

Profiling inferior left dorsal premotor cortex: when Area 55b meets Premotor Eye-Field

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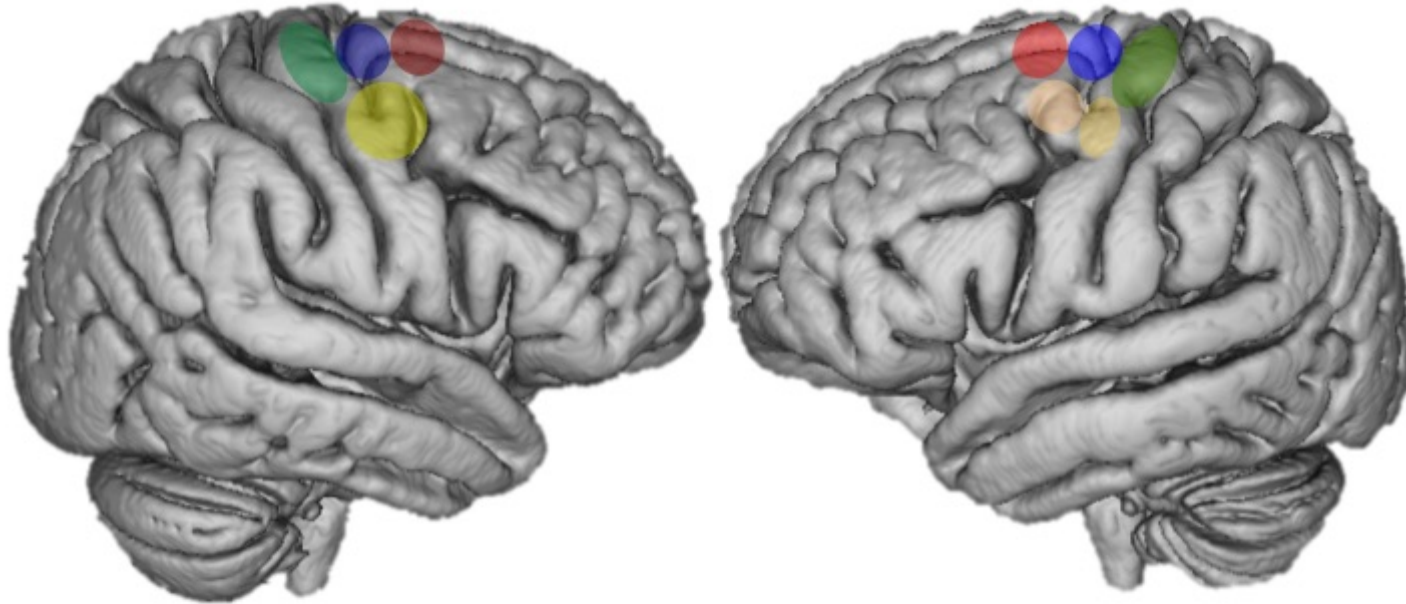
Sarah Genon¹, Andrew Reid², Robert Langner³, Angie Laird⁴, Peter Fox⁵, Simon Eickhoff⁶

Institutions:

¹Jülich Research Centre, Jülich, Germany, ²Donders Centre for Cognition, Nijmegen, Netherlands, ³Heinrich Heine University, Düsseldorf, Germany, ⁴Florida International University, Miami, FL, ⁵University of Texas Health Science Center at San Antonio, San Antonio, TX, ⁶Research Center Jülich, INM-1, Jülich, Germany

