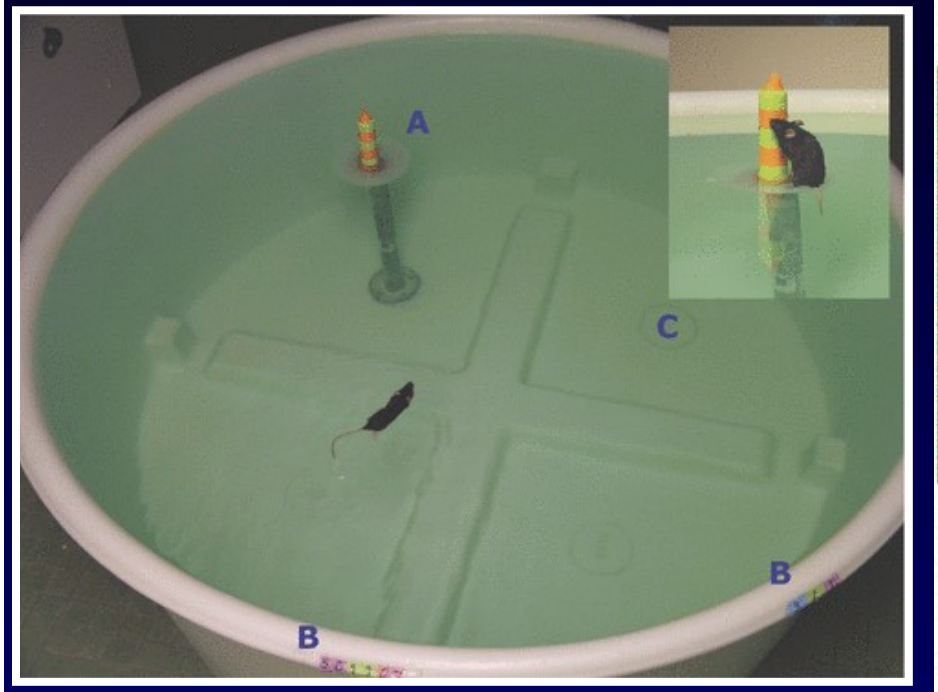
Localisation of allocentric navigation

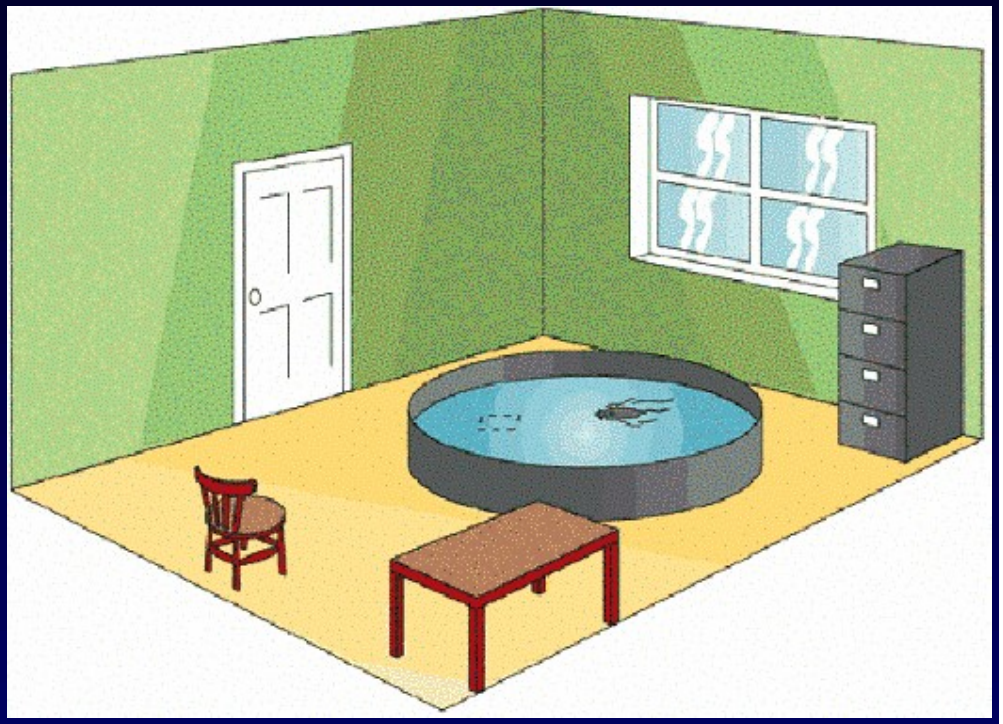
- Hippocampus
- Parahippocampus



Spatial navigation testing

- Morris Water Maze – distinguish allocentric and egocentric navigation

