

Supplemental Data

The Neural Basis of Body Form

and Body Action Agnosia

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Supplemental Material

Preliminary Neurological and Neuropsychological Examination

A preliminary standard neurological examination (Bisiach et al., 1986) showed that ten patients with anterior damage and three patients with posterior damage presented with motor impairment. Moreover, two patients suffered from tactile sensorial deficits (one in the anterior and one in the posterior group), and one patient with right posterior lesion had visual field disorders. The clinical presence of visual agnosia was excluded by investigating recognition of faces, objects, vegetables, animals, colors, letters, and geometric shapes. Patients were asked to indicate which of three pictures, showed in three different A5 sheets of paper, was identical to that placed on the table by the examiner. The images of faces were taken from the Camden Memory tests (Warrington, 1996), the stimuli of letters and geometric shapes from the BORB test (Riddoch and Humphreys, 1993). Different photos (14 x 9 cm in size) of objects, vegetables, and animals were used to test object recognition. Furthermore, 4 cm-sized square patches of different 100% saturation colors (white, yellow, green, purple, orange, and black) were used to test color recognition. Six trials for each category of stimuli were presented and subjects were included in the study when they performed perfectly in all the items. The presence of ideomotor apraxia was assessed by asking patients to imitate limb gestures (Spinnler and Tognoni, 1987). None of the patients performed below the cut-off.

Subjects 3 and 5 presented with language production disorders as assessed by means of the Aachen Aphasia Test (Luzzatti et al., 1996). The presence of non-contextual language comprehension disorders was assessed by means of the Token test (Luzzatti et al., 1996). Although patients with moderate or severe disorders of comprehension were not included in the research, LH patients had lower scores than RH patients. To test for the effect of the lesion side and location on language comprehension performance, we entered the scores obtained by the 25 unilateral lesion patients in a 2 X 2 ANOVA with group and damage side as between-subject variables. Only a significant main effect of damage side was obtained ($F_{1,21} = 16.55, p < 0.001$), showing that LH patients (Mean = 63.93, S.D. = 8.02) were more impaired than RH patients (Mean = 74.72, S.D. = 3.82). The main effect of group ($F_{1,21} = 2.51, p = 0.128$) and the interaction between damaged side and group ($F_{1,21} < 1$) were non significant, thus ruling out that subclinical deficits of language comprehension ability may explain differential performances in body action and body forms discrimination between patients with anterior and posterior damage.

In sum, no patient with clinical visual agnosia, apraxia, or language comprehension disorders was included in the study. The presence of visuospatial neglect was preliminarily ascertained in each patient by means of a series of cancellation and drawing tests (Albert test, Drawing on Copy, Drawing on Memory; Peru et al., 1996). Visual extinction was assessed by a standard confrontation technique in which the subject has to indicate if the examiner wiggles his index fingertips in the left or in the right visual hemifield or in both hemifields (Bisiach et al., 1986). Personal neglect was investigated by the Comb and Razor test (McIntosh et al., 2000). Three out of the patients with posterior damage (subjects 21, 23, and 24) presented with signs of extrapersonal neglect and one of them (subject 21) with signs of visual extinction and personal neglect.