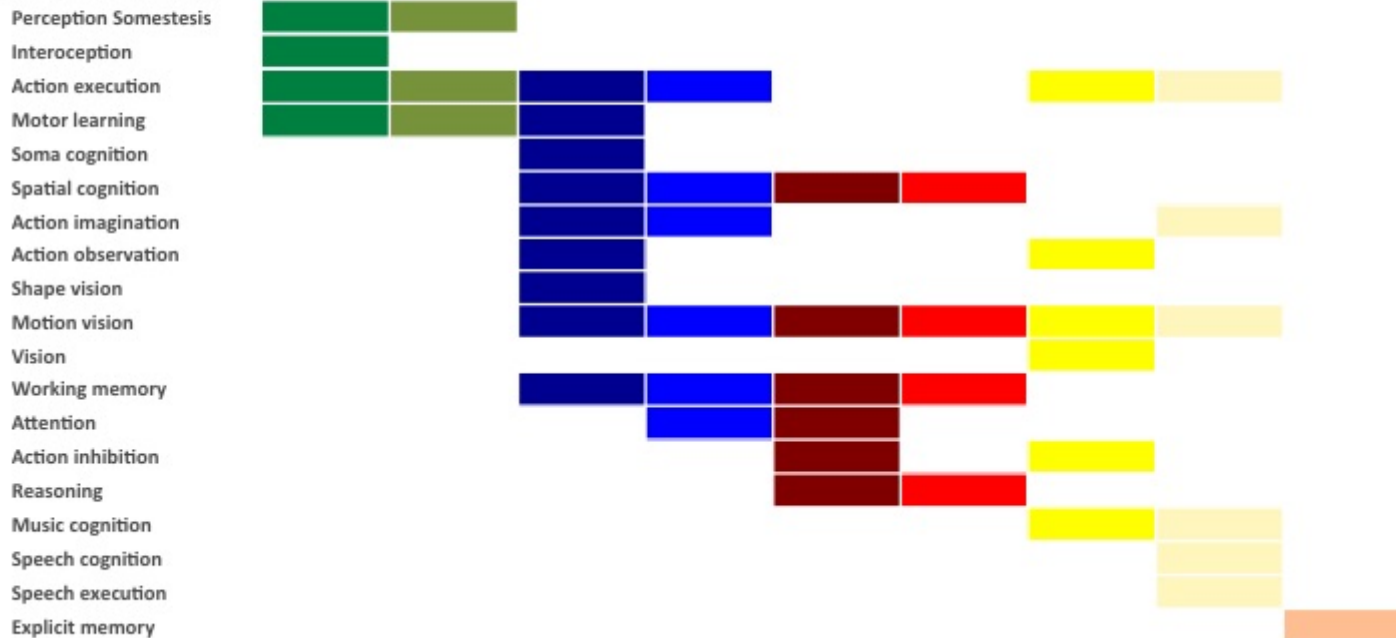
Introduction:

Previously, we applied multimodal connectivity-based parcellation (CBP) of the PMd to outline a subdivision of the superior portion into three subregions, reflecting a cognitive-motor gradient consistent across both hemispheres [1, 2, 3 summarized in Fig. 1]. In the right PMd inferior portion, one main region showing eye-field functions was highlighted, whereas the inferior portion of the left PMd was robustly subdivided into a rostral (left rostro-inferior PMd) and a caudal (left iPMd) subregions. While the left rostro-inferior PMd showed clear associations with abstract cognitive functions, the left iPMd showed associations with both visuo-motor and language functions. Recently, Glasser et al. [4] proposed a new bilateral area at the location of right and left iPMd that was activated for language processing, and thus labeled "language Area 55b". However, in our prior work we did not find significant associations with language functions in the right iPMd using our quantitative approach [1]. To address this inconsistency, in the present study we compared the location and behavioral profile of Area 55b and iPMd in the left hemisphere.



Right Caudal Left Caudal Right Central Left Central Right Rostral Left Rostral Right Inferior Left inferior Left rostro-inferior

