DPZ
Deutsches Primatenzentrum
Leibniz-Institut für Primatenforschung

# Effect of viewing distance on object responses in macaque areas 45B, F5a and F5p

Capara I[1,2] and Janssen P[1,2], bioRxiv pre-print

[1]Laboratorium voor Neuro-en Psychofysiologie, Katholieke Universiteit Leuven

[2]The Leuven Brain Institute

Presented by: James Goodman

Neurobiology Journal Club

30.06.2020

Mitglied der Leibniz-Gemeinschaft

# Introduction to peri- and extra-personal space

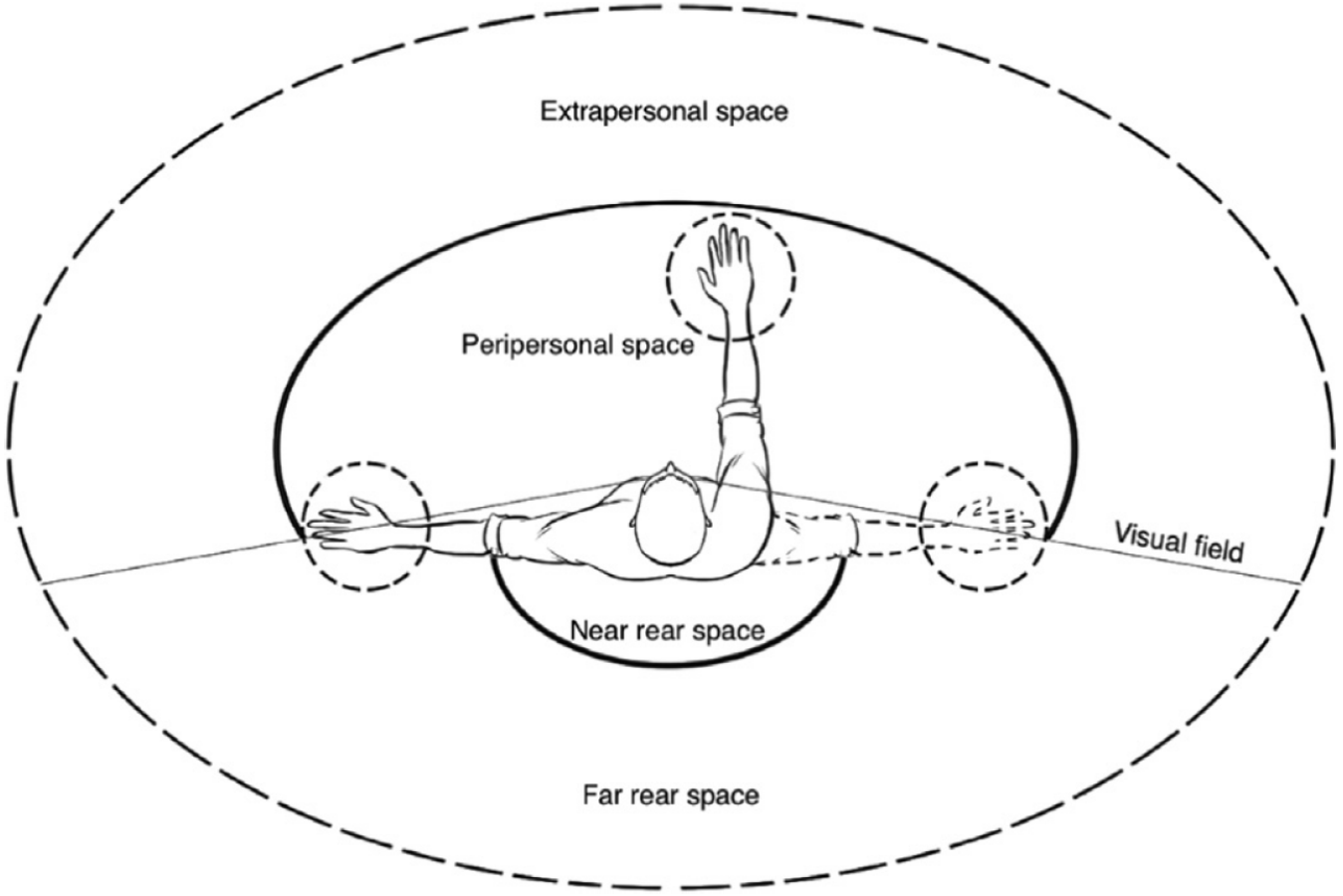
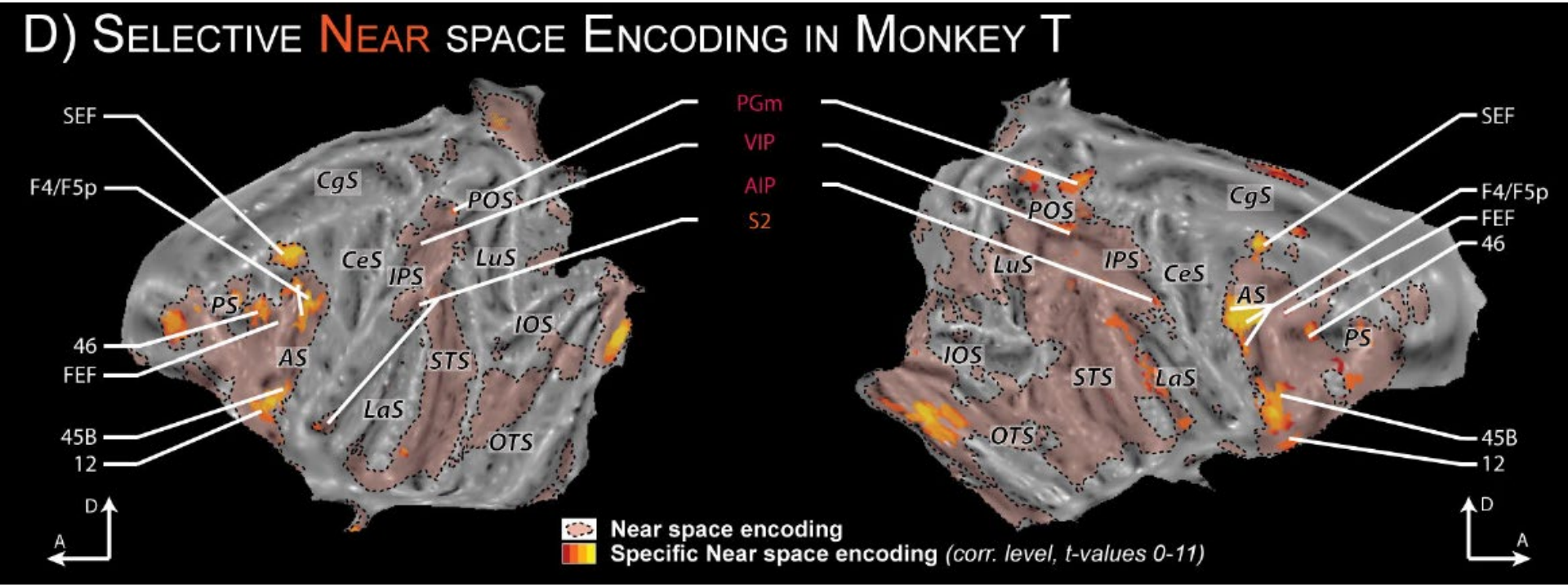
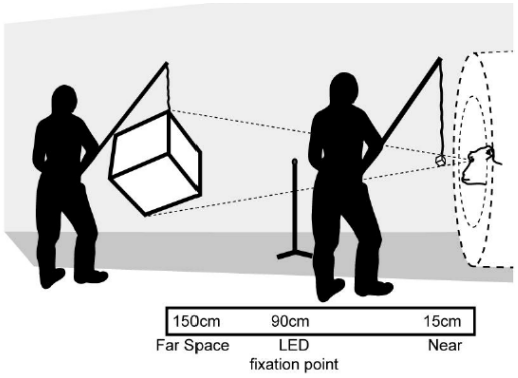



