



Sensing Navigation

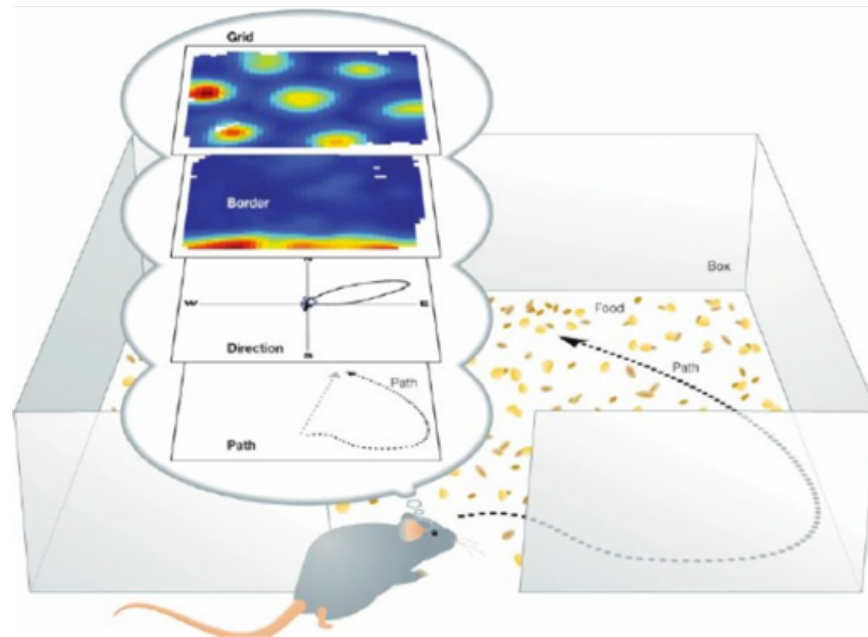
the Era of the Enhanced Human

“Why, as a society, do we spend so much time and money on making our homes and machines smarter and not our bodies?”

Daniel Lyngholm, PhD

Chief Scientist, CyborgNest

Spatial perception



(Moser & Moser 2011)

How do we know where we are?

- Local Space
 - Visual survey of surroundings
 - Place & Grid cells
- Global Space
 - Memory of past movements

How do we know our orientation?

- Visual survey of surroundings
- Proprioception
- Head-direction cells

Why do we get lost?

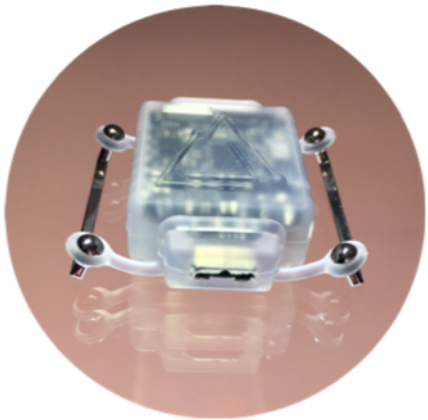
- Lack of memory of past movements
- Lack of frame of reference

Human sensory augmentation

Sensory augmentation is deeply associated with sensory substitution and rehabilitation after impairment.



BrainPort (Lee et al, 2014)



We're now moving beyond recreating a lost sense to enhance and expand our perception of the world with new senses

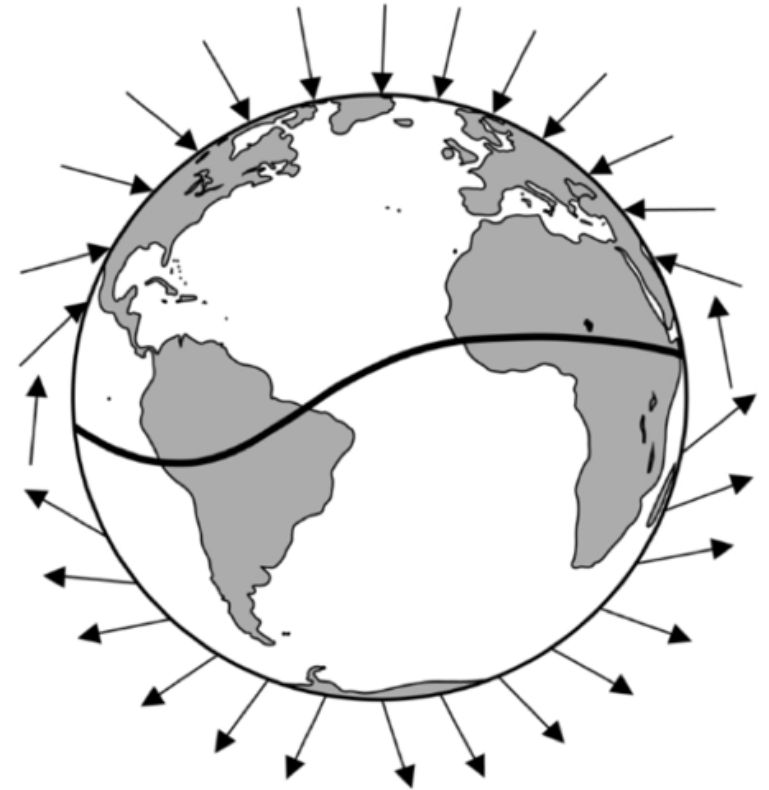
Cyborg Nest created the first permanent sense of north (the NorthSense).

