From perception to meaning:
Integrating learned information into cortical networks

Marc N. Coutanche
Today

1. The neurobiological basis of knowledge

2. Using neurobiological findings to predict and understand behavior

3. Neurobiological variance predicts how we learn
Coutanche & Thompson-Schill (2015, Cerebral Cortex)
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Patients with semantic dementia: impaired in items rich in both color and shape (Hoffman et al., 2012)

Coutanche & Thompson-Schill (2015, Cerebral Cortex)
This animal is between 6 and 7 feet long when fully grown. It stands 4 feet in height. It weighs between 400 and 800 pounds.

When the word 'imagine' appears on the screen, imagine looking at this animal in front of you.
medial occipito-temporal sulcus

lateral occipito-temporal sulcus

mediol occ/temp (lingual gyrus)
lateral occ/temp (fusiform gyrus)

Coutanche & Thompson-Schill (in prep)
Distinguishing size-similar items

Coutanche & Thompson-Schill (in prep)
Enhanced Informational Connectivity

Animals

Calcarine sulcus
Occipital pole
Cuneus
Inferior occipital gyrus
Middle occipital gyrus
Superior occipital gyrus
Lateral occ/temp
Lateral occipitotemporal sulcus
Medial occ/temp
Medial occipitotemporal sulcus

Coutanche & Thompson-Schill (in prep)
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Figure from Frankland & Bontempi (2005)
New information is not always explicitly taught

Coutanche & Thompson-Schill (2015, TiCS);
Coutanche & Thompson-Schill (2014; JEP: General)
Visual concepts

• Fast mapping studies have typically focused on lexical/phonological knowledge

• But, the visual representation is integral

• Hippocampal neural representations are stabilized by attention (Aly & Turk-Browne, 2016; Muzzio et al., 2009)

• But what if there is no representation to stabilize?
Behavioral predictions – typical learning

learning … retrieval with **divided** attention … recognition test

*prediction: weak recognition*

learning … retrieval with **full** attention … recognition test

*prediction: strong recognition*
Behavioral predictions – fast mapping

learning ... retrieval with divided attention ... recognition test

prediction: weak recognition

learning ... retrieval with full attention ... recognition test

prediction: strong recognition weak
Coutanche & Chun (submitted)
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Hubs of the semantic network
A scatter plot showing the relationship between relative volume and semantic trait score for the left temporal pole and right temporal pole. For the left temporal pole, the correlation coefficient is $r = 0.64$, with a p-value of $p = 0.003$. For the right temporal pole, the correlation coefficient is $r = 0.55$, with a p-value of $p = 0.01$. The graphs illustrate a positive correlation between relative volume and semantic trait score in both regions.
Left angular gyrus

$r = 0.12, p = 0.63$

Right angular gyrus

$r = 0.44, p = 0.05$
Thank you!

Learning in Neural Systems (LeNS) lab

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