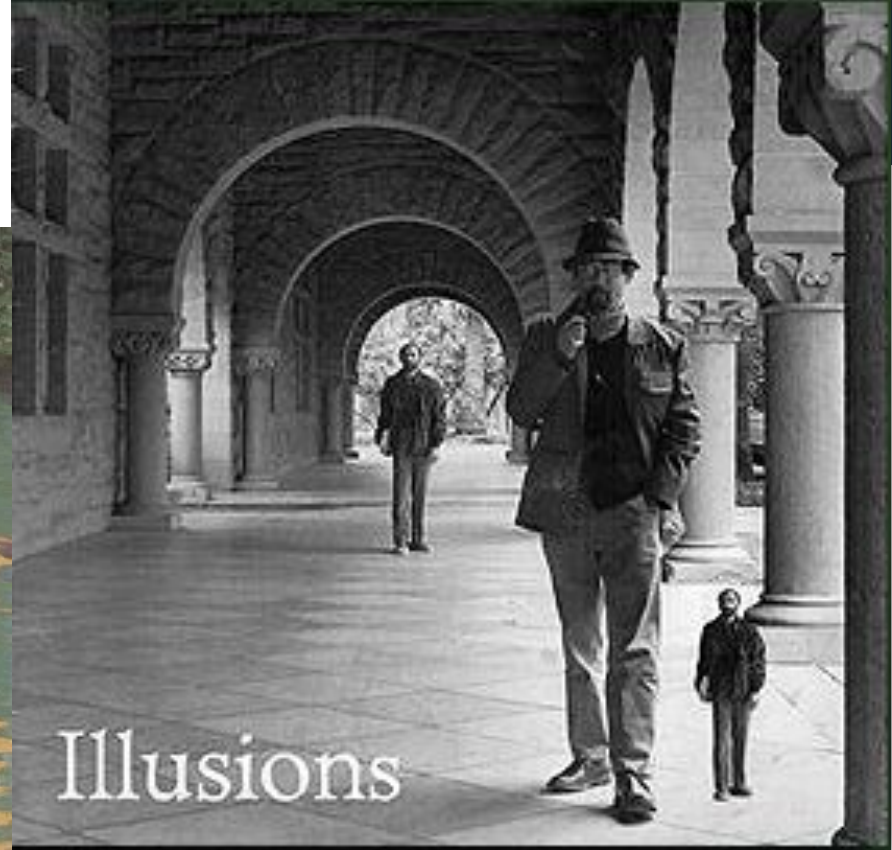




# Information, (visual) perception and (image) compression

# Where does the question come from?

- Ambiguity (underdetermination) of stimuli - e.g. size-constancy
- Assumptions? Inference? Knowledge? The temptation of constructivism



