



Neural correlates underlying spatial and social navigational distance processing

Ya-Ting Chang¹, Yi-Chuang Lin¹, Charlotte Maschke², Joshua Oon Soo Goh¹

1. Graduate Institute of Brain and Mind Sciences, National Taiwan University, Taipei, Taiwan.
2. Dept. of Psychology, Technical University Dresden, Dresden, Germany.

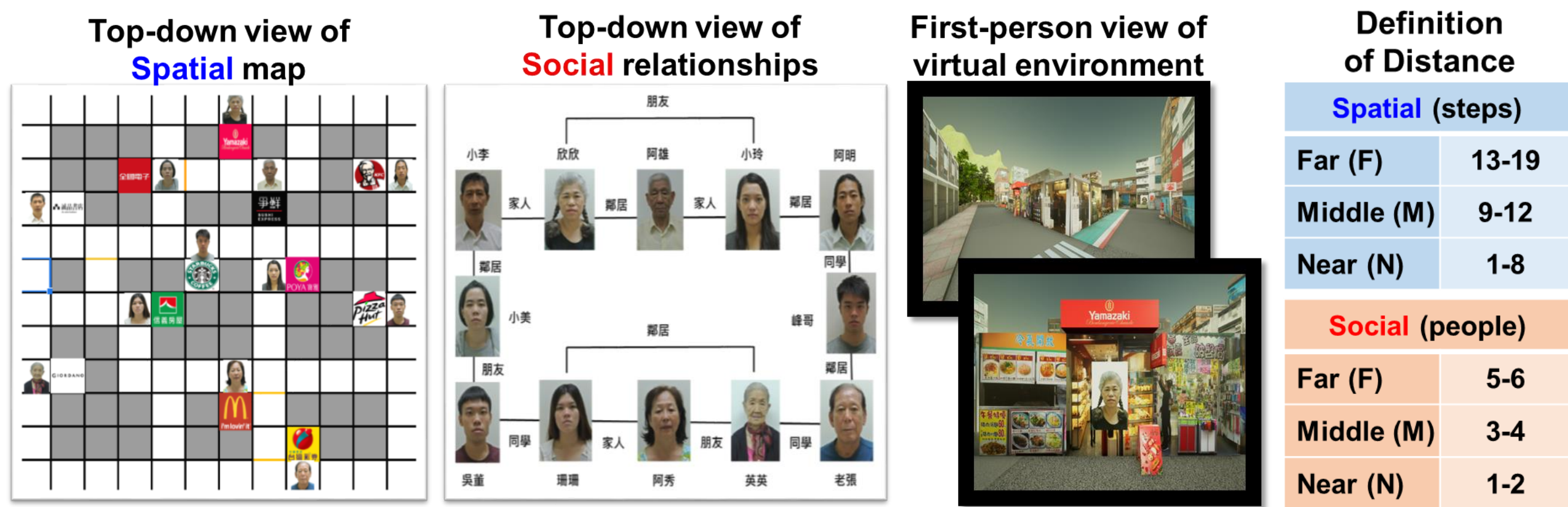
Introduction

1. Recent studies suggest common neural processes underlying spatial and social navigation^{1,2,3}.
2. Here, we evaluated more specifically how neural processes during these two types of navigation involve similar or distinct substrates.
3. In a functional magnetic resonance imaging (fMRI) experiment, we evaluated neural responses as participants judged spatial and social distances between physical landmarks and social agent nodes, respectively, in the same virtual environment.

