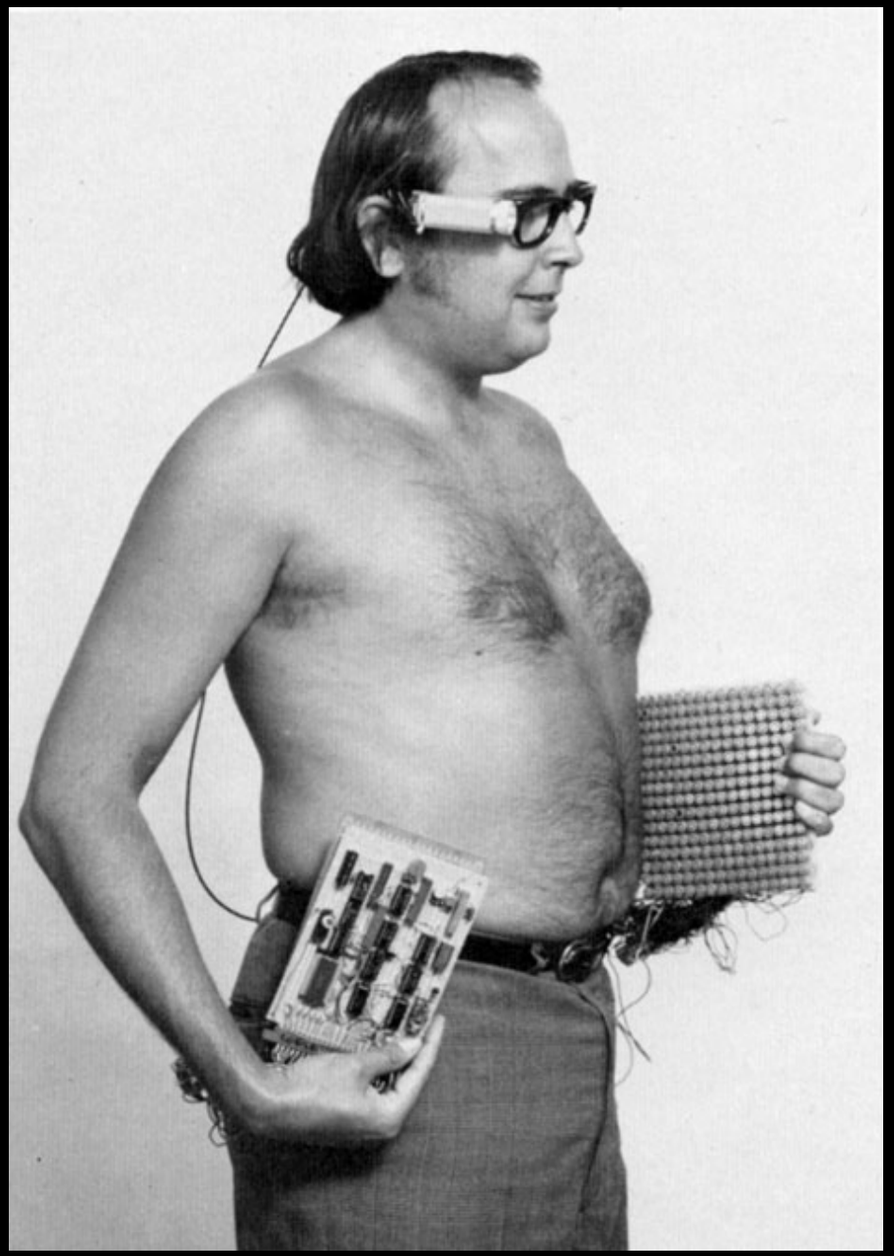


Physical Computing 2021

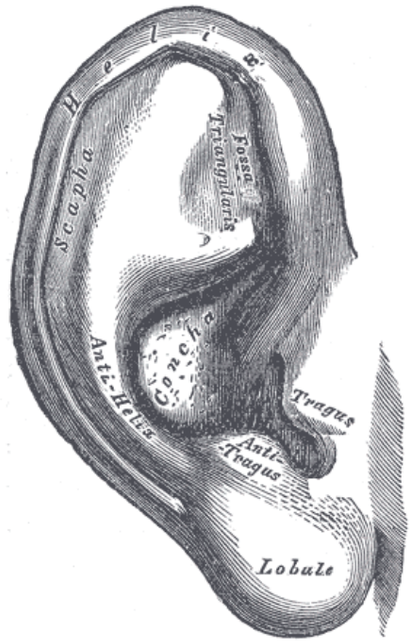
Sensory Substitution

Sensory substitution is a change of the characteristics of one sensory modality into stimuli of another sensory modality.

“I Hear with My Eyes and I See with My Ears”

To help restore lost senses, sensory substitution devices (SSD) couple information from an artificial receptor to the brain via a human-machine interface (HMI). In turn they replace information usually carried to the brain from an intact sense organ.

Exteroception



Visual system (vision)

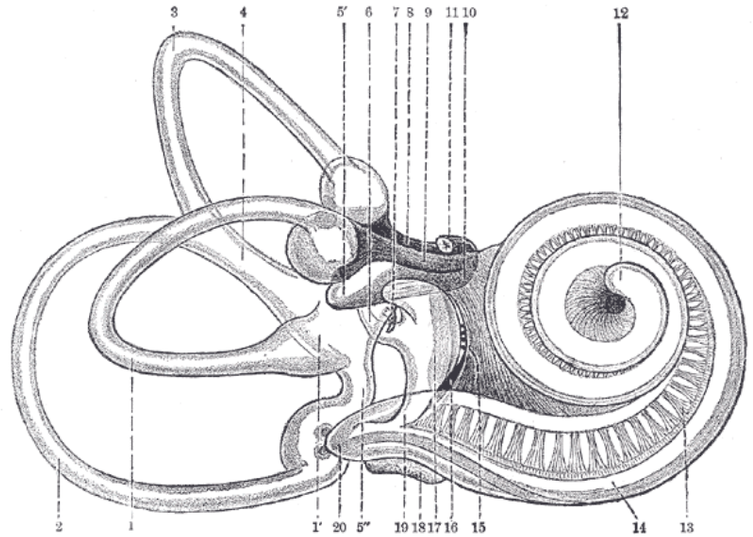
Auditory system (hearing)

Somatosensory system (touch)

Gustatory system (taste)

Olfactory system (smell)

Interoceptive



Vestibular system (balance)

