1. **When asked to name the object seen in the image (below), the answers range from bird, boat, just irregular shapes, to hanuman. But if someone sees 'snow-covered farm buildings', then it is perception. Now understand a) what can be the possible explanation for someone to 'see' snow-covered farm building? and b) given most Indians have not seen such a scene how will they form it given the clue?**

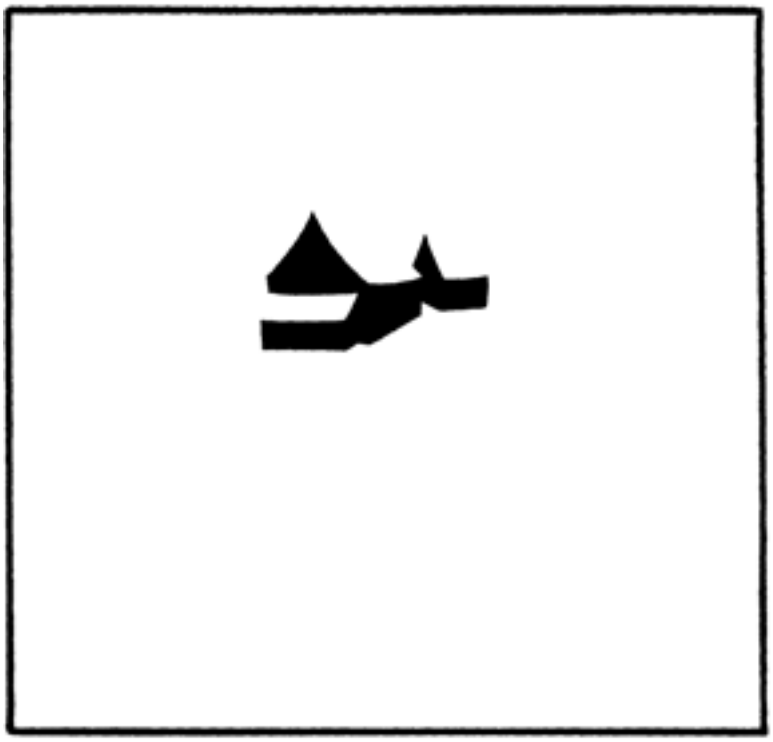

Figure 1: Perception experiment

When trying to perceive an object, there are two general approaches: a top-down approach and a bottom-up approach. Each is triggered differently based on experience (Blakemore & Cooper, 1970) - if the object we see matches our visual experience, then we identify it as such without trying to identify individual components - think of how we see a car rather than a door, a hood, etc. If it does not, we try to identify the object by identifying individual components and trying to make sense of it together, or Recognition by Components (RBC), introduced by Biederman (1987) .

Especially with limited silhouetted images like this one, identification is commonly done by applying heuristics. Gestalt principles (introduced by Max Wertheimer (King & Wertheimer, 2005), and claimed by Todorovic (2008) as still applicable to modern perception theory) are fundamental in defining here how we perceive objects top-down.

So in this instance, the experience of having seen snow-covered buildings, especially those with slanting roofs, is the experience necessary to perceive the image as 'snow-covered buildings', let alone farm buildings. The environment one grows up in shapes the patterns their brains focus on recognising (Experience-dependent plasticity, described by Blakemore & Cooper (1970)). The ideal environment to grow up in to identify the image right away would be a snow-heavy area with frequent near-whiteouts and slanting roofs.

Given that most Indians will not have seen such a scene - with different experiences on building styles and climate, they do not instantly fit the model of a snow-covered farmhouse to the stimuli. Rather, they try to process it bottom-up, identifying components and building a reasonable approximation, aka RBC (Biederman, 1987). Interestingly, they will also tend to ignore the whitespace altogether, not bothering to see how it might fit together to form an image.

I attempted to observe this phenomenon concretely, and asked seven Indians what they saw in the image. One of them has been living in Boston for three years, and recognised the image as a house with snow instantly, demonstrating the impact of experience on perception. With the other six, none of them got it in the first try. The following features were noticed:

- None of them initially considered the whitespace to be a key feature of the image
- A lot of the initial answers were dragon/flying dinosaur/bird. People seemed to identify by components - first, the larger triangle as misshapen wings and going with the closest flying animal in their imagination. It has been suggested that the dinosaur trend was due to Google Chrome's offline dinosaur game, which also builds a dinosaur from blocky grey splotches.
- All of the guesses could be attributed to bottom-up processing. When someone guessed "two mountains and a valley", they identified the two triangles as mountains and the middle strip as a river. When someone identified a "mountain, a sailboat, and a jetty", they took the large and small triangles as the mountain and sailboat respectively, and the jetty was made by identifying negative space - the only such instance.
- All participants were given hints about trying to guess with respect to it being:

  1. Something not seen often in India
  2. If seen in India, in the north - the Himalayas
  3. It has something to do with the climate
  4. It's a house

  Most people guessed by Step 3. One person guessed at Step 1, and two people took till Step 4 of whom one did not see it even after.

- Some other common first guesses were:

1. Broken sphinx
2. Anime Hair
3. 2004 graphics superman
4. Robot Dog

2. **"Mirror Neuron Theory is a myth." Explain the mirror neuron theory based on Giacomo Rizzolatti's work. What are the criticisms against it and what is your opinion on this debate?**

   Broadly, the mirror neuron theory posits that "motor representation is at the basis of the understanding of motor events" (Rizzolatti et al., 1996), which is to say that the same neurons in the system react not only to doing an action, but also observing someone else do it. Literature refers to it as "action-based processing". For instance, (Alluri et al., 2017) have shown evidence for such with how processing differs when musicians and non-musicians listen to music, where "musicians automatically engage neural networks that are action-based while non-musicians employ those that are perception-based to process an incoming auditory stream."

   Rizzolatti's work noted that mirror neurons exist in the frontal F5 area of the brain of macaque monkeys, and these respond both when monkeys:

   1. *Make* active movements
   2. *Observe* someone else making the same meaningful movements

   This was clear demonstration of the existence of mirror neurons in a species. They also suggested that given existing data and the information just given, it might be the case that the observation that motor actions activate the posterior part of the inferior frontal gyrus may imply the existence of mirror neurons in humans too, possible affecting verbal development - as there was a homology of the frontal F5 area in the monkeys with Broca's area in humans.

   The theory is not without its critiques. First is the fact that it is not possible to study individual neurons in the human brain, so most evidence for their existence is indirect.

   Secondly, Pascolo et al. (2009) claim that it is not clear whether mirror neurons really form a distinct class of cells, and are not just an occasional phenomenon that are seen in cells that have other dedicated functions.

   Hickok (2009) argued that "The early hypothesis that these cells underlie action understanding is likewise an interesting and prima facie reasonable idea. However, despite its widespread acceptance, the proposal has never been adequately tested in monkeys, and in humans there is strong empirical evidence, in the form of physiological and neuropsychological (double-) dissociations, against the claim". The lack of direct evidence, therefore, is the primary roadblock to acceptance of the mirror neuron theory.

Evidence, although indirect, suggests that there exist mirror neurons in the human brain. The existence of action-based processing is undeniable - it has been demonstrated with music (Alluri et al., 2017), treatment of aphasia (Chen, n.d.), have been hypothesized to help with speech processing and language acquisition (Behme, 2014; Hickok, 2010) .

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