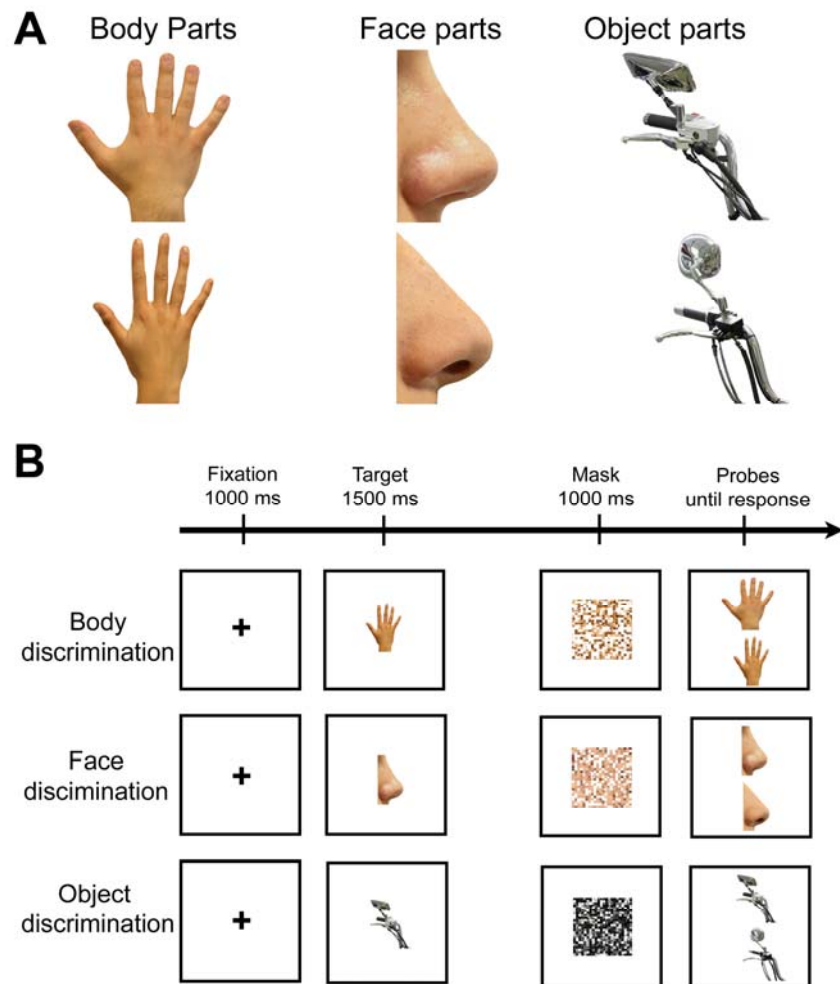


Figure S1. Body, Face, and Object Part Discrimination

(A) Examples of the experimental stimuli. Stimuli were color pictures taken with a digital camera of upper-limb parts, face parts, and motorcycle parts. Sixteen pairs of stimuli for each category were used. Upper limb stimuli included dorsum and palm views of different hands, entire arms, and a forearm flexed with the hand touching the shoulder. Face part stimuli included frontal and profile views of noses, lips, eyes, and ears. Motorcycle part stimuli included frontal and profile views of handlebars with rearview mirrors, front wheels with a front lamp, back wheels with a muffler, saddles, and tanks of different examples of motorcycles. Sixteen pairs of stimuli were used for each category and each stimulus was presented twice, for a total of 32 stimuli for category. In each pair, the non facial and facial body stimuli were pictures of two different models assuming the same bodily posture or facial expression. Pairs of object parts depicted the corresponding parts of two different models of motorcycles. Stimuli in each pair were matched for perspective, luminance, and rough contours. Thus, discrimination performance was arguably based on the details of the morphology of the different parts. Body and face parts stimuli were balanced for sex and for laterality of the models.

(B) Schematic representation of the trial events. Patients were required to decide which of the two probe stimuli presented in free-viewing conditions matched the sample stimulus previously presented for 1500 ms. The same timeline and task procedures were used for the different experimental tasks.

Inversion Effect Experiment

To control for the type of processing required by the three stimulus categories (body-, face- and object parts) we investigated the extent to which discrimination performance of the experimental stimuli was affected by inversion. We asked control participants to perform the match-to-sample task with both target and probe stimuli upright or inverted. Sixteen upright and 16 inverted stimuli were randomly presented in three separate 32-trial blocks (one for each stimulus category). Control participants were required to indicate the matching stimulus as fast as possible by verbal response. Reaction times (RTs) were recorded by means of the Psychology Software Tools Serial Response Box (Psychology Software Tools Inc., Pittsburgh, PA). The examiner recorded the subjects' responses, pressing one of the two mouse keys that corresponded to one of the two positions on the screen on which the probe stimuli were presented. Individual mean accuracy and RTs for matching upright and inverted body, face, and object parts (Figure S2) were entered in a three-way ANOVA, with stimulus category (body parts, face parts, object parts) and orientation (upright, inverted) as within-subjects variables.

The ANOVA on accuracy showed the significance of stimulus category ($F_{2,26} = 5.11, p = 0.013$), of orientation ($F_{1,13} = 5.08, p = 0.042$), and more importantly of their interaction ($F_{2,26} = 7, p = 0.004$). Post-hoc comparison showed no significant difference between matching upright and inverted stimuli for body parts (upright: Mean = 97.86%, S.E.M. = 0.8; inverted: Mean = 96.93%, S.E.M. = 1.43; $p = 0.582$) and object parts (upright: Mean = 93.07%, S.E.M. = 1.56; inverted: Mean = 94.43%, S.E.M. = 1.33; $p = 0.422$). In contrast, inversion of face part stimuli significantly impaired matching accuracy (upright: Mean = 96.07%, S.E.M. = 1.67; inverted: Mean = 88.93%, S.E.M. = 2.86; $p < 0.001$). Furthermore, while for upright stimuli non significant difference was observed between body parts and face parts ($p = 0.321$) and between face parts and object parts ($p = 0.099$), accuracy for matching inverted face parts was lower than accuracy for matching inverted body ($p < 0.001$) and object parts ($p = 0.004$). Matching body parts was more accurate than matching object parts for upright ($p = 0.014$) but not for inverted presentation ($p = 0.167$).

The ANOVA on RTs showed only a significant main effect of stimulus category ($F_{2,26} = 9.28, p < 0.001$), with RTs for face parts (1351.4 ms) being longer than for body (1168.2 ms, $p < 0.001$) and object parts (1215.1 ms, $p = 0.005$). No difference was observed between body and object parts ($p = 0.299$). The main effect of orientation ($F_{1,13} = 3.51, p = 0.084$) and the two-way interaction ($F_{2,26} < 1$) were non significant. Thus, face matching was slower and less accurate than matching the other stimulus categories. Importantly, this lower accuracy in matching the different categories is mainly due to difficulties in processing inverted face parts. At any rate, this subtle difficulty difference cannot explain the deficits exhibited by posterior damage patients, that were impaired in matching both face and body parts. In sum, we found a significant inversion effect only for face parts but not for body and object parts.

The inversion effect, originally reported for faces (Yin, 1969), has also been found for bodies (Reed et al., 2003) and is seen as an indicator of configural processing (Maurer et al., 2002; Reed et al., 2006). The absence of inversion effect for body parts is in keeping with the study by Reed et al. (2006) showing that inversion effect is present only for whole bodies or for half body images cut along the midline and thus showing both upper and lower limbs but not for body parts. Most of our experimental stimuli, indeed, depicted hands or upper limbs, where a distinction between upright and inverted stimuli could not refer to a canonical orientation. That inverted face parts were matched less accurately than upright face parts seems in contrast with studies showing that configural processing is reduced for isolated face parts (Rhodes et al., 1993). It should be noted, however, that our stimuli were not isolated face parts, but most of them showed the facial context in which the part was located, for example noses and forehead, hairs and ears etc. This may have allowed to complete the configuration of the whole faces. Thus, our stimuli were more similar to half face stimuli, whose inversion disrupt performance (e.g., Reed et al., 2006). Nevertheless, the degree of face inversion effect in the present study may be smaller (7% difference in accuracy) as compared to the amount of face inversion effect for whole faces reported in previous studies (Maurer et al., 2002). This would suggest that perceiving partial configuration of face parts involves less configural processing than whole faces. In conclusion, by testing the inversion effect in our control participants we showed that our face part stimuli involved configural processing while body- and object parts did not.