Image credit: Van der Stoep et al. 2014 *Neuropsychologia*

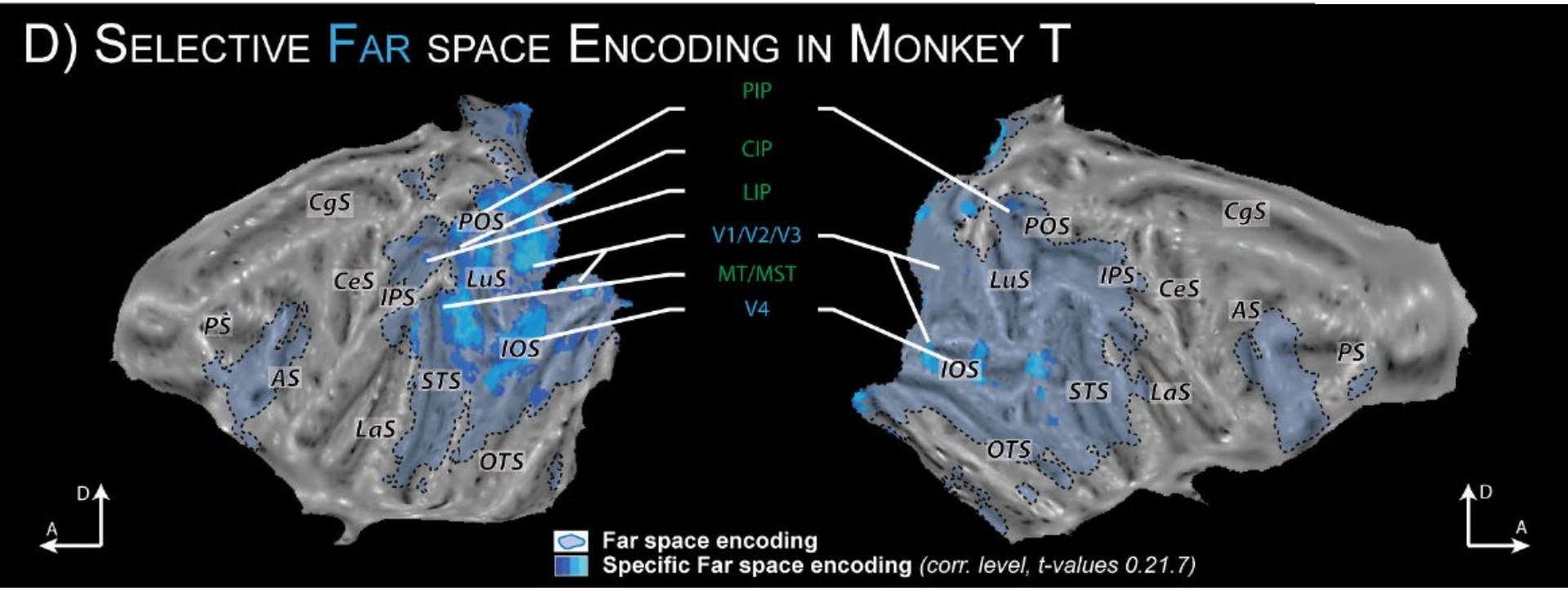
# Anatomically distinct preferences for peri- and extra-personal space

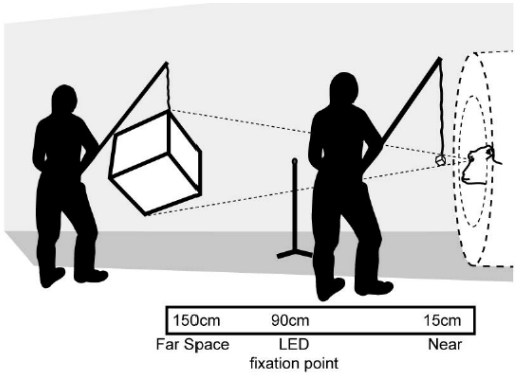



Cléry et al. 2018 *NeuroImage*

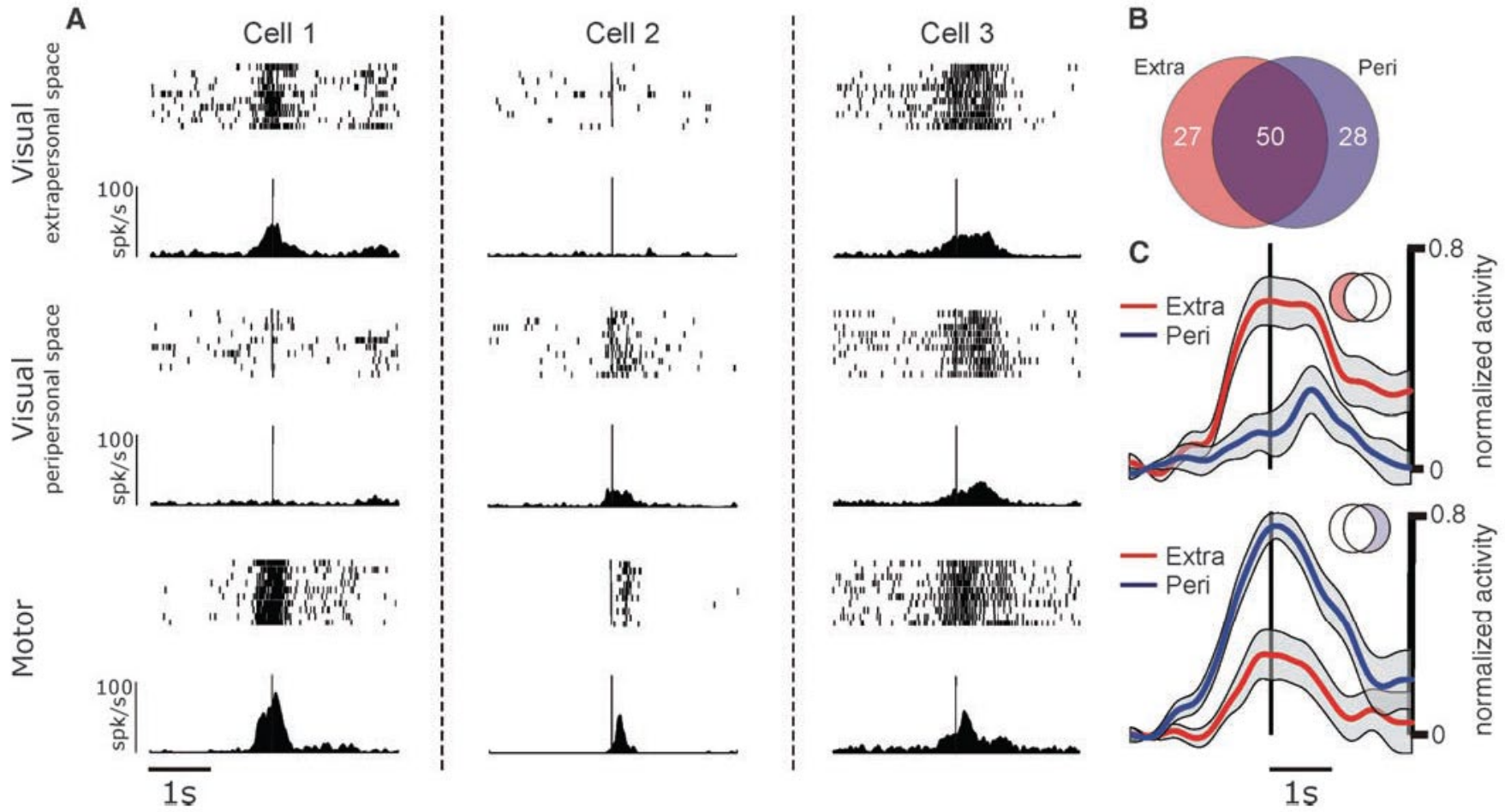
# Anatomically distinct preferences for peri- and extra-personal space



