Invariant visual object representations in the early postnatal and adult cortex: bridging theory, model and neurobiology

Consolidator Grant – Neurosciences and Neural Disorders

Davide Zoccolan
The computational challenge: object recognition

Target

“car”:
The computational challenge: object recognition

Target

“car”:

Not “car”:

This is not my target!
The computational challenge: object recognition

DiCarlo, Zoccolan and Rust (2012)
The computational challenge: how does the brain factorize object identity from other variables (position, scale, etc.)?

Target

This is still my target! (just transformed)

“car”:

Not “car”:

This is not my target!

DiCarlo, Zoccolan and Rust (2012)
We know what brain regions support object recognition: the primate ventral stream.
We don’t know what mechanisms underlie the development and maintenance of object representations.
My goal: to use a simpler animal model (the rodent) to understand how object representations are learned from the statistics of the visual environment.
The experimental approach:
1. high-throughput visual psychophysics

Zoccolan (2015)
The experimental approach:

2. in-vivo neurophysiology

Adapted from Sereno & Allaman (1991)

Adapted from Tafazoli et al (in press)
The experimental approach:
3. rearing in visually controlled environments
The experimental approach:  
4. machine learning & computational modeling

test for *linear separability*

Adapted from Tafazoli et al (in press)
Some results: emergence of invariant representations of visual objects in rat visual cortex

Adapted from Tafazoli et al (in press)
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