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Differential contributions of occipitotemporal regions to person perception

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Abstract

Downing and Peelen have produced an excellent review synthesizing the current literature on the processing of body stimuli in visual cortex. However, while they consider the Extrastriate Body Area (EBA) and Fusiform Body Area (FBA) in combination, these regions are physically separate in cortex and must contribute differentially to person perception. Here, we evaluate the hierarchical view of processing in EBA and FBA and highlight the visual field biases in these regions, which may provide insight into their origin and functional roles.

We agree with Downing and Peelen that representations in EBA and FBA primarily reflect visual features of bodies, not higher-level cognitive information such as identity or emotion. However, there are two critical aspects of these regions that remain unclear, namely what are the differential contributions of EBA and FBA to person perception and why are there two regions?

Are EBA and FBA hierarchical?

Downing and colleagues have proposed that EBA primarily represents individual body parts whereas FBA represents the whole body (combination of body parts). Support for this view comes primarily from a study (Taylor, Wiggett, & Downing, 2007) demonstrating that while the selectivity in EBA increased gradually with increasing amounts of the body presented (finger, hand, limb, whole body), FBA exhibited a step-like function with no selectivity for single fingers or hands. Such a hierarchical account is similar to that proposed for faces and objects for which there are also two selective regions, one lateral and one ventral (e.g. Liu, Harris, & Kanwisher, 2010). However, as pointed out elsewhere (Op de Beeck, Brants, Baeck, & Wagemans, 2010), Taylor and colleagues did not counterbalance the body stimuli such that each body part occurred in both isolated and combined conditions. Thus, for example, torsos, only ever occurred in combination with fingers, hands and arms and apparent selectivity for combinations of body parts could be confused with torso selectivity, which has been reported near FBA (Op de Beeck, et al., 2010; Orlov, Makin, & Zohary, 2010). Further, other studies have found no difference in selectivity in FBA for isolated mixed body parts compared with headless bodies (Schwarzlose, Baker, & Kanwisher, 2005). Thus, the current evidence for hierarchical processing within body selective regions is not entirely compelling.

What do visual field biases tell us about EBA and FBA?

Both EBA and FBA show spatial biases within the visual field, which may be important for understanding their roles in person perception. First, FBA lies in a region of cortex with a foveal bias (Levy, Hasson, Avidan, Hendler, & Malach, 2001) and exhibits stronger responses to foveal than peripheral stimuli (Schwarzlose, Swisher, Dang, & Kanwisher, 2008). In contrast, EBA shows stronger responses for peripheral than foveal stimuli

(Schwarzlose, et al., 2008) and much of EBA appears to overlap regions with an underlying preference for peripheral space (Weiner & Grill-Spector, 2011). Thus, while FBA appears to be foveally biased, EBA appears to have a bias for more peripheral parts of the visual field.

Second, EBA shows an elevation bias with stronger responses for lower compared to upper visual field body stimuli (Schwarzlose, et al., 2008) and much of EBA overlaps maps of the lower visual field (Weiner & Grill-Spector, 2011). This lower field bias is also observed in nearby regions selective for motion (MT, Maunsell & Van Essen, 1987) and objects (Kravitz, Kriegeskorte, & Baker, 2010), and is consistent with their relative proximity to the lower field representation in early visual cortex. In contrast, FBA does not show a clear bias to either the upper or the lower visual field (Schwarzlose, et al., 2008), perhaps because of the strong foveal bias, although an upper field bias has been reported in nearby regions of ventral occipitotemporal cortex, such as object-selective pFs (Kravitz, et al., 2010). Body parts primarily occur outside the fovea in the lower visual field and this may account for the larger size of EBA relative to FBA (Chan, Kravitz, Truong, Arizpe, & Baker, 2010). In addition, a lower field bias has also been reported in regions of the dorsal visual pathway involved in the visual control of action (Danckert & Goodale, 2003).

In sum, while the specific roles of EBA and FBA in person perception are unclear, the underlying visual field biases in these regions must be taken into account in any theory of their relative functional roles. These underlying visual field biases may reflect the developmental and evolutionary origin of EBA and FBA. More data are needed to test the hierarchical account and clarify the nature of the underlying visual field biases.

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