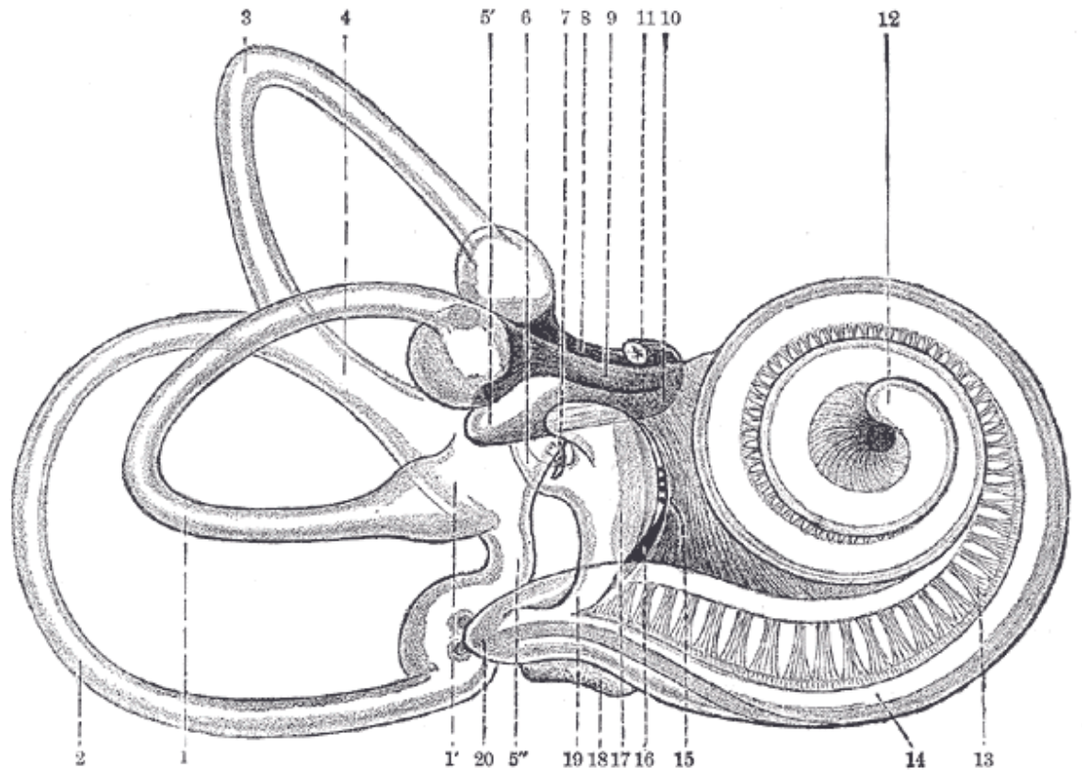
Proprioception

Pain

Chronoception

Many more…

The Senses



Vestibular System

The Man Who Mistook His Wife for a Hat, Oliver Sacks, 1985

Takuji Narumi

Sensory Cross Talk

Morrot, Gil, Frédéric Brochet, and Denis Dubourdieu. "The color of odors." Brain and language 79.2 (2001): 309-320.

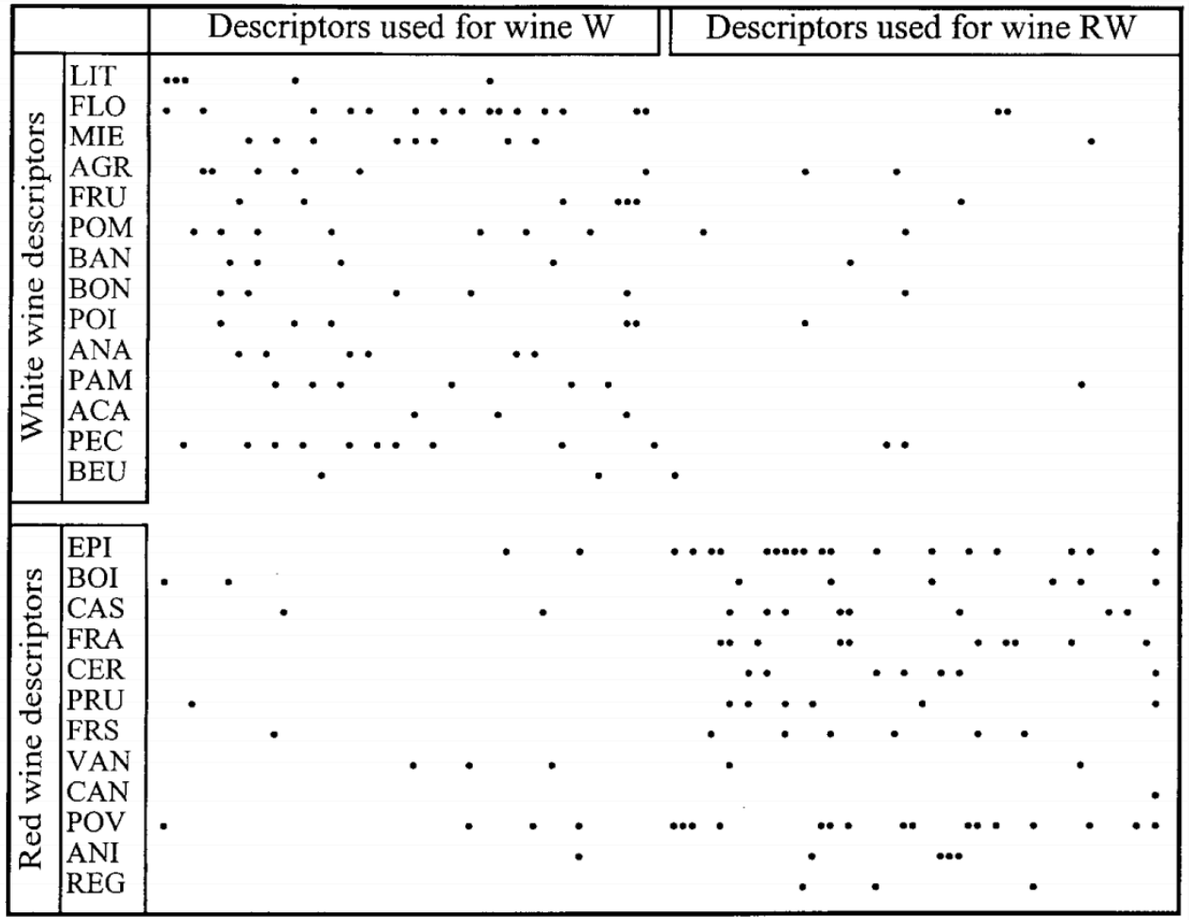
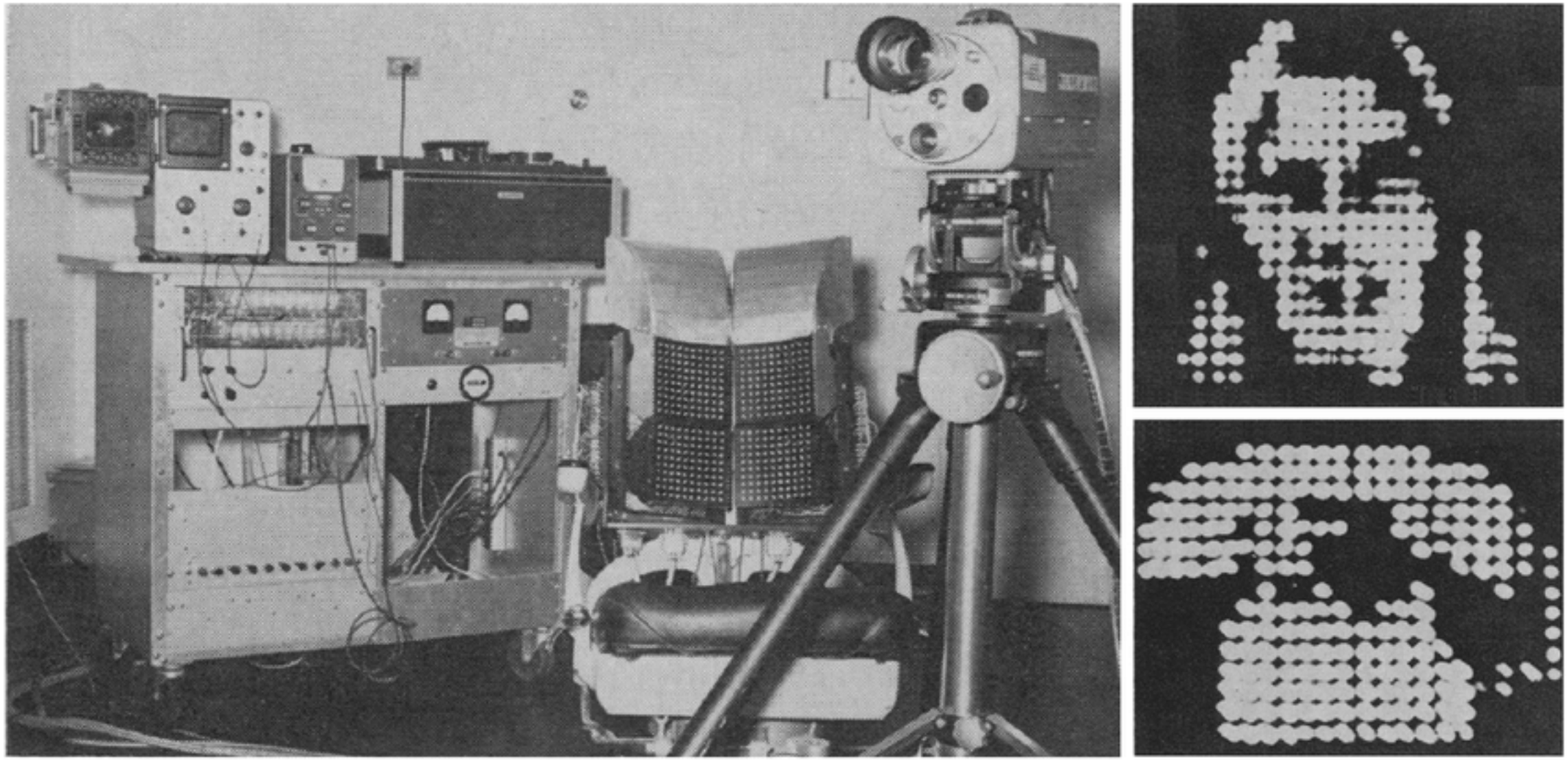