Magnetoreception

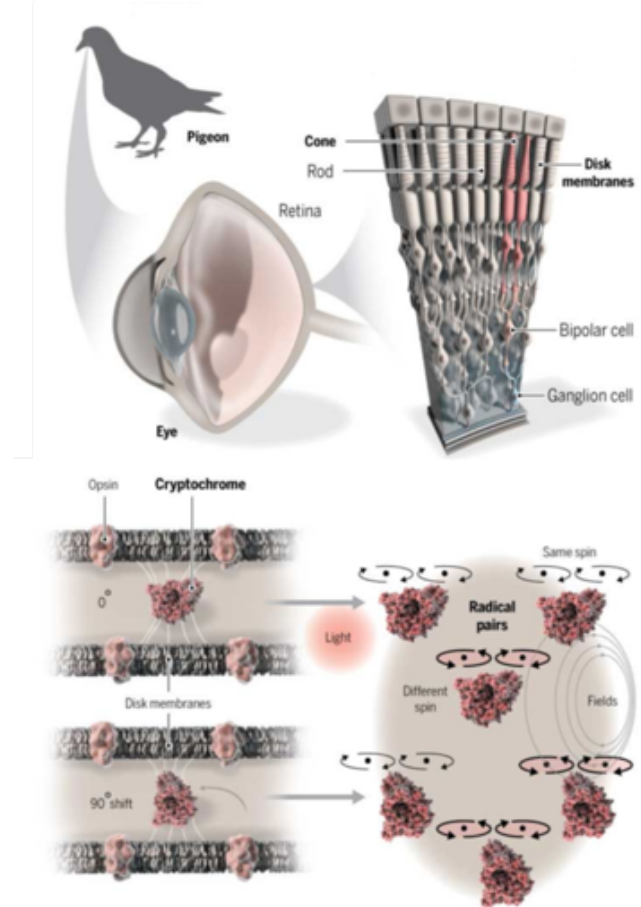
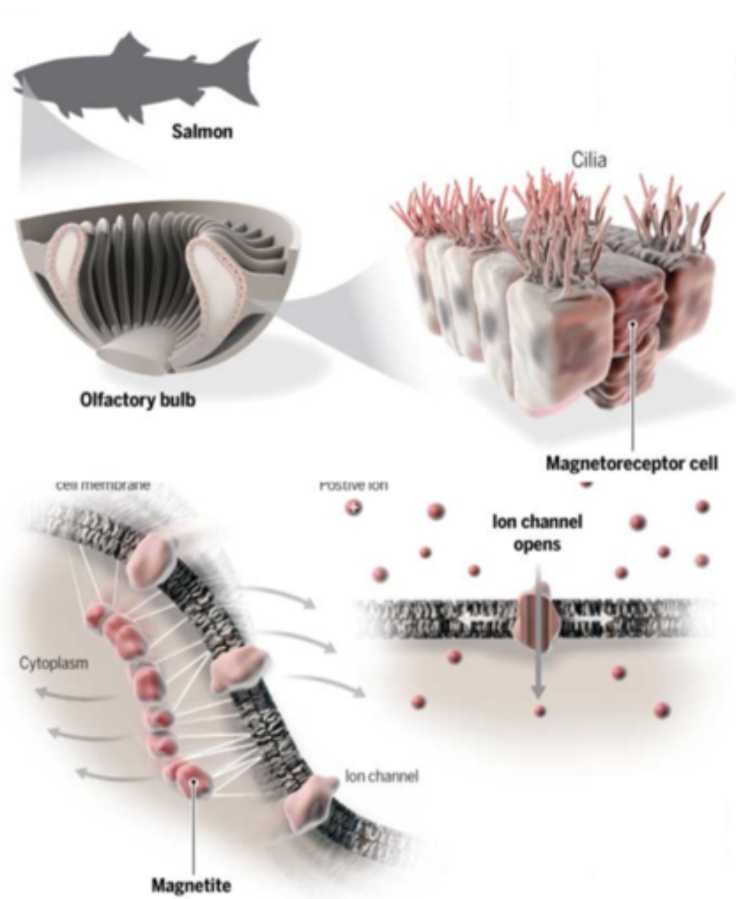
There is evidence that migratory birds sense both magnetic inclination and magnetic field strength (e.g. Günther et al 2018; Deuchlander & Muheim, 2010).