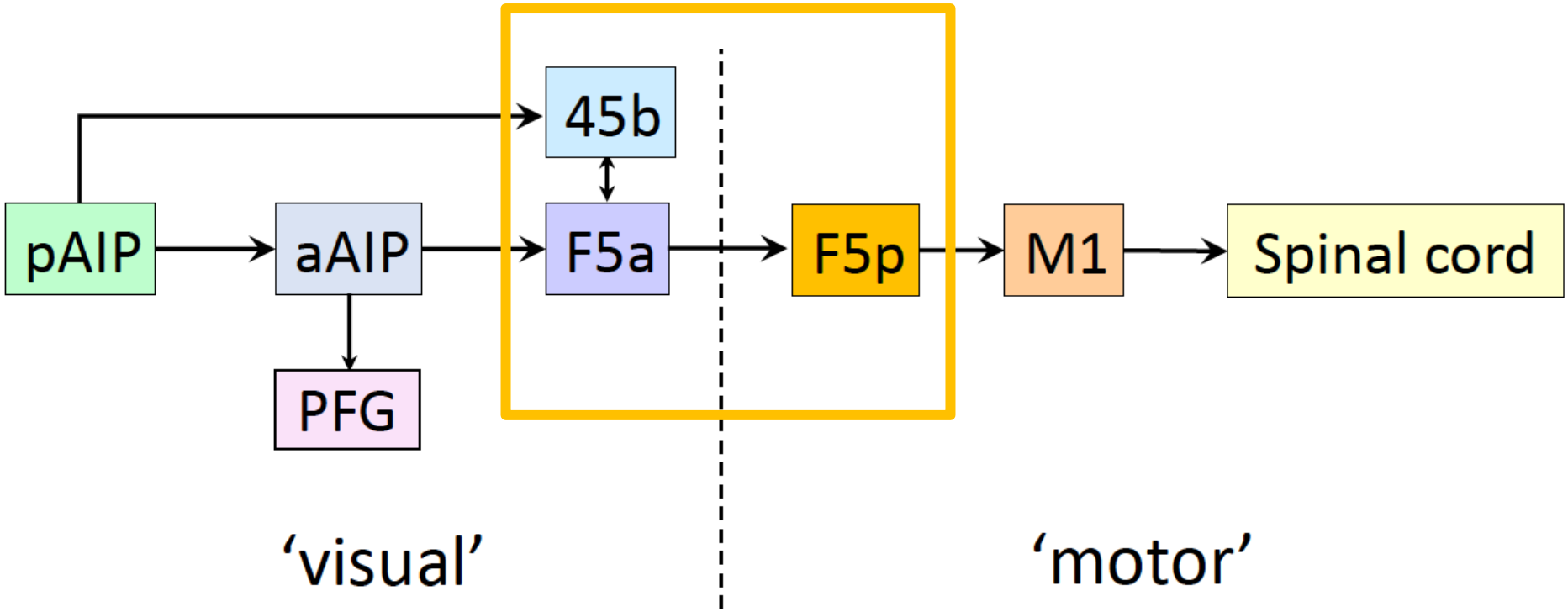

Cléry et al. 2018 *NeuroImage*

# “Mirror” neurons show a mixed distribution of preferences




Caggiano et al. 2009 *Science*

# A gradient *within* frontal areas?



# Putative conclusions

- Rostro-caudal gradient of near-far selectivity
- Rostro-caudal visuo-motor gradient
- The caudal “Motor”-like areas have stronger “far” selectivity
- The rostral “Visual”-like areas have stronger “near” selectivity

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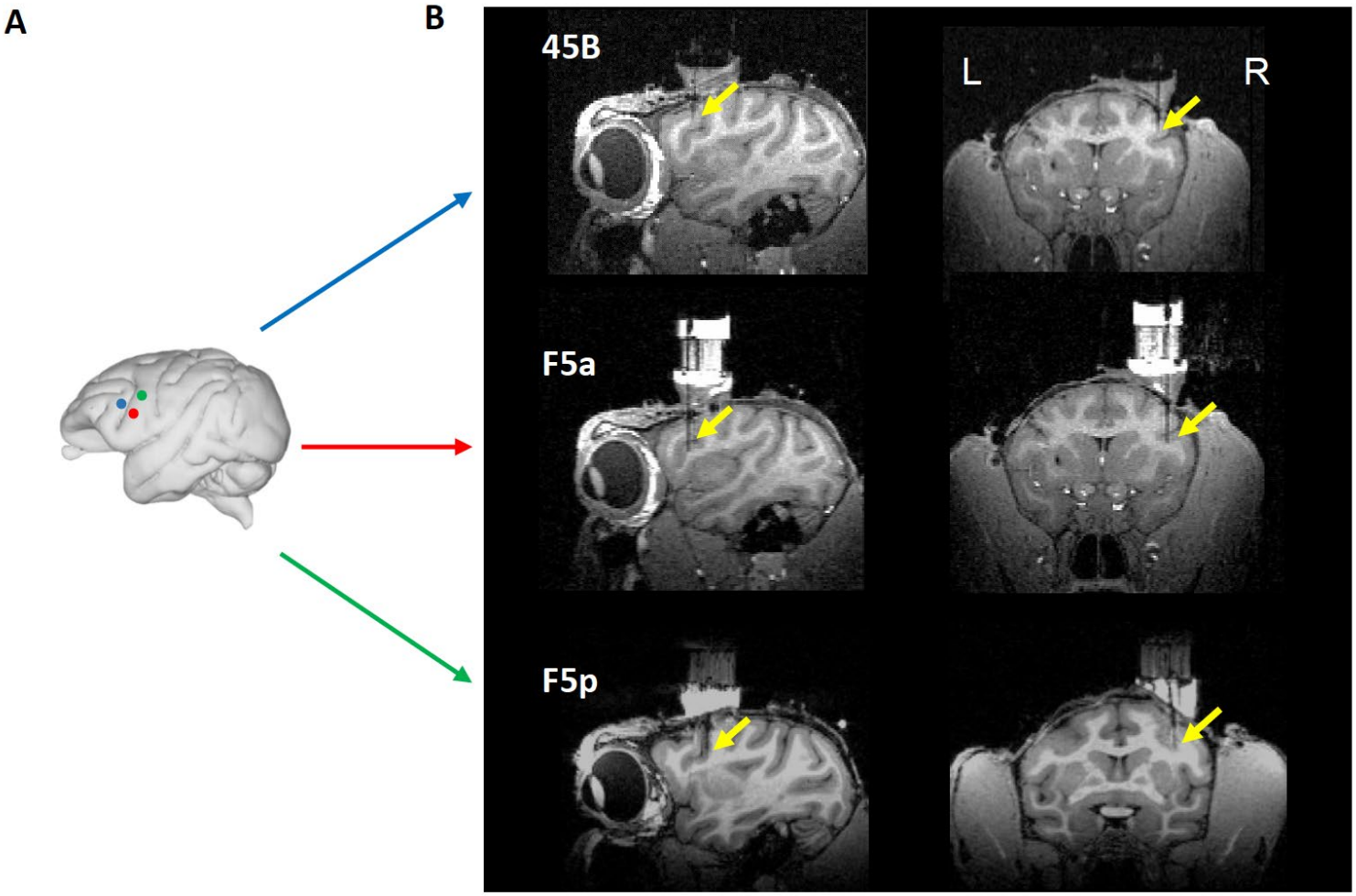
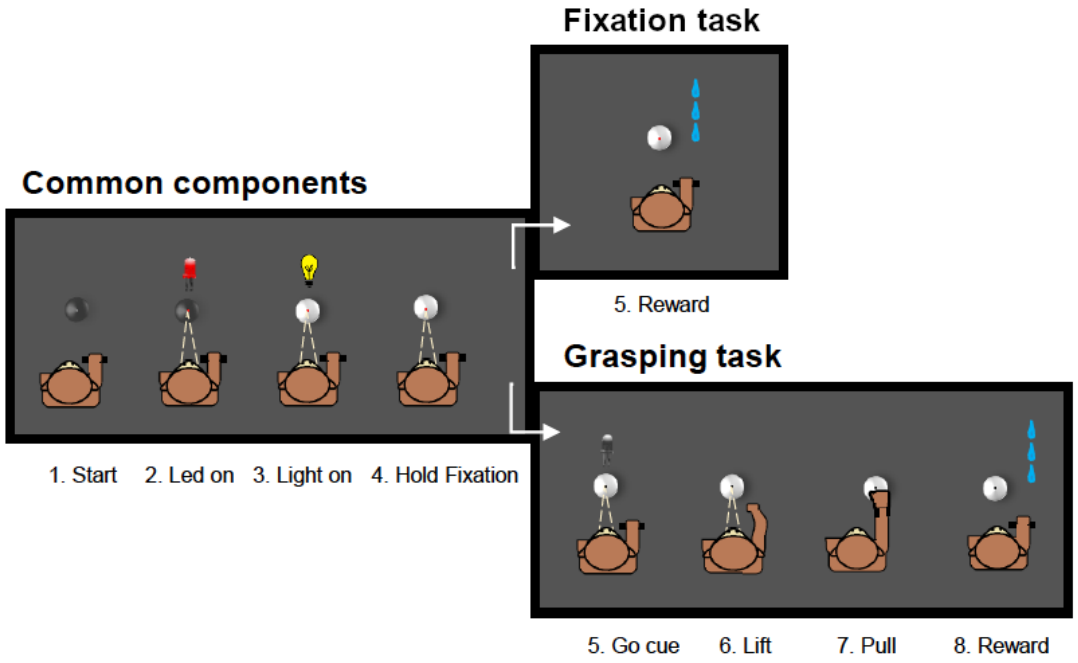
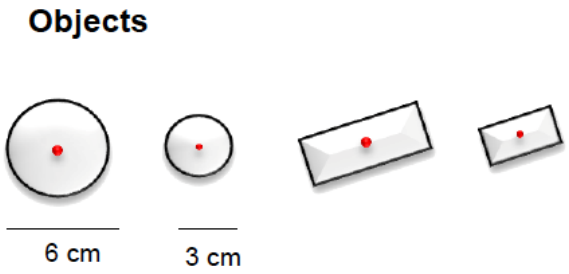
???