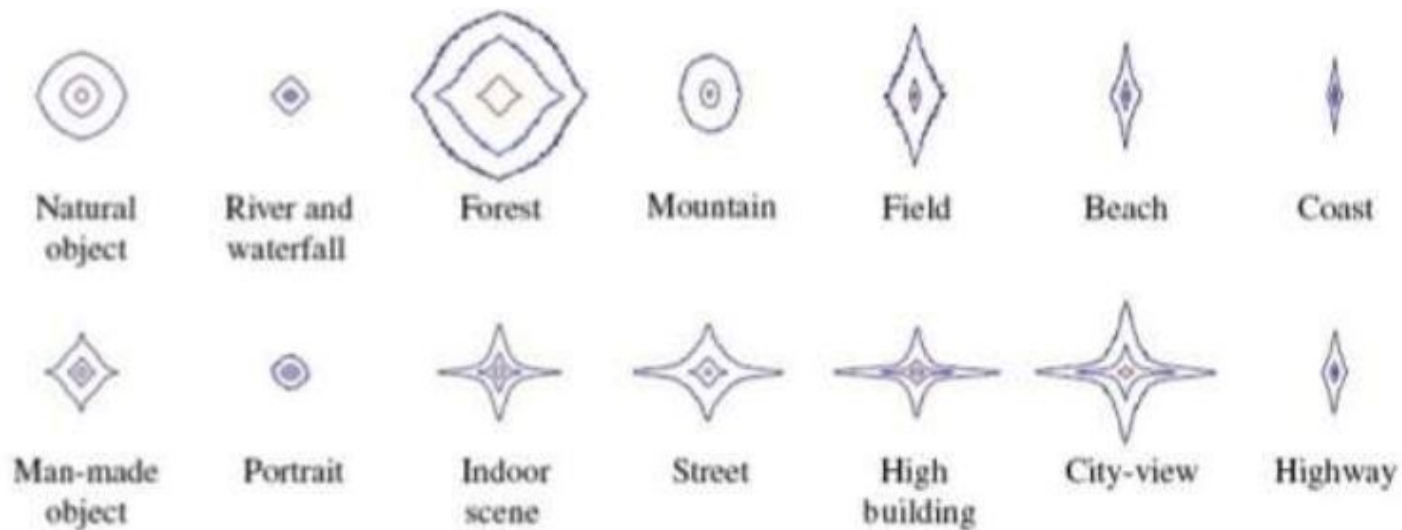
# The battlefield

- Two camps: Helmholtzian **constructivists** (inferentialists) vs. **anti-constructivists** (Gibsonians; Orlandi 2014)
- Rules, assumptions, *knowledge* vs. ‘mere’ regularities in the signal + [basic (perceptual) representations] (see: Burge 2010, ch. 3)
- **active** vs. **passive** perception?

# The regularities in the signal

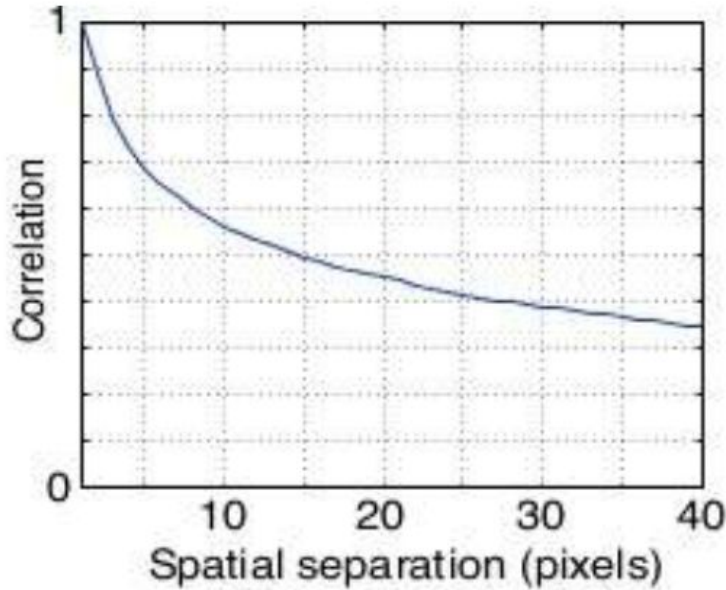
- **Regularities = redundancy = predictability** (Chaitin 2006)
- More efficient compression - processing gains (and **trade-offs**, e.g. shockproofness)
- Processing is **costly** (energy, time, space, erasion) (Szilard 1990)
- Different coding strategies on different levels
- **Error correction** - noise reduction?
- Human perceptual apparatus - **fitted** to these regularities.
- Biological constraints; **constraints =/ rules**
- Evolutionary in the light of morphological **limitations** -> Spandrels in St. Marco's cathedral (Gould & Lewontin 1979)

# Scene categorization according to Natural Scene Statistics

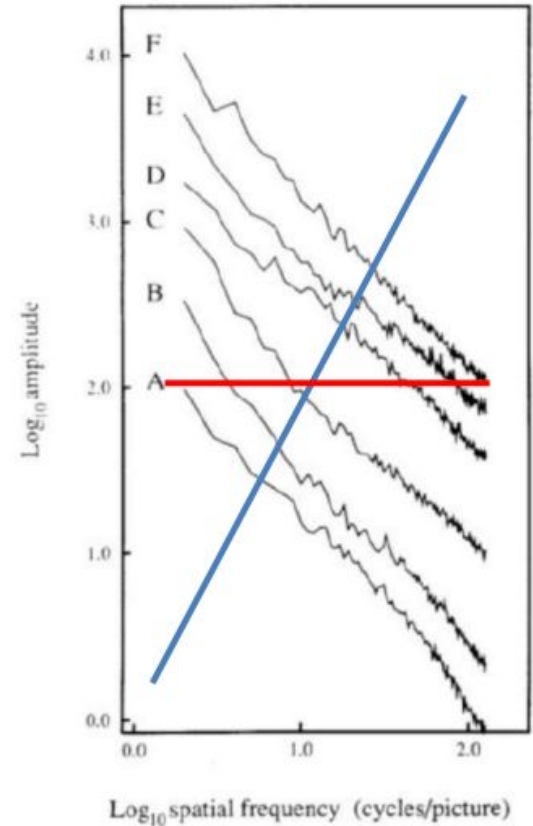


[Torralba and Oliva, 2003]

