

FaceReader 4 emotion classification performance on images from the Radboud Faces Database

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The goal of the current research was to test the emotion classification performance of the latest FaceReader version. FaceReader is a software program that can automatically detect faces in pictures / videos and classifies them into one of the following emotional expressions: Sadness, anger, fear, surprise, disgust, happiness, or a neutral expression.

Here we present the FaceReader's classification performance on the Radboud Faces Database (RaFD; Langner et al., 2010). The RaFD is a highly standardized set of pictures containing images of eight emotional expressions. Based on the Facial Action Coding System (Ekman, Frieser, & Hager, 2002), each depicted model was trained to show the following expressions: Anger, disgust, fear, happiness, sadness, surprise, contempt, and a neutral expression. Furthermore, the emotional expressions are shown with three different gaze directions: directed to the left, frontal or right. For the current project we tested FaceReader on 1197 RaFD emotional faces: 18 Moroccan males, 20 Caucasian males, and 19 Caucasian females (59 models x 7 emotional expressions x 3 gaze directions). We first report results of an overall analysis and then for separate subsets, comparing the Caucasian males with females, the Moroccan with Caucasian males and the Moroccan males with the Caucasian females. Overall FaceReader was able to fit 97.4% (1166 of 1197) of the pictures to one of the seven emotional expressions. Note that the RaFD is a highly standardized set of images and that FaceReader performance on less standardized images might be impaired.

All Faces

We ran FaceReader with default settings on all 1197 pictures and assessed its classification performance with RaFD intended emotional expressions as criterion. Classifications were coded as correct (1) or incorrect (0) and subjected to an analysis of variance (ANOVA) with Intended Emotional Expression (anger, disgust, fear, happiness, sadness, surprise, and neutral) and Gaze Direction (left, frontal, and right) as between image factors. The results show that in total 90% of the pictures were correctly classified

and that classification performances differed between Intended Emotional Expression, $F(6,1176) = 4.030$, $p < .01$. Some of the emotional expressions were more (or less) often classified correctly than others.

A comparison between expressions showed that happy ($M = 96\%$), surprised ($M = 94\%$) and angry ($M = 93\%$) faces were more often correctly classified than faces with a neutral ($M = 87\%$), sad ($M = 87\%$), fearful ($M = 85\%$) or disgusted ($M = 85\%$) expression (for an overview see Figure 1). No effects of Gaze Direction were found and therefore this factor was not included in further analyses.

Caucasian male versus female faces

Next, an analysis was performed on the Caucasian male and female pictures (see Figure 2). An ANOVA on the emotion classification correctness data with Intended Emotional Expression (anger, disgust, fear, happiness, sadness, surprise, and neutral) and Gender (male vs. female) as between image factors was performed. A main effect for Intended Emotional Expression, $F(6,805) = 4.183$, $p < .01$, and a Gender x Intended Emotional Expression interaction, $F(6,805) = 2.882$, $p < .01$, were found. Moreover, in general the classification performance between the two groups did not differ, but some emotional expressions were better classified on one group than the other.

The average emotion classification results for the two groups together show almost the same pattern as the overall pattern. The only exception is the increase of correctly classified sad faces ($M = 92\%$). Comparing the classification performance between males and females, we found that especially fearful female faces ($M = 91\%$) were more often correctly classified than fearful male faces ($M = 77\%$). Angry male faces ($M = 100\%$) were significantly more often correctly classified than angry female faces ($M = 86\%$).

Moroccan versus Caucasian male faces

We then analyzed the FaceReader classification performances on all male pictures (see Figure 2). An ANOVA on the emotion classification correctness data with Intended Emotional Expression (anger, disgust, fear, happiness, sadness, surprise, and neutral) and Ethnicity (Moroccan vs. Caucasian) as between image factors was performed. An Intended Emotional Expression main effect, $F(6,784) = 4.667$, $p < .01$ and a significant Intended Emotional Expression x Ethnicity interaction effect, $F(6,784) = 2.168$, $p = .044$, were found. Meaning that, although there was no difference between ethnicities in general, some emotional expressions were better classified for one than the other ethnicity.

The general classification performance for these two groups could be divided in two groups of emotions with the neutral expression in the middle ($M = 89\%$). Angry, happy, surprised faces (successively 96%, 95%, and 94%) were significantly more often correctly recognized than disgusted, sad, and fearful faces (successively 83%, 82%, and 82%). Comparing the two ethnicities we found that sadness was more often correctly classified on Caucasian ($M = 88\%$) than Moroccan faces ($M = 76\%$). In contrast, fearful Moroccan faces ($M = 87\%$) were more often classified correctly than fearful Caucasian faces ($M = 77\%$).

Moroccan males versus Caucasian females faces

Finally, we analyzed the FaceReader classification performances on the Moroccan male and Caucasian female pictures (see Figure 2). An ANOVA on the emotion classification correctness data with Intended Emotional Expression (anger, disgust, fear, happiness, sadness, surprise, and neutral) and Gender (male vs. female) as between subject factors was performed. This analysis yielded only a Gender x Intended Emotional Expression interaction effect, $F(6,763) = 2.739$, $p = .012$. Comparison between groups revealed that only sad faces were more often correctly classified for female Caucasian ($M = 96\%$) than male Moroccan ($M = 76\%$) faces.

References

- Ekman, P., Friesen, W. V., & Hager, J. C. (2002). Facial Action Coding System: The manual. Salt Lake City, UT: Research Nexus.
- Langner, O., Dotsch, R., Bijlstra, G., Wigboldus, D. H. J., Hawk, S. T., & van Knippenberg, A. (2010). Presentation and validation of the Radboud Faces Database. *Cognition and Emotion*, 24(8), 1377-1388.

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Figure 1. Classification matrix (all faces)