However, limited data on the details on link of magnetoreception to neural circuits of navigation

- Some amphibians and reptiles also have an inclination compass (e.g. Lohmann & Lohmann, 1994, 2019)
- Some Fish and mammals have a polarity compass. (e.g. Quinn et al 1981; Wang et al 2007; Marhold & Witschko 1997)
- Some evidence of magnetoreception in humans (e.g. Wang et al. 2019; Chae et al. 2019)



How do animals sense Magnetic fields



The NorthSense - A new frame of reference



Our NorthSense can give an external spatial frame of reference that extends our local sense of space to a global sense of orientation

It is possible that having a permanent external input may enable the brain to learn to recognise any intrinsic magnetoreceptive signals

Why is this important?

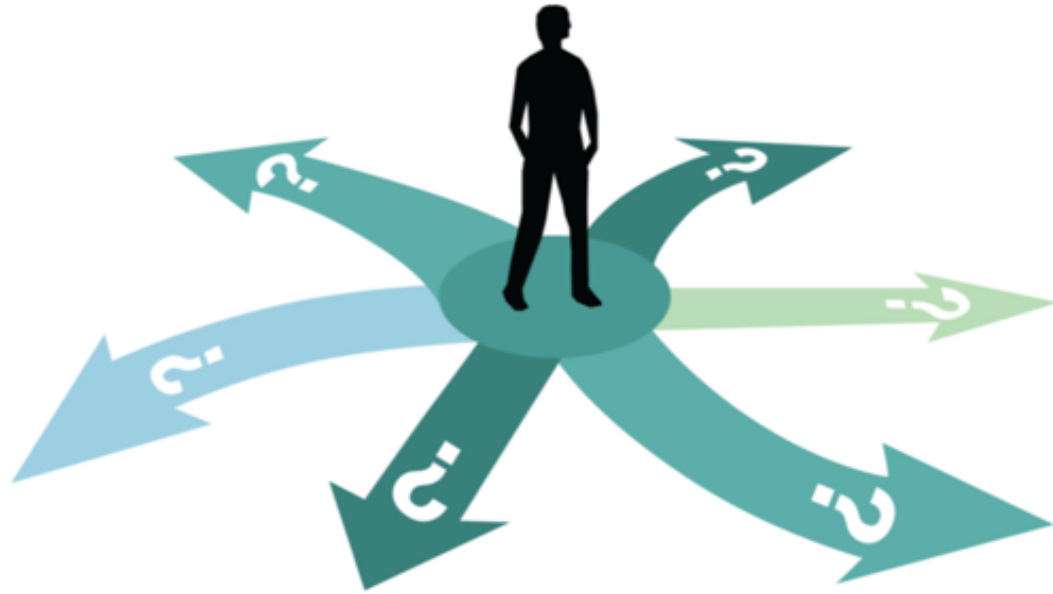
Not getting lost (as easily)

