

# Investigating the role of peripersonal space representation in contact-related action across human and non-human primates

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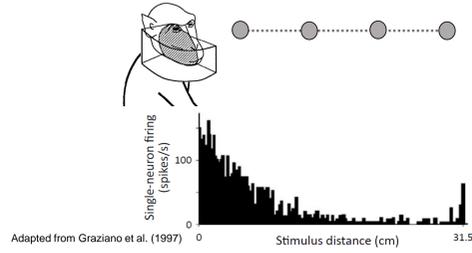
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## Background

### Mapping of Space with Neurons



- The magnitude of many behavioural and neurophysiological responses depend on the proximity of stimuli to the body
- Typically, these responses are referred to as measures of *Peripersonal Space* (PPS), and are interpreted as reflecting the position of a stimulus in egocentric coordinates

### An Action Field Theory of Peripersonal Space

- We have recently reconceptualised PPS as a set of graded fields describing the behavioural relevance of actions aimed at creating or avoiding contact with objects near the body (Bufacchi & Iannetti, TICS 2018)

### Objective

- Characterise PPS responses in human and non-human primates, and assess their role in contact-related actions

PPS-related neural responses should be:

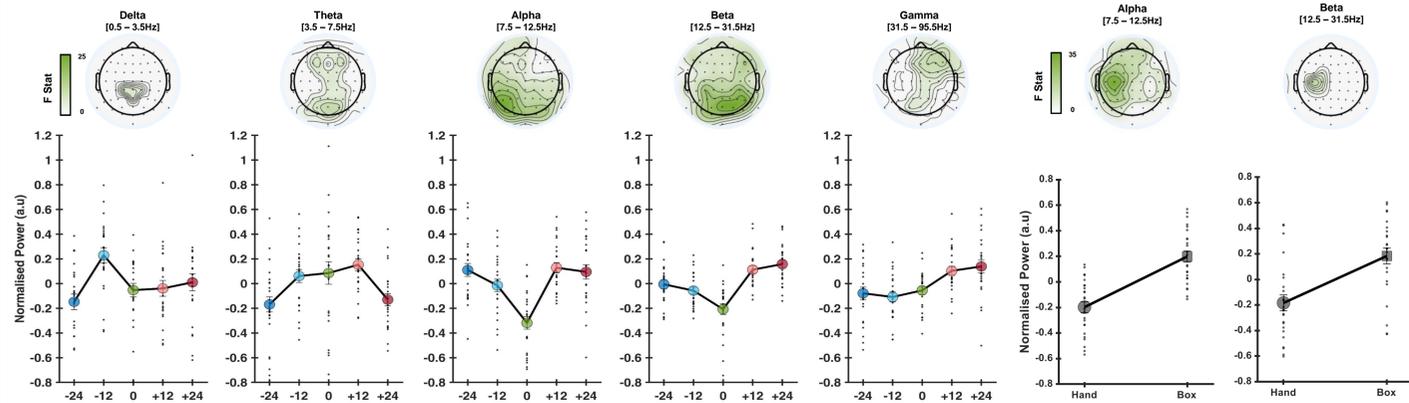
- Modulated by stimulus distance,
- Anchored to a specific body part, and
- Independent of gaze