Behavioral Domains



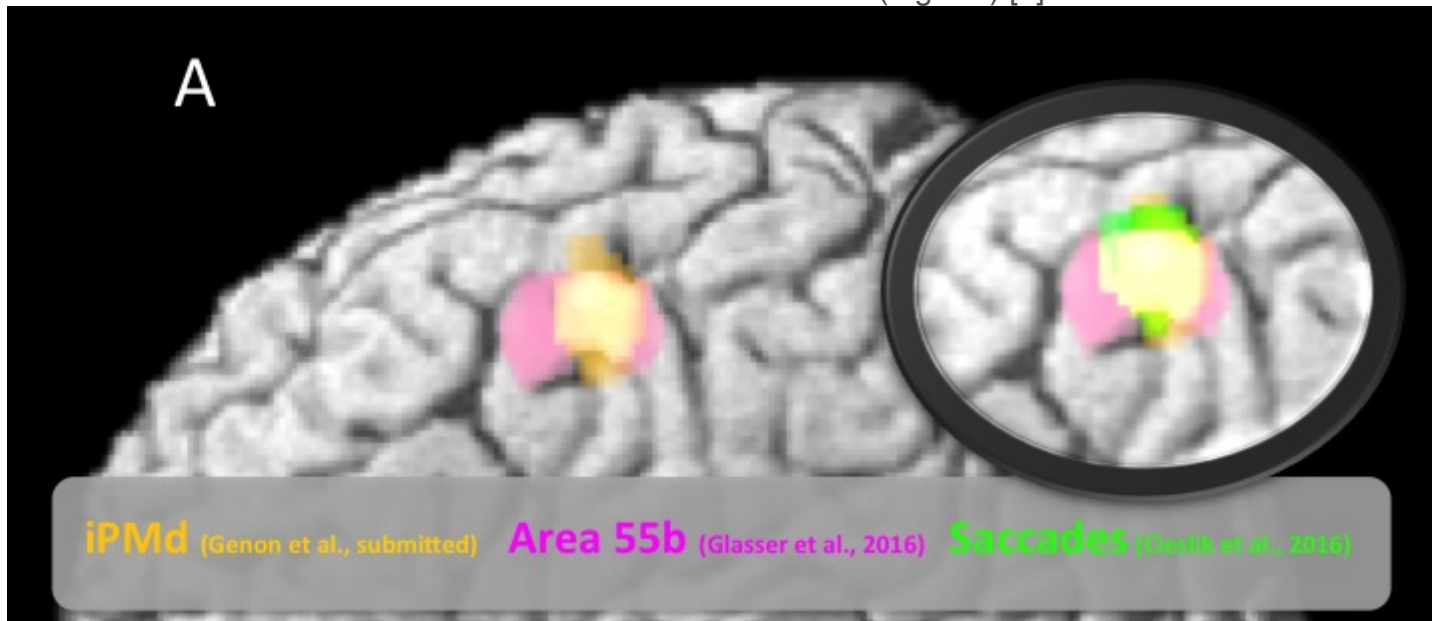
·Figure 1. Summary of right and left PMd organization [1,2,3]

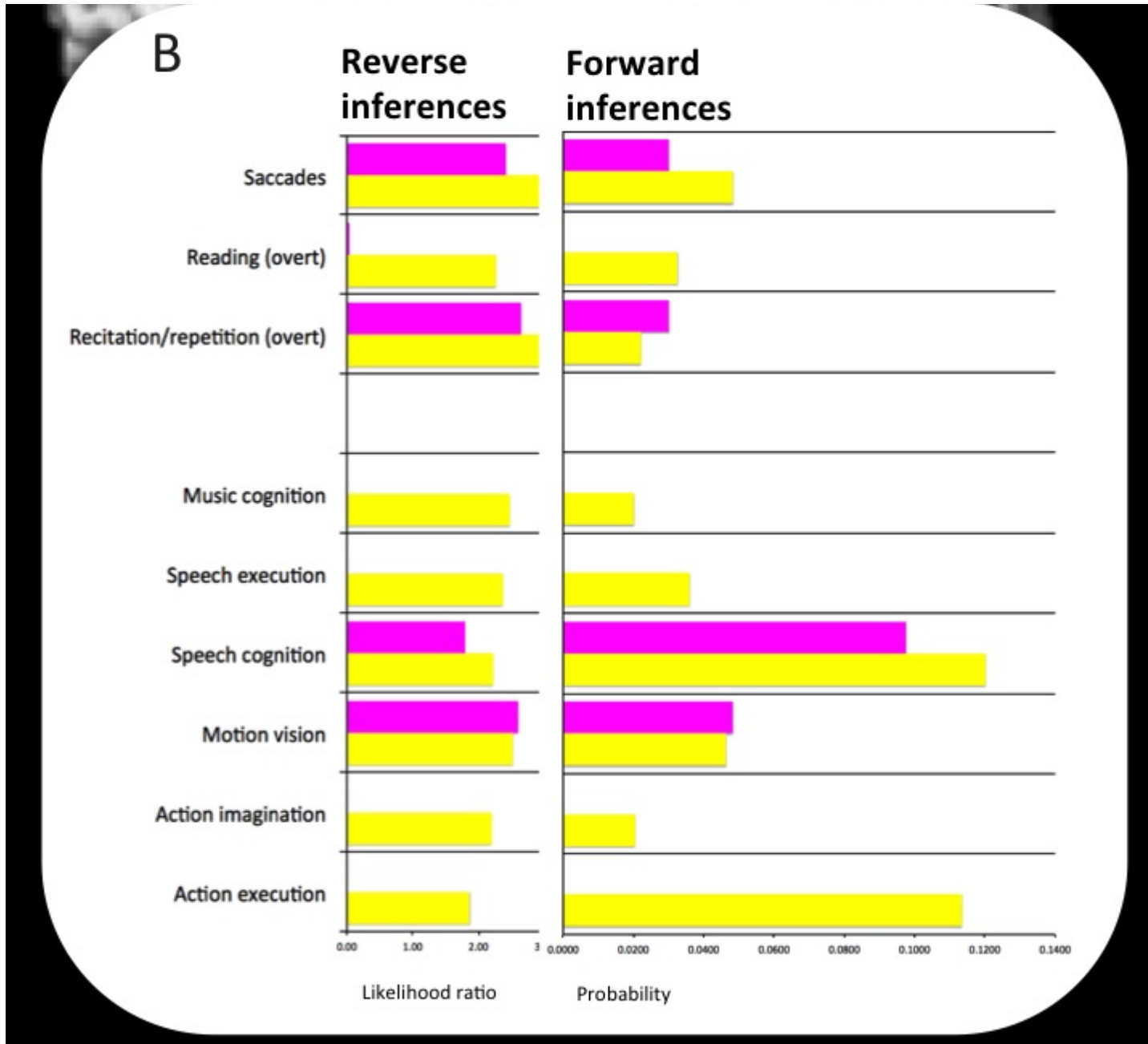
Methods:

