To: The Editors, *NATURE*: *Human Behavior*

Regarding the MS: “Face recognition invariance in four upright and inverted facial orientations”

Our ability to recognize faces accurately is fundamental to our social interactions. Human relationships would collapse if people were unable able to recognize the faces of others (including their facial reactions and emotions). A core research topic concerning the cognitive mechanism of face recognition is the Face Inversion Effect (FIE). A consistent result of this research is that the ability to recognize an inverted face is much lower than that of an upright face. Research in FIE has focused on explaining this phenomenon. To the best of our knowledge, no research has attempted to answer the following question: How does the cognitive system compare an inverted face to an upright one? This question directly touches on the mechanism responsible for the recognition of faces. An important aim of the present study is to answer this question empirically alongside other questions that arise from this research program (see below).

We tested two hypotheses: the *visual-similarity* hypothesis proposes that the comparison is made based on the similarity between the inverted and the upright faces, while the *mental-rotation* hypothesis suggests that the inverted face is rotated to the position of the upright face, a condition that allows an easy decision as to whether the two faces are congruent or not. Moreover, since the angular disparity between an inverted face and an upright one was held constant in the current study, the *mental-rotation* hypothesis would predict that the experimental manipulation will have no effect on face recognition. In contrast, the *visual-similarity* hypothesis would predict a strong effect.

The results of the experiments tend to support the *visual-similarity* hypothesis. Furthermore, it was found that facial recognition is based on certain mutual facial elements in the inverted and the upright faces that resist the transformations of inversion. That is to say, the similarity found between an upright face and an inverted face (UI) has also been discovered (by additional research) for the following orientations: UU, IU, and II. This finding motivated a new research program for finding whether the manipulation made in the UI group will be obtained also in the other three groups: UU, IU, and II. Recently our research has been completed (the study continued for a long time because of the Covid-19 pandemic). The results show the same effect in all four situational orientations: UI, UU, IU, and II. This is a remarkable finding, since as mentioned above, the ability to recognize an inverted face is much lower than that of an upright face. We call this phenomenon: Face-Recognition Invariance.

We believe that the present study’s research question and findings are new and of the highest theoretical importance for the study of face perception and recognition.

The report has a total of 3717 words and should fill no more than six and a half pages of the journal.

Thank you for your time and consideration,

Best wishes,

Sam S. Rakover, Professor