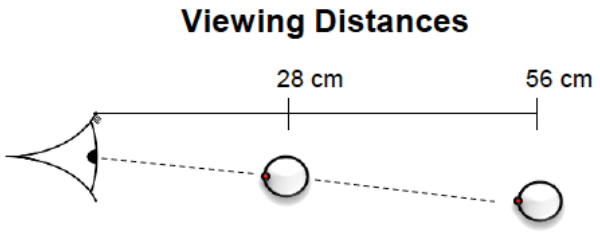
# Chamber placement and electrode locations



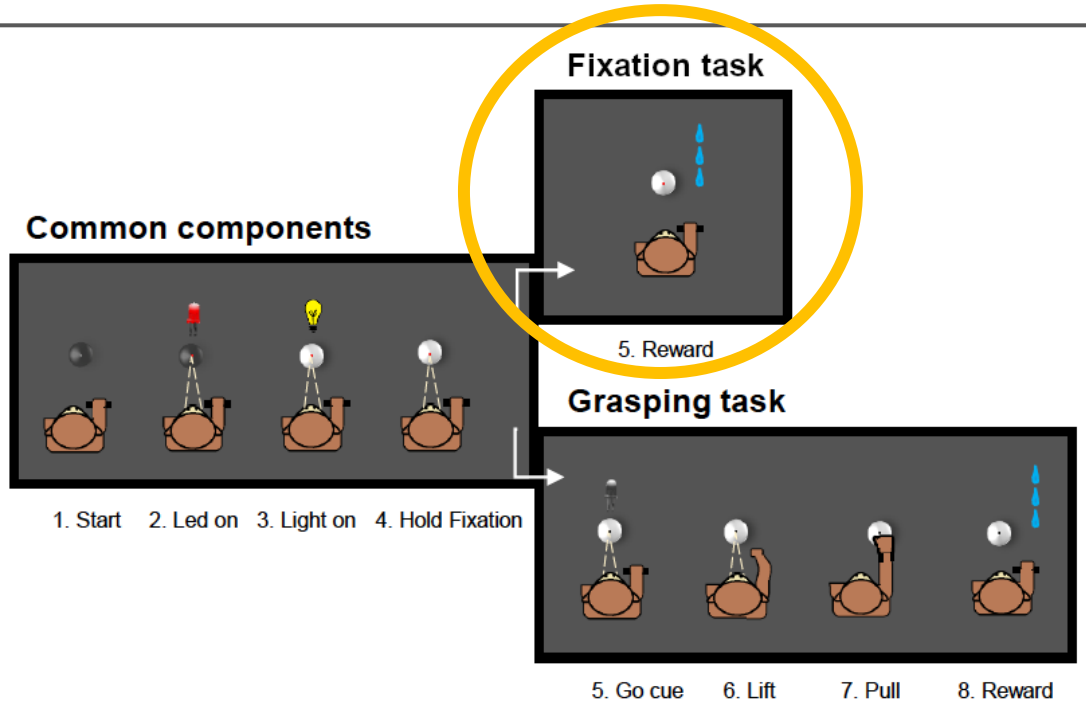
# Task


Fixation task
Common components
5. Reward
Grasping task
1. Start
2. Led on
3. Light on
4. Hold Fixation
5. Go cue
6. Lift
7. Pull
8. Reward


Objects
6 cm
3 cm


Viewing Distances
28 cm
56 cm

# Task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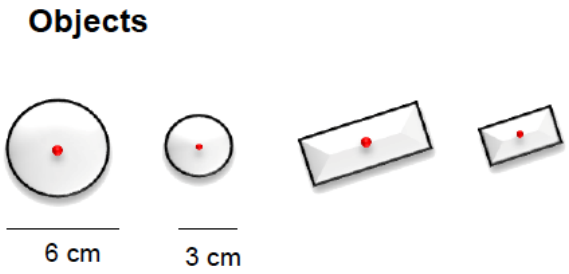
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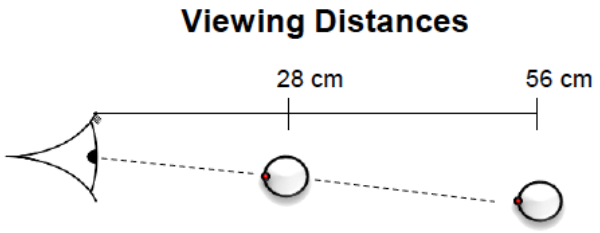
Viewing Distances
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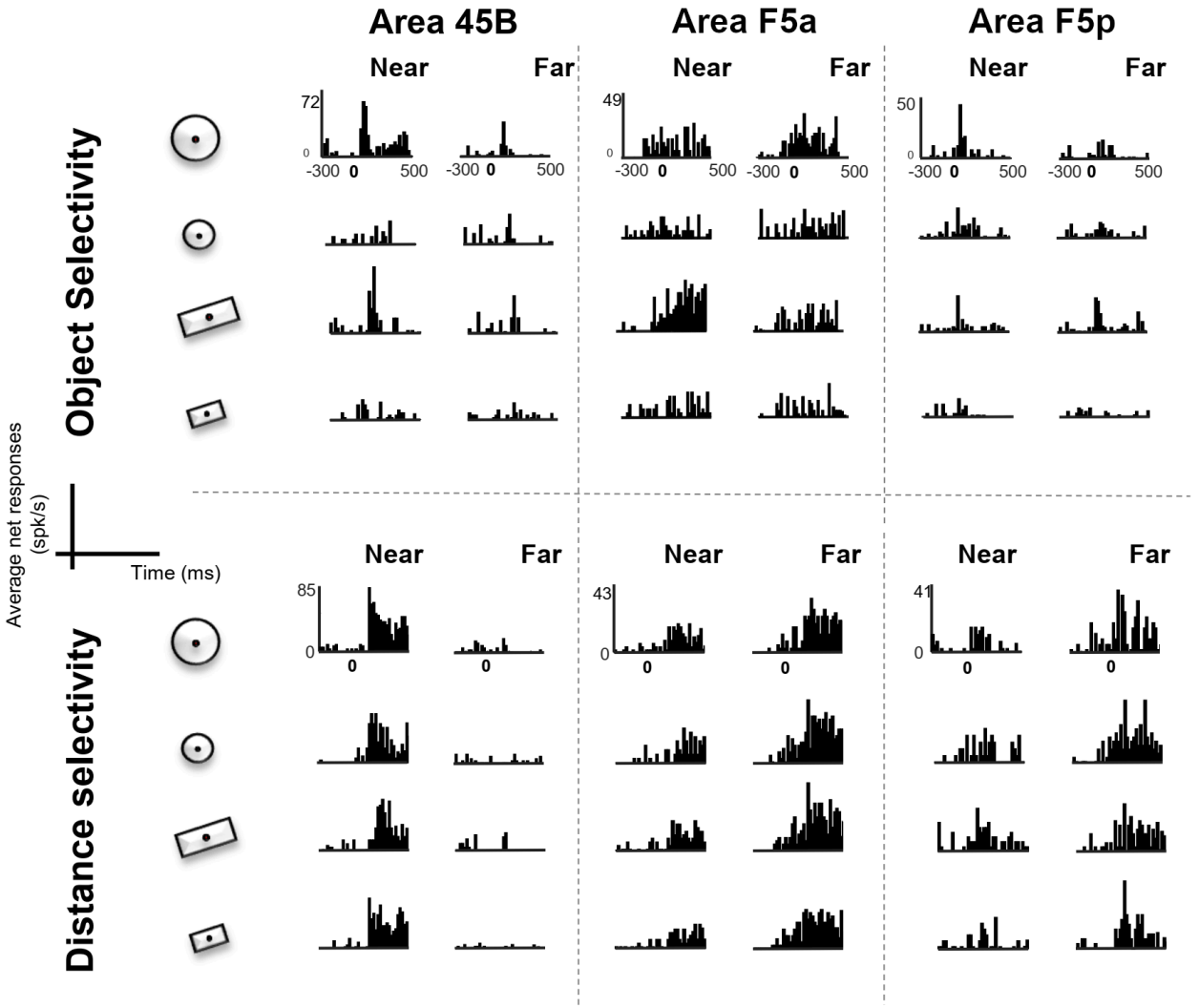
# Example PSTHs during fixation task



# Similar proportions of neurons with distance preferences across areas

| | 45B | F5a | F5p |
|---|---|---|---|
| **Object** | 47 (41%) | 18 (20%) | 18 (23%) |
| **Distance** | 50 (44%) | 32 (36%) | 29 (38%) |
| **Interaction** | 23 (20%) | 12 (13%) | 9 (12%) |