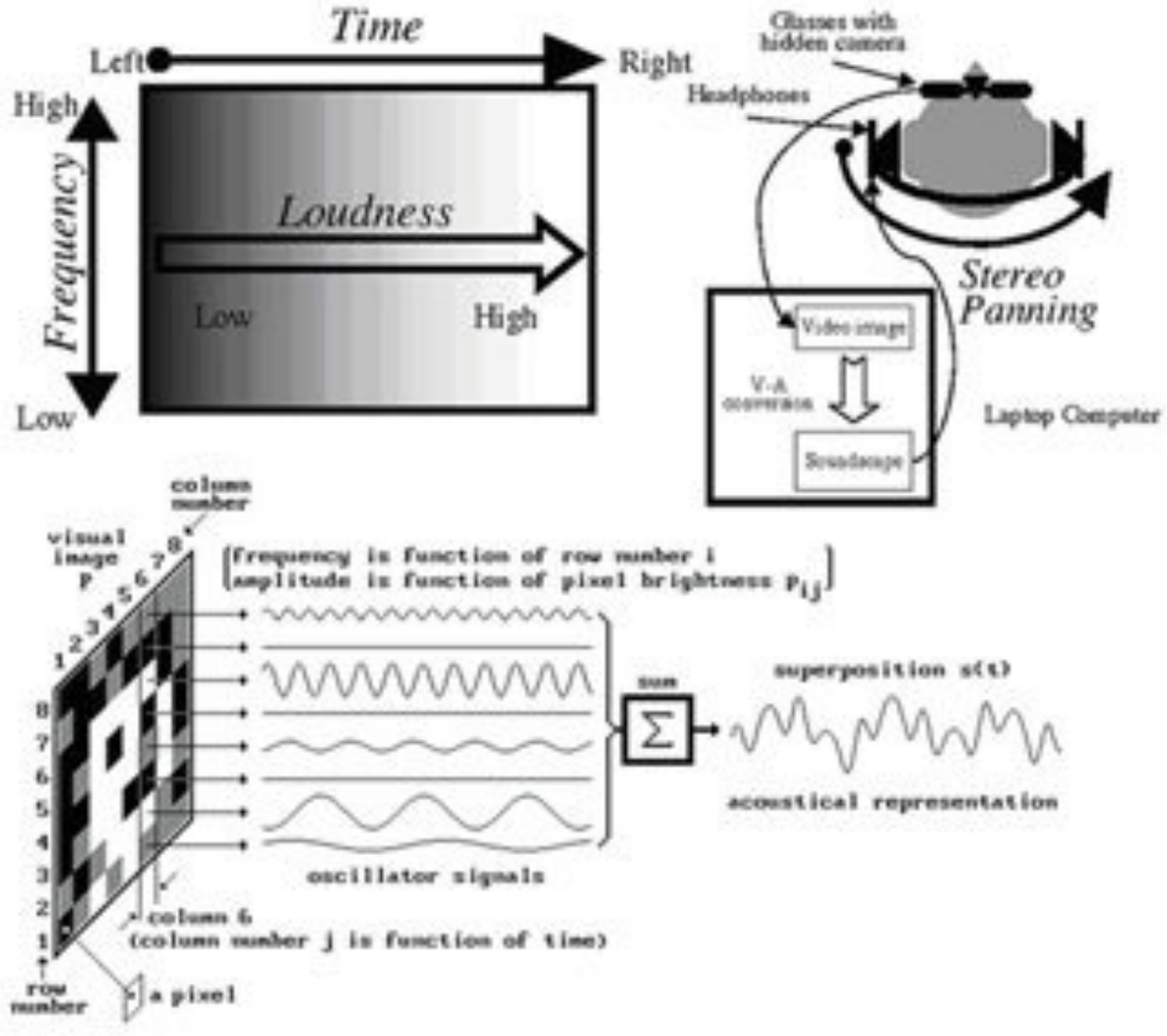
FIG. 2. Distribution of the odor descriptors used by at least 3 different subjects during the second session of the wine comparison test for the description of W and RW by 54 subjects. Labels ‘‘White wine descriptors’’ and ‘‘Red wine descriptors’’ contain the terms used for describing the W and the R wines during the first session, respectively.
White wine descriptors: LIT = litchi (lychee); FLO = floral (floral); MIE = miel (honey); AGR = agrume (citrus fruit); FRU = fruit de la passion (passion fruit); POM = pomme (apple); BAN = banane (banana); BON = bonbon (candy); POI = poire (pear); ANA = ananas (pineapple); PAM = pamplemousse (grapefruit); ACA = acacia (acacia); PEC = pêche (peach); BEU = beurre (butter). Red wine descriptors: EPI = épice (spice); BOI = boisé (wooded); CAS = cassis (blackcurrant); FRA = framboise (raspberry); CER = cerise (cherry); PRU = pruneau (prune); FRS = fraise (strawberry); VAN = vanille (vanilla); POV = poivre (pepper); ANI = animal (animal); REG = réglisse (liquorice).



