The neural basis of Face Identity Recognition in macaques with fMRI frequency-tagging

Marie-Alphée Laurent*[1], Pauline Audurier[2], Jean-Baptiste Durand[2], Jacques Jonas[1,3], Bruno Rossion[1], and Benoit Cottereau[2]

[1]Centre de Recherche en Automatique de Nancy – Université de Lorraine, Centre National de la Recherche Scientifique – France

[2]Centre de recherche cerveau et cognition – Université Toulouse III - Paul Sabatier, Centre National de la Recherche Scientifique, Toulouse Mind Brain Institut – France

[3]Service de neurologie [CHRU Nancy] – Centre Hospitalier Régional Universitaire de Nancy – France

Résumé

The face has great significance for social interactions in primates and is the most diagnostic information for identifying specific individuals. While monkeys appear particularly proficient at recognizing gaze, head orientation, and facial expressions, their ability to perform face identity recognition beyond image-based discrimination and similarly to humans is questionable (Rossion & Taubert, 2020). Having recently validated a powerful frequency-tagging fMRI face localizer (Gao et al., 2018) for non-human primate imaging (Laurent et al., in revision), here we extend this approach to target the neural basis of monkeys' recognition of variable natural images of facial identities. FMRI recordings were performed in two awake macaques. Natural images of a single unfamiliar identity were presented within a rapid 6Hz stream in two conditions: (1) with the same image across low-level (size, luminance, contrast) changes only, or (2) different images (background, head orientation, expression) changes additionally. Every 9s during a 243s run, variable natural images of 7 different unfamiliar identities were introduced in bursts. Either human or monkey faces, upright and upside-down, were presented. Analyses were performed in the Fourier domain where individual face discrimination responses were objectively identified and quantified, at the peak of the identity change frequency (0.111Hz), and its second harmonic (0.222Hz). Analyses focused on monkey face-selective regions defined with our functional frequency-tagging localizer, mainly in the STS (clusters PL, ML, MF, AL, AF). In all these regions, image-based individual face discrimination responses were found in both monkeys for condition 1, with a significant reduction for inverted faces in one monkey. Responses were negligible in condition 2, with little evidence of significant inversion effect for human and monkey faces. In contrast, preliminary evidence from two human subjects tested in the same paradigm indicates robust individual discrimination effects across both conditions in their core-selective ventral regions (OFA, FFA) and exhibits large inversion effects, restricted to conspecific face pictures. This extension of the frequency-tagging fMRI approach provides the first evidence of fMRI adaptation to different face identities in non-human primates. However, contrary to humans, this effect appears to be essentially restricted to image-based discrimination, with no evidence of significant advantage for conspecific faces.

*Intervenant

Mots-Clés: face identity discrimination, macaque, fMRI, vision, nonhuman primate, frequency tagging, face inversion