# More object selectivity in area 45B relative to area F5

| | 45B | F5a | F5p |
|---|---|---|---|
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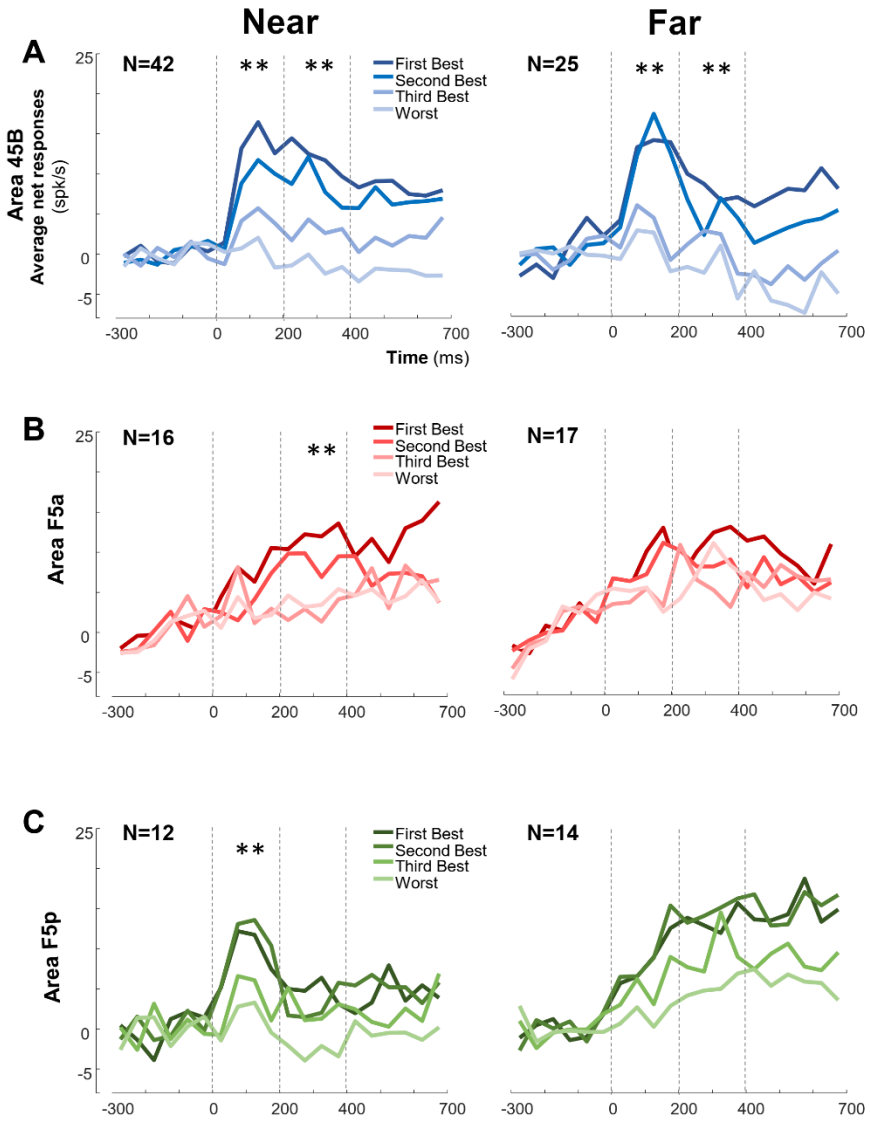
# Population-averaged responses reflect gradients of object preference



# Comparing near vs. far responses reveals (?) rostrocaudal gradient of distance preference

| | 45B | | F5a | | F5p | |
|---|---|---|---|---|---|---|
| | **Near** | **Far** | **Near** | **Far** | **Near** | **Far** |
| **Large** | 42 | 23 | 24 | 18 | 14 | 25 |
| **Small** | 24 | 25 | 25 | 22 | 16 | 22 |
| **Total** | 66 (58%) | 48 (42%) | 49 (55%) | 40 (45%) | 30 (39%) | 47 (61%) |

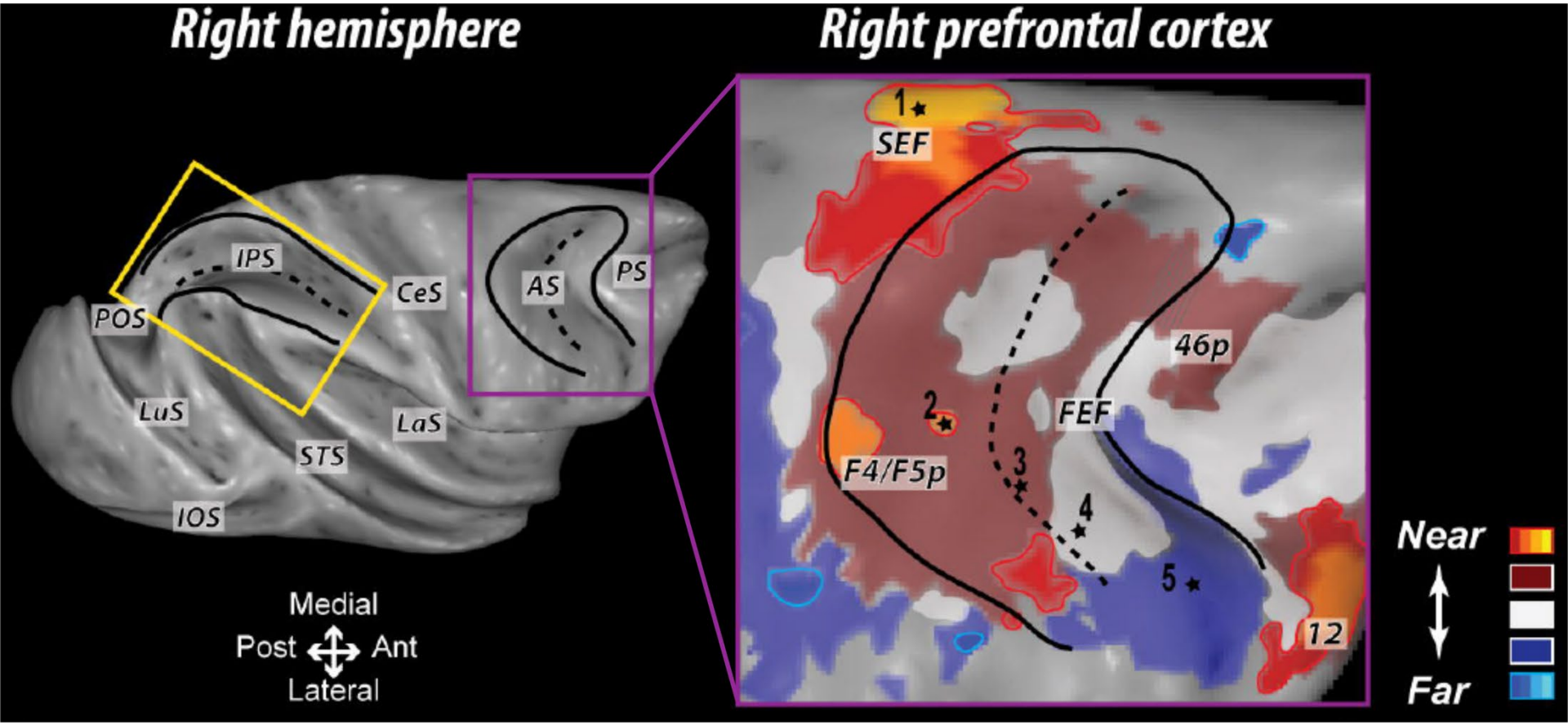
# Gradient inconsistent with previous literature!


SUMMARY

The visual responses of single neurons of the periarcuate cortex have been studied in the macaque monkey. Two sets of neurons responding to visual stimuli have been found. The first set, located rostral to the arcuate sulcus, was formed by units that could be activated by stimuli presented far from the animal. These neurons had large receptive fields and were neither orientation nor direction selective. The second set, found predominantly caudal to the arcuate sulcus, was formed by units that were maximally or even exclusively activated by stimuli presented in the space immediately around the animal. These neurons were bimodal, responding also to somatosensory stimuli.

