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Supplementary Data 1: Identification of Face- and Body-Selective ROIs

The table below summarizes the results of the functional localizers. A minimum cluster size of 15 voxels was used for identification of the ROIs. Note that in one participant we did not have time to run the face-selective localizer, so localization of face-selective regions was only possible in 14/18 participants.

In addition to EBA and FFA, our functional localizers also identified a face-selective region in posterior cortex, sometime referred to as the Occipital Face Area or OFA, and a body-selective region near the fusiform gyrus, commonly referred to as the Fusiform Body Area or FBA\textsuperscript{1,2}.

Voxels showing both face- and body-selectivity were excluded from all ROIs\textsuperscript{2}.

Consistent with prior reports\textsuperscript{2-5}, all face and body-selective regions were larger in the right than left hemisphere.

| Left Hemisphere | Right Hemisphere |
|-----------------|------------------|
| ROI             | Median no. of voxels | No. of Participants | ROI | Median no. of voxels | No. of Participants |
| IEBA            | 147               | 18/18               | rEBA | 161               | 18/18               |
| IFFA            | 30                | 11/17               | rFFA | 40                | 14/17               |
| IOFA            | 31                | 10/17               | rOFA | 56                | 11/17               |
| IFBA            | 27                | 11/18               | rFBA | 37                | 13/18               |

Supplementary Table 1: Number of voxels in participants across all ROIs.
Supplementary Data 2: Response Magnitude in rEBA and rFFA

We examined the magnitude of response in rEBA and rFFA across all stimulus types (body parts and half-faces) with a 3-way repeated measured ANOVA, with Stimulus Type (half-face, shoulder, elbow, hand, knee, foot), Field (left, right), and Side (left, right) as factors (Supplementary Figure 3).

In rEBA, we found no significant main effect of Stimulus Type ($F_{5,85} = 2.139, p < 0.091$) with a similar level of response across all body parts and half-faces. The lack of a difference in response magnitude between half-faces and body parts is consistent with a prior report showing a strong response to face parts, stronger than to whole faces, in rEBA. There was a significant main effect of Field ($F_{1,17} = 4.597, p < 0.047$), demonstrating stronger responses to stimuli in the contralateral compared to the ipsilateral field. Furthermore, there was a significant three-way interaction of Stimulus Type, Field, and Side ($F_{5,85} = 3.345, p < 0.02$).

In rFFA, there was a significant main effect of Stimulus Type ($F_{5,65} = 12.022, p < 0.0001$), reflecting stronger responses to half-faces than body parts, and a main effect of Field ($F_{1,13} = 15.945, p < 0.002$) reflecting stronger responses to stimuli in the contralateral field as has previously been reported. Further, there was a significant interaction between Field and Side ($F_{1,13} = 20.409, p < 0.01$) arising primarily from strong activation for the right side of the body in the left visual field.

Overall, these results show that while average magnitude of response is sufficient to discriminate half-faces from body parts in rFFA, it is insufficient to differentiate between body parts or even differentiate between body parts and half-faces in rEBA.
Supplementary Figure 3: Average magnitude of response in rEBA and rFFA. (a) In rEBA, response magnitude was similar across all conditions. (b) In rFFA, there was a stronger response for half-faces compared with body parts, and for contralateral compared with ipsilateral stimuli, particularly those from the right side of the body.
Supplementary Data 3: Full similarity matrices for rEBA and rFFA.

Within each ROI, we compared the pattern of response across conditions using a series of pairwise comparisons. The results of these comparisons can be summarized in similarity matrices (Supplementary Figure 4). Within the similarity matrices, each square represents the correlation value either within a given condition (e.g. left hand versus left hand) or between a pair of conditions (e.g. left hand versus left foot). Within-condition correlations are plotted along the main diagonal from the upper left to lower right of the similarity matrices. Between-condition correlations are plotted off the diagonal. The correlations between the two halves of the data are averaged so the matrix is symmetric across the diagonal.

Discrimination between body parts was determined by a comparison of the within- and between-condition correlations across the two halves of the data. If the within-condition correlation (main diagonal) for a given body part is significantly greater than the average of its between-condition correlations (off diagonal), this indicates the pattern of response across the ROI can reliably discriminate that body part condition from the others.