The left iPMD was defined by multimodal CBP [3] and left area 55b was extracted from the transposition of Glasser et al's multimodal brain map [4] to volume (https://figshare.com/articles/HCPMMP1_0_projected_on_MNI2009a_GM_volumetric_in_NIfTI_format/3501911) [Fig 2]. Behavioral profiling was performed using the "behavioral domain" (BD) and "paradigm class" (PC) meta-data within the BrainMap database [5] for those experiments that activated the respective VOI. To robustly characterize the profile of each VOI, we combined a "forward inference" and a „reverse inference" approach. Forward inference identifies taxonomic labels for which the probability of finding activation in the VOI is significantly higher than finding activation for that label across the whole database by chance. Reverse inference identifies the most likely labels given activation in the VOI, i.e., the likelihood $P(\text{Task}|\text{Activation})$. For the sake of robustness, only BDs and PCs that were significantly associated to the VOIs across both forward and reverse inferences were taken into account.

Results:

Left iPMD VOI and Area 55b VOI exhibited substantial overlap, however, while iPMD showed a vertically elongated shape following the anterior wall of the precentral gyrus, area 55b demonstrated an horizontally elongated shape as described in [4] (Fig. 2A). Behavioral profiling of Area 55b revealed a mixed behavioral profile including both visuo-motor and language functions, which was similar to the profile characterizing the left iPMD VOI (Fig. 2B). In particular, A55b and iPMD both showed activations for recitation/repetition and saccades. As several PMd subregions have been found to be activated by saccades [1, 2, 3], we further compared both iPMD and Area 55B with clusters from a recent meta-analysis examining significant spatial convergence of activations for eye-movements. This comparison revealed substantial overlap between both VOIs and the cluster of activation for saccades (Fig. 2A) [6].





·Figure 2. Left iPMD and Area 55b. A. Spatial overlap B. Behavioral profiling

Conclusions:

Quantitative behavioral profiling revealed that left iPMd and area 55b are "behaviorally" similar, activating during both visuo-motor and language functions. Such mixed pattern could be explained by interindividual variability in loci of activations for language and visuo-motor functions, switching location between subjects, therefore resulting in a mixed functional profile at this location when averaged across subjects. However, according to [4], 89% of the subjects show a consistent organization in this region, distinguishing area 55b from assumed eye-fields. We might expect this substantial topological convergence across subjects to result in distinct activation peaks for eye-field and language functions at the group level and therefore in BrainMap. However, we did not find evidence of corresponding two specific cortical areas in the left PMd.

Imaging Methods:

BOLD fMRI

Informatics:

Brain Atlases ²

Language:

Speech Production

Motor Behavior:

Visuo-Motor Functions

Neuroanatomy:

Cortical Anatomy and Brain Mapping ¹

Keywords:

Language
Vision

¹²Indicates the priority used for review

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