Supporting Information

THAT'S NEAR MY HAND!

Parietal and premotor coding of hand-centered space contributes to localization and self-attribution of the hand

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# Equal contribution

A – Table S1: Main effects of the position of the visual stimuli in Experiment 1.

B – Table S2 and Figure S1: Neural correlates of the illusion in Experiment 2.

C – Supporting analyses and results in Experiment 2.

A – Table S1: Main effects of the position of the visual stimuli in Experiment 1

OBJECT TO THE LEFT*

Anatomical location	MNI coordinates X	Y	Z	Peak t-value	Peak p-value
R. medial occipitotemporal gyrus	22	-62	-8	7.57	0.004
R. medial occipitotemporal gyrus	12	-68	-4	6.84	0.018
R. lateral occipitotemporal gyrus	30	-74	-8	6.71	0.023

OBJECT TO THE RIGHT§

Anatomical location	MNI coordinates X	Y	Z	Peak t-value	Peak p-value
L. superior occipital gyrus	-20	-86	34	7.75	0.003
L. lingual gyrus	-10	-80	2	6.39	0.043

* $[(OL^{1st} \text{ vs. } OL^{2nd})_{HR} + (OL^{1st} \text{ vs. } OL^{2nd})_{HL}]$ vs. $[(OR^{1st} \text{ vs. } OR^{2nd})_{HR} + (OR^{1st} \text{ vs. } OR^{2nd})_{HL}]$

§ $[(OR^{1st} \text{ vs. } OR^{2nd})_{HR} + (OR^{1st} \text{ vs. } OR^{2nd})_{HL}]$ vs. $[(OL^{1st} \text{ vs. } OL^{2nd})_{HR} + (OL^{1st} \text{ vs. } OL^{2nd})_{HL}]$

B – Table S2 and Figure S1: Neural correlates of the illusion in Experiment 2

Illusion-related activity [($Synch_{POST}$ vs. $Asynch_{POST}$)]

Anatomical location	MNI coordinates X	Y	Z	Peak t-value	Peak p-value
L. precentral sulcus (PMv)	-56	0	38	4.71	0.018
R. precentral gyrus (PMv)	62	8	30	4.00	0.049
R. intraparietal sulcus	26	-56	50	4.49	0.024
L. supramarginal gyrus	-60	-52	40	6.10	<0.001*
R. supramarginal gyrus	66	-18	26	5.16	<0.001*
R. anterior insula	28	24	8	7.57	<0.001*

* uncorrected for multiple comparisons.

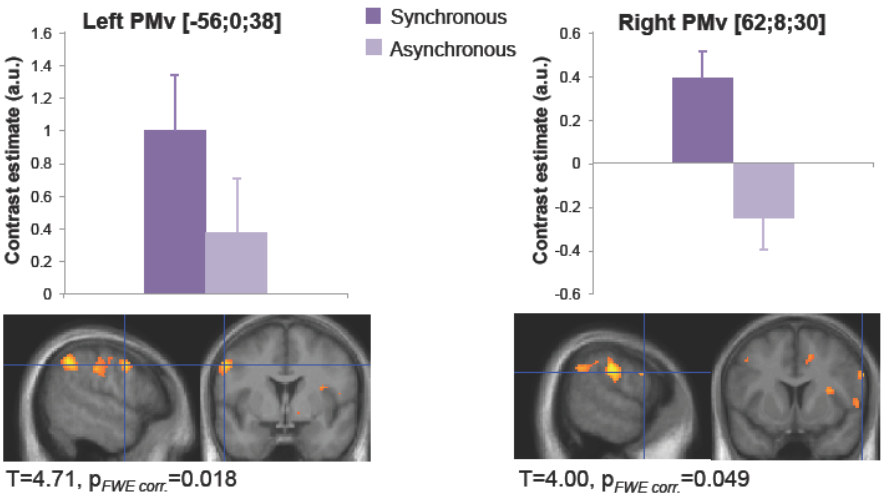

Figure S1 Four regressors were defined to model the different phases of synchronous and asynchronous trials. $Synch_{PRE}$, $Synch_{POST}$, $Asynch_{PRE}$ and $Asynch_{POST}$ regressors modeled the *pre-* and *post-* phases with respect to participants' button press indicating the subjective onset of the illusion in the synchronous trials and the presentation of the visual cue in the asynchronous trials, respectively. As a first step, we focused our analysis on the periods after the key button press, which allowed us to identify activations associated with the experience of the rubber hand illusion [1]. Specifically, we searched for voxels displaying more activity during the illusion period compared to the corresponding period in the asynchronous condition: [($Synch_{POST}$ vs. $Asynch_{POST}$)].

Ventral premotor areas bilaterally and the right intraparietal sulcus showed significantly more activation following the onset of the illusion in the synchronous than in the asynchronous trials (Figure S1). Additional activations were noted in the bilateral inferior parietal cortices and right anterior insular cortex.

This set of active areas also showed stronger activity during the illusion period compared to the period before the key press at which point the participant was not experiencing the illusion (by the interaction contrast [($Synch_{POST}$ vs. $Synch_{PRE}$) vs. ($Asynch_{POST}$ vs. $Asynch_{PRE}$)].