## Results

### 1 | ANOVA

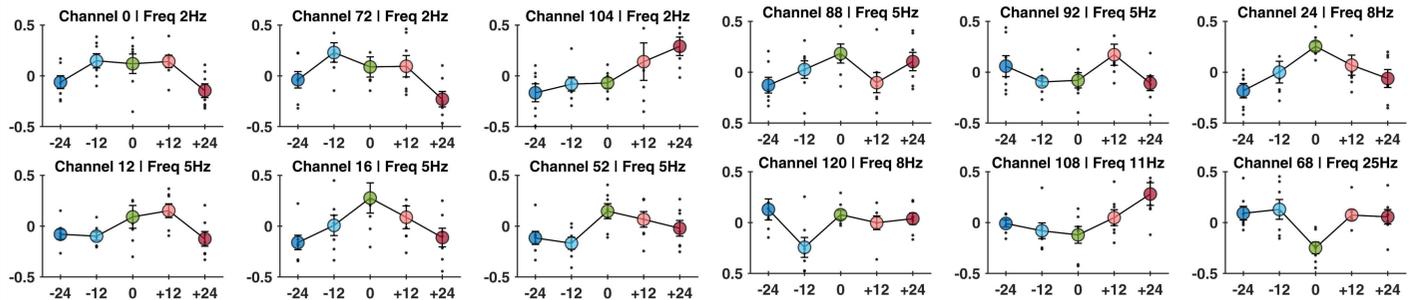
#### Main Effect of Stimulus Location

#### Main Effect of Hand v Box



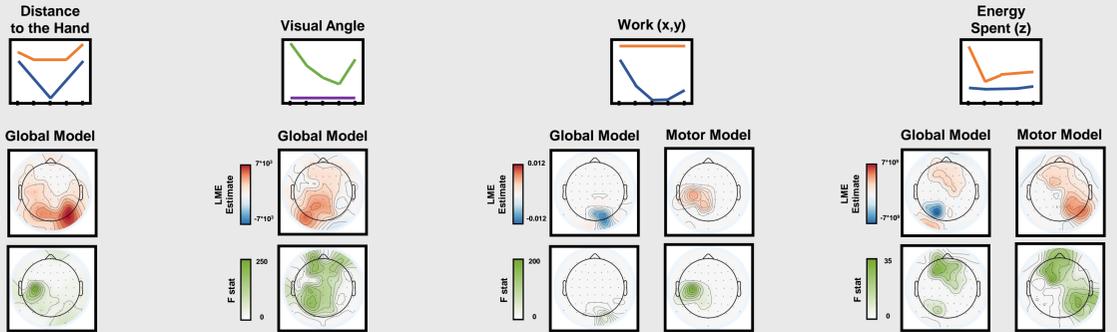
#### Main Effect of Stimulus Location

[independent of Gaze position]



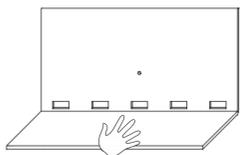
124	120	116	112	108	104	100	96
92	88	84	80	76	72	68	64
60	56	52	48	44	40	36	32
28	24	20	16	12	8	4	0

### 2 | Modelling



## Methods

### Stimulation paradigm



- Visual stimuli [Duration - Human: 5s, NHP: 3.5s] presented on a mediolateral axis centred on the right hand
- 5 stimulus positions:  $\pm 24$ ,  $\pm 12$ , 0cm relative to the hand
- 2 Gaze conditions: Central fixation, Foveate
- 2 Hand positions: Centre, By the Side [box]

### Neurophysiological recording



Human

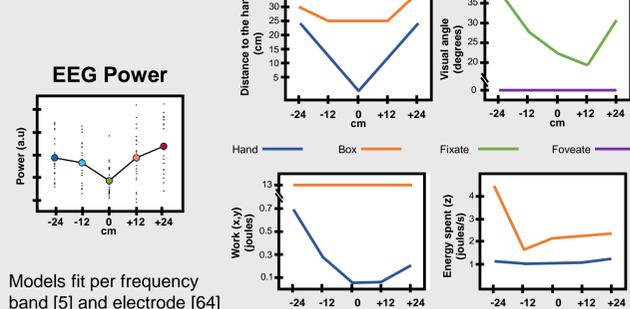
NHP

- 64-channel EEG
- N = 24
- 4 Intracranial electrode arrays
- 32 channels per array [A, B, C, D]

### Analyses

#### 1 | ANOVA

#### 2 | Modelling



## Conclusions

### Coding of stimulus location

- Human** | Our results demonstrate that the position of visual stimuli with respect to the hand is reflected in EEG power in a *spatially-specific* manner. In particular, alpha and beta power in posterior parietal and frontal electrodes yielded the most reliable encoding of stimulus position with a clear "V" shape.
- NHP** | A comparable coding of stimulus position was observed in LFP power in the posterior ventral premotor cortex [Array A]. Crucially, this stimulus encoding within a hand-centred reference frame was *independent of gaze*.

### Hand-specific coding of stimulus location

- Human** | ANOVA revealed a significant decrease in alpha and beta power when visual stimuli were specifically delivered around the hand. This effect occurred in electrodes overlying sensorimotor cortex contralateral to the stimulated hand. Our modelling analyses further revealed that the hand-specific modulation of alpha power was also coding the distance between the hand and the stimulus.

### Action relevance

- Human** | Modelling the EEG data revealed that alpha power in central electrodes contralateral to the hand around which the stimuli were delivered reflected the biomechanical costs of a potential movement towards the stimulus.
- These results uphold the notion that so-called PPS measures do not simply reflect stimulus spatial coding, but also information about possible actions to make contact with the stimulus.

## References

Bufacchi, R. J., & Iannetti, G. D. (2018). An action field theory of peripersonal space. *Trends in cognitive sciences*, 22(12), 1076-1090.  
Graziano, M. S., Hu, X. T., & Gross, C. G. (1997). Visuospatial properties of ventral premotor cortex. *Journal of neurophysiology*, 77, 2268-2292.

## Contact

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