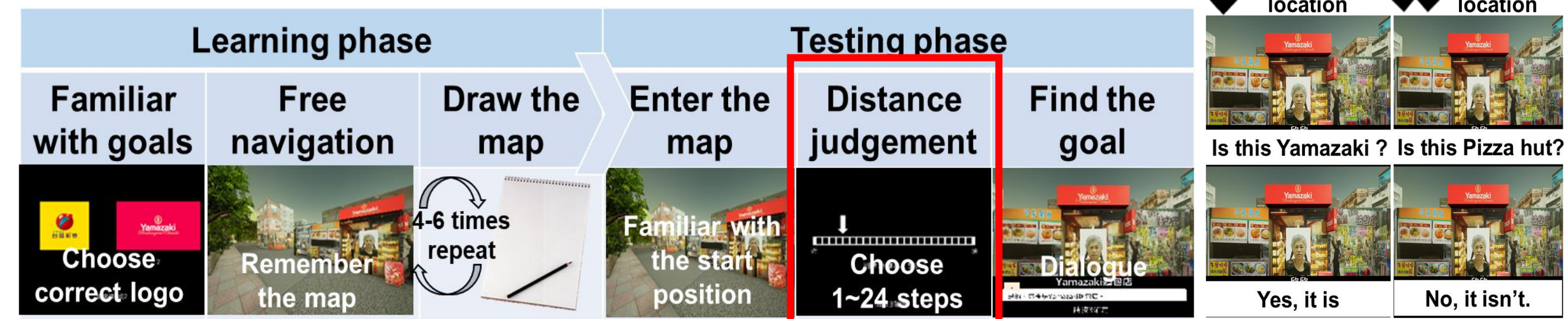
Methods

18 participants, 10M/8F, mean age \pm SD = 24.3 \pm 2.95 yrs.

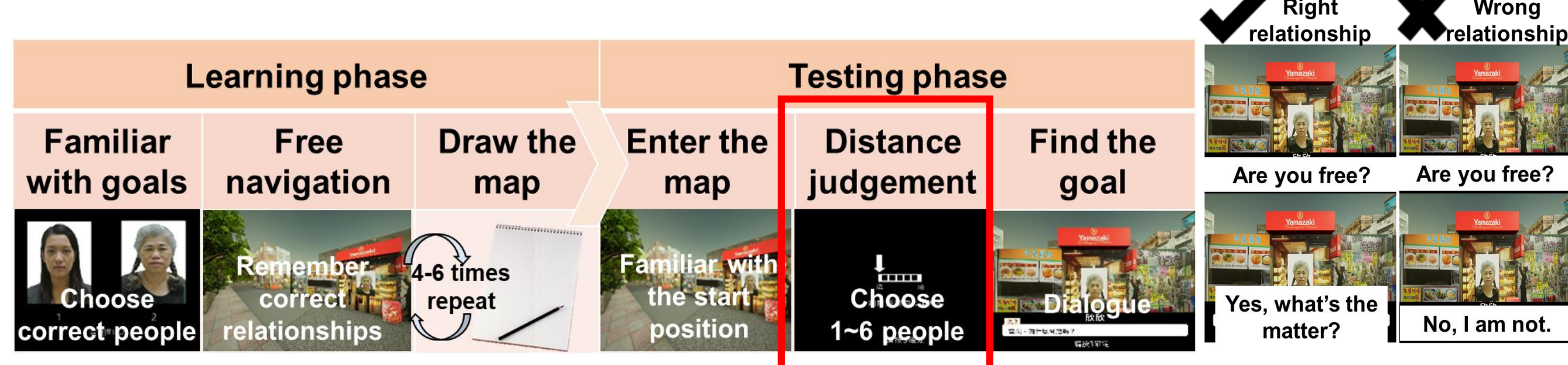
Stimuli: We constructed a virtual maze consisting of 12 physical landmarks separated at various distances. There were also 12 virtual agents in the same maze who were related to each other according to a constructed social network.



Spatial task: Participants first learned locations of the landmarks via free navigation in the maze then were tested in-scanner on physical distances between probe and target landmarks.