# Auto-correlation in natural images



Power spectrum of  
natural images  
(Field, 1987)



# Theoretical motivations

- Minimal explanation
- Simplicity - no explanatory 'epicycles'
- Proximity to **artificial systems** engineering
- Information-flow - measurable and quantifiable
- **Information-talk omnipresent** in philosophy of perception, but tacitly treated as an uninterpreted primitive -> **equivocation**
- Muddled terminology - barren debates (**see: 'inference'**)
- A new framework needed?

# Some predecessors

Algorithmic Information Theory (Solomonoff-Chaitin-Kolmogorov) -> (**Gauvrit, Zenil, Tegner 2015, Wang et al 2014**)

- **Wolff, 1993** - computing, cognition, information-processing
- **Chater & Vitanyi, 2003** - simplicity as cognitive principle
- **Hutter 2005** - AIXI; general intelligence, action guidance and planning
- **Grunwald, 2005** - Minimum Description Length (MDL)
- **Chaitin, 2006** - 'compression is comprehension'
- **Schmidhuber, 2009** - data-compression as basis for prediction in cognition
- **Wilkenfeld, 2019** - 'Understanding as Compression'
- & a voice from afar: **Tononi-Sporns** Integrated Information Theory

# Types of compression

**Lossless**

**(cognition)**

Keeps information

(Buckley 2008)