"Tactile Television" by Paul Bach-y-Rita et al.

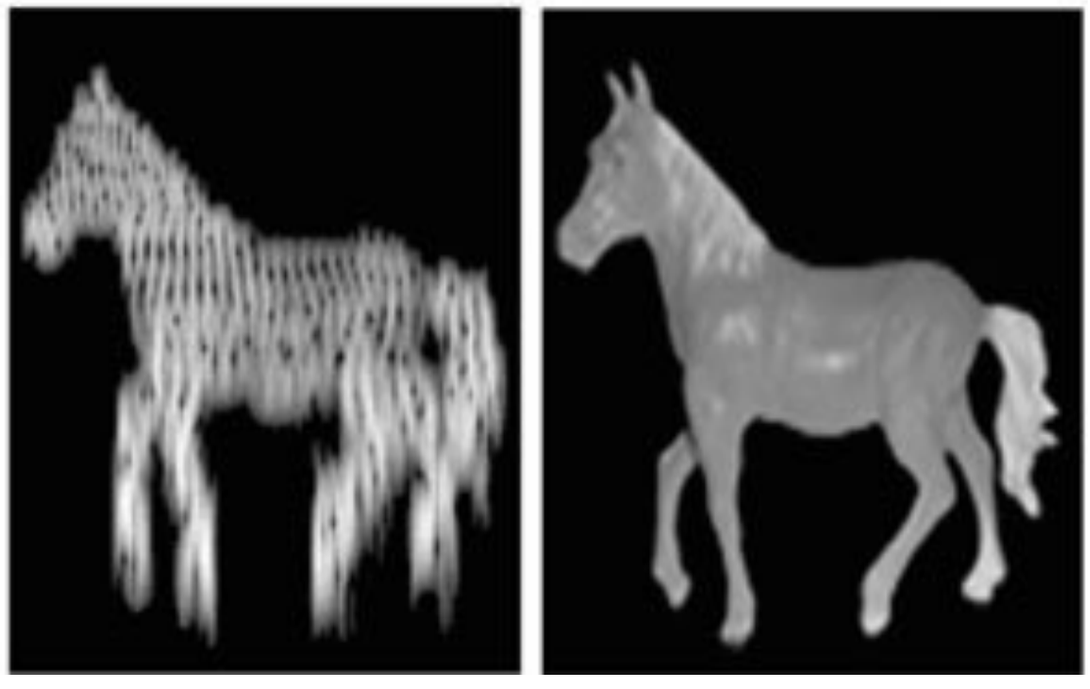

Brain Port, Paul Bach-y-Rita et al.