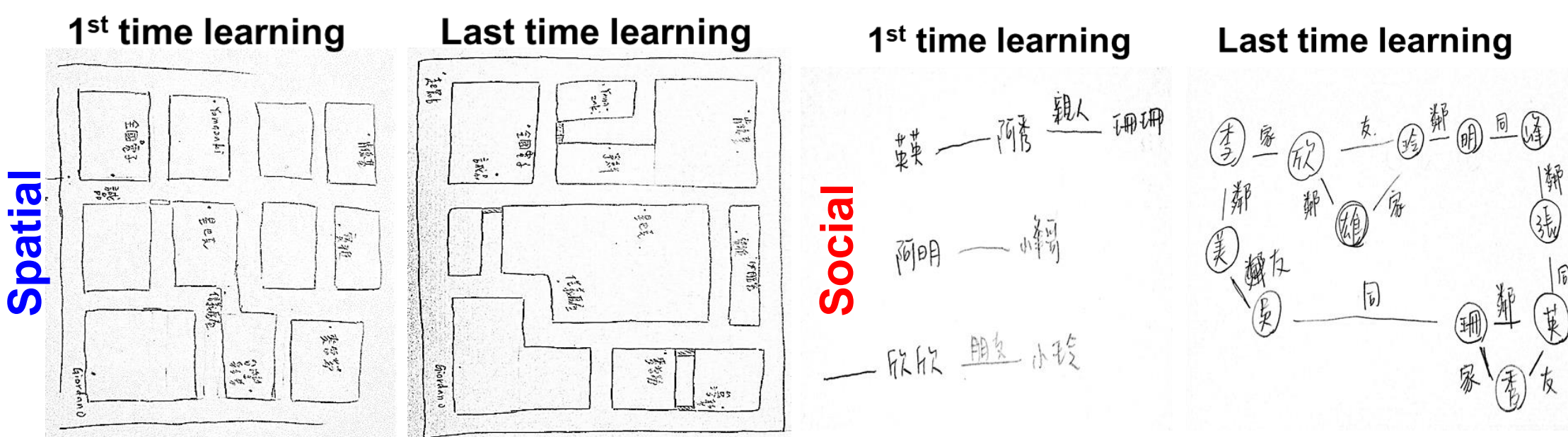
Social task: Participants first learned the social network of the agents located in the same maze environment via scripted interactions then were tested in-scanner on social distances between probe and target agents.



MRI: 64ch multi-band, 4 EPI runs, voxel 2*2*2 mm, FOV 220x220 mm, 60 axial slices, TR 1s.

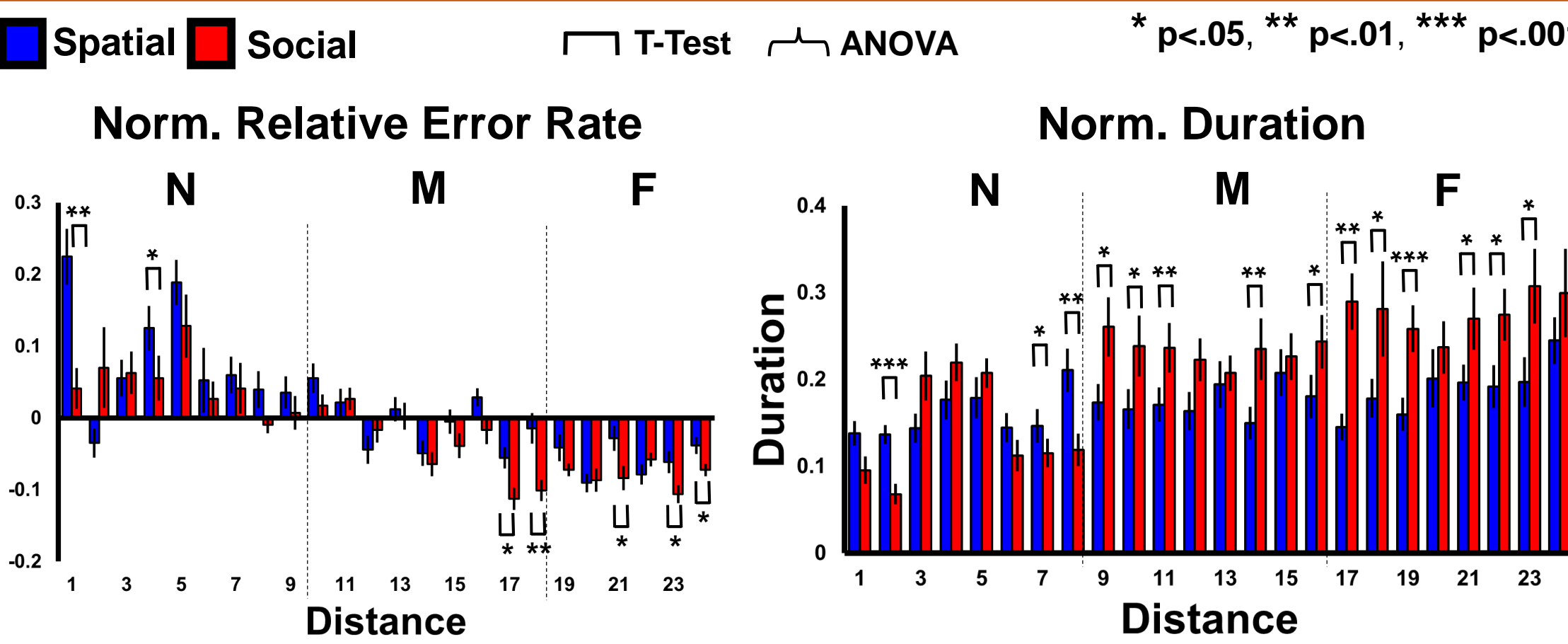
Map Learning Criterion

Drawn maps during learning were scored for accuracy of shop locations and paths (spatial) and agent names and relationships (social). Sample below.