C – Supporting analyses and results in Experiment 2.

Besides the right parietal cluster described in the main text, a cluster of activity in the left posterior parietal region ([x=-32; y=-68; z=50], t=9.34, p=0.001 unc.) proved to be correlated with the proprioceptive drift. Activity in the posterior portion of the intraparietal sulcus in response to an object presented close to a rubber hand is thought to be based primarily on visual information about hand position, regardless of conflicting proprioceptive information [2]. Activity in similar posterior parietal regions has also been linked to the visual localization of the hand across the body midline [3] which is consistent with the fact that the owned rubber hand was placed across the midline.

We ran an independent whole-brain linear regression analysis in Experiment #2 in which we looked for correlation between the subjectively rated referral of touch (Statement 1 of the questionnaire data) and the effect size of the BOLD-adaptation response indicative of hand-centered remapping of space onto the rubber hand. We computed the difference in subjective ratings between synchronous and asynchronous blocks for Statement 1 of the questionnaire. The individual values were entered as a covariate in a regression analysis to identify significant positive correlations between the subjective rating and the differential adaptation to visual stimuli following the synchronous or asynchronous conditions. Importantly, like the previously described correlation analyses, this was carried out in a whole-brain voxel-wise fashion that was independent from all previous analyses, without any circularity in the statistics.

The results showed that the more individual participants reported feeling the stimuli on the rubber hand, the stronger the BOLD-adaptation responses indicative of hand-centered remapping of space in the left posterior section of the intraparietal sulcus ([-20;-68;58], t=6.89, p<0.001 unc.). Furthermore, the referral of touch correlated with activity in the right putamen ([24;18;4], t=4.75, p<0.001 unc.; see Figure S2). These activations did not survive correction for multiple comparisons but it is nevertheless worth noting that both the posterior parietal cortex and putamen have been shown to respond to somatosensory stimuli applied to a visible hand [3-5] and to contain visuo-tactile neurons [5].

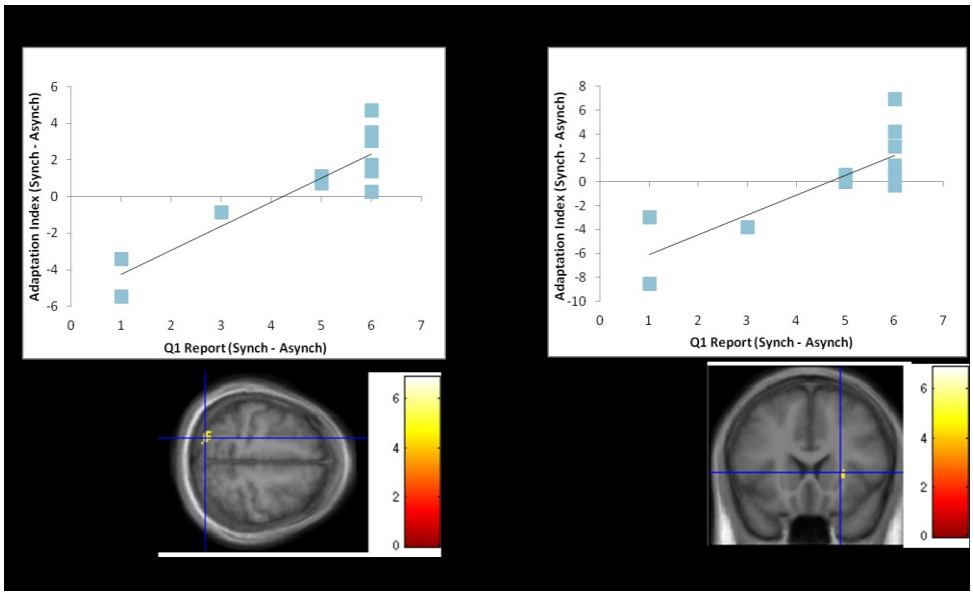

Figure S2

Supplementary References

1. Ehrsson, H.H., Spence, C., and Passingham, R.E. (2004). That's my hand! Activity in premotor cortex reflects feeling of ownership of a limb. Science 305:875-877.
2. Makin, T.R., Holmes, N.P., and Zohary, E. (2007). Is that near my hand? Multisensory representation of peripersonal space in human intraparietal sulcus. J. Neurosci. 27(4):731-40.
3. Lloyd, D.M., Shore, D.I., Spence, C., and Calvert, G.A. (2003). Multisensory representation of limb position in human premotor cortex. Nat. Neurosci. 6:17-18.
4. Graziano, M.S.A., and Botvinick, M.M. (2002). How the brain represents the body: insights from neurophysiology and psychology. In Common Mechanisms in Perception and Action: Attention and Performance XIX, W. Prinz, and B. Hommel, eds. (Oxford University Press, Oxford England), pp. 136-157.
5. Graziano, M.S.A., and Gross, C.G. (1993). A bimodal map of space: somatosensory receptive fields in the macaque putamen with corresponding visual receptive fields. Exp. Brain Res. 97:96-109.