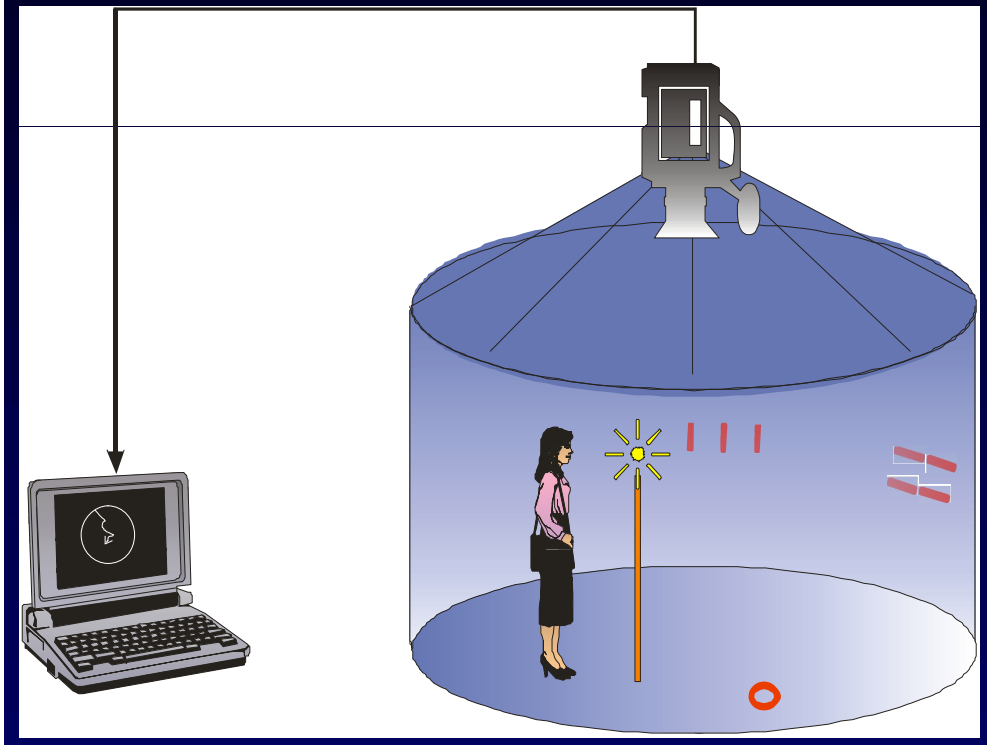




Morris, 1981

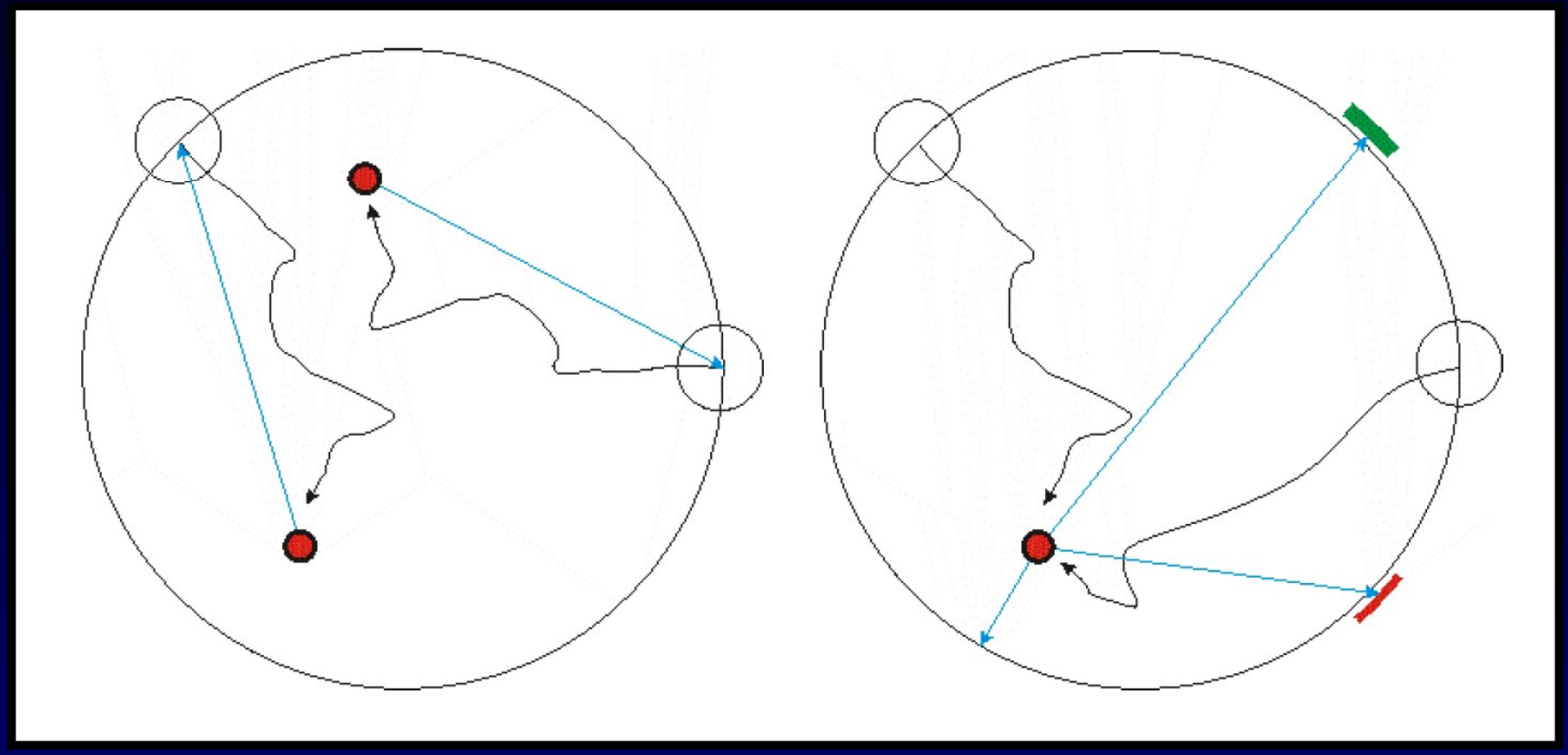
Spatial navigation testing

- Human analogue of the Morris Water Maze



Spatial navigation testing

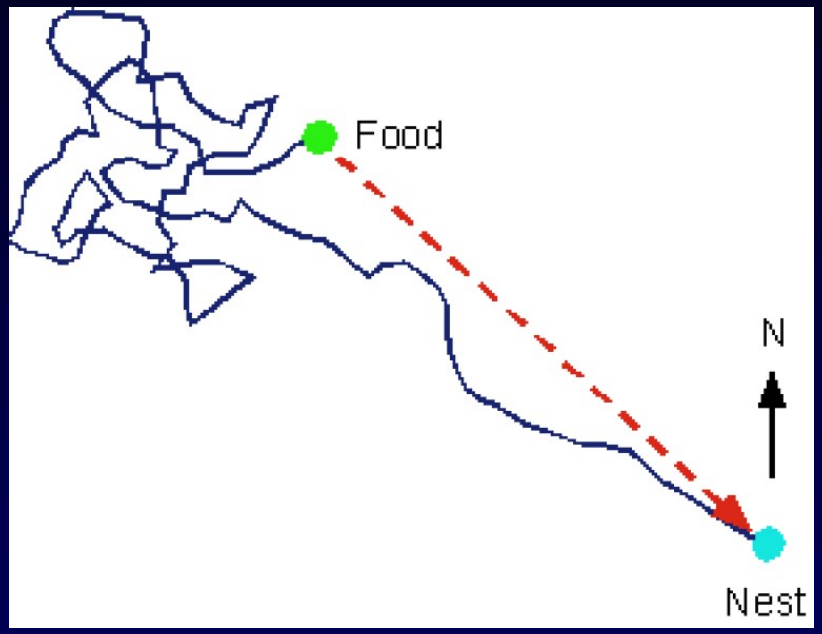
- Human analogue of the Morris Water Maze



Egocentric navigation Allocentric navigation

Navigation without vision

- = path integration – positional information is acquired by the movement recording, without using orienting cues