A



B

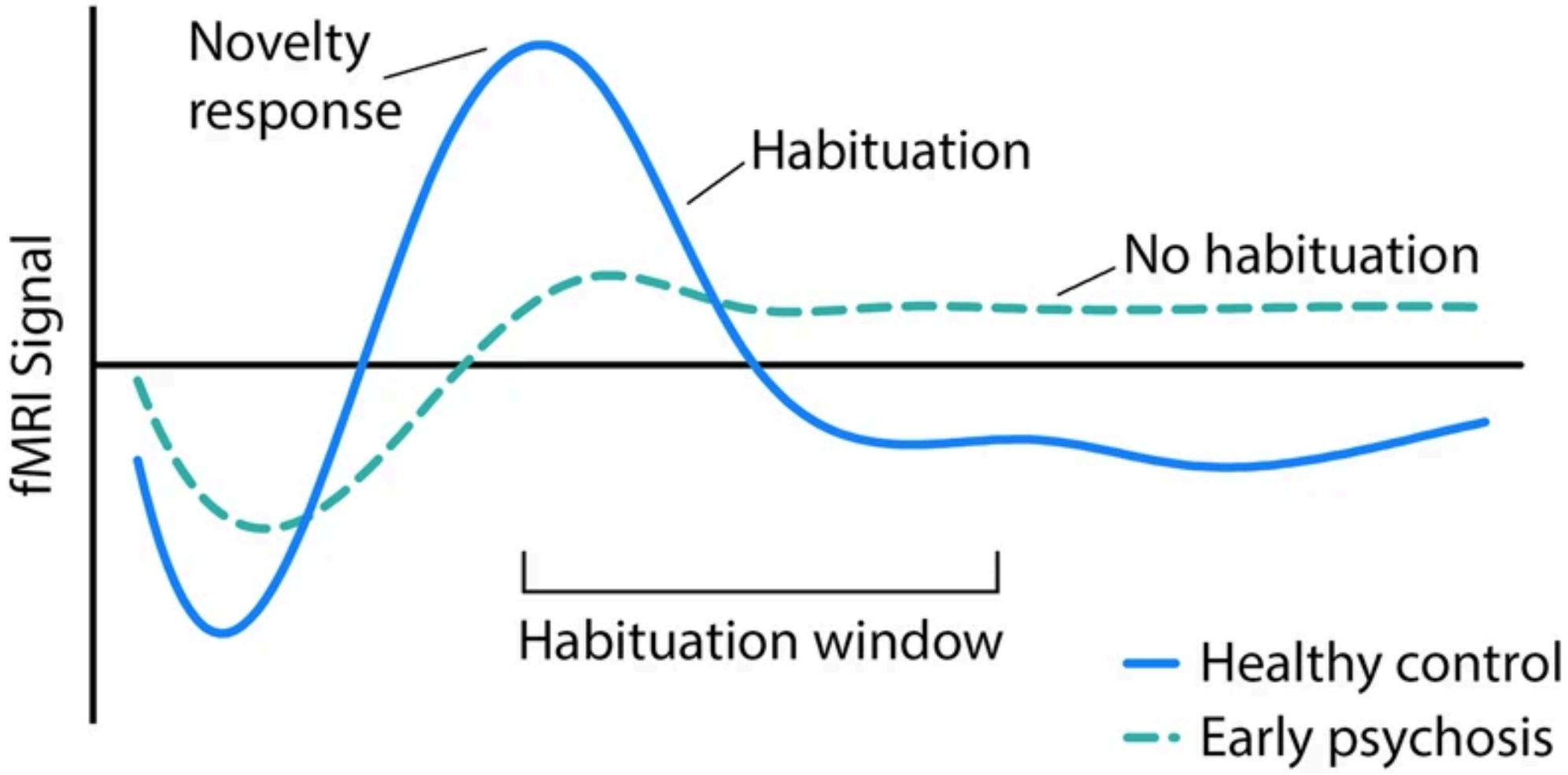
C



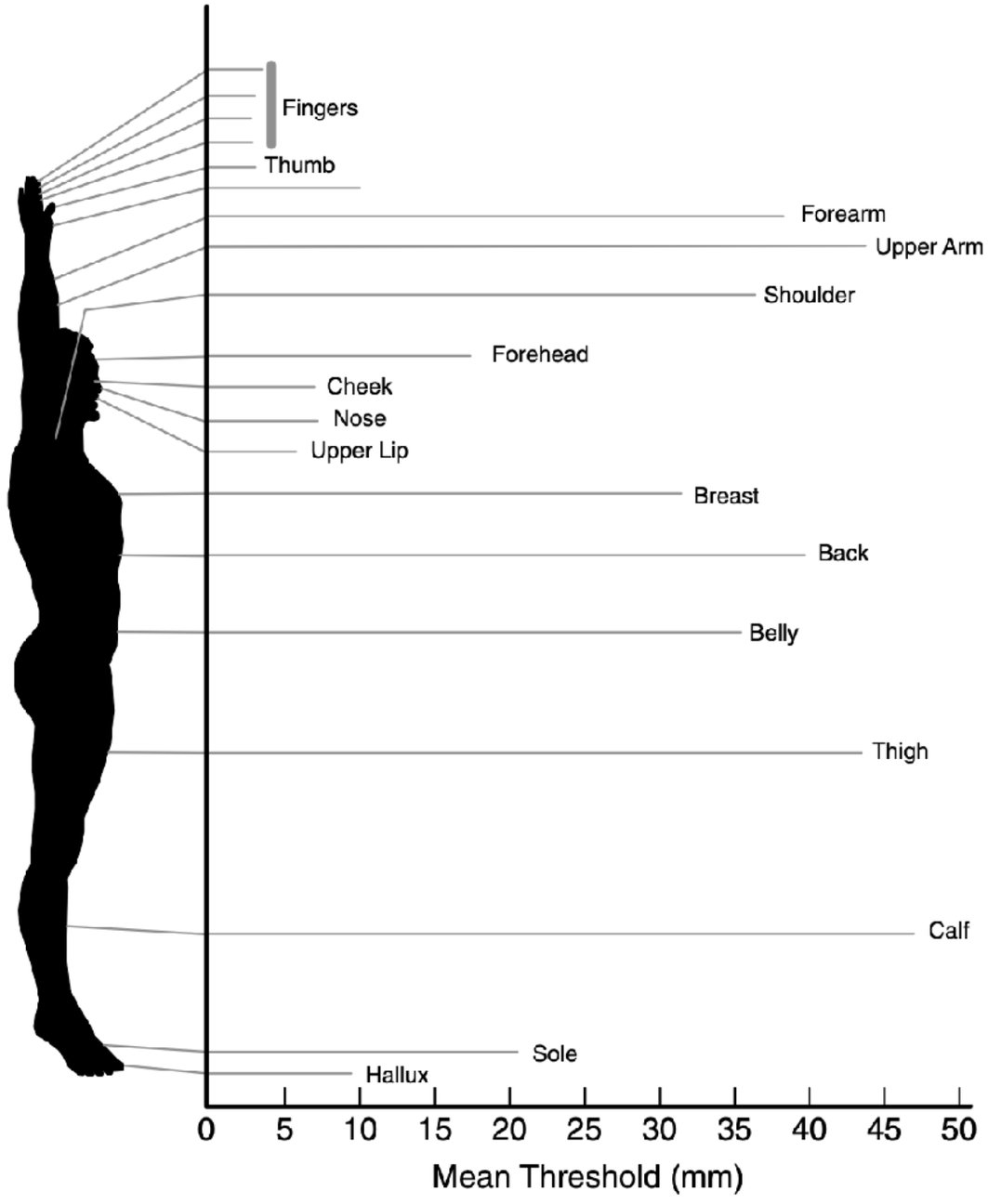
vOICe SSD, Peter Meijer

“I Always Wanted to See the Night Sky”: Blind User Preferences for Sensory Substitution Devices

