

WE SEEM TO BE INSIDE A LABYRINTH. WILL YOU JOIN US?

ENTER IF YOU WANT TO KNOW MORE ABOUT HOW THE BRAIN'S INNER NAVIGATOR WORKS.



THE ABILITY TO ORIENT THEMSELVES IN NATURE IS FUNDAMENTAL FOR LIVING BEINGS WHEN IT COMES TO FINDING FOOD, SHELTER AND SO ON.

IN FACT, A COMMON NAVIGATION SYSTEM HAS BEEN DISCOVERED IN THE BRAINS OF MAMMALS: BATS, RODENTS, MONKEYS, PRIMATES... AND HUMANS.

AN INTERNAL POSITIONING SYSTEM THAT IS LOCATED IN TWO SPECIFIC AREAS OF THE BRAIN: THE HIPPOCAMPUS AND THE ENTORRHINAL CORTEX, WHICH ARE CLOSELY CONNECTED TO EACH OTHER.

SCIENTISTS HAVE DISCOVERED HOW AND ON WHAT BASIS THIS INTERNAL POSITIONING SYSTEM OR "GPS OF THE BRAIN" WORKS BY STUDYING THE NEURAL ACTIVITY OF THESE AREAS IN RODENTS' BRAINS.

FIRST, A PARTICULAR TYPE OF NEURONS - WHICH THEY CALLED "PLACE CELLS" - WAS DISCOVERED IN THE HIPPOCAMPUS.

THEY ARE ACTIVATED BY RECEIVING EXTERNAL INFORMATION FROM THE SENSES, ESPECIALLY SIGHT, WHEN WE PASS THROUGH A SPECIFIC PLACE. THEY CREATE MARKS IN SPACE THAT WE REMEMBER TO GUIDE US...

EVERY TIME WE CHANGE SCENE AND MOVE TO A NEW ONE, THESE NEURONS GENERATE A NEW UNIQUE PHYSICAL MAP.

...AND, JOINTLY, THEY FORM A PHYSICAL MAP OF THE ENVIRONMENT WHICH SERVES AS THE BASIS FOR KNOWING WHERE WE ARE AT ALL TIMES.

AND EACH OF THESE MAPS ARE STORED IN OUR MEMORY AND BECOME PART OF OUR LOCAL ARCHIVE OF MAPS.

THUS, WHEN WE VISIT A SCENE AGAIN, THE BRAIN RETRIEVES THE CORRESPONDING MAP AND DOES NOT NEED TO GENERATE IT AGAIN. THAT'S WHY WE MOVE MORE FREELY AND SAFELY IN FAMILIAR ENVIRONMENTS.

MOREOVER, THE BRAIN NOT ONLY RETRIEVES THE MAP, BUT ALSO TAKES ADVANTAGE OF EACH VISIT TO THAT SCENE TO REVISE, UPDATE AND COMPLETE IT. THAT IS WHY THE MORE TIMES WE VISIT A PLACE, THE EASIER IT IS FOR US TO FIND OUR WAY AROUND, SINCE WE HAVE MORE REFERENCES.

LATER ON, ANOTHER TYPE OF NEURONS WAS IDENTIFIED IN THE ENTORRHINAL CORTEX. AS WE MOVE THROUGH AN ENVIRONMENT, THESE NEURONS ARE ACTIVATED ONE BY ONE AT REGULAR INTERVALS, EVERY CERTAIN DISTANCE. UNLIKE "PLACE CELLS", THEY DO NOT CORRESPOND TO A SPECIFIC PLACE, TO SOMETHING THAT CAPTURES OUR ATTENTION, BUT RATHER ARE LIKE THE BREADCRUMBS THAT TOM THUMB REGULARLY DROPPED TO MARK THE WAY.

THESE NEURONS ARE CALLED "GRID CELLS" BECAUSE WHAT THEY DO IS SIGNAL OR PLACE MARKS IN SPACE AND ALL TOGETHER, THEY FORM OR GENERATE A FRAME OF REFERENCE. TO PUT IT SIMPLY: WHAT THESE NEURONS DO IS TO FRAME THE SCENE IN A GRID, A SYSTEM OF COORDINATES, SOMETHING SIMILAR TO THE GRIDS ON STREET MAPS.

WHAT IS MOST INTERESTING IS THAT THE NEURONS THAT DELIMIT EACH CELL COMMUNICATE WITH EACH OTHER, AND THIS ALLOWS THE BRAIN TO KNOW WHICH SECTOR WE ARE IN AT ANY GIVEN MOMENT, WHEN WE MOVE FROM ONE TO ANOTHER, AND WHICH ONE WE ENTER.