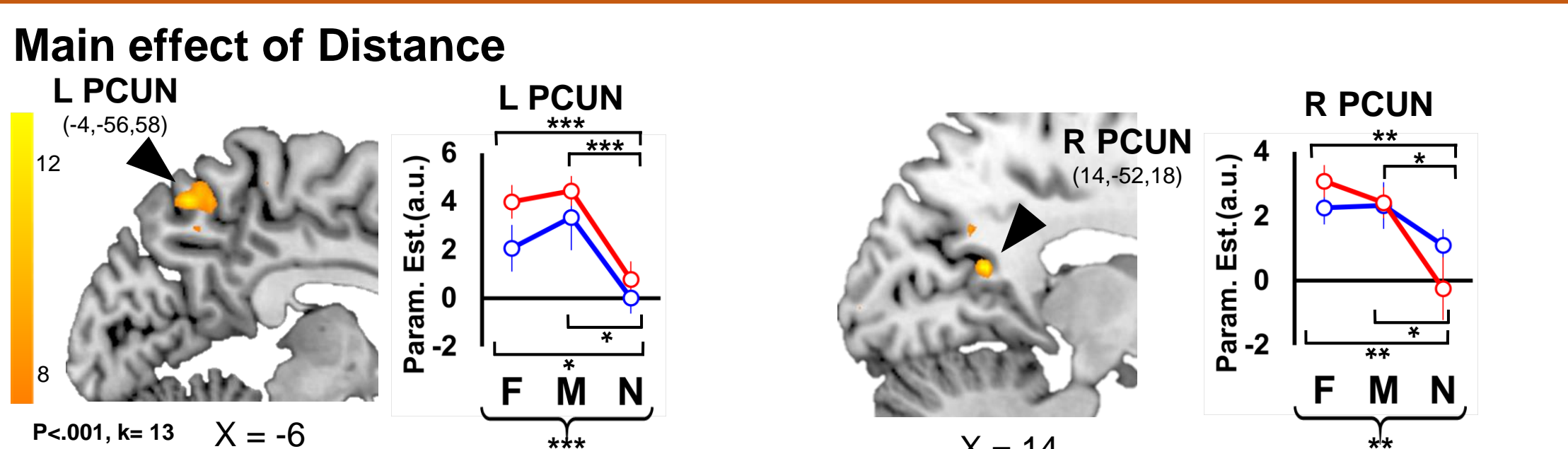


Participants took on average 4.78 and 3.94 rounds in Spatial and Social tasks, respectively, to reach over 80% accuracy, which was the criterion.