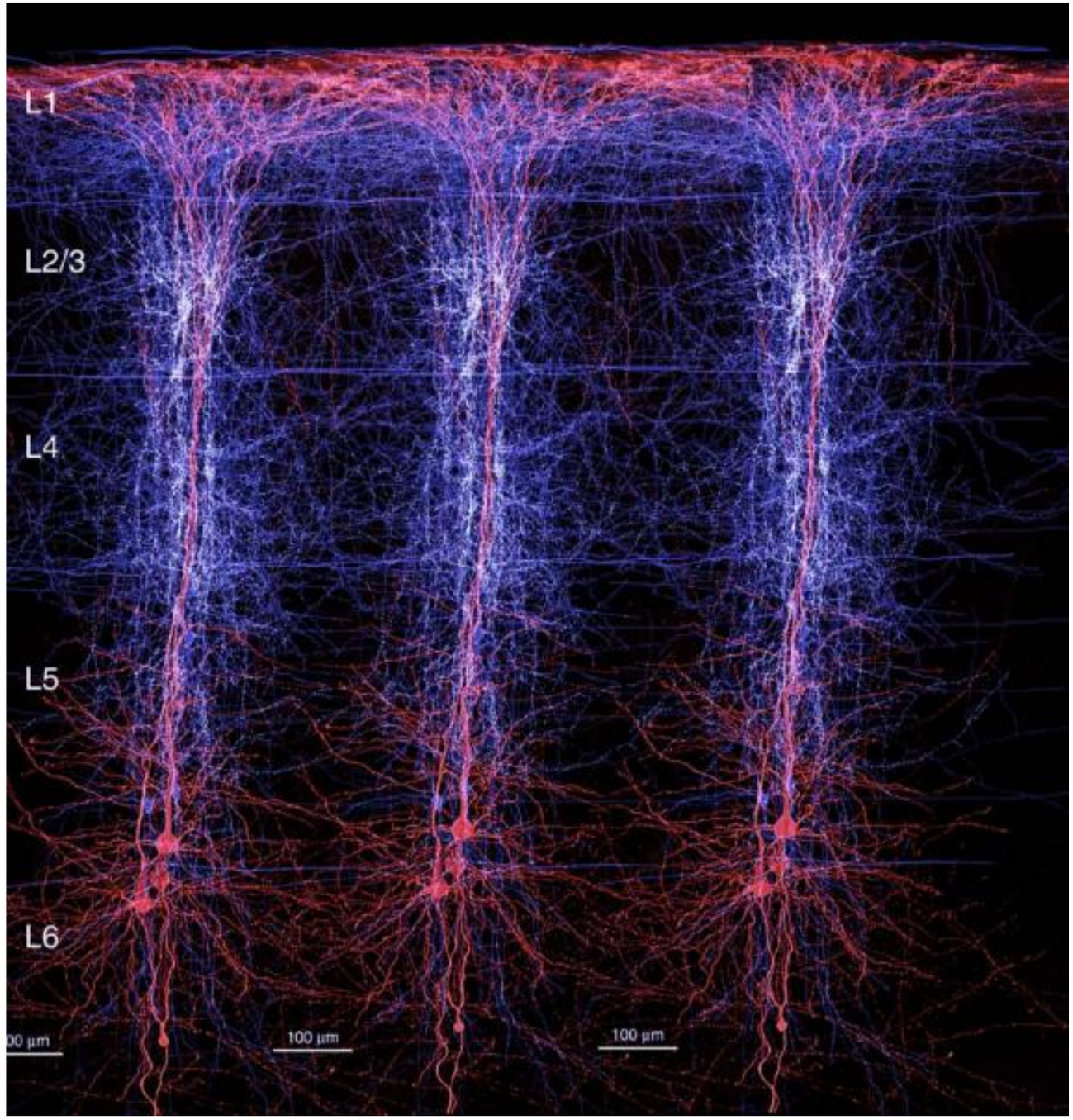
Giles Hamilton-Fletcher, Marianna Obrist, Phil Watten,
Michele Mengucci, Jamie Ward



Sensory Habituation



Receptor Density (two point discrimination test)

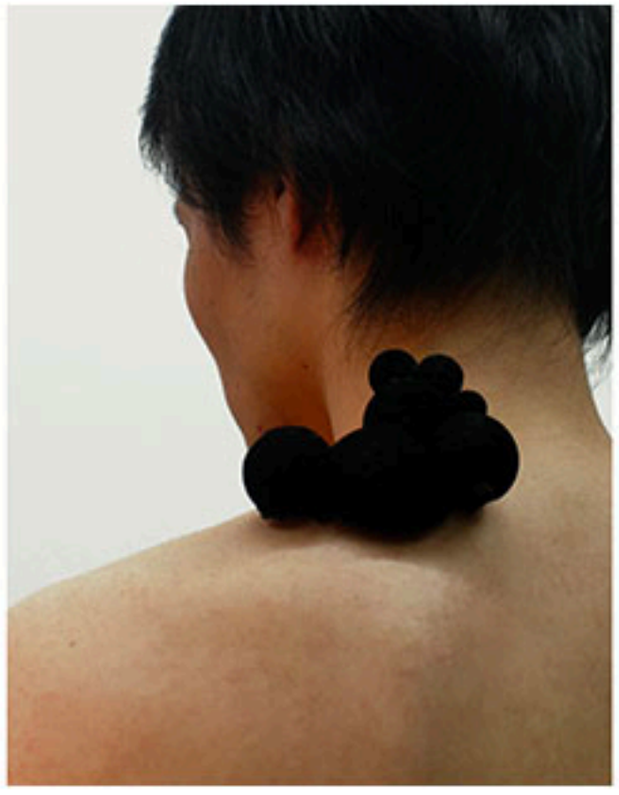


Cajal Blue Brain Project, EPFL

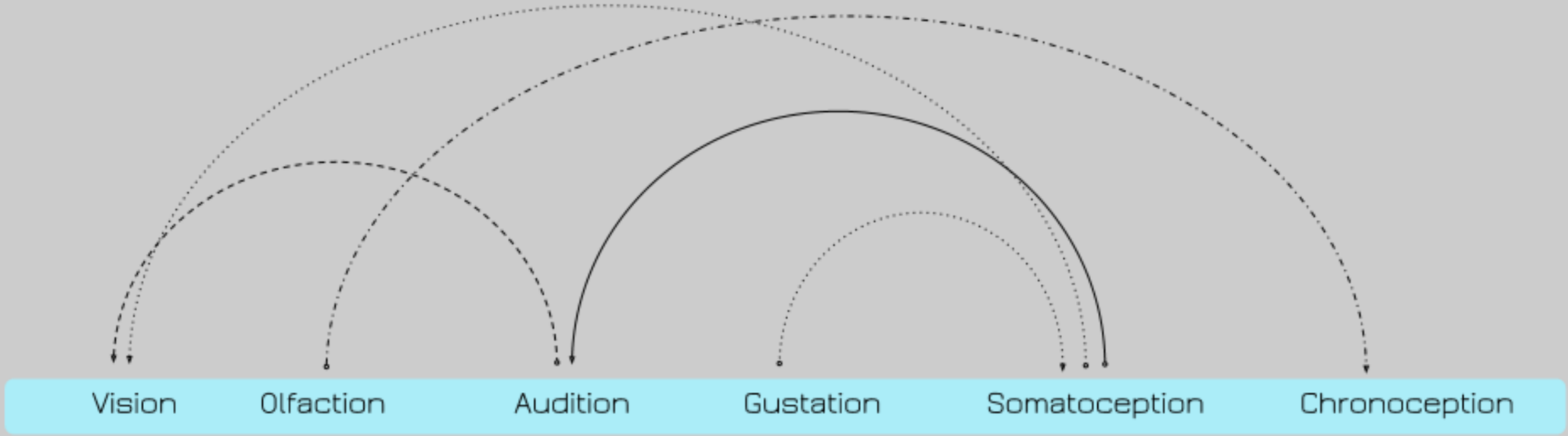
Jeff Hawkins: Sensorimotor Object Recognition