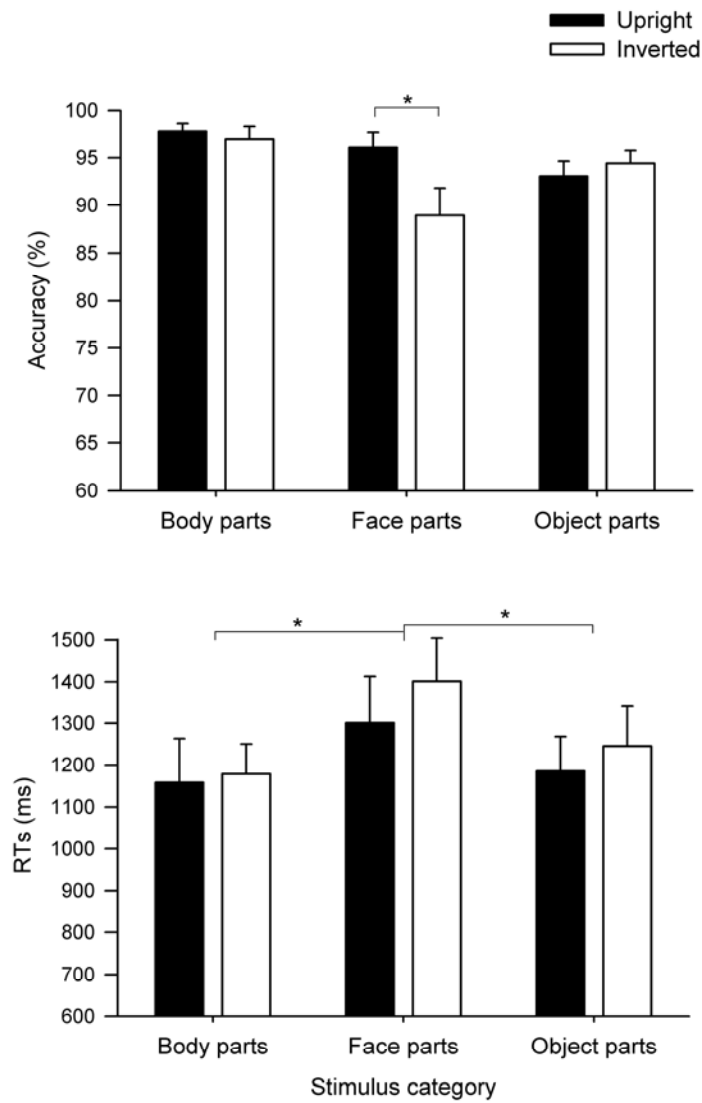


Figure S2. Control Subjects' Performance in the Discrimination of Upright and Inverted Body, Face, and Object Parts

Mean (\pm S.E.M.) accuracy and vocal reaction times (RTs) of the control subjects in the discrimination of upright and inverted body parts, face parts, and object parts. A significant inversion effect was found only for face part. *: $p < 0.05$.

Supplemental Results of Study 1

Absence of Hemispheric Dominance in the Discrimination of Body, Face, and Object Parts

To test for the presence of possible differences in the performance of patients with LH and RH damage, we entered the percent correct discriminations of body, face, and object parts of the 25 patients with unilateral lesions in a $2 \times 2 \times 2$ ANOVA with group and damage side (LH and RH) as between-subject variables and stimuli category as within-subject variable. We found non significant effects of damage side ($F_{1,21} < 1$), of the 2-way interactions between group and damage side ($F_{1,21} < 1$) and between stimuli category and damage side ($F_{2,42} = 1.9, p = 0.163$), as well as of the 3-way interaction ($F_{2,42} < 1$). Therefore, patients with posterior lesions of both LH and RH presented with specific deficits in the perception of body and face parts but not of object parts. Furthermore, in keeping with the analysis on the whole sample of patients, the main effects of the stimuli category ($F_{2,42} = 6.66, p = 0.003$) and group ($F_{1,21} = 13.42, p = 0.001$) and the interaction between stimuli category and group ($F_{2,42} = 6.06, p = 0.005$) were significant. Post-hoc tests revealed that patients with posterior damage were more impaired than patients with anterior damage in the visual discrimination of body parts (posterior: Mean = 74.43%, S.D. = 11.25, anterior: Mean = 90.85%, S.D. = 6.54; $p = 0.024$) and face parts (posterior: Mean = 71.02%, S.D. = 5.94; anterior: Mean = 88.17%, S.D. = 11.64; $p = 0.017$), but not in the visual discrimination of object parts (posterior: Mean = 82.67%, S.D. = 10.3; anterior: 88.62%, S.D. = 11.27; $p = 0.371$). Furthermore, the visual discrimination of body parts was significantly more impaired than the discrimination of object parts in the patients with posterior lesions ($p = 0.002$), but not in the patients with anterior lesions ($p = 0.372$). In a similar vein, discrimination accuracy was lower for face parts than for object parts in the patients with posterior damage ($p < 0.001$), but not in the patients with anterior damage ($p = 0.858$). Discrimination accuracy for body and face parts were comparable in both posterior ($p = 0.176$) and anterior patient groups ($p = 0.314$).