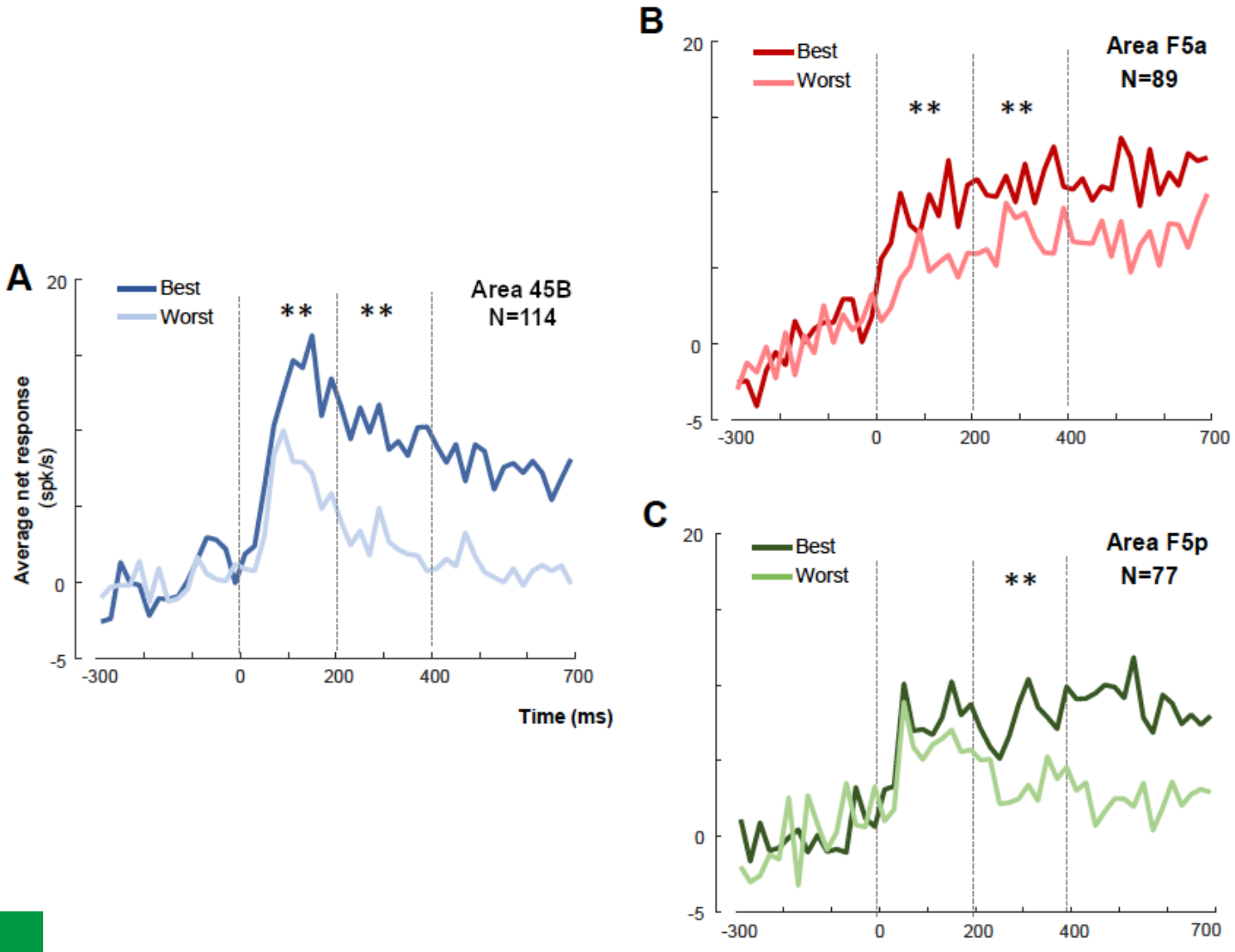

Rizzolatti et al. 1981 *Behav. Brain Res.*

# Gradient inconsistent with previous literature!

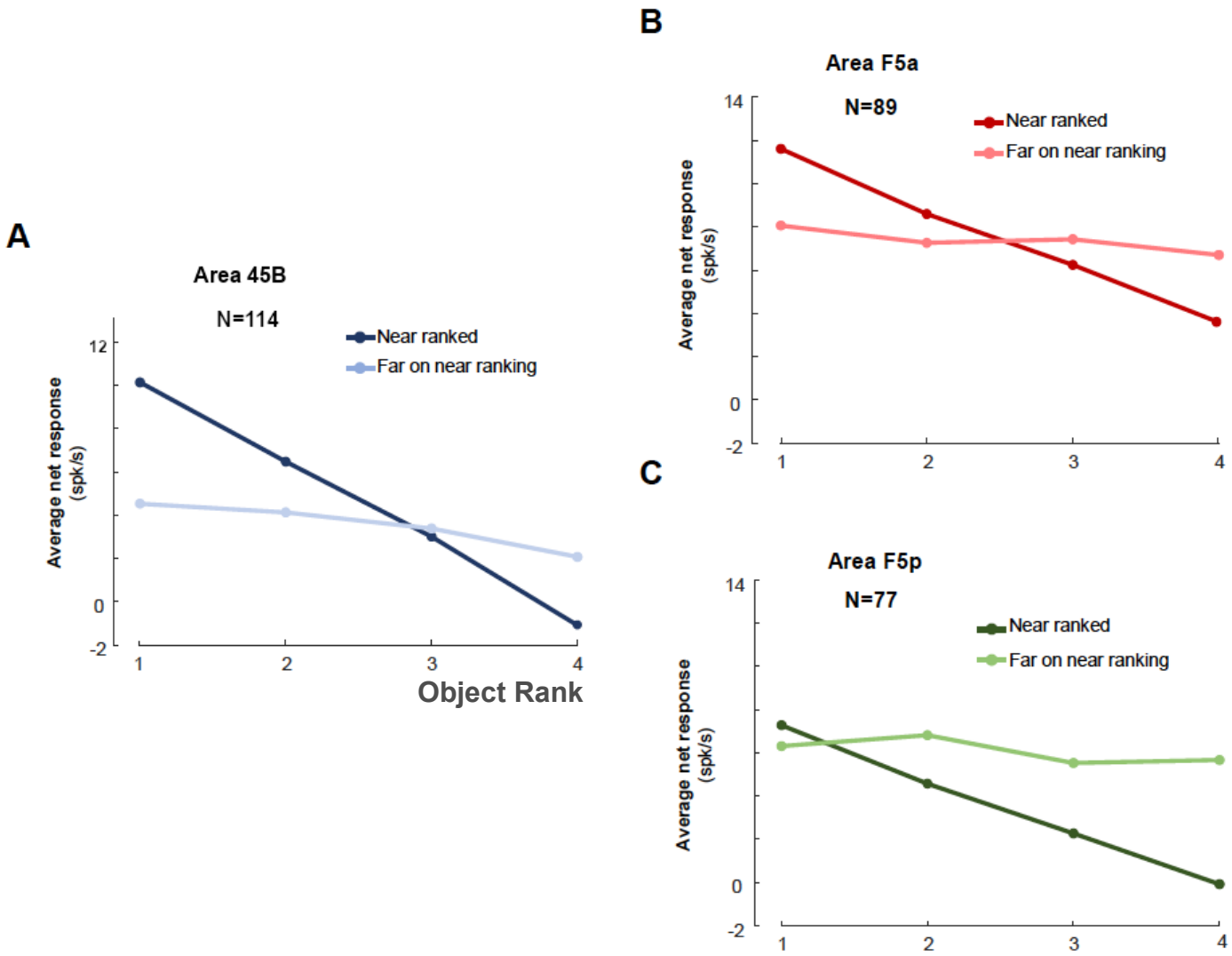



Cléry et al. 2018 *NeuroImage*

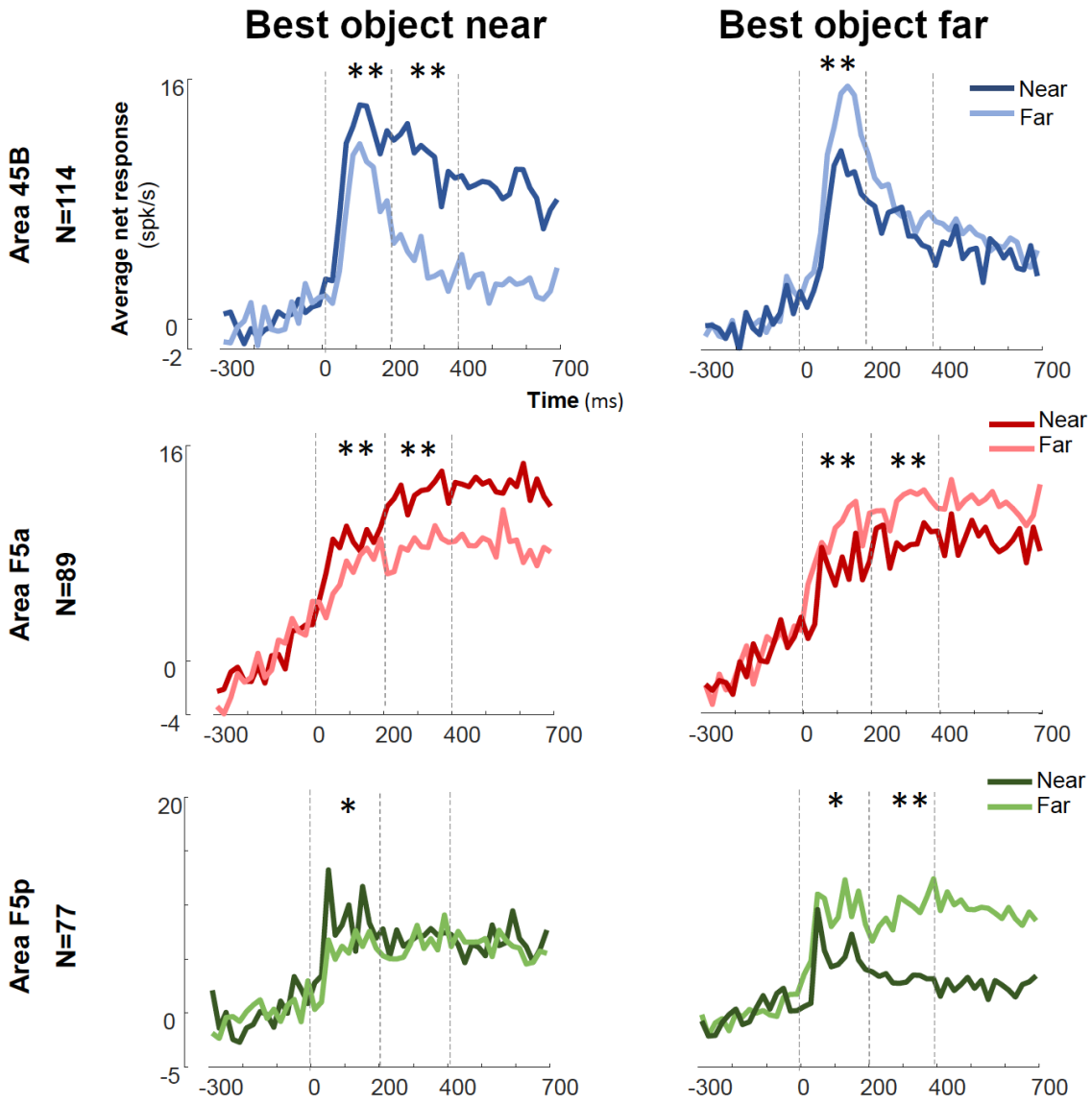
# Typical distance selectivity is weak in F5, strong in 45B



