Multisensory Perception: From Integration to Remapping
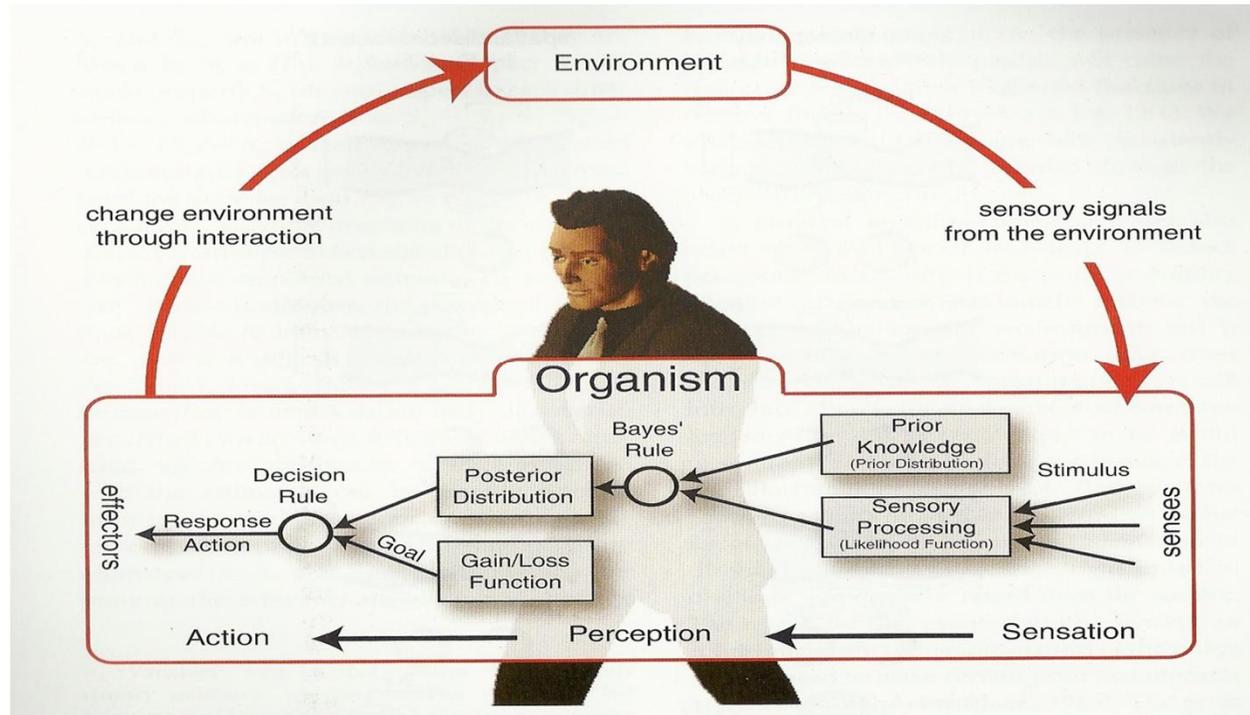
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Quiz

❖ What cause D(discrepancy) between the cue estimates and in what situation would remapping happen?
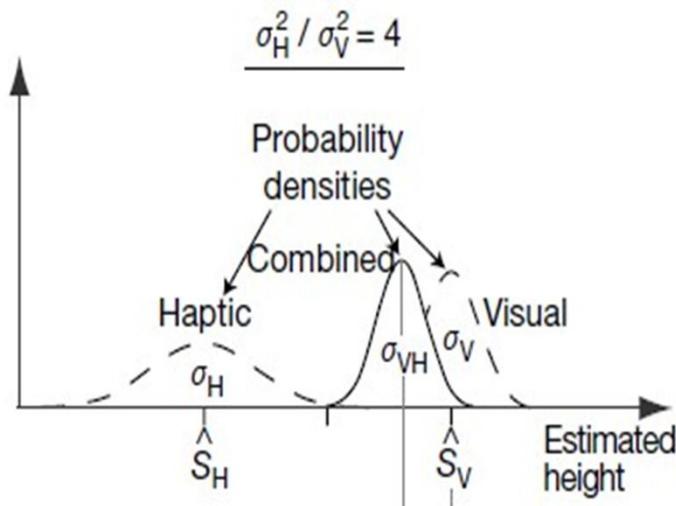
The reason for the discrepancy could either be a difference between signals or a random noise perturbation. If the discrepancy is consistent, we could adapt to the discrepancy, which process is called remapping.

The action/perception loop

The action/perception loop schematically illustrates the processing of information according to Bayesian decision theory.

Multisensory Integration

$$\sigma_H^2 / \sigma_V^2 = 4$$

Probability
densities

Combined

Haptic

Visual

σ_{VH} σ_V

σ_H

$\hat{S}_H$ $\hat{S}_V$ Estimated height

Visual and haptic estimates are combined to determine the size of an object.

❖ Assumption

An observer has access to accurate estimates of a particular world property from each cue.