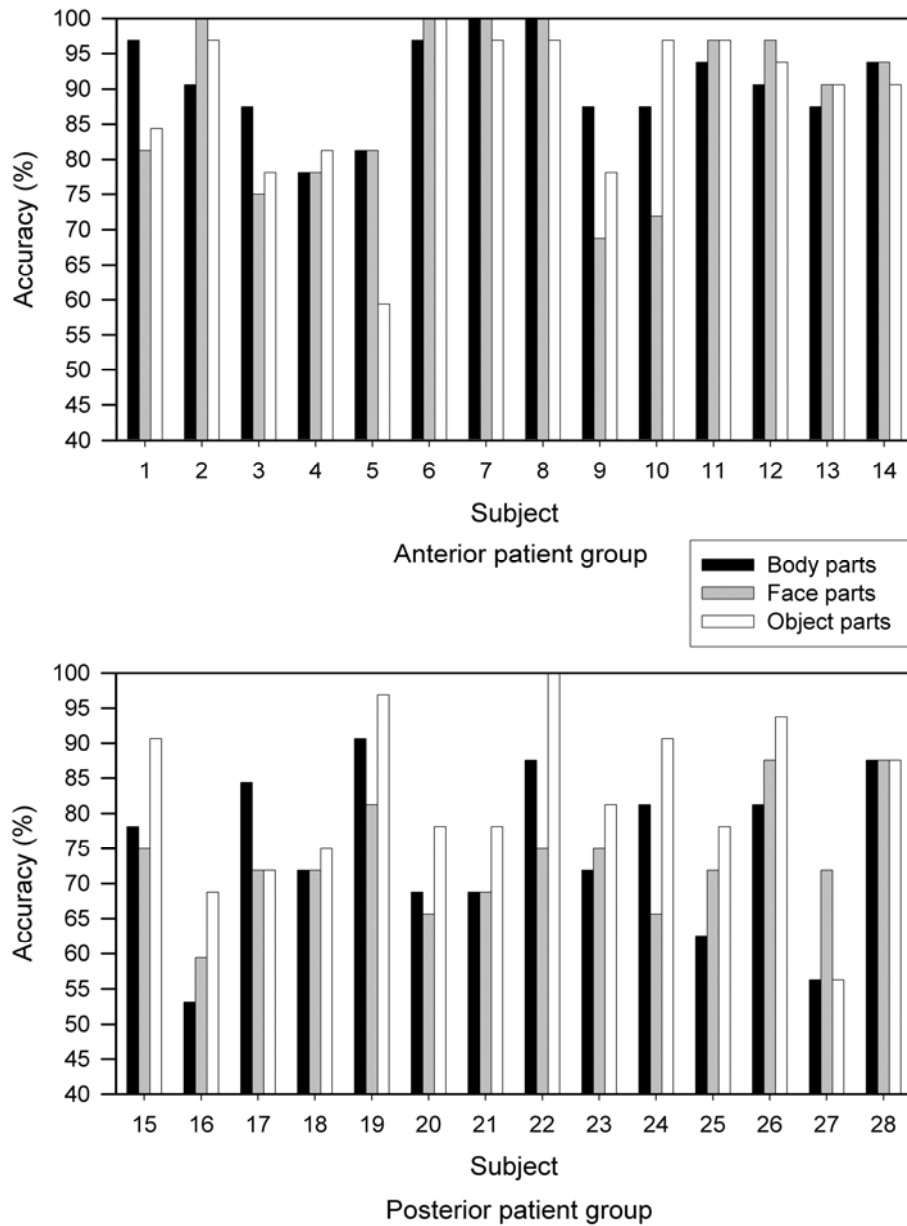


Figure S3. Individual Accuracy Scores in Study 1

Individual percent correct responses provided by the patients with anterior and posterior lesions in the discrimination of body parts, face parts, and object parts. While the accuracy of all anterior damaged patients in body and face parts discrimination was similar or better than that in object parts discrimination, 10 out of the 14 posterior damaged patients showed lower accuracy in body and face discriminations than in object discrimination.

Localization of VLSM Clusters with Respect to fMRI Studies

To specify the anatomical localization of the lesion areas associated with selective deficits in body and face perception, we compared the location of the VLSM clusters with that of body- and face-selective areas found in previous fMRI studies. We searched for previous fMRI studies that localized EBA and FBA by comparing neural activity during viewing bodies and/or body parts with that during viewing object and/or object parts. Moreover, we also searched for studies that localized FFA and OFA by comparing neural activity during observation of faces with that during observation of objects. As FFA has been localized in a high-number of studies, we restricted our analysis to the studies that localized both FFA and OFA. Furthermore, we only considered the studies that provided the mean coordinates in standard space of the peak activation for the whole group of participants or the coordinates for each single participant from which we could calculate group mean coordinates. Coordinates in Talairach spaces (Talairach and Tournoux, 1988) were transformed into MNI space by using Matlab (MathWorks, Natick, MA) and the tal2mni algorithm developed by M. Brett (<http://www.mrc-cbu.cam.ac.uk/Imaging/mnispace.html>). Table S1 lists the MNI coordinates reported by the fMRI studies localizing EBA (17 studies), FBA (4 studies), and FFA and OFA (24 studies). In keeping with standard procedures to identify body and face selective functional ROIs in fMRI studies (Downing et al., 2006; Spiridon et al., 2006), we created series of 6-mm radius ROIs centered over these coordinates using MRICron. Overlap images were then created for EBA, FBA, FFA, and OFA and overlaid on the standard brain along with the VLSM cluster associated with selective deficits in body part, but not face and object part discrimination (Figure 3B). Furthermore, we calculated the geometric distance between the center of mass of the VLSM clusters selectively associated with body and face part discrimination deficits with the coordinates of EBA, FFA, and OFA as reported in the fMRI studies selected for this analysis. Since FBA coordinates were reported only in four fMRI studies and its location overlaps with FFA, we considered the distance from FFA as an estimate of the distance from FBA.