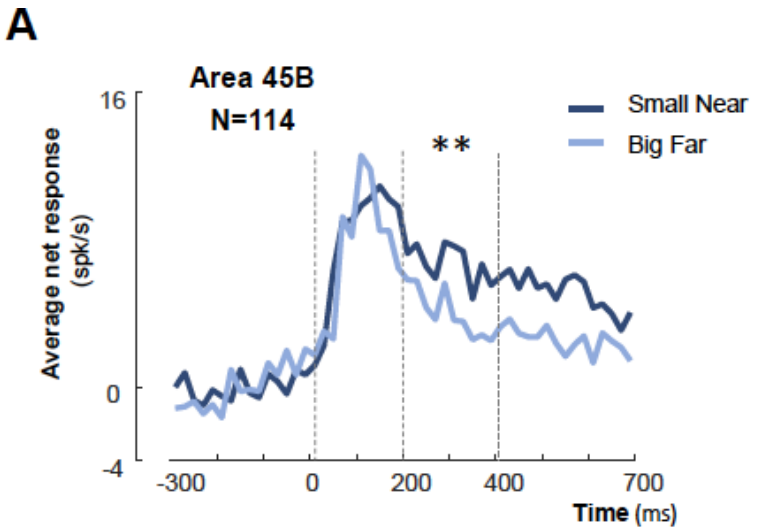
# Object selectivity is not preserved across near & far viewing conditions

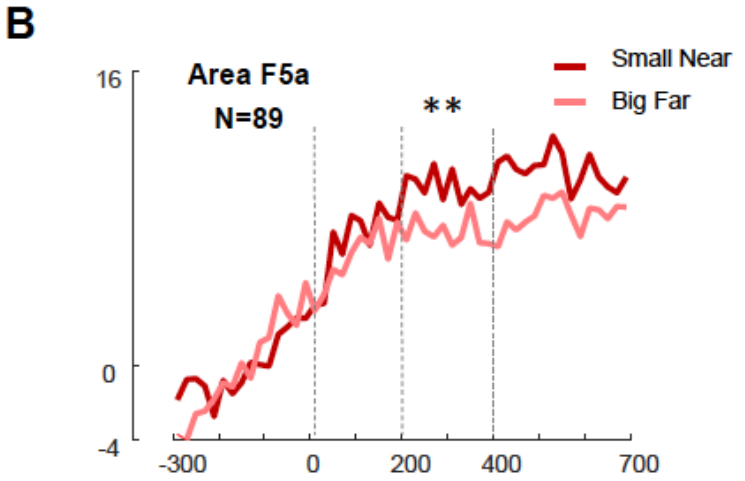


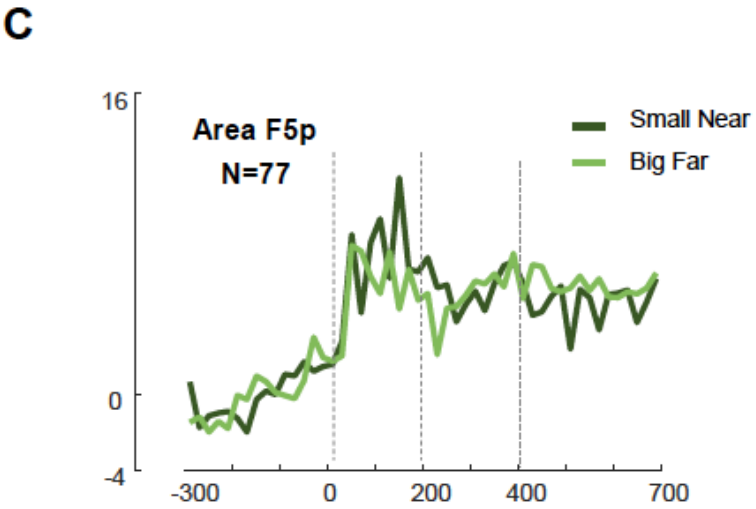
# Object selectivity is *shifted*, rather than nonexistent, in the “far” condition



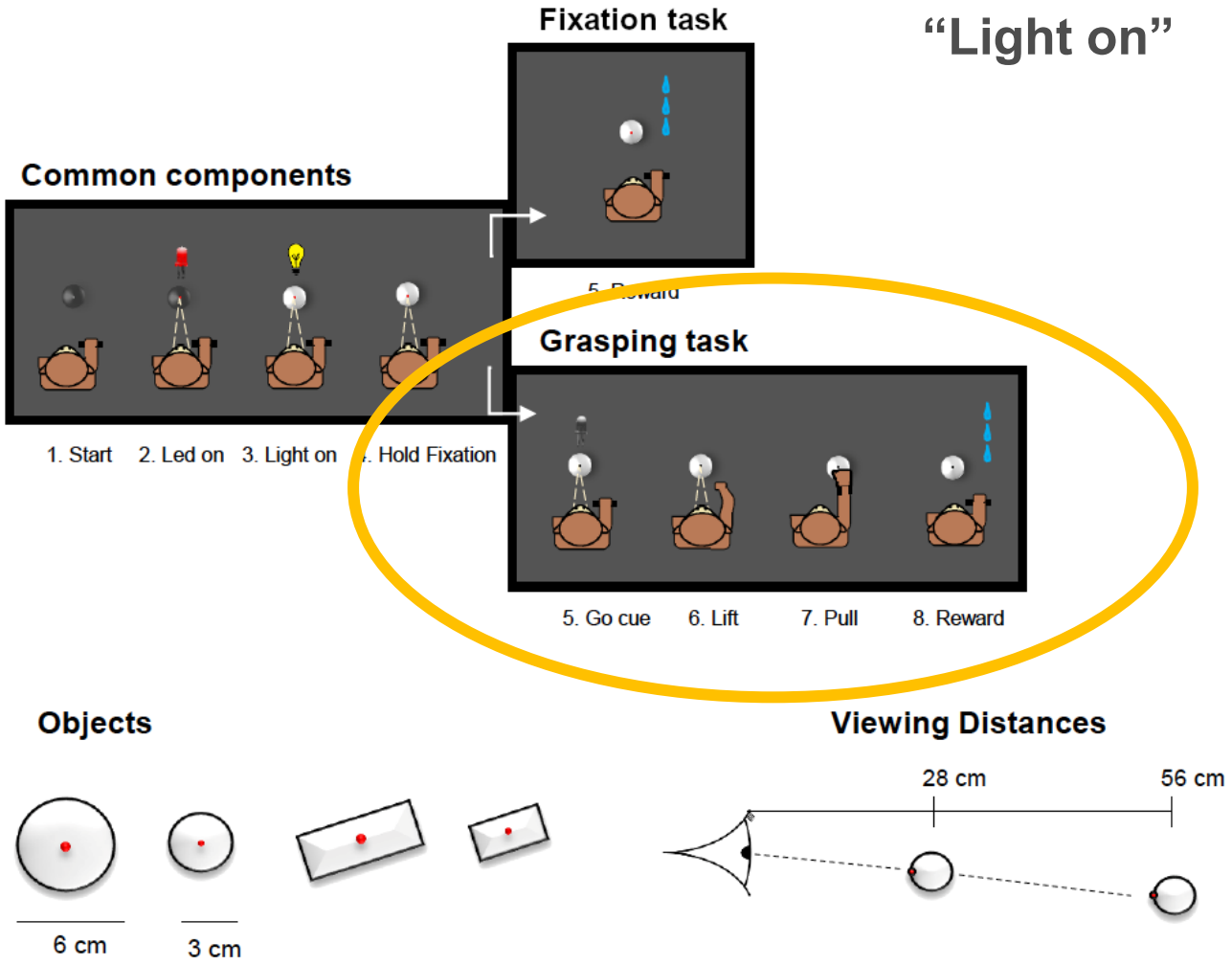
# Retinal size explains most of these effects



