Introduction

How do humans learn new patterns and features while observing unfamiliar scenes? According to traditional accounts, a recursive application of pair-wise Hebbian associative learning appropriately captures this process. More recent studies propose that human learning can be better described by Bayesian model selection than by pair-wise associative learning (Orban et al. 2008). These two learning mechanisms are in polar opposite in terms of how they build their internal representations: The Bayesian method favors the simplest model until additional evidence is gathered, which means a global, approximate, "low-pass" initial description of the scene. In contrast, pair-wise associative learning, by necessity, first focuses on details defined by conjunctions of elementary features, and only later learns more extended global features.

Questions

- Can the resulting representations of these two learning mechanisms be distinguished experimentally?
- Which mechanism captures more adequately the way humans develop their internal representation of new visual features?

Associative vs. Bayesian learning

- Both develop hierarchical representations of the scenes but via very different progression of intermediate stages

Experimental rationale

- Create a learning task that leads to erroneous initial interpretations of the underlying structure by the Bayesian account and allows the correct representation to emerge only after more extended learning in a manner that cannot be replicated by associative learning.

Experimental paradigm: Visual statistical learning

- Learning the underlying structure of unknown visual scenes implicitly by unsupervised learning without relying on low level cues and with a complete control over the relevant statistics

Modeling

- Bayesian model averaging (Orban et al 2008)

Results

- The MAP chunks learned after short and long training demonstrate the coarse-to-fine progression in the representation

Conclusions

- After controlling for the size of the stimulus features, a correlational structure of feature combinations can be designed that leads to different development of internal representations in the associative and Bayesian learning frameworks.
- Human learning follows the Bayesian framework: based on limited data it encodes a coarse description of the input, and refines it to smaller details as more data become available.

Supported by NIH NEI R01 18196