

# Face to Face



Happy Holidays from us here at Dartmouth. It's been two years since you last heard from us, and we're excited to begin producing our newsletters again. We hope you will contact us if you have thoughts or feedback to share!

**-Prosopagnosia Research Center** (soc.per.lab@gmail.com)



## Which brain areas contribute to developmental prosopagnosia?

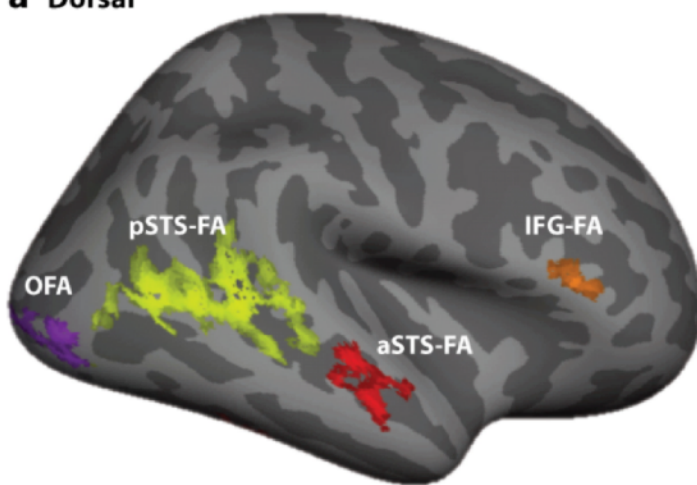
by Jiahui Guo

The human visual system contains category-selective areas that respond selectively to faces, bodies, scenes, and objects, and these areas are critical for recognition of these categories. Researchers have identified 12 or so areas that respond much more strongly to faces. These face areas are found in the ventral temporal cortex (VT), along the superior temporal sulcus (STS), and in the frontal lobe (Figure 1). (continues on page 2.)

## The Update

Since the last newsletter, the lab's personnel have changed a lot. Many of our researchers have moved on to other positions. Jiahui Guo is now the senior grad student, and two new PhD students have joined the lab. In this newsletter, we discuss results from an exciting project on developmental prosopagnosia, and we update you on three lab researchers.

