

Supplemental Data

S1

Congruent Embodied Representations for Visually Presented Actions and Linguistic Phrases Describing Actions

Lisa Aziz-Zadeh, Stephen M. Wilson,
Giacomo Rizzolatti, and Marco Iacoboni

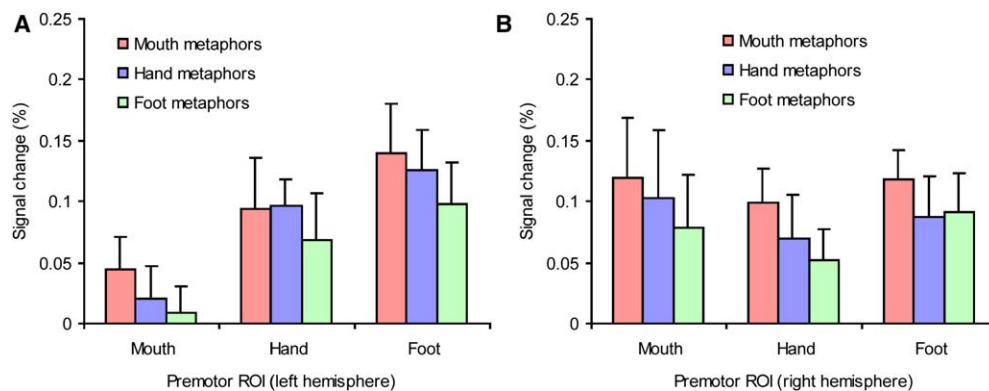


Figure S1. Signal Change in the Left and Right Premotor Cortex during Reading of Metaphorical Phrases, for Voxels Identified by Action Observation of Each Effector

Signal change in the left (A) and right (B) premotor cortex during reading of metaphorical phrases, for voxels identified by action observation of each effector. There were no significant interactions. These data may be difficult to interpret due to several methodological issues. First, the degree of correspondence between language and action observation may be important; whereas most of the literal phrases that were presented had high congruence with the actions that were presented (e.g., “grasping the keys” and observing someone grasping keys), metaphorical phrases inherently match actual physical actions less closely (e.g., “grasp the meaning” does not correspond to an action which could be presented visually). Second, it is possible that once a metaphor is learned, it no longer activates the same network that it may have initially. That is, although a metaphor like “grasping the situation” when first encountered may have utilized motor representations for its understanding, once it is overlearned, it no longer relies on these representations and instead utilizes other representations that have to do with the concept of “understanding.” This hypothesis could be tested by studying activations to metaphors on a continuum from novel to overlearned, with the prediction that novel metaphors would more strongly activate sensory-motor representations than overlearned metaphors. Error bars represent the SEM.

Table 1. Areas Activated during Action Observation, Averaged across the Three Effectors, as Compared to the Resting Baseline, and Reading, Averaged across Literal and Metaphorical Sentences and across the Three Effectors, as Compared to Rest

Area	MNI coordinates (mm)			Extent (mm ³)	Max T	Cluster P
	x	y	z			
Observation						
Bilateral visual areas, dorsal stream, and LGN				244936		< 0.0001
bilateral V1	6	-92	-2		20.4	
left IT	-42	-58	-16		16.5	
right IT	44	-52	-18		13.7	
left superior parietal	-34	-44	46		7.0	
right superior parietal	28	-56	48		9.0	
left supramarginal gyrus	-54	-32	30		8.2	
R precentral gyrus				5832		0.0012
dorsal peak	52	0	48		7.5	
ventral peak	54	4	28		7.3	
L precentral gyrus	-52	4	30	3360	8.2	0.016
Language						
Bilateral visual areas extending to inferior temporal areas				115648		< 0.0001
left visual	-36	-90	-8		14.3	
right visual	28	-96	6		16.5	
L posterior IFG and precentral gyrus				21192		< 0.0001
precentral gyrus	-40	6	32		8.7	
IFG pars opercularis/pars triangularis	-44	20	18			
IFG pars orbitalis	-54	32	-6			
R posterior IFG (dorsal pars opercularis)	28	22	18	4336	5.7	0.0053
L LGN	-26	-30	-8	3904	13.4	0.0085

Table S2. Areas Activated by Observation of Each of the Three Effectors as Compared to Resting Baseline

Area	MNI coordinates (mm)			Extent (mm ³)	Max T	Cluster P []=p value for a priori ROI
	x	y	z			
Observe foot						
Bilateral visual areas and dorsal stream plus bilateral LGN	6	-92	-4	240464	27.4	< 0.0001
L anterior inferior parietal lobule	-54	-32	30	3632	9.3	0.012
L ventral precentral gyrus/posterior IFG	-40	6	28	1832	6.2	0.15 [0.0021]
R ventral precentral gyrus/posterior IFG	50	12	26	1208	5.1	0.44 [0.0074]
Observe hand						
Bilateral visual areas and dorsal stream	26	-90	16	203552	14.9	< 0.0001
L dorsal precentral gyrus	-30	-6	46	2320	6.2	0.069
R precentral gyrus	54	2	38	2032	6.1	0.11 [0.0015]
L ventral precentral gyrus/posterior IFG	-58	0	28	1264	4.4	0.40 [0.0065]
Observe mouth						
Bilateral visual areas and dorsal stream	26	-84	18	232944	25.3	< 0.0001
bilateral LGN	-20	-30	-4	8272	9.4	0.0002
R precentral gyrus	60	2	42	6024	10.4	0.001
L precentral gyrus	-54	4	26	3144	8.7	0.022
L temporal pole	-34	0	-34	2952	7.6	0.028
L cerebellum	-32	-56	-58	2752	5.7	0.037