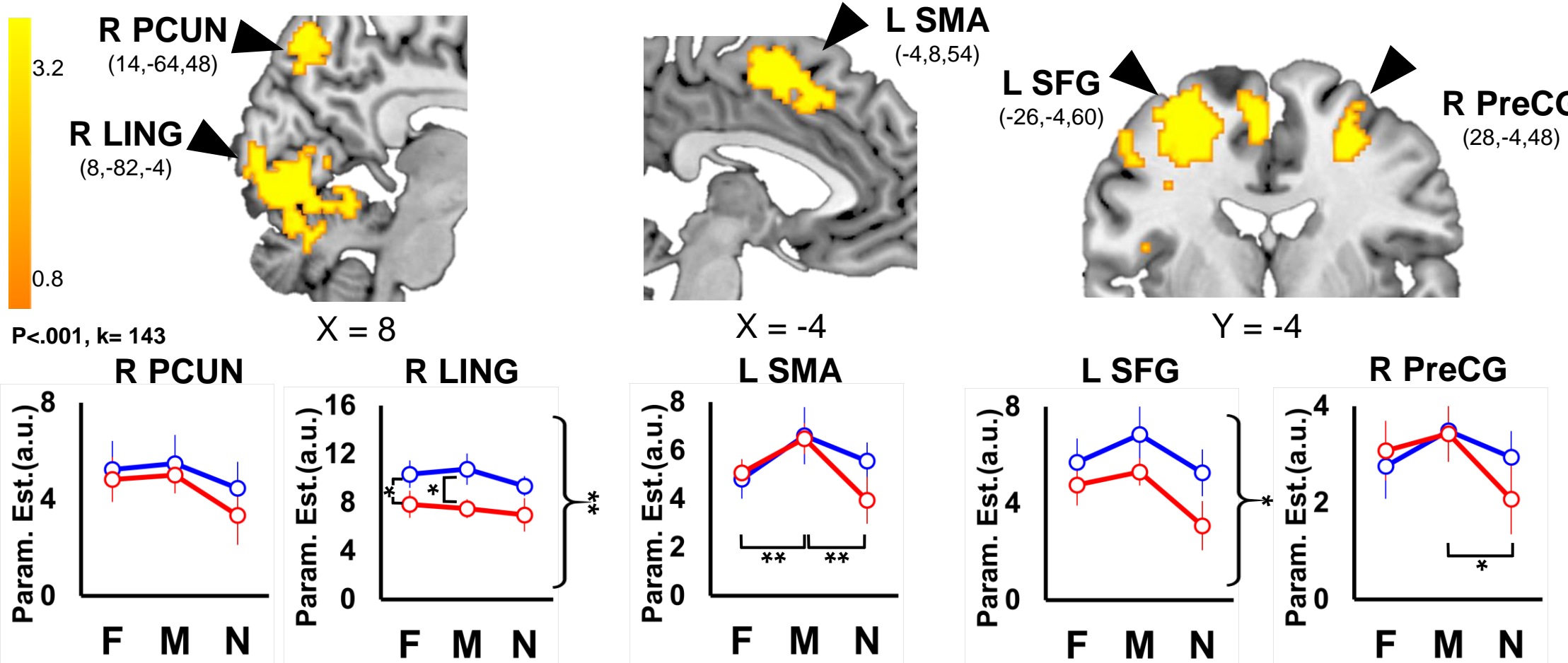
Over- and Under-estimation of Near and Far Distances



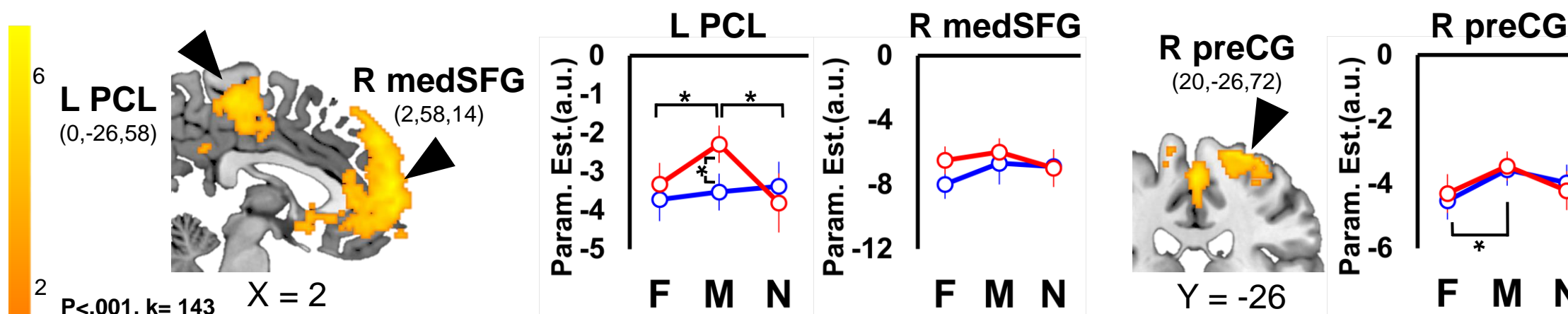
Common Midline and Dorsal Frontal Task Responses