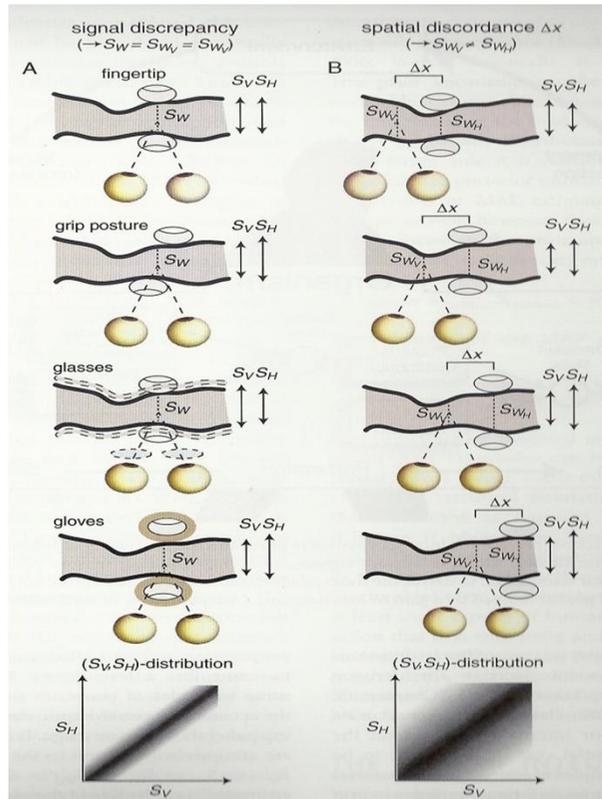The cues are Gaussian distributed (Gaussian noise) and conditionally independent.

$$\hat{S}_{VH} = w_V \hat{S}_V + w_H \hat{S}_H \ , where \ \ w_V + w_H = 1$$

$$w_j = \frac{r_j}{\sum_i r_i} \qquad\qquad r_i = \frac{1}{\sigma_i^2}$$

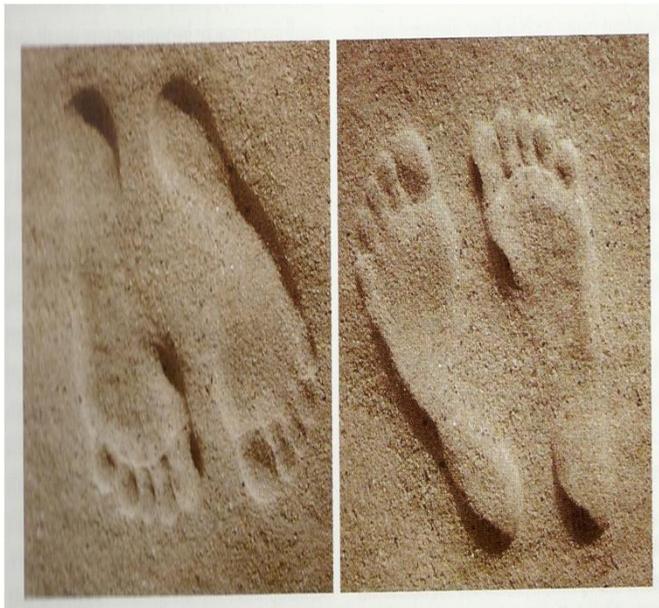cue's reliability(r) (inverse proportion of variance(σ))

signal discrepancy
($\rightarrow S_W = S_{W_V} = S_{W_H}$)

spatial discordance Δx
($\rightarrow S_{W_V} \neq S_{W_H}$)

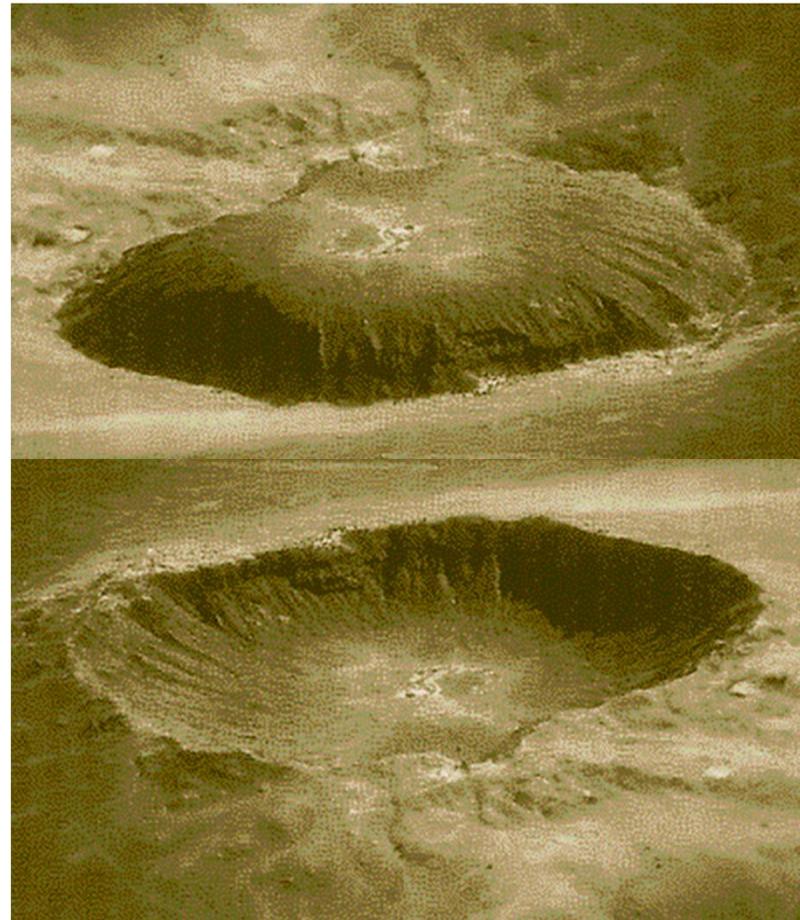**The cost is the introduction of potential biases(inaccuracy) into perception.**

Picture A give some examples of signal discrepancy while picture B give some examples of spatial discordance.

The cost of integration

This picture illustrate the discrepancy caused by **prior knowledge**.

We normally assume that light is coming From **above**.

Balancing benefits and costs

❖ Whether to integrate different multisensory depends on the presence of an actual difference D(discrepancy) between the multiple sensory signals.

❖ The reason for the D(discrepancy) could either be a difference between the signals or a random perturbation as a result of noise. Since both possibilities are plausible and have associated uncertainty, the optimal strategy would be to use them both and weight each according to its relative certainty.