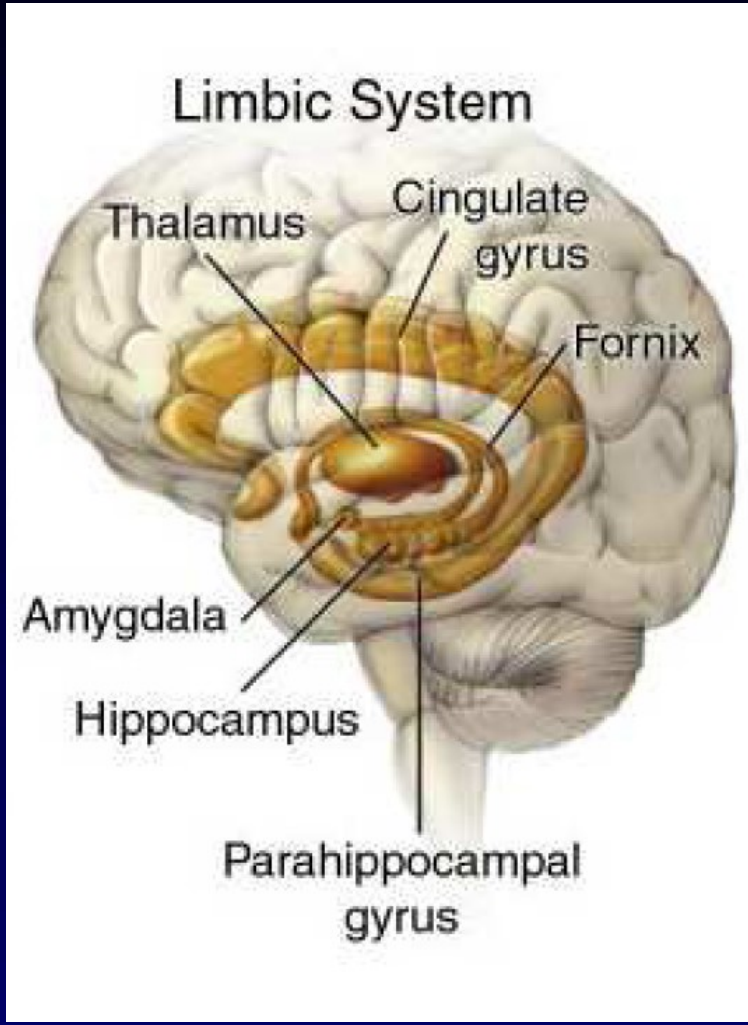
- Integration of speed and its direction in the course of navigation

- Enable to return from any place and to repeat the same route

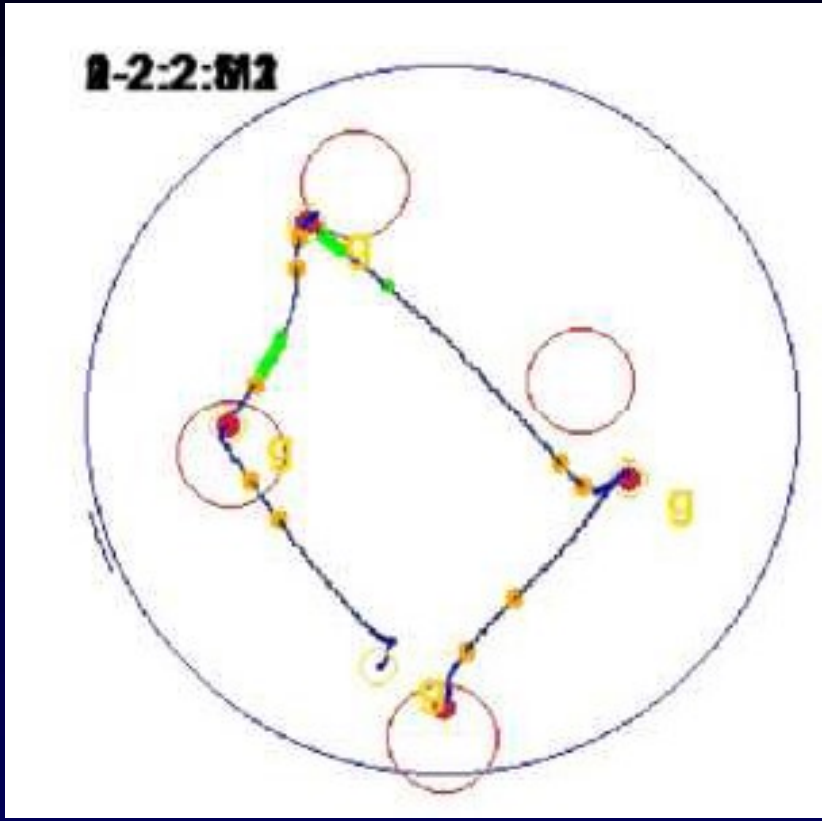
Gallistel, 1990

Localisation of path integration

- Medial temporal lobe (hippocampus)
- Medial entorhinal cortex
- Parietal cortex



Spatial navigation testing



- Error – increases by the number of turns

Conclusion

- Navigation – a process of determining and maintaining a route from one place to another
- Is divided into:
  - egocentric x allocentric
  - navigation without vision = path integration
- Testing – Morris Water Maze