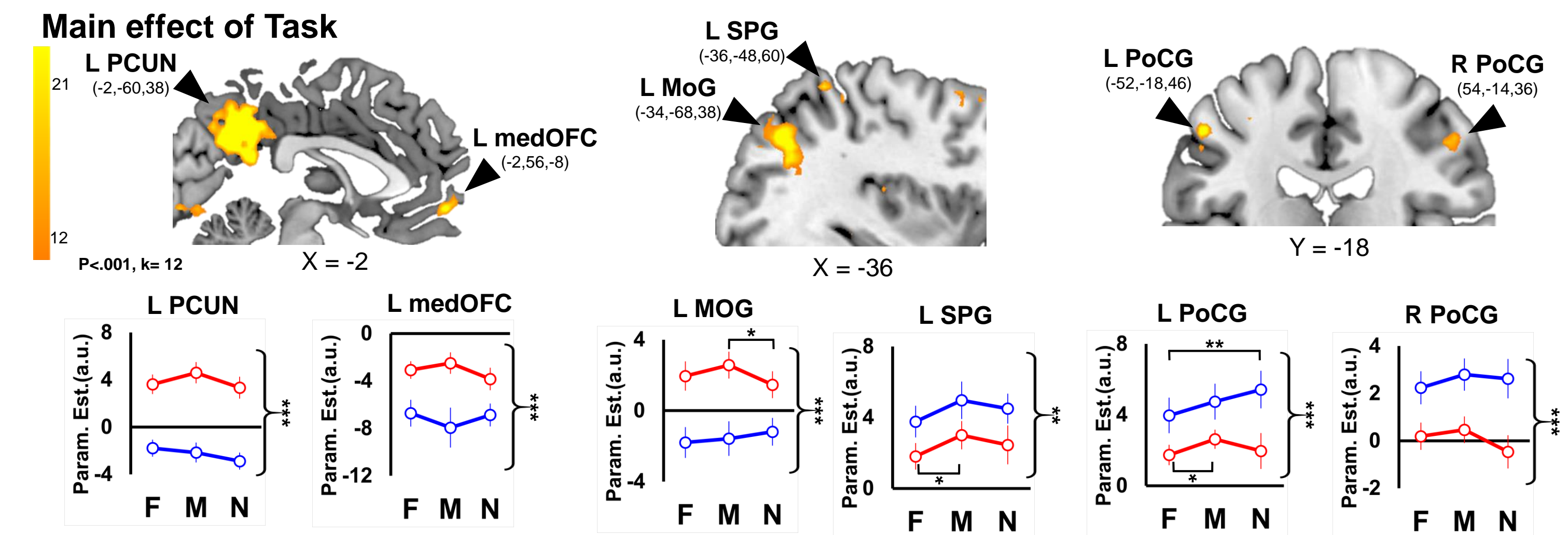
Conjunction of +ve Responses (Spatial \cap Social)



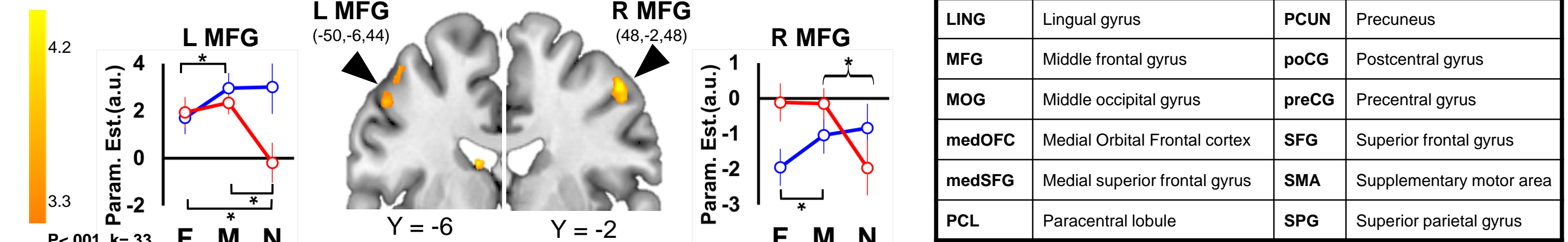
Conjunction of -ve Responses (-Spatial \cap -Social)



