EVERY so often, we witness scenes such as an inebriated person staggering along, muttering some nonsense, or slumped in a filthy gutter, unmindful of the honking cars and the usual din around. It can happen also in your own living room. A group of old friends, a peg or two, the feel-good-factor gently leading to a brawl, sometimes even to fisticuffs. And the question doing the rounds next day – “Did he do it? How could he, such a gentleman….”

Was he unconscious? Not in the real sense. He was just lost to the surroundings. He did not know who he was, where he was, what he was doing or what day or time it was and so on. He was not sober.

Let us call him ‘disoriented’. A situation that reminds me of a game we played as children – blind man’s bluff. One of our friends was blind-folded, given a spin and was then expected to locate the other children. The blind-fold and the spin ensured that he or she was disoriented – he had no clue where he was and where the others were and his probing in the vacuum led others to great excitement. Again, remember – ‘Mein Kahaan Hoon’ made famous by Bollywood heroine/heroes on regaining consciousness?

Sleeplessness, extreme anxiety too can cause disorientation. Imagine yourself alone in a totally unknown place without any clue to your whereabouts or in a dark room over a prolonged period – the situation can be scary, almost choking you to tears. Why? Your bearings, your whereabouts in a time frame are very important to you. Disorientation is a hazy, grey area; nothing is clear to you – a state of utter confusion. This is a twilight zone – an ill defined mental state between reality and fantasy – an area with no boundaries between real and unreal.

How do you stay oriented and when and how does your brain get disoriented? Scientists have made some headway into understanding how the brain functions in such conditions. But this most mysterious organ has many surprises up its sleeve and is not yet ready to spill all its beans!

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The word disorientation implies that there is orientation. When you are aware of your bearings you are conscious; consciousness involves functions of orientation in time, space and your personal existence. Your conscious experiences are constantly shifting and changing. For example, in one moment you may be focused on reading an article; your consciousness may then shift to the memory of a conversation you had earlier with a friend and you may even smile.

Orientation constantly provides an understanding of: Who am I? Where am I? What time of day is it? Which year is it? and so on. All this suggests that orientation is a function that is being monitored all the time – often without your knowledge.

Orientation in space, time and person is a basic ability with memory also being a component – keeping the person’s feet firmly ‘grounded’; neurologists and psychiatrists use this as a tool for mental status examination. In short, orientation means the tuning between the person and his external world; the person refers not only to the spatial landmarks but also to remembered and imagined events and people around, suggesting the brain’s involvement in the process. If so, the brain must have an internal GPS-like arrangement to achieve such precise orientation.

But it is not yet very clear whether such mental orientation depends on any specific areas in the nervous systems, that is to say, are there any anatomical landmarks that can be involved in the orientation process? There is a flurry of activity in this direction among several neuroscientists.

With this idea in mind, scientists set out to solve the mystery using various clinical techniques producing images, by non-invasive methods, of such structures in the brain and their function. Magnetic resonance imaging is one such technique; an improved version called functional Magnetic Resonance Imaging (fMRI) looks at blood flow in the brain to detect areas of activity, by capturing them on a computer – telling you which area of the brain is involved in a particular activity.

The technique works on the principle that oxygen-poor hemoglobin in the blood is affected differently by a magnetic field than the oxygen-rich hemoglobin. Brain tissue that is more active because more neurons are firing, will need more blood flow and therefore blood flow can be used to deduce relative brain activity. 7-Tesla fMRI is an improved technique enabling one to study common and unique brain responses to complex stimulations; in addition, it also enables one to relate functional response patterns directly to structural properties of the brain.

Suppose you are not doing anything – that is to say there are no intentional sensory (incoming) or motor (outgoing) inputs – you are in some kind of meditative mood and your brain is at wakeful rest. Now you go through an fMRI test; the regions, that ‘light up’ because they need more blood flow, are those that are active during this wakeful rest. These areas represent the Default Mode Network or DMN, a system involved in self-referential processing of information. This also tells you that even when you are apparently not doing anything your brain is ticking – non-stop; your heart beats, lungs breathe, your intestines digest, kidneys cleanse and so on – you are unmindful of all this. This housekeeping-business is a thankless job, I can tell you!

Now you go through a few tests: since orientation involves three domains of space, time and person, keeping one domain constant, you are given a questionnaire involving the other two. You have to answer as quickly as you can. There will also be a control test to see if you are otherwise sound and alert. And you are monitored on 7-Tesla fMRI during this procedure.

In a recent study published in the Proceedings of National Academy of Sciences, by Peer and collaborators, in which sixteen healthy right-handed persons, including five females with a mean age around 25-years participated in the programme that used the 7-Tesla fMRI technique, participants were given the following tasks:

a. Time stimuli consisted of two-word description of common events from personal life (such as, final examinations) or non personal world events (presidential elections) as well as potential future events (Mars landing).

b. Space stimuli consisted of names of cities in Europe, distance 50-1500 km from the experimental location.

c. Personal stimuli consisted of names of people, personally familiar to the subject (family members, friends) or famous people (Obama, Julia Roberts).

Special care was taken to avoid memorization of stimuli as also some consistency between subjects was
ascertained. The following pictures show some of the brain regions involved in the process of mental orientation. The results also indicated that there is specificity of each cluster to one orientation domain.

The above picture is just to illustrate how the images obtained on the fMRI scan have been used to find overlaps in the brain regions corresponding to activation by the above mentioned stimuli.

All this can be summarized as follows:

a. There is a functional subdivision along a ‘front to back’ axis.

b. Being adjacent to each other, there is relationship between the three domains.

c. DMN, i.e., Default Mode Network is deactivated when a person is involved in active awareness; this region provides self-reference in different domains particularly in person orientation.

The study thereby concluded that it has been possible to identify brain regions along a front-to-back axis underlying perception of mental orientation; this relates to the person behaving in the space, time and person domains. These regions follow a strict internal organization and there is a domain-specific subdivision. All these results indicate that, after all, mental orientation appears to have specific correlation to specific regions in the brain.

Coming back to drunken behavior, are the same regions in the brain involved? Previous studies have suggested that alcohol (especially at high doses) causes significant damage in the frontal and middle regions of the brain causing impairment in functions related to memory, planning and overall control, error-monitoring and so on.

What happens when such areas in the brain are damaged due to accidents or disease or a natural cause like ageing? Studying patients with disorientation can be another way of understanding brain functions. For this, researchers turned to patients with dementia, Alzheimer’s disease and so on. In the Alzheimer’s brain, massive cell death causes the cortex to shrivel, damaging areas involved with thinking, planning, and remembering finally leading to a general collapse.

All these results suggest that cell death caused by disease, ageing or excessive alcohol consumption in specific regions of the brain causes similar symptoms of disorientation. “Similar biological mechanisms may be involved in the effects of Alzheimer’s disease and alcohol abuse on the brain,” says Suzanne L. Tyas of Sanders-Brown Center on Aging and at the Kentucky School of Public Health, University of Kentucky, Lexington, Kentucky.

However, that is not all. Patients with Alzheimer’s disease typically lose orientation in time first, then in place and then in person, whereas, Tate and collaborators find that patients with traumatic brain injury regain their orientation gradually from personal to spatial and temporal orientation. This suggests that there are partially separate systems which may cause orientation in each domain.

Diverse causes, similar damages and similar loss of functions – yet the mechanisms used may be varying. That is baffling, and that is brain’s own secret. You never stop being amazed how clever this system is. All we can say is – more work is necessary for further understanding of the enigmatic brain. In short, this most mysterious organ on this planet has many surprises up its sleeve and is not yet ready to spill all its beans!

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