For both rEBA and rFFA, we observed a striking effect of visual field (see Supplementary Figure 4). Correlations were much higher for stimuli presented within the same field across the two halves of the data, than for conditions presented in different fields (rEBA, $t_{1,17} = 4.359$, $p < 0.0001$; rFFA, $t_{1,13} = 1.851$, $p < 0.043$).
**Supplementary Figure 4:** Full similarity matrices for the spatial response patterns of rEBA (top) and rFFA (bottom). Squares along the main diagonal (from upper left to lower right) show the within-condition correlations, whereas squares off the main diagonal show the between-condition correlations. For a given condition, a stronger within-condition than between-condition correlations indicates a distinct and reproducible pattern of response for that condition. Note the strong within-condition correlation for the right body in the left visual field in rEBA, and for half-face in the left visual field (but not for body parts) in rFFA.
Supplementary Data 4: rEBA data from individual participants

Supplementary Figure 5: Individual rEBA data from all 18 participants showing the similarity matrix for the right side of the body in the left visual field and the average discrimination indices for body parts. Note that the similarity matrix corresponds to the light blue bar in the bar plots.
Supplementary Data 5: Distributions of within- and between-condition correlations

In order to more thoroughly investigate the source of our effects and to ensure that the use of parametric statistics are appropriate we decided to more closely examine the two components of our discrimination index. First, we divide the index into its two components: the within- and between-condition correlations (Supplementary Figure 6) and consider each individually. We observe that the interaction between Field and Side is generated by both an increase in the within-condition correlations (Supplementary Figure 6a) and a decrease in the between-condition correlations (Supplementary Figure 6b) in the commonly experienced combinations of Field and Side. This suggests that the representations of body parts and half-faces in their natural configurations are both stronger and more consistent (Supplementary Figure 6a) as well as being more distinct from one another (Supplementary Figure 6b).

A further concern with the discrimination index is the possibility that its components are not normally distributed, as can be observed for correlation values as they approach 1 or -1, or that outliers in the between-condition correlations might drive differences in the discrimination index. Both of these possibilities are unlikely. First, most of the correlations we observe lie between -.5 and .5, a range in which the distribution of correlations approximates normal. Further, reanalysis of our data with Fischer transformation yields no differences in our results. Second, the analysis in Supplementary Figure 6 suggests that an increase in within-condition correlations is a major component of the observed interaction. Nonetheless, we decided to plot the distributions of within and between-condition correlations for left and right body parts in the left visual field to verify their normality (Supplementary Figure 7). As there were not enough correlations within a single-subject to plot a meaningful distribution we combined correlation values across subjects. Note that all of the distributions are symmetric and approximately normal, especially the between-condition correlations where more data is available. Note also that the means of the within- and between-condition distributions differ only for right and not left body parts.

These two analyses verify the source of our effect as the greater overall strength of the representations for body parts and half-faces in the commonly experienced configurations. They further verify the normality of data and the appropriateness of the statistics we applied.
Supplementary Figure 6: Panels a and b show the within-condition correlation and between-condition correlation, averaged across each participant. Note that within-condition correlations were strongest and between-condition correlation were weakest in the commonly experienced configurations, right side left field and left side right field.
Supplementary Figure 7: Distribution plots for within-condition correlation and between-condition correlation in the left visual field in rEBA (fixed effect). Importantly, these plots show that our data are normally distributed around the mean. For right body parts in left visual field (strong discrimination), the mean value of within-condition correlation is greater than the mean value for between condition correlation. For left body parts in left visual field (weak discrimination), the mean values for both within- and between-condition correlation are about the same.
Supplementary Data 6: Discrimination for both body parts and half-faces in rEBA and rFFA

To investigate whether the discrimination within rEBA and rFFA differ for body parts and half-faces, we conducted a three-way ANOVA (ROI, Field, and Side) within each category. We found that for body parts, there is a strong difference between the two ROIs ($F_{1,13} = 10.59, p < 0.006$), indicating that rEBA produced stronger discrimination for body parts than rFFA. No other significant main effects or interactions were found (all $p > 0.1$).