**a Dorsal**

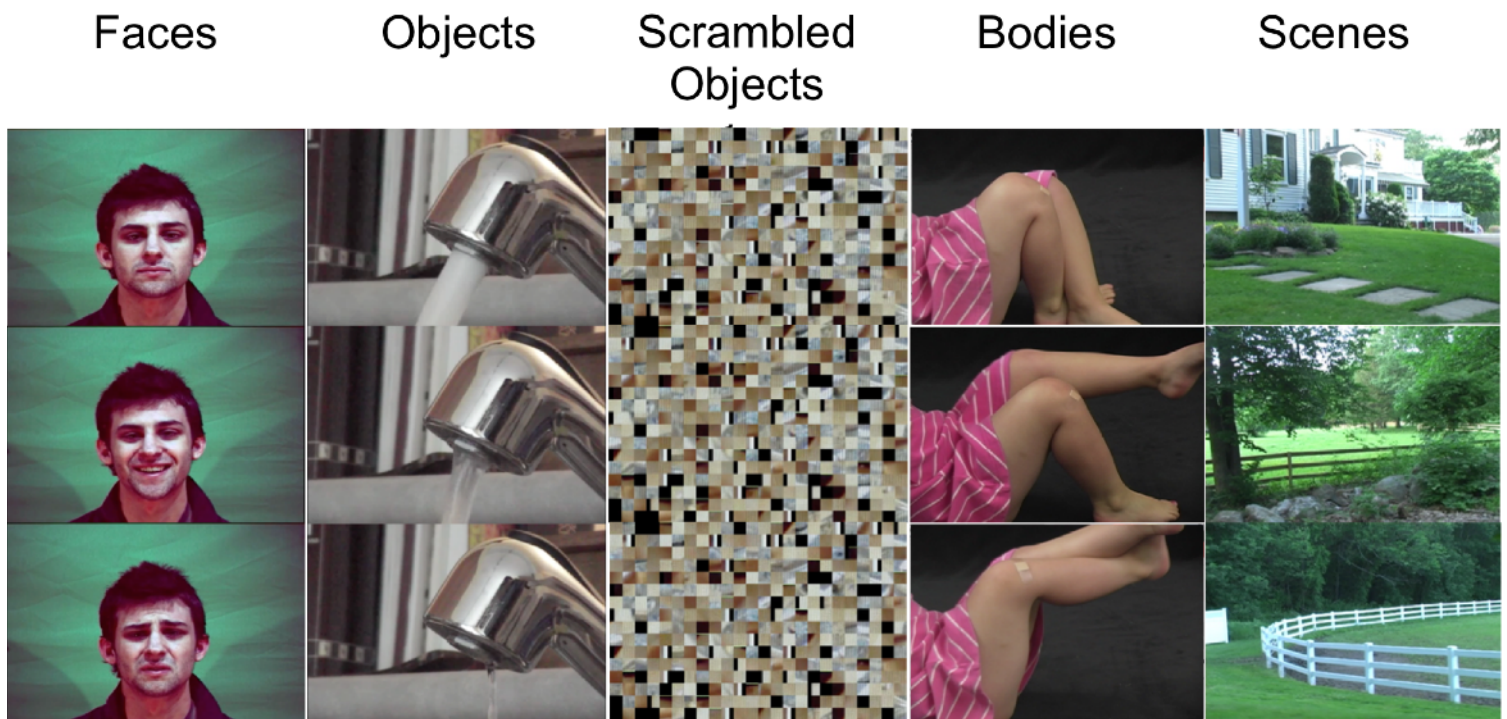


**b Ventral**



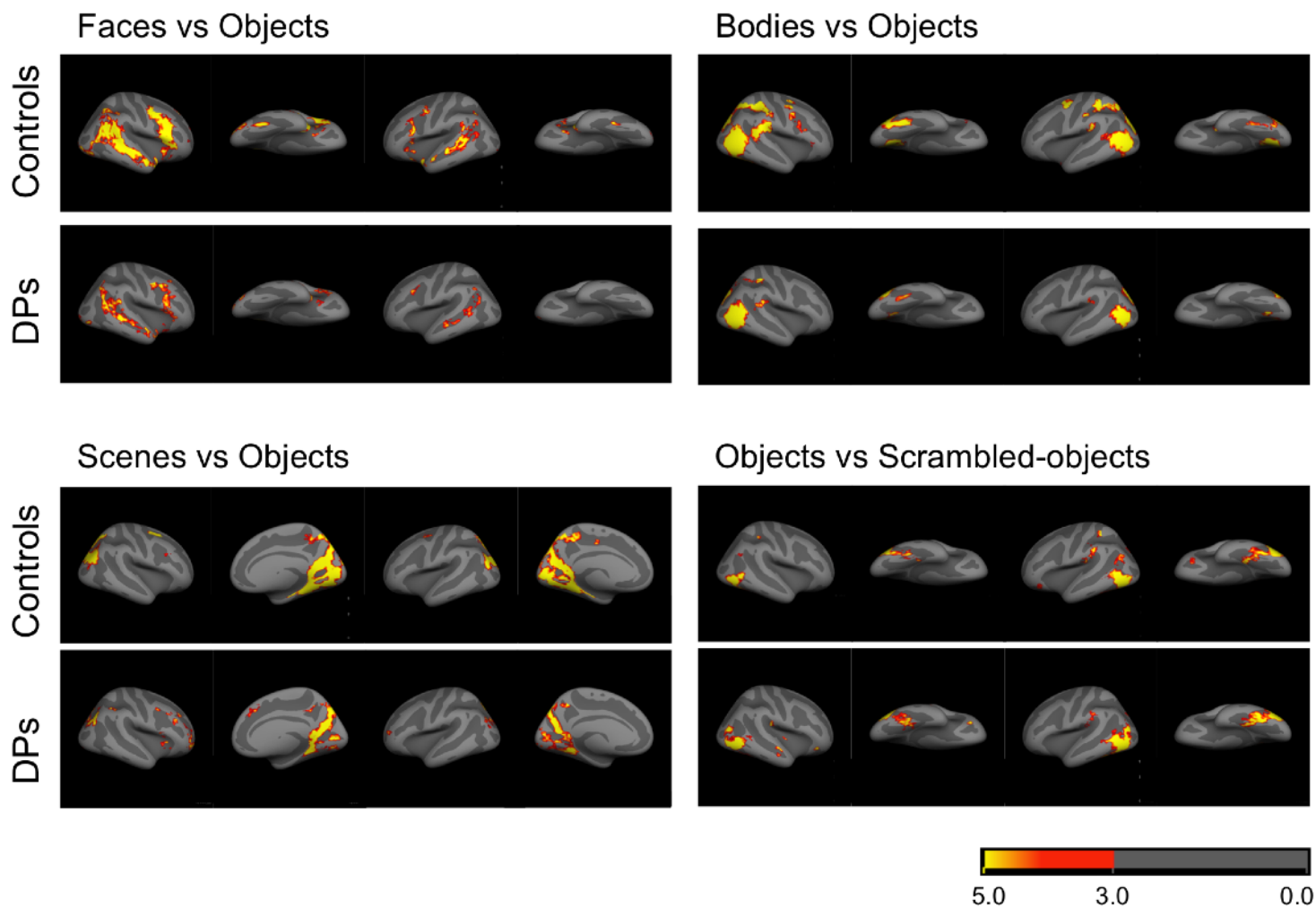
**Figure 1.** Face processing system. 1a shows areas along the STS (pSTS-FA, aSTS-FA) and on the frontal lobe (IFG-FA). 1b shows face areas along the bottom surface of the occipital and temporal lobes. (OFA, FFA, ATL-FA.) (Duchaine & Yovel, 2015).