Table S1. MNI Coordinates of EBA, FBA, FFA, and OFA Reported in Previous fMRI Studies

	EBA						FBA					
	RH			LH			RH			LH		
	x	y	z	x	y	z	x	y	z	x	y	z
Downing et al., 2001	51	-71	1	-51	-72	8	-	-	-	-	-	-
Grossman and Blake, 2002	41	-68	8	-39	-73	11	-	-	-	-	-	-
Astafiev et al., 2004	-	-	-	-52	-74	5	-	-	-	-	-	-
Chan et al., 2004	46	-71	-3	-46	-75	0	-	-	-	-	-	-
Peelen and Downing, 2005a	46	-67	-2	-	-	-	40	-43	-23	-	-	-
Peelen and Downing, 2005b	48	-70	-4	-46	-76	-8	-	-	-	-	-	-
Peelen and Downing, 2005c	46	-72	-5	-43	-74	-7	-	-	-	-	-	-
Downing et al., 2006a	46	-69	2	-46	-71	1	41	-43	-25	-	-	-
Downing et al., 2006b	48	-72	-4	-	-	-	-	-	-	-	-	-
Saxe et al., 2006	54	-66	3	-45	-72	3	-	-	-	-	-	-
Spiridon et al., 2006	33	-77	2	-64	-83	21	-	-	-	-	-	-
David et al., 2007	52	-70	5	-50	-76	10	-	-	-	-	-	-
Downing et al., 2007	48	-72	-1	-48	-69	3	-	-	-	-	-	-
Taylor et al., 2007	50	-67	1	-48	-73	-4	38	-41	-23	-	-	-
Hodzic et al., 2008	48	-64	0	-46	-70	0	45	-65	-6	-	-	-
Lamn and Decety, 2008	54	-67	8	-54	-68	9	-	-	-	-	-	-
Myers and Snowden, 2008	50	-66	2	-50	-64	8	-	-	-	-	-	-
Mean	47.6	-69.3	0.8	-48.5	-72.7	4	41	-48	-19.3	-	-	-

	FFA						OFA					
	RH			LH			RH			LH		
	x	y	z	x	y	z	x	y	z	x	y	z
Puce et al., 1996	30	-55	-20	-38	-60	-21	36	-67	-24	-	-	-
Kanwisher et al., 1997	40	-56	-15	-35	-64	-16	39	-78	-10	-34	-71	-4
Haxby et al., 1999	39	-60	-22	-39	-55	-23	42	-81	-13	-37	-83	-14
Gauthier et al., 2000a	35	-50	-12	-35	-57	-13	31	-77	-4	-30	-79	-5
Gauthier et al., 2000b	38	-51	-11	-38	-57	-10	40	-77	-8	-	-	-
Rossion et al., 2000	38	-44	-34	-42	-50	-34	46	-78	-21	-	-	-
Grossman and Blake, 2002	38	-39	-19	-34	-40	-20	38	-55	-15	-35	-56	-18
Hasson et al., 2003	36	-49	-22	-38	-50	-26	39	-71	-15	-42	-74	-19
Rossion et al., 2003	41	-51	-22	-36	-54	-21	38	-82	-13	-34	-83	-22
Andrews and Ewbank, 2004	44	-59	-30	-46	-61	-36	43	-85	-17	-46	-84	-11
Ewbank et al., 2005	36	-47	-27	-33	-58	-26	25	-67	-16	-18	-66	-11
Ganel et al., 2005	36	-52	-22	-	-	-	35	-73	-21	-	-	-
Peelen and Downing, 2005a	39	-44	-24	-	-	-	39	-65	-28	-	-	-
Peelen and Downing, 2005c	41	-48	-23	-38	-46	-22	37	-75	-25	-36	-74	-25
Pourtois et al., 2005	48	-57	-33	-45	-51	-27	54	-72	-3	-54	-72	15
Rotshtein et al., 2005	45	-40	-24	-	-	-	43	-61	-20	-	-	-
Caldara et al., 2006	40	-51	-23	-38	-53	-23	33	-78	-14	-36	-81	-21
Spiridon et al., 2006	32	-57	-10	-51	-71	-13	18	-89	-11	-	-	-
Mazard et al., 2006	37	-48	-27	-37	-47	-25	34	-75	-26	-32	-68	-27
Steeves et al., 2006	36	-49	-21	-38	-51	-21	37	-77	-16	-41	-81	-17
Summerfield et al., 2006	38	-61	-17	-37	-67	-25	38	-82	-7	-40	-83	-8
Dricot et al., 2008	36	-49	-21	-	-	-	34	-72	-21	-	-	-
Iaria et al., 2008	39	-52	-20	-36	-40	-26	24	-93	-22	-24	-93	-26
Large et al., 2008	35	-49	-22	-39	-46	-23	36	-77	-20	-34	-70	-23
Mean	38.2	-50.8	-21.7	-38.7	-53.9	-22.6	36.6	-75	-16	-35.8	-76.1	-14.8

Series of independent sample *t*-test (two-tailed) were used to compare the geometric distances between each VLSM cluster and body and face selective activations in fMRI studies.

