Preserved functional selectivity within the parieto-frontal motor networks in congenitally blind individuals

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BACKGROUND & AIM

Background. The dorsal stream has been classically associated with the neural computations necessary for "vision for action" (1). Nevertheless, a recruitment of the dorsal stream has been also described in congenitally blind individuals while performing motor tasks (2,3). This finding suggests that parieto-frontal networks underlying motor control might follow a similar development even in the absence of visual experience. Still, it is not clear whether the lack of visual input affects the functional selectivity of the regions within these networks.

Aim. Our study investigated similarities and differences in functional selectivity within the motor networks of congenitally blind and sighted individuals by means of fMRI.

We focused on the representation of 2 different motor features:

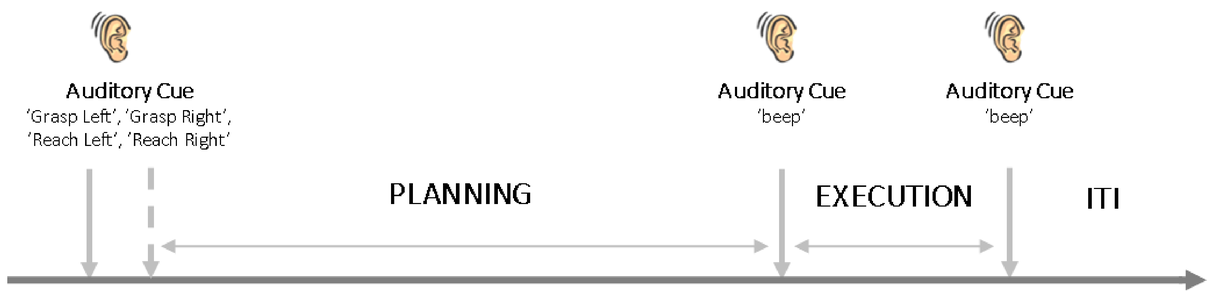
1.action encoding, distinguishing between different actions;

2.direction encoding, distinguishing between movements performed towards different spatial positions.

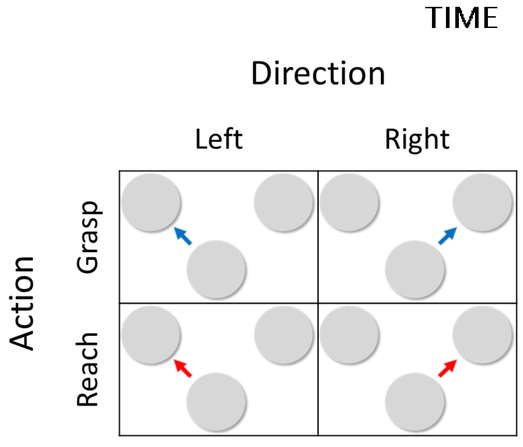
MATERIALS & METHODS

Participants. Sighted controls (N=15) and congenitally blind individuals (N=8) performed the same motor task with the right dominant hand within the MR scanner.

Task. We adopted a delayed motor task which involved performing different movements. Participants were instructed to perform two specific actions, either reaching or grasping, towards one of two objects positioned in different spatial positions (left vs. right with respect to the midline).



Experimental design. The experimental conditions were embedded in a 2x2 factorial design. First factor: Action (grasping vs. reaching). Second factor: Direction (leftward vs. rightward movements).

