What Does It Mean To Visually Estimate?

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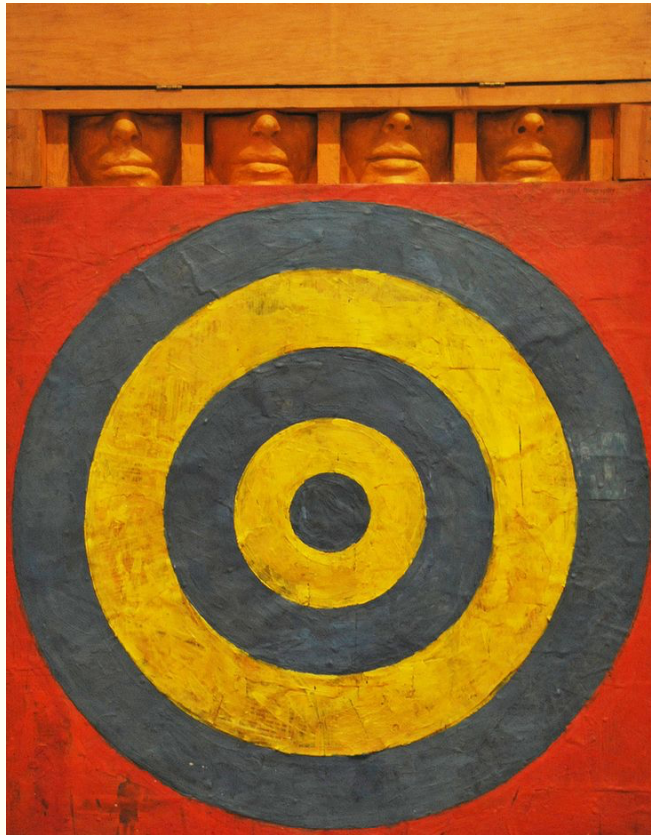VSS 2018

Re-understanding internal noise as internal confidence

Do This!

- Stand as far from this poster as you can (about 6 feet is good)

- After you read these directions, Close your eyes.

- With your eyes closed, walk toward the poster and try to touch your nose to bullseye of the target – without opening your eyes.

- Pay special attention to how you feel as you get closer and closer to the poster.

- Do you feel a tingle; are you not sure when you will hit the poster; do you feel the urge to put your hands up to protect yourself?

- (Please, really do this to feel the whole point of this poster).

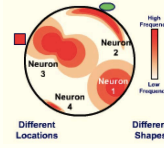- When you are done doing this demo look to the THINK THIS column to read what this all means
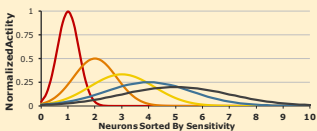
Further reading on this demo
Halberda, J. (2016). Epistemic limitations and precise estimates in analog magnitude representation, Halberda, J. & Odic, D. (2014). The precision and internal confidence of our approximate number thoughts.

Target With Four Faces, *Jasper Johns,* 1955

Think This!

- We are all familiar with "noisy" place cells whose activation looks like this:

- Such coding is familiar for many dimensions in visual perception & cognition, Gaussian tuning curves (length, angle, number, density, brightness)

- We often think of the spread in these tuning curves as internal noise. Rarely do we recognize that the "noise" in these tuning curves is optimal for representing 2 signals at once: both a very fine-grained estimate of a value (e.g., position in space) and our *confidence* in our current estimate of the value (e.g., the tingle).

- It is this *confidence* that you experienced as you walked towards the poster with your eyes closed.

- It is this *confidence* that gives you the sense that you are getting closer to the poster, but that you just can't tell exactly when you will hit it.

- Visual dimensions are fine-grained (e.g., more precise than the precision of any one place cell), and always offer a signal of *internal confidence*.

- To a first approximation, visual dimensions are noiseless.

Box 1. The Case For Number

- When you show a monkey these:

- You can find neurons like these in the intraparietal sulcus:

- This has led folks to make statements such as,

  - Experienced numerosities produce "*a blur on the number line*" (Spelke & Tsivkin, 2001)

- But just like place cells in the hippocampus, the "numerosity cells" of the intraparietal sulcus represent any possible real valued number (up to the fine-grained resolution of the system) along with a sense of internal confidence for knowing that number.

- The number cells, and all other visual magnitudes, represent an estimate of one true value, along with the epistemic limitations for knowing that value.