EBA was localized in the left hemisphere by 15 studies and in the right hemisphere by 16 studies (Table S1). The coordinates of the center of mass of the left middle occipito-temporal area associated with body perception deficits in the present study ($x = -38, y = -76, z = 13$) were within the range of coordinates reported in fMRI studies for left EBA ($x = -39 \dots -64, y = -64 \dots -83, z = -8 \dots 21$). Furthermore, its geometric distance from left EBA coordinates (Mean = 16.6 mm, S.D. = 5.4) was smaller than the distance from left FFA (Mean = 42.7 mm, S.D. = 7.5; $t_{33} = -11.39, p < 0.001$) and from left OFA coordinates (Mean = 34.2 mm, S.D. = 15.6; $t_{30} = -4.13, p < 0.001$). In a similar vein, the coordinates of the center of mass of the right middle occipito-temporal area associated with body perception deficits ($x = 34, y = -79, z = 0$) were within the range of coordinates of right EBA ($x = 33 \dots 54, y = -64 \dots -77, z = -5 \dots 8$). The geometric distance of this VLSM cluster from right EBA (Mean = 17.4 mm, S.D. = 5) was smaller than the distance from right FFA (Mean = 36.5 mm, S.D. = 6.5; $t_{38} = -9.96, p < 0.001$), but not from right OFA (Mean = 20.1 mm, S.D. = 7; $t_{38} = -1.3, p = 0.2$). The proximity of the right middle occipito-temporal cluster associated with body perception deficits to OFA is in keeping with the relative location of OFA and EBA in fMRI studies. It is worth noting that, while the greatest deviation of the middle occipito-temporal VLSM clusters from OFA coordinates was in the dorso-ventral axis, the greatest deviation from left and right EBA was in the medio-lateral dimension. Indeed, the VLSM clusters were centered in a more medial location, because they involved not only the gray matter, but also the underlying white matter.

FBA was localized only in the right hemisphere in all the four selected studies and its location overlapped that of right FFA, which was reported by all 24 selected studies (Table S1). The coordinates of the center of mass of the right inferior occipito-temporal area associated with body and face perception deficits ($x = 34, y = -55, z = -6$) presented small deviation from the range of coordinates of right FBA ($x = 38 \dots 45, y = -41 \dots -65, z = -6 \dots -25$) and of right FFA ($x = 30 \dots 48, y = -39 \dots -61, z = -10 \dots -34$). The greatest deviation was in the ventro-dorsal dimension, because the VLSM cluster involved mainly the white matter just dorsal to the fusiform gyrus. The geometric distance of the right inferior occipito-temporal cluster from right FFA (Mean = 8.1 mm, S.D. = 5.2) was smaller than the distance from right EBA (Mean = 21.8 mm, S.D. = 2.7; $t_{38} = -9.78, p < 0.001$) and from right OFA (Mean = 28.4 mm, S.D. = 8.8; $t_{46} = -9.75, p < 0.001$).

FFA was also localized in the left hemisphere by 19 fMRI studies. The left inferior temporal gyrus area associated with face and object discrimination deficits (center of mass coordinates: $x = -43, y = -30, z = -8$) was not only more dorsal but also more anterior as compared to the range of coordinates of left FFA ($x = -33 \dots -46, y = -40 \dots -67, z = -10 \dots -36$). The geometric distance of this VLSM cluster from left FFA (Mean = 29.6 mm, S.D. = 6.9) was smaller than the distance from left EBA (Mean = 45.4 mm, S.D. = 5.9; $t_{33} = -7.13, p < 0.001$) and from left OFA (Mean = 49.3 mm, S.D. = 8.2; $t_{35} = -7.97, p < 0.001$). However, the distance between the left inferior temporal gyrus cluster and left FFA was greater than the distance between the left middle occipito-temporal cluster and left EBA ($t_{33} = 6.06, p < 0.001$), thus suggesting that the anatomical correspondence between VLSM clusters and fMRI activation was weaker for left FFA than for left EBA. Thus, since the left inferior temporal gyrus cluster involved almost exclusively the white matter, was more anterior than the FFA coordinates reported in fMRI studies and was associated with deficits in processing not only faces but also objects, it may reflect not left FFA damage but the disconnection of early visual areas from anterior temporal areas involved in high-order processing of objects.

As compared to the left inferior temporal cluster associated with face discrimination deficits, a more posterior location was occupied by the left inferior occipito-temporal area associated with selective deficits in body part discrimination (center of mass coordinates: $x = -34, y = -86, z = -7$). The coordinates of this cluster were slightly more dorsal and posterior than the coordinates of left FFA. This cluster, indeed, involved the inferior occipital gyrus more than the fusiform gyrus, in a location just ventral and posterior to left EBA. Furthermore, the geometric distance between this VLSM cluster from left FFA (Mean = 36.8 mm, S.D. = 7.8) was greater than the distance from left EBA (Mean = 23.8 mm, S.D. = 6.8; $t_{33} = 6.53, p < 0.001$) and from left OFA (Mean = 23 mm, S.D. = 19.6; $t_{35} = 2.9, p = 0.006$). No difference was observed between the distance from left EBA and from left OFA ($t_{30} = 1.54, p = 0.879$). However, the distance between the left inferior occipito-temporal area associated with body perception deficits and left EBA was greater than the distance between the left middle occipito-temporal cluster and left EBA ($t_{28} = 3.2, p = 0.003$), showing that the more dorsal cluster was closer to the EBA location than the ventral cluster (see Figure 3B). Furthermore, the location of FBA reported in fMRI studies presents a large variability, with a recent study (Hodzic et al., 2008) reporting body selective activations attributed to FBA in the right inferior occipito-temporal cortex in a location which corresponds, in the contralateral hemisphere, to the coordinates of the left inferior occipito-temporal VLSM cluster associated with the body perception deficits found in the present study (Table S1). Therefore, the inter-individual variability of the location of category selective areas in the temporal cortex and the limited numbers of fMRI studies describing FBA activations may explain the lack of exact correspondence between this VLSM cluster and fMRI activations. The body selectivity of the left inferior occipito-temporal cluster, however, was confirmed by study 2, which demonstrated that lesions to this area were associated with deficits in processing body forms as compared to processing body actions. What remains unclear, however, is whether the inferior occipito-temporal cluster associated

with body perception deficits reflects damage to left FBA, to left EBA or to their connections.