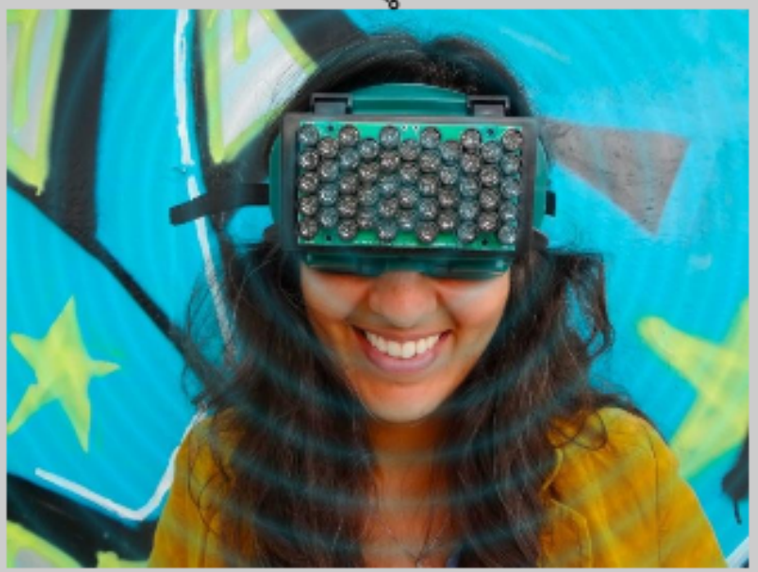
David Eagleman: Neosensory



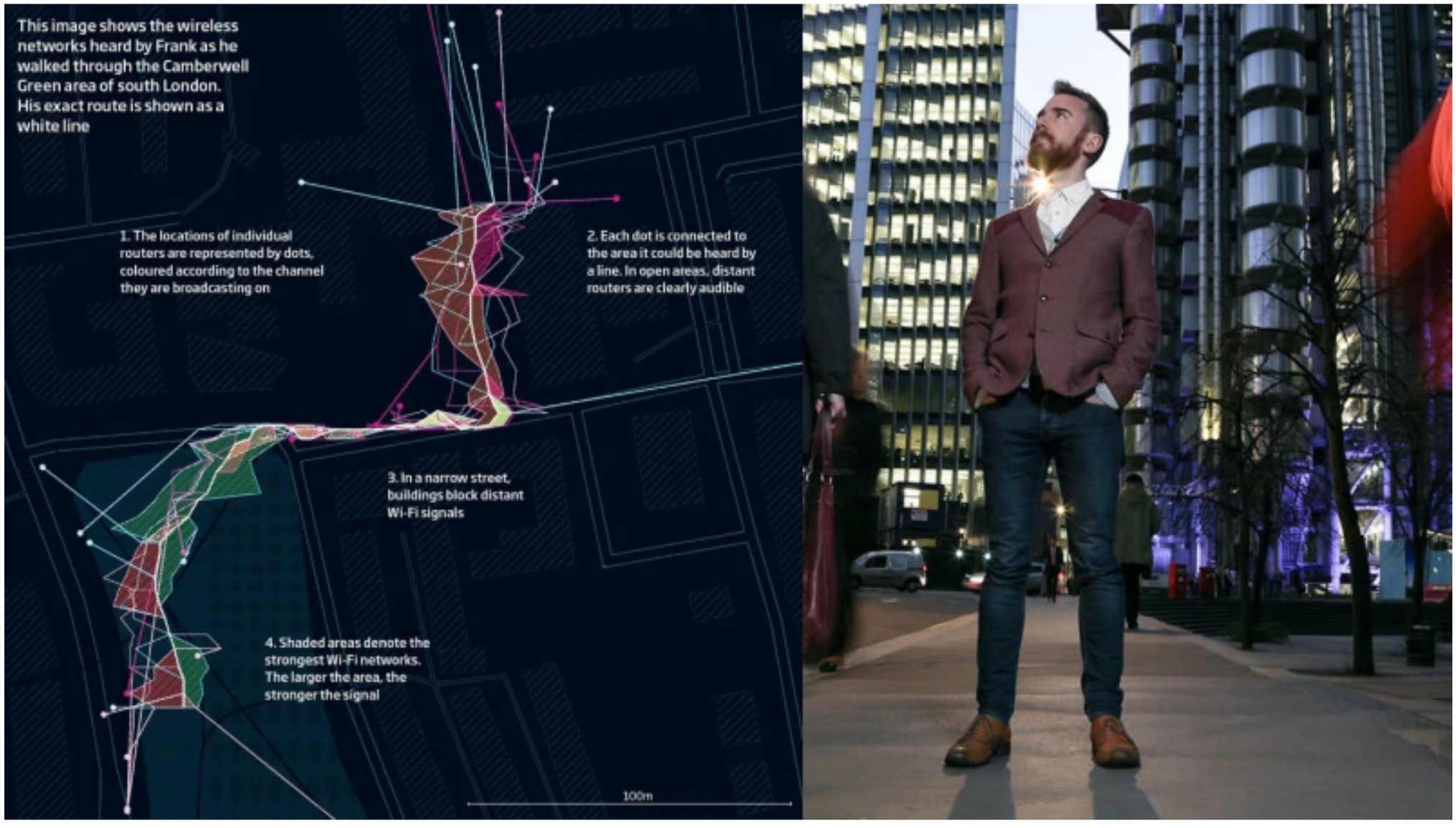



Susanna Hertrich

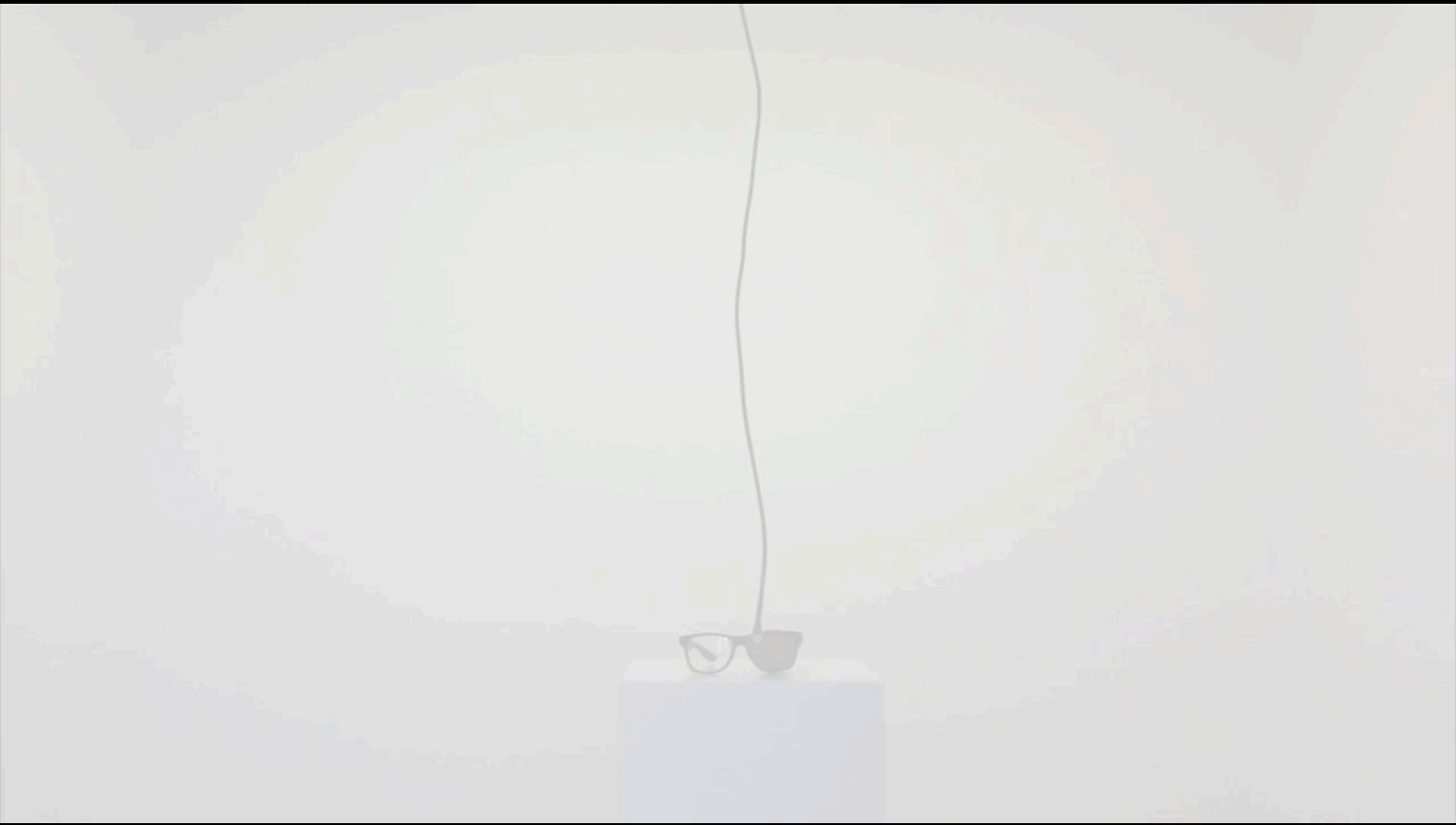




Aisen Caro Chacin


This image shows the wireless networks heard by Frank as he walked through the Camberwell Green area of south London. His exact route is shown as a white line
1. The locations of individual routers are represented by dots, coloured according to the channel they are broadcasting on
2. Each dot is connected to the area it could be heard by a line. In open areas, distant routers are clearly audible
3. In a narrow street, buildings block distant Wi-Fi signals
4. Shaded areas denote the strongest Wi-Fi networks. The larger the area, the stronger the signal
100m

Frank Swain



Michal Kohut (2010)

TASK: Form groups of 3 to 4.

Background Research:

- **Investigate 3 to 4 phenomena that we can not directly (or consciously) perceive**
- **Identify sensors/devices that can measure these phenomena**