However, it is still unclear which category-selective areas contribute to face deficits in developmental prosopagnosia (DP) and whether other category-selective areas function normally in DP. To address these issues, we scanned 22 DP participants and 27 controls at Dartmouth. We asked participants to watch short video clips of natural moving faces, scenes, bodies, objects, and scrambled objects (Figure 2) in the scanner and recorded their brain responses when they watch different kinds of video clips. Then we analyzed the data for each category-selective area and computed the selectivity for that area. Selectivity provides a way to measure how tuned to a particular category a brain region is by comparing how strongly a brain area responds to two different categories. For instance, face selectivity was defined as how much stronger the response in an area was to faces than to objects.



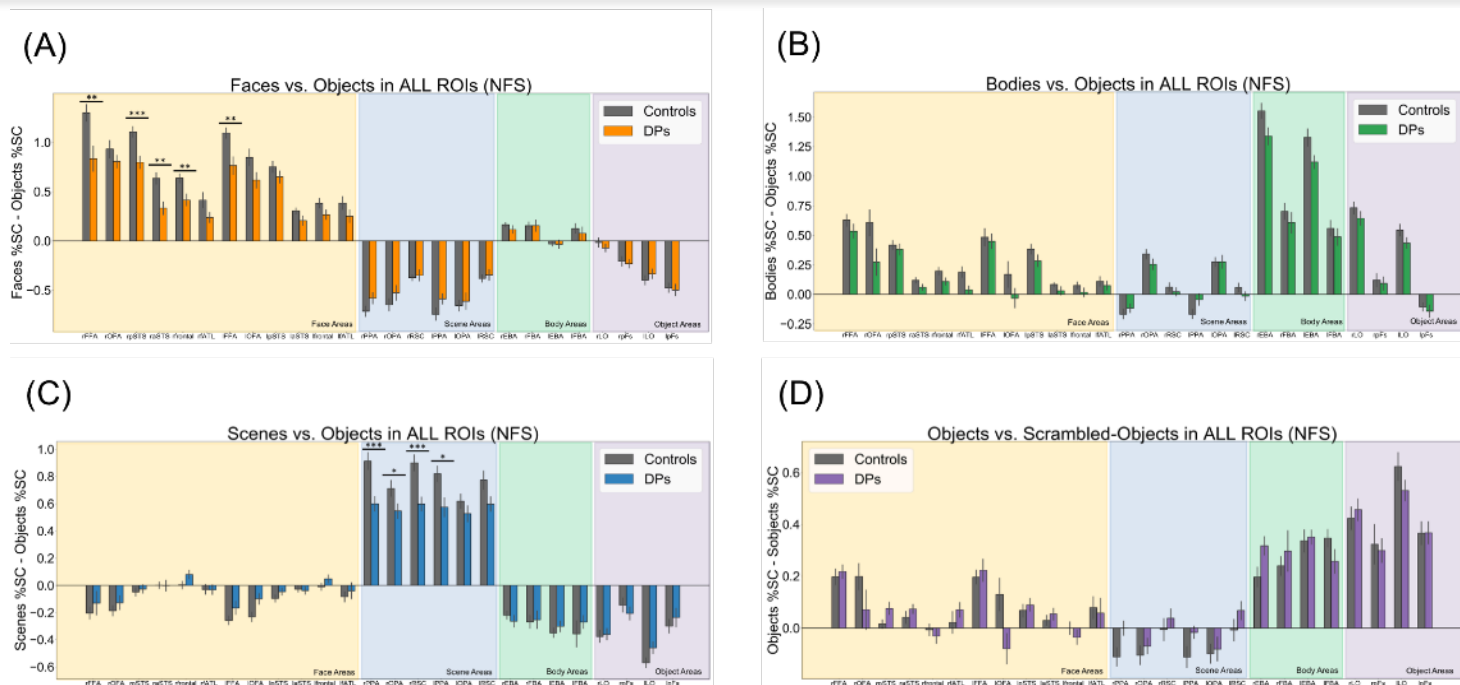
**Figure 2.** The natural stimuli contain five categories, and each category contains multiple short videos as stimuli. This figure displays three frames from an example video in each category.