Link orientation of disparate locations

Improve wayfinding and route recall

Improve memory recall

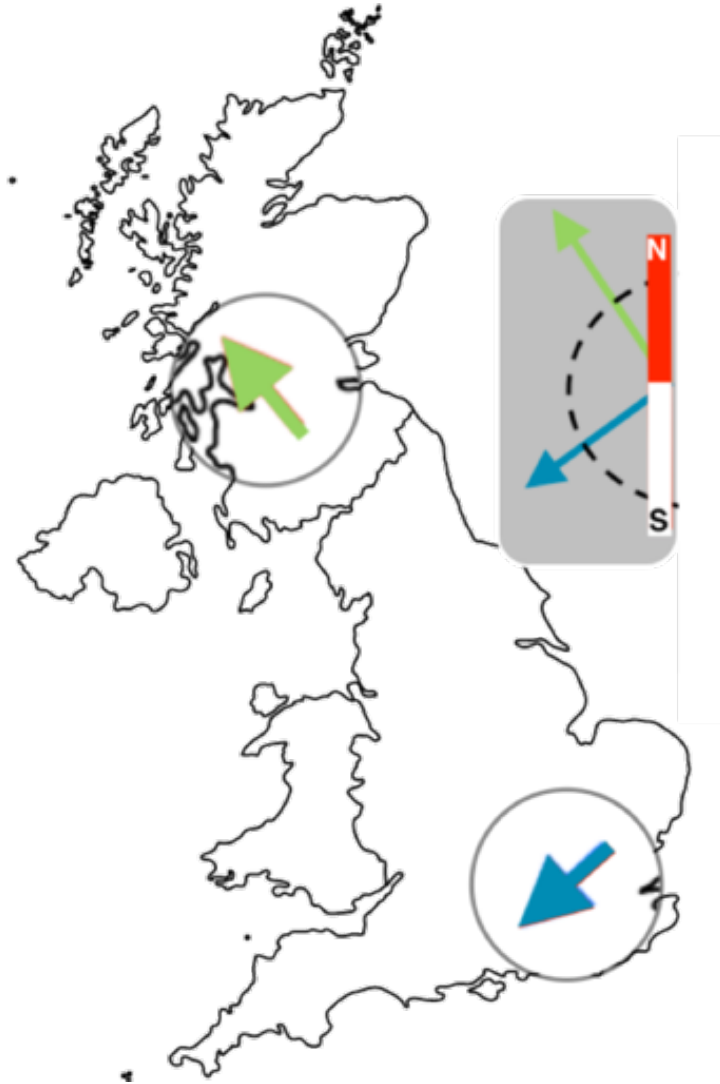
Not getting lost (as easily)



Knowing the direction of north allows recovery from confusion caused by built environments and transport

The moment of greatest confusion is when exiting a “blind” mode of transport, as all external references have been lost.

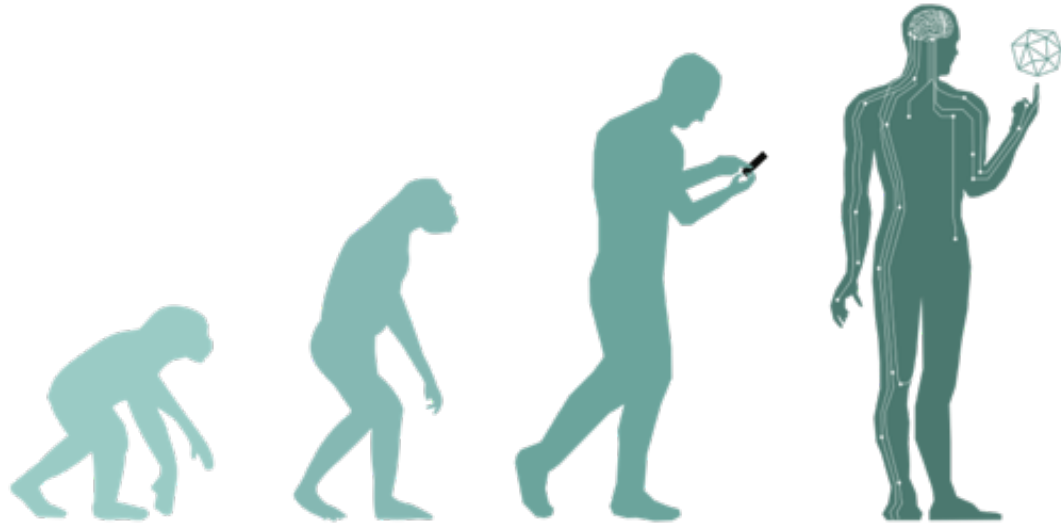
Linking orientation of disparate locations



- Having a permanent reference means you intuitively link the relative orientation of different locations
- The extra vector allows for triangulation to form new associations and realisations

“my home-desk is oriented 90° to my work desk...”