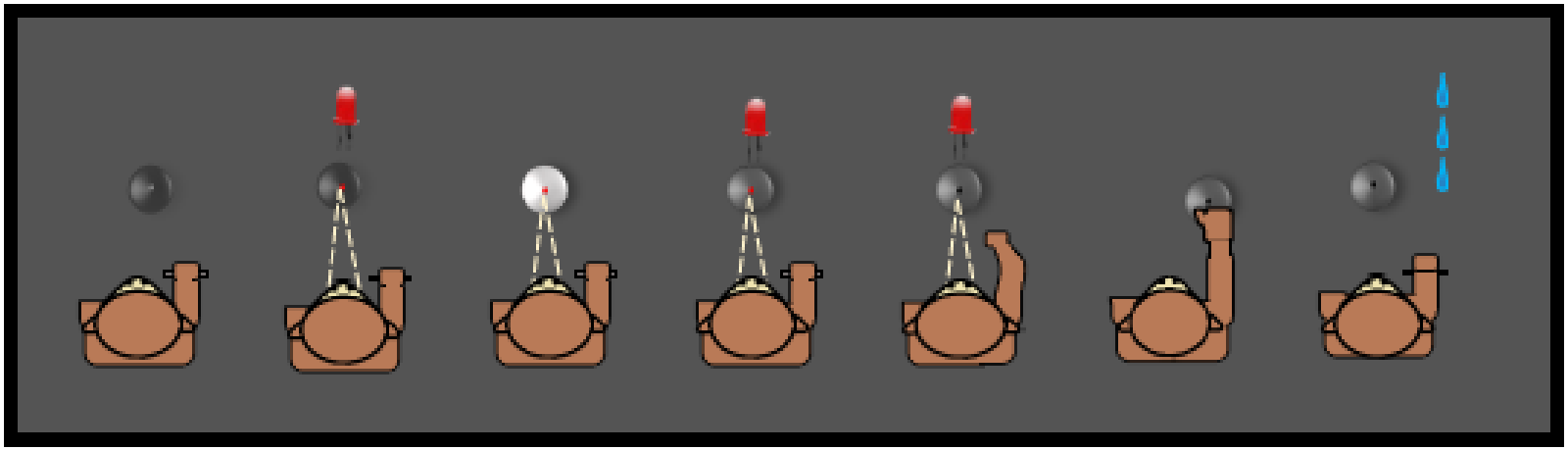



# Responses during visually-guided grasping

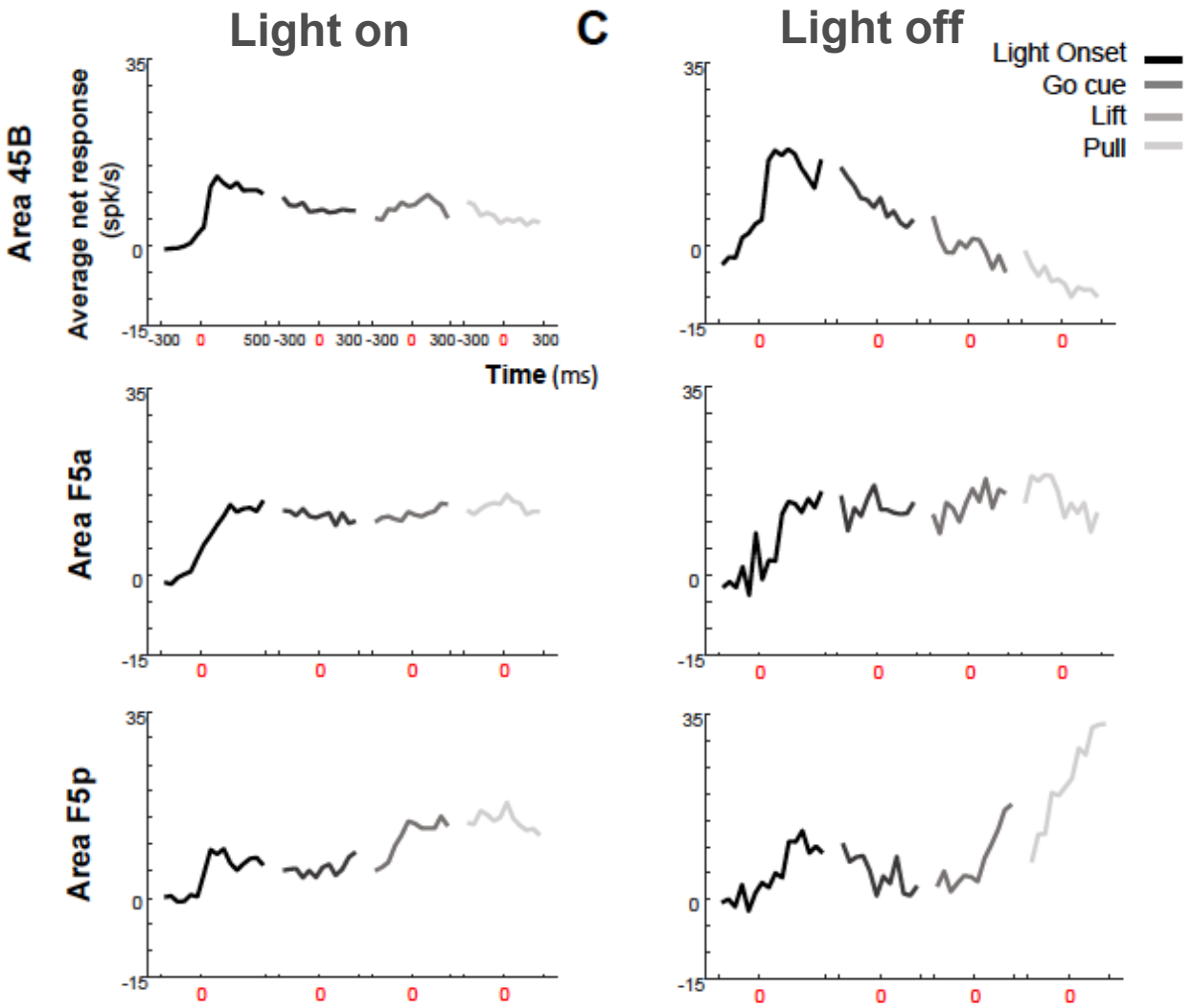


# Responses during memory-guided grasping

**“Light off”**



# “Early-to-late” response gradient



# “Early-to-late” response gradient

| | 45B | F5a | F5p |
|---|---|---|---|
| **Go Cue** | 60 (53%) | 55 (62%) | 33 (43%) |
| **Lift** | 61 (54%) | 59 (66%) | 61 (79%) |
| **Pull** | 59 (52%) | 61 (69%) | 55 (71%) |
| **Total** | **114** | **89** | **77** |

# Recall: object selectivity during fixation

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# Re-assessed conclusions

- Mixture of near-far preferences in peri-arcuate cortex
- Near-far gradients are subtle, mostly explained by retinal size
- Rostro-caudal visuo-motor gradient consistent with expectations
  - Rostral 45B has more visual object selectivity
  - Caudal F5p is more selectively active during movement

# Refinement needed!

- Assess near-far preference *after* correcting for retinal size
- Count neurons with near-far preference using a significance criterion
- Block “near with grasp” and “near without grasp” trials

# Related inactivation study posted last week


New Results

**The causal role of three frontal cortical areas in grasping**

Posted June 26, 2020.

I Caprara, P Janssen

**doi:** https://doi.org/10.1101/2020.06.25.170126

# The “exciting” paper I was considering

nature COMMUNICATIONS

ARTICLE

https://doi.org/10.1038/s41467-020-15890-w OPEN

Check for updates

## Perceptual saccadic suppression starts in the retina

Saad Idrees[1,5], Matthias P. Baumann[1,2,5], Felix Franke[3], Thomas A. Münch[1,4]✉ & Ziad M. Hafed[1,2]✉