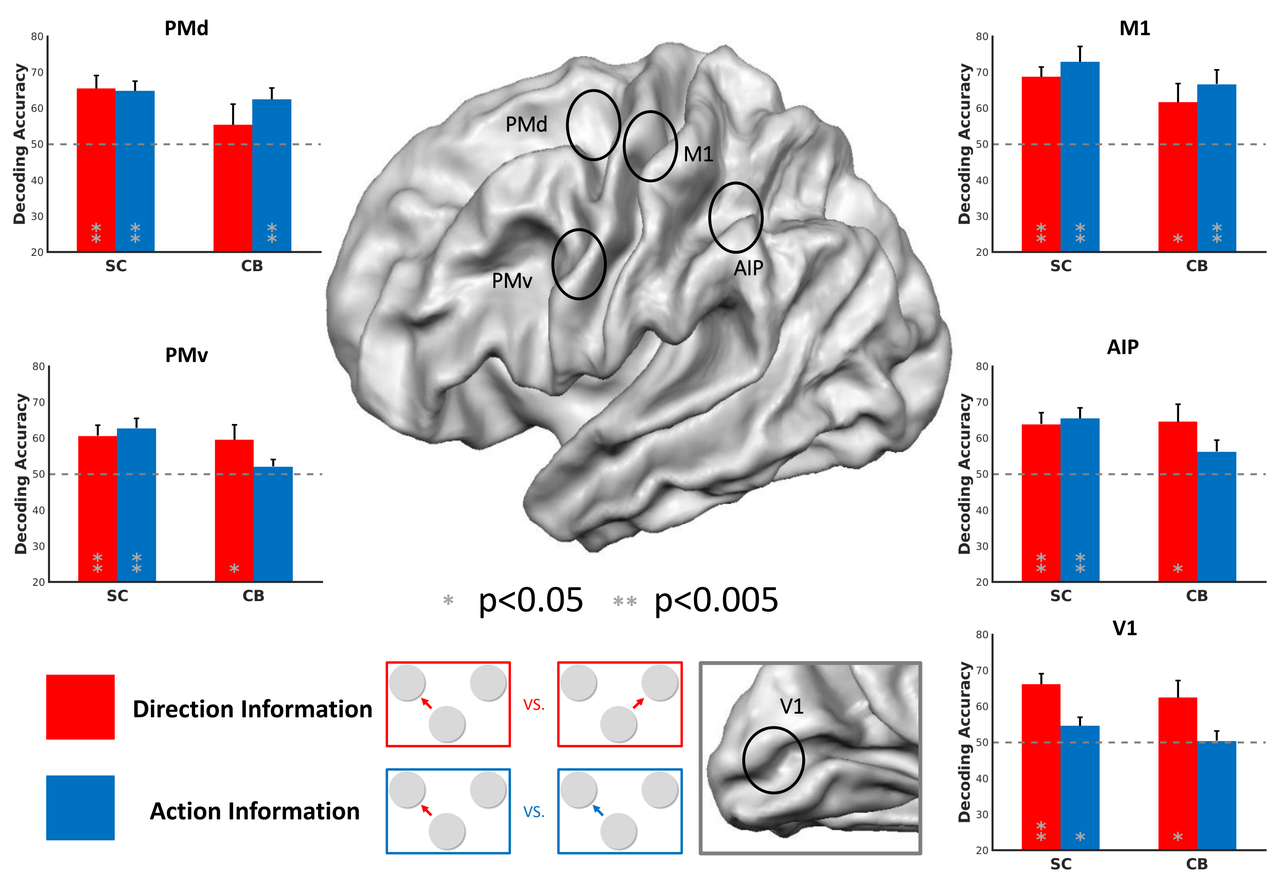


RESULTS: MVPA

ROIs selection. We selected the following regions of interest (ROIs): dorsal premotor cotex (PMd), ventral premotor cortex (PMv), anterior intraparietal area (AIPS), primary motor cortex (M1) and primary visual cortex (V1).

MVPA approach. We performed a ROI-based multivariate analysis (MVPA) comparing the spatial distribution of the decoding for two motor features within the motor networks of the two groups. MVPA was performed on data extracted from the execution phase of the task modelling each time point with a finite impulse response. We focused on the execution phase of the task.

Multivariate analysis allowed to test if our ROIs contained information about the direction and the type of performed action in sighted controls (SC) and in congenitally blind individuals (CB).



CONCLUSIONS

1. Direction and action information did not differ within the motor networks in NS and CB individuals;
2. V1 encoded direction information in CB as well;
3. Vision is not a mandatory prerequisite for the functional development of the parieto-frontal motor networks.

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