**Hamid Karimi-Rouzbahani**,

MRC Cognition and Brain Sciences Unit,

University of Cambridge, Cambridge, CB2 7EF, UK

Email: [hamid.karimi-rouzbahani@](mailto:hamid.karimi-rouzbahani@)mrc-cbu.cam.ac.uk

Phone: +44 75 0865 0947



**Masoud Ghodrati**,

Department of Physiology, Neuroscience Program,

Biomedicine Discovery Institute,

Monash University, Clayton, VIC 3800, Australia

Email: [ghodrati.masoud@gmail.com](mailto:ghodrati.masoud@gmail.com)

Phone: +61 469 726 096

Editor-in-Chief

*Nature Communications,*

We are pleased to submit an original research article “Perceptual difficulty modulates the direction of information flow in familiar face recognition” for consideration for publication in *Nature Communications.* The preprint is available at <https://doi.org/10.1101/2020.08.10.245241>.

Faces are crucial for our social interactions, allowing us to extract information about identity, gender, age, familiarity, intent and emotion. Humans categorise familiar faces more quickly and accurately than unfamiliar ones. The neural correlates of this behavioural advantage suggest an enhanced representation of familiar over unfamiliar faces in the brain. One of the main limitations of previous studies, which hinders our progress in understanding of familiar face processing and the role of different brain areas, is that they mostly used celebrity faces as the familiar category. A better understanding of familiar face recognition in the brain requires characterising the computational steps and representations for sub-categories of familiar faces, including personally familiar, visually familiar, famous, and experimentally learned faces. This manuscript takes a novel approach to studying familiar face processing by asking *whether there is a “familiarity spectrum” for faces in the brain, with enhanced representations for more vs. less familiar faces along the spectrum, and how levels of face familiarity and perceptual difficulty impact the neural dynamics of face processing.*

This work combines behavioural psychophysics, human electroencephalography (EEG) and a novel brain connectivity analysis to address these fundamental questions. We show the existence of a neural familiarity spectrum using electroencephalography. We also demonstrate that feed-forward (peri-occipital to peri-frontal) information flow is dominant for familiar faces and was maximised for the most familiar faces. In particular, using our novel connectivity analysis method, we show that top-down (peri-frontal to peri-occipital) information flow was only dominant when sensory evidence was insufficient to support face recognition. Our results demonstrate that perceptual difficulty and the level of familiarity influence the neural representation of familiar faces and the degree to which peri-frontal neural networks contribute to familiar face recognition.

We believe that this manuscript will be of interest to a broad audience as it combines a range of technical approaches to address an enduring and fundamental question in face processing in the brain - how does familiar face processing unfolds in the brain and ultimately affects perception. By systematically varying familiarity across stimuli, and examining spatiotemporal dynamics of familiar face recognition, our manuscript creates a novel paradigm and analysis methodology for future studies in face processing at the perceptual and neural levels.

We suggest the following reviewers, with whom we have no conflicts:

Meike Ramon

*Department of Psychology, Université de Fribourg*

*Email:* [*meike.ramon@unifr.ch*](mailto:meike.ramon@unifr.ch)

Gyula Kovacs

*Institute of Psychology, Friedrich Schiller University Jena*

*Email:* *gyula.kovacs@uni-jena.de*

Hamed Nili

[*Nuffield Department of Clinical Neurosciences*](https://www.ndcn.ox.ac.uk/team/hamed-nili)*, University of Oxford*

*Email:* [*hamed.nili@ndcn.ox.ac.uk*](mailto:hamed.nili@ndcn.ox.ac.uk)

Yalda Mohsenzadeh

*Brain and Mind Institute, Western University*

*Email:* [*ymohsenz@uwo.ca*](mailto:ymohsenz@uwo.ca)

Mike Burton

*Department of Psychology, University of York*

*Email:* [*mike.burton@york.ac.uk*](mailto:mike.burton@york.ac.uk)

Ida Gobbini

*Department of Experimental, Diagnostic and Specialty Medicine, University of Bologna*

*Email:* [*mariaida.gobbini@unibo.it*](mailto:mariaida.gobbini@unibo.it)

Sincerely,

Hamid Karimi-Rouzbahani

Farzad Remezani

Alexandra Woolgar

Anina Rich

Masoud Ghodrati

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