Social Context Impacts Brain Activation Pattern during Visual Perception of Movement: an fMRI Study

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***Abstract*—Perception of biological movements is integral to one's ability to interpret actions of others. In the present study, we conducted a comparative analysis of neural responses in a functional Magnetic Resonance Imaging (fMRI) setting during visual perception of biological movement within a social context (which has not been studied yet) as opposed to a non-biological baseline stimulus. Our results demonstrate right lateralization of superior temporal Region Of Interest (ROI), likely reflecting the underlying differences in social characteristics of each given stimulus.**

Keywords - functional magnetic resonance imaging; movement perception; biological movement; social movement.

I. Introduction

The movements of living beings provide rich and meaningful information that facilitates social interaction. Despite improved understanding of the brain regions involved in social behavior and its perception, the details of neural representations require further experimental and theoretical work. The neurofunctional differences between different types of biological movement may serve for interpretation of one's immediate intentions. This study comprised a comparative analysis of neural responses in an fMRI setting during visual perception of different types of biological movement with and without social context.

The rest of the paper is structured as follows. In Section II, we present the methods. In Section III, we show the results. In Section IV, we discuss the outcomes. Finally, Section V concludes the work.

II. Methods

20 healthy subjects aged 21 to 31, IQ > 85, were scanned on a 3-T Prisma scanner at the National Institute of Mental Health in Klecany, Czech Republic. The study was approved by the local ethical committee. The fMRI block design paradigm included two sessions with all stimuli presented twice; the order of stimuli was counterbalanced across subjects. All participants observed three types of biological movement within different social contexts (single hand, fist, and a handshake) and a control stimulus (a stationary cross).

Data analysis was executed in the Statistical Parametric Mapping (SPM) software [1]. Whole brain analysis as well as ROI analysis were applied to address brain activations under each condition. The areas selected for the ROI analysis (precentral, superior, and inferior temporal and parietal gyrus bilaterally) were based on predefined brain structures that are involved in movement processing as well as social perception [2][3].

III. Results

A. *Whole Brain Analysis*

The observation of all stimuli elicited activation in the frontal, parietal, and occipital-temporal regions involved in visual movement perception (see Table 1). Bigger cluster size and a higher Z-score correspond to increased activity in the peak area.

B. *ROI analysis*

ROI-based analysis highlighted cluster differences. Figures 1-3 depict the activation pattern overlap upon presenting the biological stimuli. The inferior parietal (Fig.2) and the precentral gyrus (Fig.1) were more active in the left hemisphere, while the superior temporal gyrus (Fig.3) showed right lateralization.

IV. Discussion

The current study compared neural responses of three types of biological movement. Right hemisphere lateralization was previously documented [4], and the brain areas that elicited higher activity go in line with several studies [4][5]. However, Sokolov et al. [6] did not find substantial activation in the inferior parietal gyrus, contrary to our findings, likely due to the difference between presented stimuli.

V. Conclusion

Our results showed that the right-lateralized superior temporal ROIs were more selective in response to the presented visual cues, likely reflecting the underlying differences in social characteristics of each given stimulus. This provides further insight into the neurobiology of social movement perception and may serve as a baseline for future studies.

Acknowledgment

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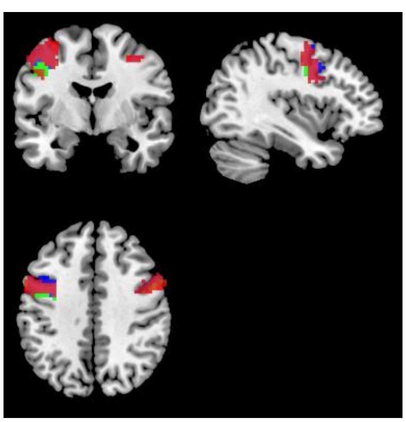

Figure 1. Precentral gyrus activation.

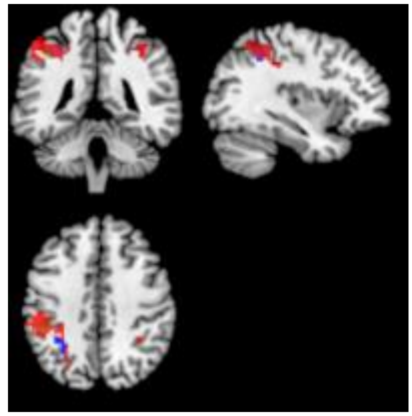

Figure 2. Inferior parietal gyrus activation.

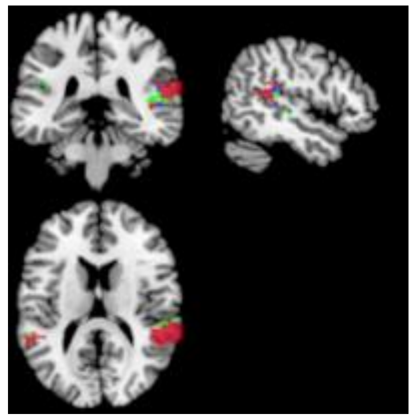

Figure 3. Superior temporal area activation.

Legend: **Green** – hand vs cross, **Red** – fist vs cross, **Blue** – handshake vs cross

TABLE I. WHOLE BRAIN ANALYSIS

Stimulus	Cluster size (voxels)	Z score	Peak			p(FWE)	Peak area
			x	*y*	*z*		
Hand vs. cross	5074	6.23	-48	-76	-5	< 0.001	Middle Occipital L
	400	4.74	-36	-4	50	< 0.001	Precentral L
	296	4.36	42	5	47	< 0.001	Precentral R
	266	4.21	27	-67	38	< 0.001	Superior Occipital R
Fist vs. cross	6696	6.32	39	-67	-16	< 0.001	Fusiform R
	764	05.09	51	5	47	< 0.001	Precentral R
	444	05.01	-51	8	41	< 0.001	Precentral L
Handshake vs. cross	5418	06.04	39	-61	-7	< 0.001	Inferior Temporal R
	489	05.01	42	5	50	< 0.001	Precentral R
	415	4.71	-42	5	41	< 0.001	Precentral L
	201	4.24	30	-46	50	0.001	Inferior Parietal R