For faces, a main effect of ROI was found ($F_{1,13} = 13.376, p < 0.003$), reflecting that rFFA produced stronger discrimination for half-faces than rEBA. A significant interaction between ROIs, Field, and Side was also found ($F_{1,13} = 6.732, p < 0.022$), showing that the effect of Field and Side is different between the two ROIs, with rFFA showing preferential discrimination for the commonly experienced side in each visual field. In addition, there was a significant interaction between ROI and Field ($F_{1,13} = 6.660, p < 0.023$), arising from a stronger contralateral bias in rFFA than rEBA, and an overall main effect of Field ($F_{1,13} = 5.654, p < 0.033$). No other main effects or interactions were found (all $p > 0.07$).
Supplementary Figure 8: Average discrimination for both body parts and half-faces in rEBA and rFFA as a function of visual field and side. Panels a and d show the same data as plotted in Figure 2. Note that there is no discrimination between body parts in rFFA. In rEBA, there is weak discrimination for half-faces from body parts, but only for right half-faces. Error bars indicate the between-subjects standard error. # indicates significant difference from zero, * p < 0.05.
**Supplementary Data 7: Lack of body part discrimination in rFFA is not due to the smaller number of voxels compared with rEBA**

To investigate whether the lack of differentiation between body parts in rFFA is due to the smaller size of the ROI compared with rEBA, we matched the number of voxels between the rEBA and rFFA within each participant by shrinking the larger ROI to match the size of the smaller ROI (median = 31 voxels).

The matched-size ROIs produced exactly the same pattern of results as before. In rEBA there was a significant interaction between Field, and Side ($F_{1,13} = 5.705$, $p < 0.033$). Specifically, we found significant discrimination for the commonly experienced right side in the left visual field ($t_{1,13} = 2.492$, $p < 0.0135$). Whereas in rFFA, there were no significant main effects or interactions (all $p > 0.33$).

Further, a three-way ANOVA (ROI, Field, and Side), revealed a significant interaction between ROI, Field, and Side ($F_{1,13} = 5.134$, $p < 0.041$), indicating that the interaction of field and side was significantly stronger in rEBA than rFFA.
**Supplementary Data 8: Discrimination for each stimulus type in rEBA and rFFA**

**Supplementary Figure 9:** Similarity matrices and average correlations for rEBA broken down by body part for all combinations of field and side. Note that the data plotted in panel a are the same data as plotted in Figure 2. Error bars indicate the between-subjects standard error, *p < 0.05.
Supplementary Figure 10: Similarity matrices and average correlations for rFFA broken down by body part for all combinations of field and side. Note that the data plotted in panel a are the same data as plotted in Figure 2. Error bars indicate the between-subjects standard error, * p < 0.05.
Supplementary Data 9: Other body- and face-selective ROIs

Our main analyses focused on rEBA and rFFA but, as shown in Supplementary Data 1 and 2, we were also able to identify other body and face-selective ROIs. However, these ROIs tended to be small and could only be identified in a subset of participants. Here we briefly describe the results from these regions for their preferred category. First we describe the results from EBA and FFA in the left hemisphere before considering FBA and OFA.

a) Left EBA and left FFA

Both rEBA and rFFA showed their strongest discrimination for the commonly experienced side (right side) of the preferred category in the left visual field, which is the contralateral visual field. This is consistent with prior reports of contralateral biases in high-level visual cortex both in response magnitude and discrimination based on response patterns (Kravitz et al, abstract for Society for Neuroscience Conference 2008). But what happens in the left hemisphere? If the contralateral organization of the visual system dominates then one might expect to find a reverse pattern in the left hemisphere with best discrimination in the right visual field. Interestingly, we found that in FFA the patterns of response are indeed reversed in the two hemispheres. However, the same is not true in EBA.

IEBA: We observed stronger magnitude of response for the right visual field, there is a significant effect of field ($F_{1,17} = 15.113, p < 0.001$). No other effects were found (all $p > 0.09$). The lack a difference in response magnitude across all stimuli is also consistent with previous evidence that body selectivity is weaker in the IEBA. We observed significant but weak body part discrimination for all configurations except the right side in the left visual field (Supplementary Figure 11). In contrast to rEBA, we found no significant main effects or any interaction between Field and Side (all $p > 0.7$), indicating that the IEBA does not show preferential discrimination for any side of body in either visual field. Adding ROI (IEBA, rEBA) as an additional factor to our ANOVA revealed a significant three-way interaction of ROI, Field, and Side ($F_{1,17} = 6.764, p < 0.019$), indicating that the effect of Field and Side on discrimination differs significantly between the left and right EBA.