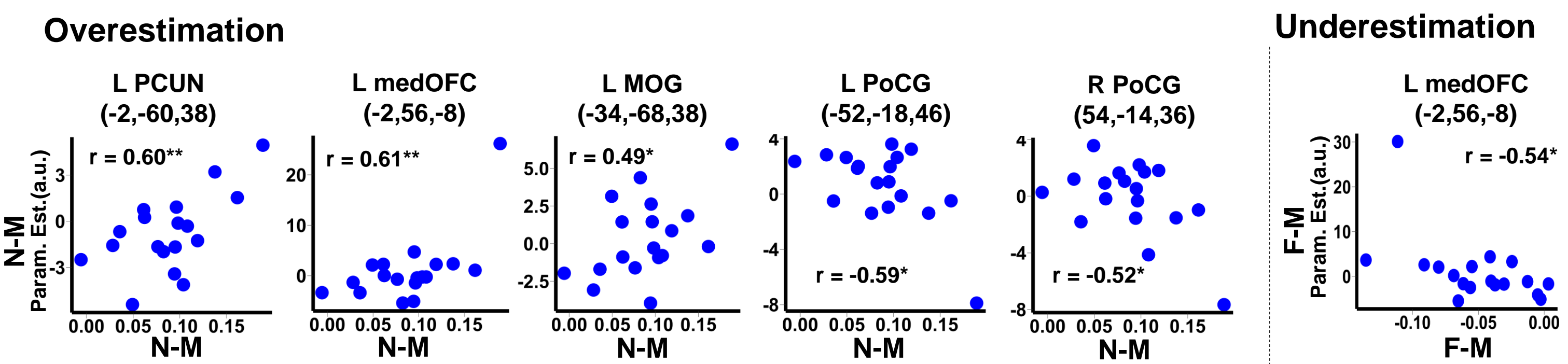
Distinct Midline and Frontoparietal Task Responses



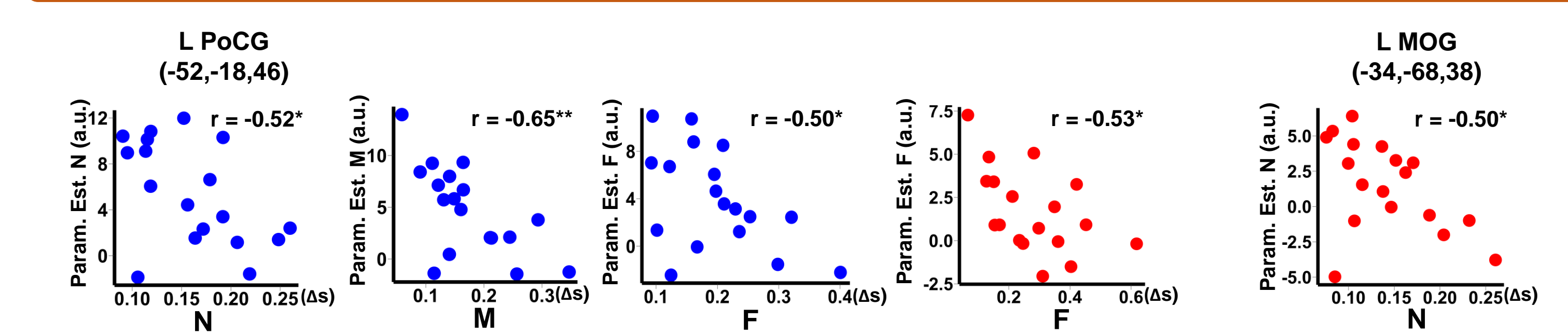
Social (F-N) > Spatial (F-N)



Spatial Distance Errors Associated with Midline, Occipital, & Parietal Responses



Longer Response Times Associated with Lower Occipital & Parietal Responses



Conclusion

1. Common and distinct neural processes were implicated within midline and frontoparietal areas for spatial and social distance computations.
2. Similar patterns in spatial and social distance judgment errors implicated brain areas showing distinct rather than common task responses.
3. Distance errors modulated neural responses more evidently for spatial judgments.
4. Our findings highlight a common neural circuit in midline and dorsal frontal areas that represents spatial and social allocentric distances.
5. Nevertheless, spatial and social distances might also require domain-specific operations in other sub-regions of the midline and frontoparietal areas as well.

References

1. Morgan et al. Journal of Neuroscience 31.4 (2011): 1238-1245.
2. Tavares et al. Neuron 87.1 (2015): 231-243.
3. Tyson, Einstein Journal of Biology & Medicine 29 (2013).

Acknowledgements

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Contact Information

1. Ya-Ting Chang: annie85301@hotmail.com
2. Yi-Chuang Lin: gracelin029@gmail.com
3. Charlotte Maschke: charlotte.maschke@gmx.de
4. Joshua Oon Soo Goh: joshuagoh@ntu.edu.tw



Brain and Mind Laboratory
http://gibms.mc.ntu.edu.tw/bmlab/