Initial Concept development:

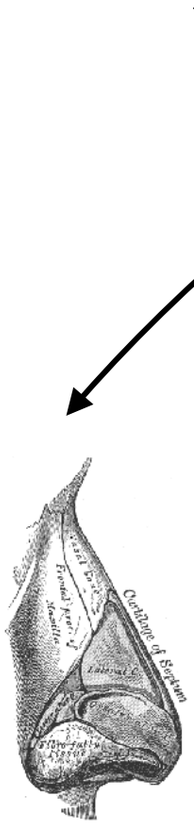
- **Choose 1-2 possible modalities for perceiving your phenomena (touch, taste, smell, pain etc).**
- **Create sketches and descriptions of possible sensory-substitution devices that might result.**

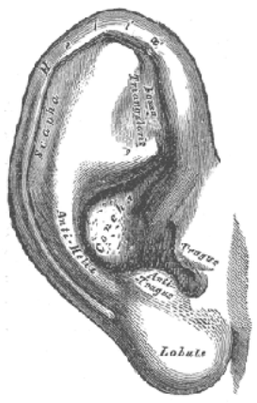
Infrared Sensing

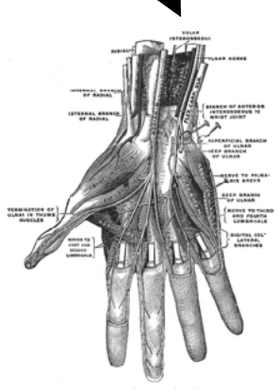
Magnetoception

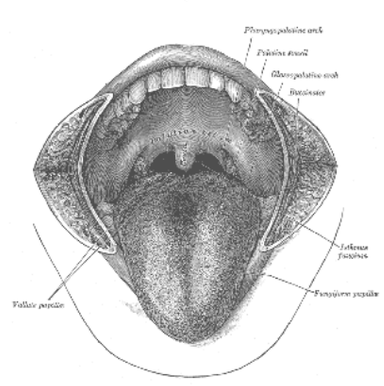
Echolocation

Electroreception









Modalities for your device

Questions to ask of your concept proposals:

- **What are sensory-motor pairings are needed for your device? Does the user move or does the device move?**

- **Do you loose one sense in order to gain the new sense?**

- **Does your device substitute or enhance sensory sensation?**

- **What reference frames/processes do you need in order to understand this new perception?**

- **What ethical and societal issues might be involved in designing and using this device?**

Conceptual development