IFFA: Similar to rFFA, we observed strong discrimination between half-faces and body parts that again reflected natural experience: strong discrimination for the right side in the left visual field and for the left side in the right visual field (Supplementary Figure 12). Furthermore the strongest discrimination was in the right (contralateral) visual field, the opposite to that observed in rFFA. The interaction between Field and Side was marginally significant ($p > 0.06$), and there was a significant main effect of Field ($F_{1,11} = 16.163, p < 0.02$) with stronger discrimination in the contralateral visual field.
b) FBA

In both right and left FBA there was no significant discrimination between body parts in any configuration (Supplementary Figure 11). Further in the ANOVA with Field and Side as factors, there were no main effects or interactions (all p > 0.09).

c) OFA

Both left and right OFA showed a qualitative effect of experience with stronger discrimination for the commonly experienced side in each visual field (Supplementary Figure 12). However, only in lOFA was there a significant interaction of Field and Side ($F_{1,9} = 21.01, p < 0.001$). Interestingly, as for FFA, we observed strongest discrimination for the commonly experienced side in the contralateral visual field.
Supplementary Figure 11: Average discrimination for body parts in all body-selective ROIs. Conventions are the same as Figure 2. While we found evidence for discrimination in both left and right EBA, there was no significant discrimination in FBA. Right EBA showed a strong effect of natural experience and the same pattern was observed in IFBA. * p < 0.05, # indicates significant discrimination (discrimination index > 0).
Supplementary Figure 12: Average discrimination for half-faces from body parts in all face-selective ROIs. Conventions are the same as Figure 2. All four ROIs show a qualitatively similar pattern of results reflecting the effects of visual experience with stronger discrimination for the right body in the left visual field and for the left body in the right visual field. Further, in each ROI the strongest discrimination is observed for the commonly experienced side of body in the contralateral visual field (blue rectangles). * p < 0.05, # indicates significant discrimination (discrimination index > 0).
Supplementary Data 10: Discrimination performance in EBA and FFA is not predicted by low-level stimulus differences

To investigate whether the results we observed in category-selective regions of cortex might be predicted by low level feature differences between the stimuli, we conducted two separate control analyses. First, we analyzed pixel-wise similarity between the body part and half-face images. Second, in a subset of participants we extracted retinotopic regions of cortex and conducted the same analyses we used previously for category-selective cortex. Both analyses show that low-level feature differences cannot explain our findings.

a) Analysis of stimuli

We used the intensity values of the pixels in each stimulus to measure the Euclidean distance between the pixels across all stimuli. This analysis is not intended as a measure of perceptual similarity, just as a measure of physical similarity. If pixel-wise similarity matches the pattern of response observed in higher level areas, this would suggest that low-level physical differences might account for the pattern observed. Note that in all of our discrimination analyses of the imaging data we only considered discrimination between body parts in a given combination of Field and Side. Thus, this analysis serves as a measure of the physical similarity between stimuli within any of those combinations.

The similarity matrix of these distances (Supplementary Figure 13a) shows as expected that each exemplar is most similar to other exemplars of the same stimulus type (main diagonal from top left to bottom right). To examine if there are systematic differences in pixel distance between stimulus types that match the preference for the upper body observed in rEBA and lEBA, difference scores were computed by subtracting the averaged between stimulus types comparison from the average pixel distance within each stimulus type (Supplementary Figure 13b). In contrast to the imaging findings, we find that face, shoulder, knee, and foot are the most distinct from the other stimulus types, whereas elbow and hand are the most similar. Since our imaging data shows a stronger discrimination for upper body parts (shoulder, elbow, and hand) and a lack of discrimination for knee and foot, we conclude that physical stimulus similarity (as measured by pixel-wise analysis) cannot explain our imaging results.