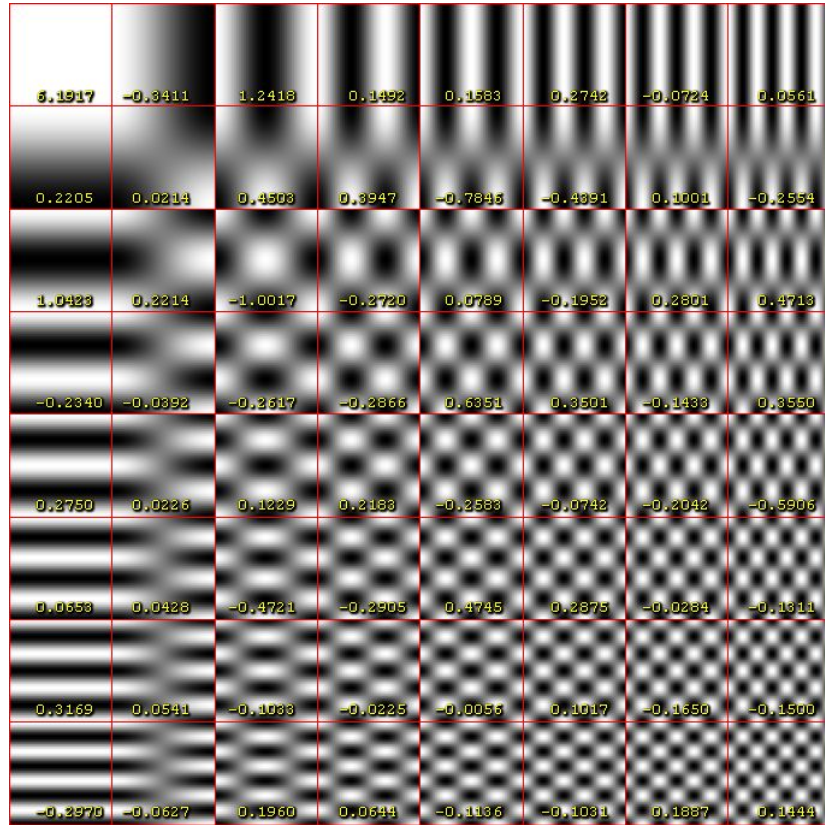
Information

**Lossy (vision?)**

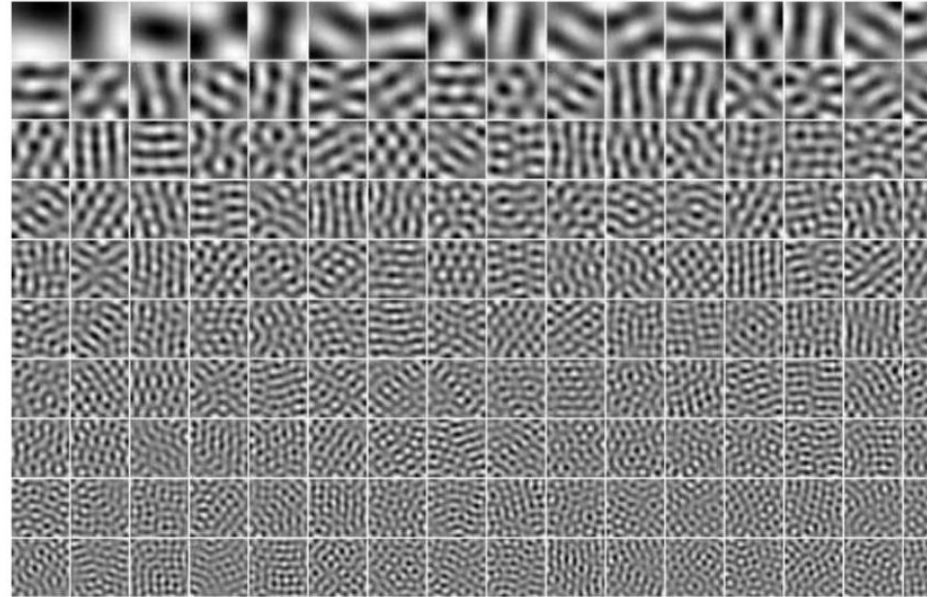
Aborted

# Compression in perception?

- Stored or built-in **'rules'** (*~formation principles* - Burge 2010) as generative kernels for percepts
- Learning as finding regularity. Evolutionary perspective - dynamic systems (Skyrms)
- Use of regularities - e.g. filling out the gaps
- Wilkenfeld (2017) - understanding (contrary to knowledge) is generative: ration of generating new information (*producible*) from stored (*encoded*) ones is important; similar point to be made about 'fitness' of a perceptual system? -> **'signal to scaffolding ratio'**
- **First we need to establish the rules of the 'coding game' (Lewis 1973)**
- **What's the status of brain information? Objective property? Relative? (Rathkopf 2017, 2018)**



Discrete Cosine Transform (JPEG)

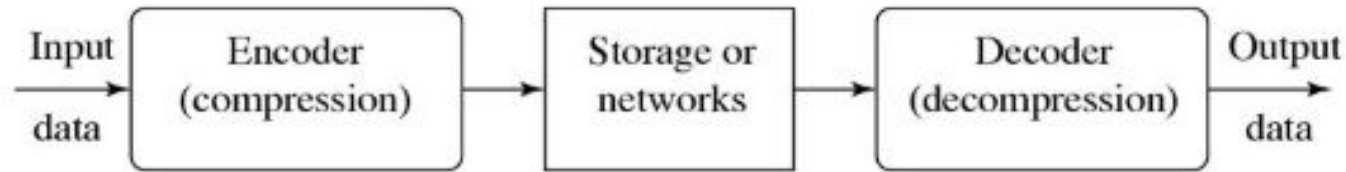


PCA Analysis Effect (Field, Olshausen 1995)

Inter-frame  
compression  
scheme?  
(Nortmann et  
al. 2013)



- **Compression:** the process of coding that will effectively reduce the total number of bits needed to represent certain information.



*stimuli-->visual filters (SC, whitening) -->perceptual repr.-->'interpretation'-->formed percepts*

**Fig. 7.1:** A General Data Compression Scheme.



‘It is part of the structure of the game that the states occur with certain probabilities.’ (Skyrms 2010: 35)



# Can the 'compression game' be an alternative?

- Nothing mysterious about data-compression (being complex on the other hand...)
- Quantifiable measures and artificial simulations of agents (computer vision, artificial neural nets)
- Does not discriminate apriorically any agents from enquiry (**no hyper-intellectualisation**)
- Backing of well-established, precise and complex mathematical theory (and according toolbox)
- Vision is a multi-layer process. Constructive (active) and receptive (passive) components?
- **Compression depends on building/possessing the statistical model of the target data - so does perception!**
- **Consideration points:** mapping of 'compression game' into biological processes - setting up the 'coding game' ? How limited is it as a model?