THIS REFERENCE SYSTEM ALLOWS THE BRAIN TO GRID OUR MOVEMENT IN SPACE AND TRACE THE ROUTE OR PATH WE TRAVEL.

UNLIKE "PLACE CELLS" THAT GENERATE A NEW PHYSICAL MAP UNIQUE TO EACH SCENE, "GRID CELLS" ALWAYS GENERATE THE SAME COORDINATE SYSTEM OVER ALL SCENES. JUST AS STREET MAPS USE THE SAME GRID SYSTEM FOR ALL CITIES.

"GRID CELLS" ADJUST THE SIZE OF THE GRIDS ACCORDING TO THE SIZE OF THE SCENE - INFORMATION THEY RECEIVE FROM THE VIEW - JUST AS ON STREET MAPS, THE SIZE OF THE GRIDS (THEIR SCALE) VARIES ACCORDING TO THE SIZE OF THE URBAN NUCLEUS ON THE MAP.

THANKS TO THIS ABILITY TO SIZE GRIDS, THEY ARE FUNCTIONAL IN ANY SCENE: WHETHER IT IS A ROOM OR A PARK, THE BRAIN CAN FOLLOW OUR MOVEMENT BY THE SEQUENTIAL ACTIVATION OF THE DIFFERENT GRIDS.

BUT IF THESE "GRID CELLS" DO NOT RESPOND TO SPECIFIC EXTERNAL STIMULI, BUT INSTEAD ARE ACTIVATED REGULARLY, HOW DO THEY KNOW WHEN TO ACTIVATE?

THE RESPONSE IS FOUND IN TWO OTHER TYPES OF NEURONS ALSO PRESENT IN THE ENTORRHINAL CORTEX.

"HEAD DIRECTION CELLS" ARE ACTIVATED DEPENDING ON THE DIRECTION IN WHICH OUR HEAD IS POINTING, WHERE WE ARE LOOKING.

THEY ACT AS AN INTERNAL COMPASS SINCE DIFFERENT CELLS ARE ACTIVATED DEPENDING ON WHETHER WE LOOK TO THE RIGHT OR LEFT, FORWARDS OR BACKWARDS, ETC.

OTHER NEURONS MONITOR SPEED AND ESTIMATE AT WHAT PACE WE ARE MOVING AND THEREFORE HOW FAR WE HAVE TRAVELED.

THIS IS EASY TO UNDERSTAND SINCE WE CAN ALL TELL IF WE ARE MOVING FAST OR SLOW, EVEN WITH OUR EYES CLOSED, WITHOUT THE NEED FOR EXTERNAL INFORMATION.

AND WE ALSO KNOW IN WHICH DIRECTION OUR HEAD IS POINTING EVEN IF OUR EYES ARE CLOSED. THE BRAIN KNOWS HOW TO ESTIMATE HOW FAST WE ARE MOVING AND IN WHICH DIRECTION OUR HEAD IS POINTING IN ANY GIVEN CIRCUMSTANCE AND ENVIRONMENT.

IN ADDITION, ANOTHER TYPE OF NEURONS HAS ALSO BEEN DISCOVERED, BAPTIZED AS "BOUNDARY OR BORDER CELLS", SINCE THEY ARE ACTIVATED WHEN WE APPROACH THE LIMITS OF THE SCENE IN WHICH WE ARE MOVING.

FOR EXAMPLE, WHEN WE APPROACH THE WALLS IN A ROOM OR WHEN WE APPROACH THE FENCE IN A PARK.

AND OTHER NEURONS ARE ACTIVATED WHEN WE ENCOUNTER AN OBSTACLE, FOR EXAMPLE, A WALL IN A LABYRINTH, WHICH PREVENTS US FROM MOVING FORWARD AND WE HAVE TO CHANGE DIRECTION.

AND POSSIBLY THERE ARE EVEN MORE TYPES OF NEURONS WITH SPECIFIC FUNCTIONS THAT HAVE NOT YET BEEN IDENTIFIED.

ALL THESE NEURONS ARE CONNECTED TO EACH OTHER. IN THIS WAY, THE BRAIN'S POSITIONING SYSTEM, OUR "INTERNAL GPS", INTEGRATES ALL THIS INFORMATION AND PROCESSES IT...

...AND IN DOING SO, IT ENABLES US TO ORIENT OURSELVES EFFECTIVELY IN THE ENVIRONMENT IN WHICH WE ARE MOVING, WHETHER IT IS FAMILIAR OR UNFAMILIAR, CLEAR OR MAZE-LIKE.