b) Retinotopic ROI

In 13 participants we included an independent retinotopic localizer to identify regions of early visual cortex responsive to our stimulus locations. Flickering checkerboards, identical in size to the stimuli in the event-related experiment (5 degrees by 5 degrees), were presented alternately in the left and in the right visual fields (3° from the central fixation), which covered the same location as the stimuli in the main fMRI experiment. Eight stimulus blocks were presentation with a fixation block in the beginning and at end of the scan. Each block lasted for 16 sec, the scan lasted for 2 mins 40 sec. Participants were required to maintain fixation throughout the scan.
For each participant we identified retinotopic regions responding more to checkerboards in the contralateral than ipsilateral visual field. Within those regions, we first examined the average magnitude of response to our body part and half-face stimuli. As expected, both regions showed a very strong effect of Field (both p < 0.0001) with responses in the contralateral field that were almost three times that observed in the ipsilateral field. The right retinotopic region also showed an interaction between Field and Side, although this was driven almost entirely by the response to faces. The effect was no longer observed when faces were excluded from the analysis.

We then repeated the multi-voxel pattern analysis we used for category-selective cortex (Supplementary Figure 14). Although we observed discrimination for some configurations (e.g. between right body parts in the left field in the right retinotopic region), which is expected given the retinotopic differences between stimuli, in neither ROI did we find an interaction of Field and Side (both p > 0.3) as we observed in rEBA. Further, in no visual field for either retinotopic ROI was there a significant effect of side of body (all p > 0.06).

We then directly compared rEBA and the right retinotopic region (in those participants with both ROIs), including ROI as a factor. Importantly we observed a three-way interaction between ROI, Field and Side (F 1,12 = 4.760, p < 0.05) indicating that the interaction between Field and Side was significantly stronger in rEBA than in the right retinotopic region.

Finally, to rule out the possibility that the failure to observe an interaction of Field and Side in retinotopic regions is simply due to weak responses in the ipsilateral field, we conducted two separate analyses. First, we combined the contralateral responses from each retinotopic ROI (left field responses from the right retinotopic ROI, right field responses from the left retinotopic ROI) and re-ran the ANOVA with Field and Side as Factors. Again, there was no interaction of Field and Side (F 1,12 = 1.251, p > .285) as observed in the same set of 13 participants in rEBA (F 1,12 = 4.905, p < 0.047).

Second, we compared the effect of side of body in both rEBA and the right retinotopic region in the contralateral (left) field only. In rEBA there was a highly significant effect of Side with stronger discrimination for the right than left side of the body (p < 0.012). In contrast in the right retinotopic ROI there was no effect of Side (p > 0.098). Furthermore, there was a significant interaction between ROI and Side (F 1,12 = 3.430, p < 0.0445), demonstrating a significantly stronger effect of Side in rEBA than in the right retinotopic ROI.

Collectively, these analyses demonstrate that any low level differences between the stimuli, as evidenced in the response of retinotopic cortex, cannot explain the pattern of results we observed in rEBA.
Supplementary Figure 13: Physical similarity between stimuli. (a) Similarity matrix of the Euclidean distance between images, averaged by stimulus type. For each stimulus type, the greatest similarity is with other members of the same stimulus type (main diagonal from top left to bottom right). (b) Pixel-wise discrimination index based on Euclidean distances. Each bar show the difference of the within stimulus-type distance and the between-stimulus type distance. A higher discrimination index indicates greater difference between that stimulus type and the others. Note that elbows and hands are the least distinct according to this measure in contrast with our fMRI results, which show strong discrimination for elbows and hands in rEBA.
Supplementary Figure 14: Supplementary Figure 13: Discrimination in retinotopic cortex. Average discrimination in left and right retinotopic cortex for body parts and half-faces as a function of field and side. Note that while there is some weak ability to discriminate, which is not surprising given the retinotopic differences between the stimuli, there is no evidence for the effect of natural experience observed in rEBA and rFFA (i.e. no interaction of Field and Side). Further, there was no significant pair-wise difference between sides of body in any visual field (all $p > 0.06$). # indicates significant discrimination (discrimination index $> 0$).
Supplementary Data 11: Behavioral discrimination performance for each body and face part.

Supplementary Figure 15: Accuracy of performance (d’) in the behavioral experiment broken down by stimulus type. Note that the pattern of response, with better performance for the right side of the body in the left visual field and for the left side of the body in the right visual field, is similar across all body parts.
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