Among the high number of fMRI studies investigating neural activations to faces, we selected only those reporting also the coordinates of OFA. All the 24 selected studies reported OFA in the right hemisphere, while only 16 studies reported left OFA coordinates (Table S1). The coordinates of the right inferior occipito-temporal cluster associated with deficits in face part discrimination but not in body and object part discrimination (center of mass coordinates: $x = 26$, $y = -82$, $z = -10$) were comprised in the range of coordinates of right OFA ($x = 18...54$, $y = -55...-89$, $z = -3...-28$). Furthermore, the geometric distance between this VLSM cluster and right OFA (Mean = 18 mm, S.D. = 6.3) was smaller than the distance from right EBA (Mean = 27.7 mm, S.D. = 5.2; $t_{38} = -5.1$, $p < 0.001$) and from right FFA (Mean = 36.2 mm, S.D. = 6.1; $t_{46} = -10.18$, $p < 0.001$).

In sum, by comparing the coordinates of the VLSM clusters associated with body and face processing we have been able to determine that the location of the bilateral middle occipito-temporal clusters associated with selective deficits in body processing corresponded to the location of left and right EBA reported in fMRI studies. The location of the right inferior occipito-temporal cluster associated with body and face part discrimination deficits corresponded to the location of right FBA and FFA. On the other hand, the right inferior occipito-temporal cluster associated with deficits in processing face- but not body parts corresponded to right OFA. In contrast, the location of the left inferior occipito-temporal cortex associated with selective deficits in processing body forms could not be determined with respect to previous fMRI studies. Future studies using fMRI in patients with body perception deficits will allow to specify better the functional neuroanatomy of body form and body action agnosia.

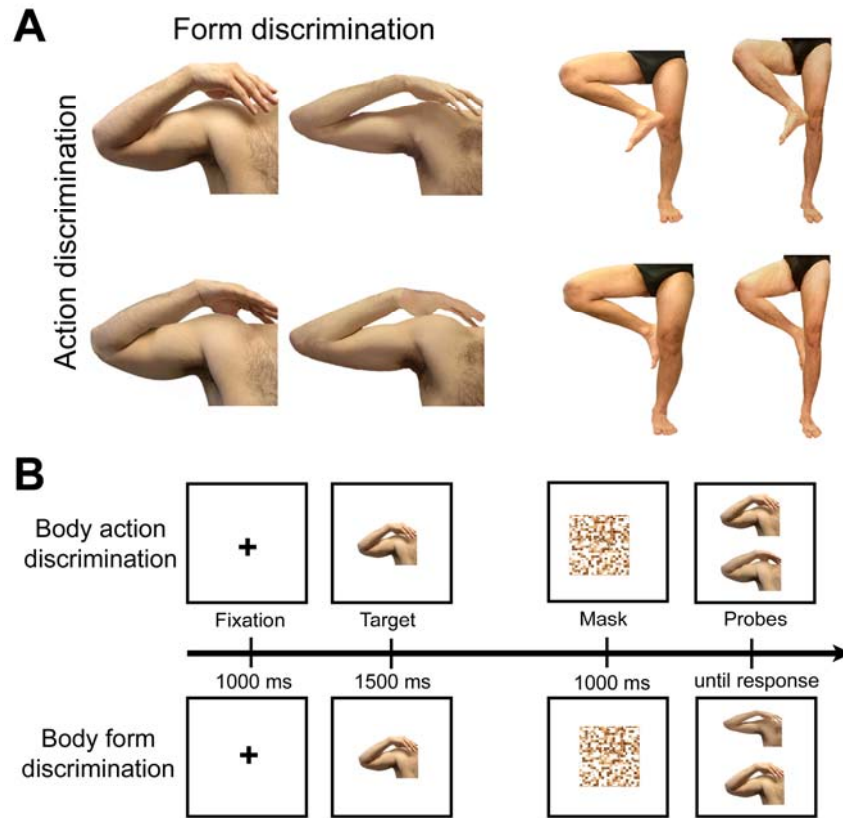


Figure S4. Body Form and Body Action Discrimination Task

(A) Experimental stimuli. Stimuli used in study 2 to test the ability of patients with anterior and posterior brain damage in the visual discrimination of body action and body forms. The stimuli were static snapshots depicting the middle phase of specific actions performed by two models, aged 26 and 27 years. All actions were performed by both models and the movement pattern of each model was matched with that of the other model. Four pairs of different actions were used. Each pair was composed of two slightly different, meaningful or meaningless, actions performed with the same limb. The different stimuli in each pair were matched for perspective, luminance, and rough contours. Using the mirror image of each stimulus allowed us to balance the laterality of the stimulus set. Thus, 32 stimuli were presented, i.e., 8 right- and 8 left-limb stimuli per model. Each image was paired with an image representing a different action performed by the same model (action discrimination task) and with an image representing the same action executed by a different model (form discrimination task). Four pairs of different actions were used. Two pairs of actions involved the right upper limb and the other two pairs involved the right lower limb. Pairs of stimuli represented meaningful (precision grip or gross grasping for upper limb and forward or backward walking for lower limb) or meaningless actions (hand approaching the anterior or posterior part of the shoulder for upper limb, and foot moving towards the contralateral knee, either in front of or behind it, for lower limb).

(B) Schematic representation of the trial events. The procedure was the same of experiment 1.