Improving wayfinding and route recall



Restricting navigation to using devices may limit your ability to form cognitive maps that can be recruited when navigation is unaided

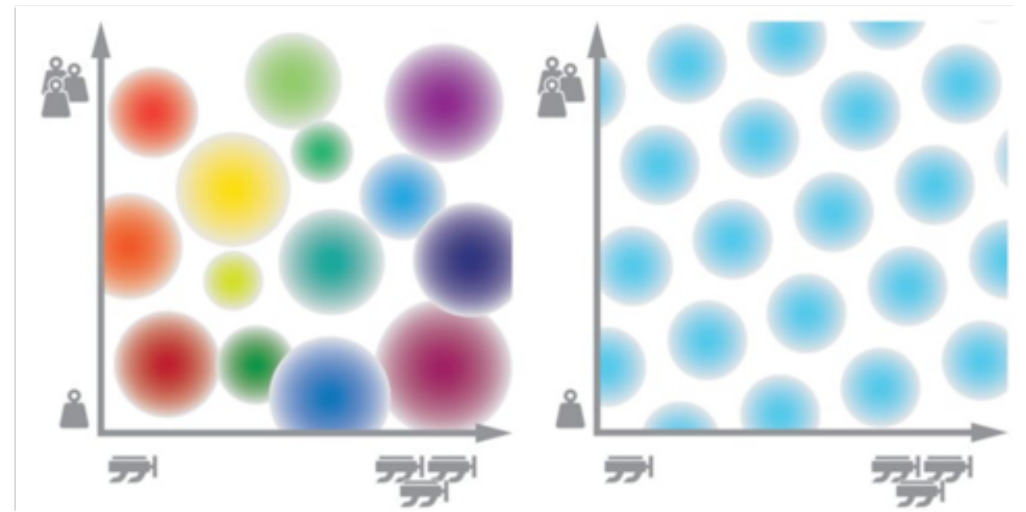
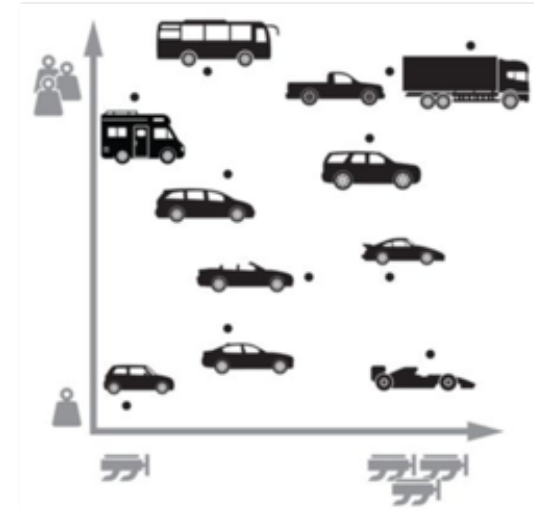
Not looking at a screen frees us up to look at and interact with cues in the environment

Improving memory recall

The hippocampus is crucial for episodic memory

- Memories show grid-like representations suggesting this mechanism may be used beyond spatial memory and may also be linked directly to abstract (conceptual) memory.

This could suggest that an additional axis could not only improve spatial perception and memory, but could potentially also act as a memory-aid

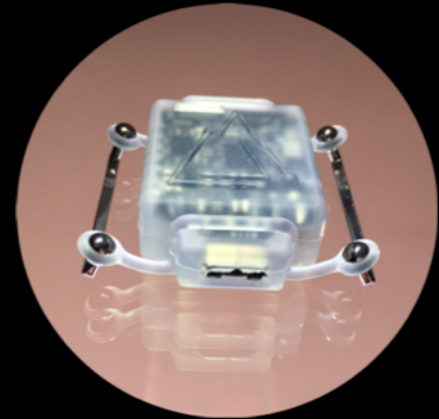


(Bellmund et al, 2018)

What is this NorthSense?

The NorthSense is **sold out**

- Tells you when you face North
- Simple vibrotactile stimulator mounted on chest





Get in Touch

We're actively looking for people interested in working with us, collaborating and/or participating in future research into the potential impact of this permanent artificial sense.

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