THE PARADOX OF TOP-DOWN INFLUENCES ON PERCEPTION

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Paradox

• On the one hand
  – perception is naturally top-down

• On the other hand
  – not easy to pinpoint these top-down effects in a precise fashion
    • neurally
    • quantitatively
    • behaviorally
PART 1.

PERCEPTION IS NATURALLY TOP-DOWN
Smith, Gosselin & Schyns (2012), *Current Biology*
Smith, Gosselin & Schyns (2012), Current Biology
Theoretical views

• Predictive coding
  – The brain as a prediction engine

• Phenomenology of vision
  – Vision as controlled hallucination
Predictive coding
Phenomenology of vision

• one is aware of an endless sequence of “presentations”
  – presentations just happen: there is nothing you can do about them
  – presentations are organized: they are composed of qualities and meanings

• the pre-conscious process that yields these presentations = psychogenesis
Vision as controlled hallucination

• invert the chain of events, and replace inverse optics with “controlled hallucination”

• solid biological grounding
  – organisms learn about their world through informative probings
    • when resistance to a probing is met, there is “a spark of enlightenment, a germ of awareness” (Schrödinger, 1956)
    • probing may be understood as “questioning”
    • questions (probings) are intentional, world-directed, active, and therefore meaningful by their very nature
PART 2.

NOT EASY TO PINPOINT THESE TOP-DOWN EFFECTS IN A PRECISE FASHION
What is the problem then?

• Perception is naturally top-down

• Not easy to pinpoint these top-down effects in a precise fashion
  • neurally
  • quantitatively
  • behaviorally

• 3 case studies
Case study 1: Neural


- behavioral results

- fMRI decoding results
Behavioral results

Parts + corner → whole

Accuracy:

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<th>Testing Runs</th>
<th>Percent Correct</th>
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<tr>
<td>1</td>
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<tr>
<td>2</td>
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<td>6</td>
<td>50</td>
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Response time:

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(parts) vs (whole)
Scanning protocol

**Experimental runs**
- 150 ms parts cond.
- 1850 ms
- 150 ms whole cond.
- 1850 ms

**Localizer runs**
- 300 ms
- 500 ms 16 sec objects block
- 300 ms 16 sec scrambled objects block
- 500 ms

**Meridian mapping runs**
- 16 s
- 16 s
fMRI results: Retinotopic mapping
MVPA: decoding

**fMRI data voxel responses**

**condition 1**
- run 1
- run 2

**condition 2**
- run 1
- run 2

**split in half**

**half 1**
- learn a rule to differentiate between the two conditions

**half 2**
- test how well the rule does on unseen patterns (reported as % correct)
fMRI results: decoding
Study 1. Conclusions

- behavioral configural-superiority effect

- neural configural-superiority effect:
  - better coding of “wholes” than “parts” in higher shape-selective regions
  - better coding of “parts” than “wholes” in lower-level retinotopic regions

- conclusions:
  - at least some Gestalts emerge only at higher stages of visual information processing
  - feedforward processing may be sufficient to produce some Gestalts
Case study 2: Quantitative

Apparent motion
Apparent motion (AM)

• Which brain areas are involved in this perceptual filling-in?

• Increased activation of neurons in V1 tuned to that location and orientation?
  – conflicting evidence
Apparent motion masking (AMM)

• Impaired performance for targets on the path of apparent motion

• Usually taken as evidence for increased activation of V1 neurons
  – causing interference

• However, AMM is also compatible with predictive coding (explaining away)
  – active suppression of inputs compatible with prediction
Van Humbeeck et al. (2016)

- Measure AMM
- Develop population coding model to explain the effects
Methods + Basic results

**Graph a:**
- Inducers 80ms
- ISI 38ms
- Target 30ms
- ISI 38ms
- Inducers 80ms

**Graph b:**
- Proportion correct
- Contrast

**Graph c:**
- Maximal performance (prop. correct)
- Various symbols representing different conditions:
  - Flicker condition
  - AM condition
  - SG
  - BO
  - EV
  - AV
  - CV
Results: orientation tuning
Results: orientation tuning
Model

Inducer

AM-induced excitation (\(\alpha\))

AM-induced suppression (\(\gamma\))

AM-induced inhibition (\(\beta\))

Target

Linear orientation filtering

Expansion

Gain control

Noise

Decoding into decision statistic D
Results: modeling

![Graph showing Proportion correct vs. Contrast for Flicker and AM conditions with different model fits.](image-url)
Study 2: Conclusions

• V1 activation cannot account for AMM

• Instead, AMM is due to V1 suppression
  – supporting predictive coding models

• AM perception as such is probably generated at higher levels (V5, hMT)
Case study 3: Behavioral


• scenes with a semantically *incongruent* object-background relationship break interocular suppression *faster* than scenes with a semantically congruent relationship

• semantic relations between objects and background of a scene can be extracted in the absence of visual awareness of the stimulus
Continuous Flash Suppression
Design

(a) Left Eye  Right Eye

(b) Left Eye  Right Eye

1 s

(c)

[Images of different scenes with labels and timelines]
Results

CFS Condition

Control Condition

Incongruent Detection Time (s)

Congruent Detection Time (s)

Congruent Faster

Incongruent Faster

Incongruent Faster

Incongruent Faster
**Moors et al. (2016)**

- **Aim:** to try to replicate this

- **Conclusion:** a clear failure to replicate
Design

- Same stimuli
- Same experimental paradigm
- One extra condition: picture inversion
Results
Results
Results
Study 3: Conclusions

• Failure to replicate

• No evidence for top-down effect (scene congruency effect) on suppression breakthrough times

• No evidence for unconscious high-level processing
General conclusion

• Perception = top-down

• Top-down effects are difficult to pinpoint exactly
  – at least within the mainstream view of perception as inverse optics
    • reconstruction of external world
    • as veridical as possible
Thank You

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www.gestaltrevision.be