Supplemental Results of Study 2

Absence of Hemispheric Dominance in the Discrimination of Body Forms and Body Actions

To test for the presence of possible differences in action and form discrimination performance due to the damaged hemisphere, we entered the percent correct responses of the 25 patients with unilateral lesions in a three-way ANOVA with group and damage side (LH and RH) as between-subject variable and task as within-subject variable. In keeping with the analysis on the whole sample of patients, only the main effect of group ($F_{1,21} = 6.27, p = 0.021$) and the interaction between group and task ($F_{1,21} = 37.5, p < 0.001$) was significant. Post-hoc tests revealed that while patients with anterior lesions had lower scores in the action than in the form task ($p < 0.001$), patients with unilateral posterior damage, no matter whether to the LH or the RH, performed with significant less accuracy in the form (Mean = 72.72%, S.D. = 8.4) than in the action task (Mean = 84.38%, S.D. = 5.76; $p < 0.001$). Furthermore, while the action discrimination performance of patients with anterior damage was not different with respect to that of patients with unilateral posterior damage ($p = 0.637$), the form discrimination performance was worse in patients with unilateral posterior damage than in patients with anterior damage ($p = 0.001$). The main effects of task ($F_{1,21} < 1$) and damage side ($F_{1,21} < 1$) were non significant. Furthermore, the 2-way interactions between damage side and group ($F_{1,21} < 1$) and between damage side and task ($F_{1,21} = 2.283, p = 0.146$) were non significant. Crucially, the 3-way interaction ($F_{1,21} = 3.01, p = 0.097$) was non significant, thus suggesting that the double dissociation between the action and form tasks and anterior and posterior lesions was independent from the side of the damaged hemisphere. Therefore, our findings suggest that lesions involving the anterior areas, either on the LH or the RH, selectively impair the ability to match the action performed by other individuals. By contrast, lesions involving the posterior areas, either on the LH or the RH, impair performance in matching the identity of the acting body.

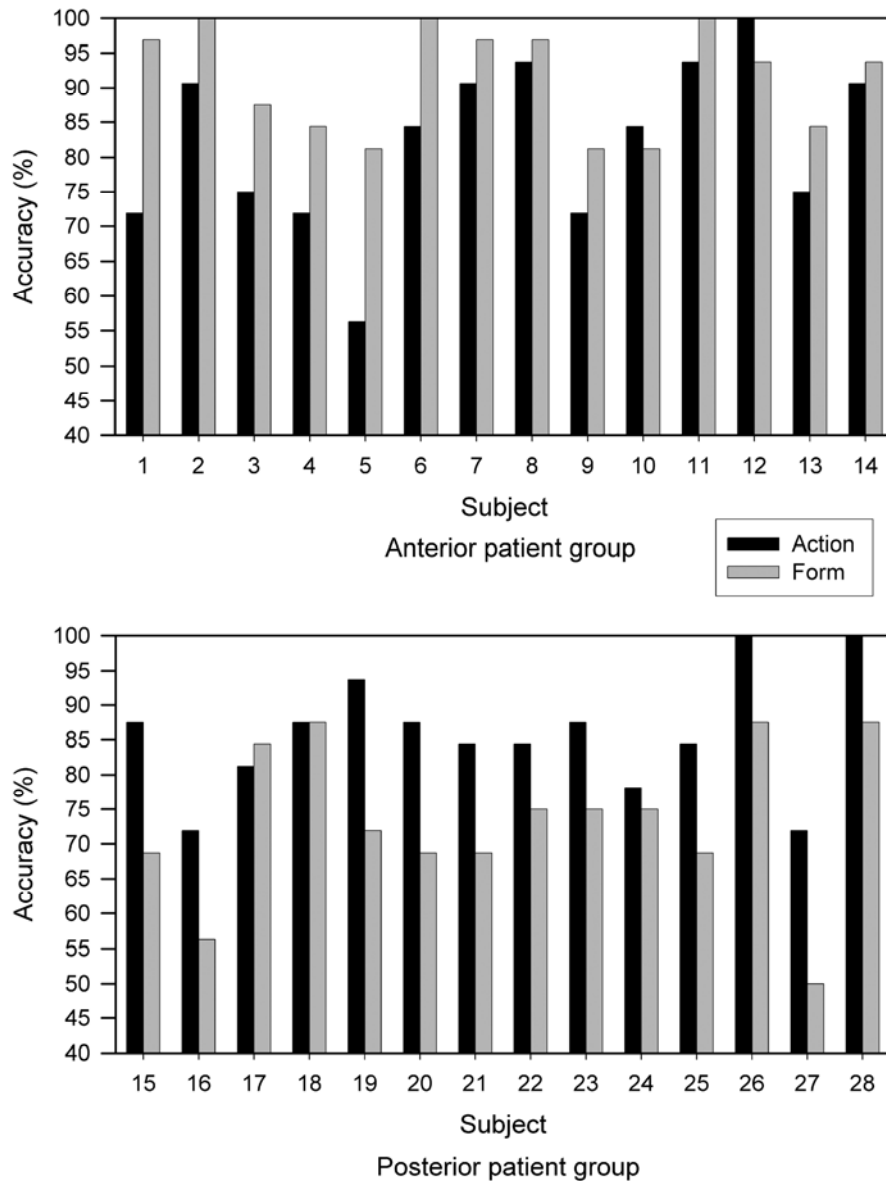


Figure S5. Individual Accuracy Scores in Study 2

It is relevant that while 12 out of 14 patients with anterior lesion showed lower performance in the body action than in the body form discrimination task, 12 out of 14 patients with posterior damage showed lower accuracy in the body form than in the body action discrimination task. Thus, inspection of the individual behavioral performance revealed a great stability of the dissociation between anterior and posterior brain lesions and the relative performance in the two tasks. The degree of discrepancy between the two tasks, however, was different for the different patients within each group.

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