First, we checked the distribution of different types of category-selectivity in the entire brain. Generally, DPs and controls shared a similar activation organization -- the areas that were colored in Figure 3 were in similar locations in the two groups. However, it is also pretty clear that the DP group had weaker selectivity for most categories -- DPs' brain has smaller yellow patches and more red color than the controls' brain in Figure 3.



**Figure 3.** Category-selectivity over the entire brain. The upper left corner shows the face-selectivity map. The upper right corner shows the body-selectivity map. The lower two shows scene-selectivity and object-selectivity map on the left and right, respectively.

Next, we quantitatively compared face selectivity in each area in the face processing system. We call each area a region of interest (ROI), and we included six face ROIs in each hemisphere. DPs' face selectivity was weaker in all the ROIs, and reached statistical significance in four ROIs in the right hemisphere as well as one ROI in the left hemisphere (Figure 4A). We also compared the face selectivity in areas selective for other categories (scenes, bodies, objects) that are outside of the face processing system, and the DP face selectivity was comparable to the controls selectivity in these other areas. That indicates that face processing deficits in DP originate in the face network and not in areas selective for other categories.



**Figure 4.** Category-selectivity across all category-selective areas. Each panel shows a different contrast: (A) face selectivity, (B) body selectivity, (C) scene selectivity, and (D) object selectivity. The panels are divided into four sections: face areas, scene areas, body areas, and object areas. Control values are shown in dark gray while DP values are colored. The vertical axis shows the difference for each contrast. For example, in Panel A in the first area (right FFA), the % signal change in controls for faces was about 1.25% greater than the % signal change for objects. The difference for DPs was around 0.8%. The asterisks indicate the difference between 1.25% and 0.8% was statistically significant. \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

Next, we compared the selectivity in DPs and controls for scenes, bodies, and objects. Like we found for face-selective areas, scene-selective areas showed a clear reduction in scene selectivity. Statistically, all three ROIs in the right hemisphere and one ROI in the left hemisphere reached significance (Figure 4B). In body-selective areas, DPs' body selectivity was lower in all ROIs, and one ROI in each hemisphere was marginally significant (Figure 4C). Unlike face, scene, and body areas, we did not find a difference in object selectivity between DPs and controls in object-selective areas (Figure 4D).

Our results demonstrate DPs have widespread deficits throughout the face network and the selectivity reductions in scene and body areas indicate DP often results from disruption of developmental processes contributing to broad swaths of cortex. The selectivity reductions we found in non-face areas fits with previous behavioral studies demonstrating that some, though not all, DPs have recognition deficits with categories other than faces.

*This research will soon be submitted to a journal, and it will eventually appear as:*

*Jiahui, G., Yang, H., & Duchaine, B. (2018). Developmental Prosopagnosics Have Widespread Selectivity Reductions Across Category-Selective Visual Cortex.*



*Researcher Spotlight*

## Sarah Herald



Sarah grew up in San Diego and received a B.S. in Computational Neuroscience from the University of Southern California. While at USC, she worked with Irving Biederman to study object recognition, face recognition, and phonagnosia (the inability to recognize people on the basis of voice).

Sarah is now a second-year Ph.D. student in Brad Duchaine's lab. Her current project examines how higher-level visual information (faces, objects, scenes) is integrated across the entire visual field. In her free time, Sarah enjoys listening to way too many podcasts.

Mary is originally from Germany and has received her B.Sc. and M.Sc. in Psychology from Leipzig University. She is currently a first-year graduate student with Brad Duchaine, working on her Ph.D. at Dartmouth College. Mary is interested in investigating which brain areas contribute to the complex processes that are involved in recognizing a person or deducing information from facial expressions and will research this with the help of those with prosopagnosia.

Mary divides her free time evenly between indoor and outdoor activities. Chances are you will see her hiking and enjoying the great outdoors with her dog, no matter the weather. Indoors she likes to explore all the great baked good recipes the United States have to offer.

## Marie-Luise Kieseler



## Tirta Susilo



Tirta Susilo moved on from postdoctoral position and is now running his own lab at Victoria University of Wellington, New Zealand. Some of you may have heard from him, because his lab is conducting online studies of developmental prosopagnosia. Those of you in and around that wonderful part of the world can get in touch with him under his new address: [susilolab@vuw.ac.nz](mailto:susilolab@vuw.ac.nz)