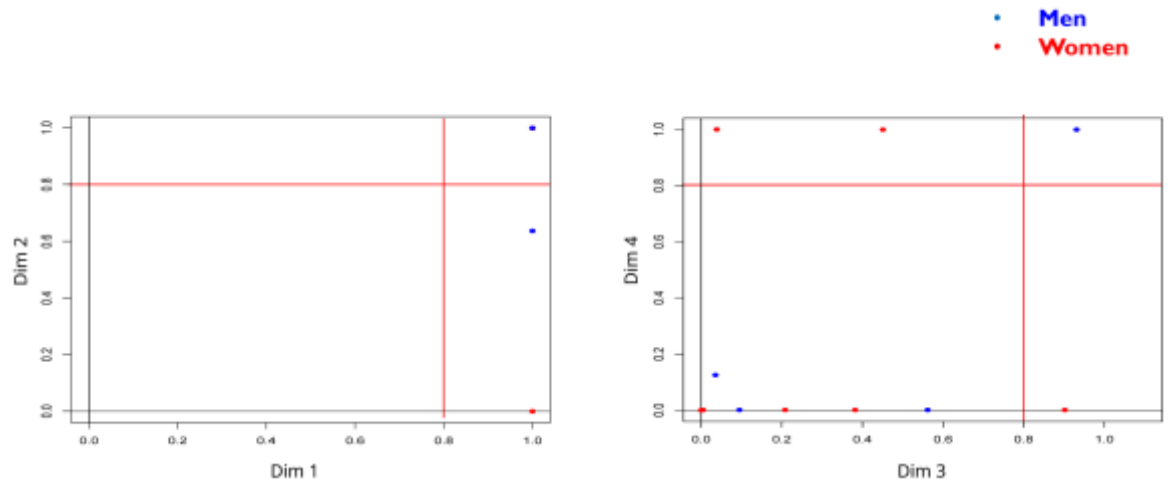
Supplementary materials

Age/Gender/Emotions, Experiment 3

Subject Map

To assess the homogeneity of categorization, analysis was performed on the factor maps derived from the populations of participants with respect to the 4 principal dimensions. Taking an arbitrary value of 0.8, the analysis showed that most subjects used the Emotion (Dim 1) and Age criterion (Dim 2). The choice of the criteria of Gender, present in both Dim 3 and Dim 4, is less consistent across subjects. No differences between men's and women's strategies were found.

Supplementary Figure 1. The usage of the dimensions for Age/Gender/Emotions by the subjects (Experiment 3)



The majority of subjects used the Emotion (Dim 1) and Age criterion (Dim 2) according to the arbitrary threshold (0.8) indicated by the red line. For the high level of categorization, subjects are often presented at the same point giving the number of points less than the number of subjects.

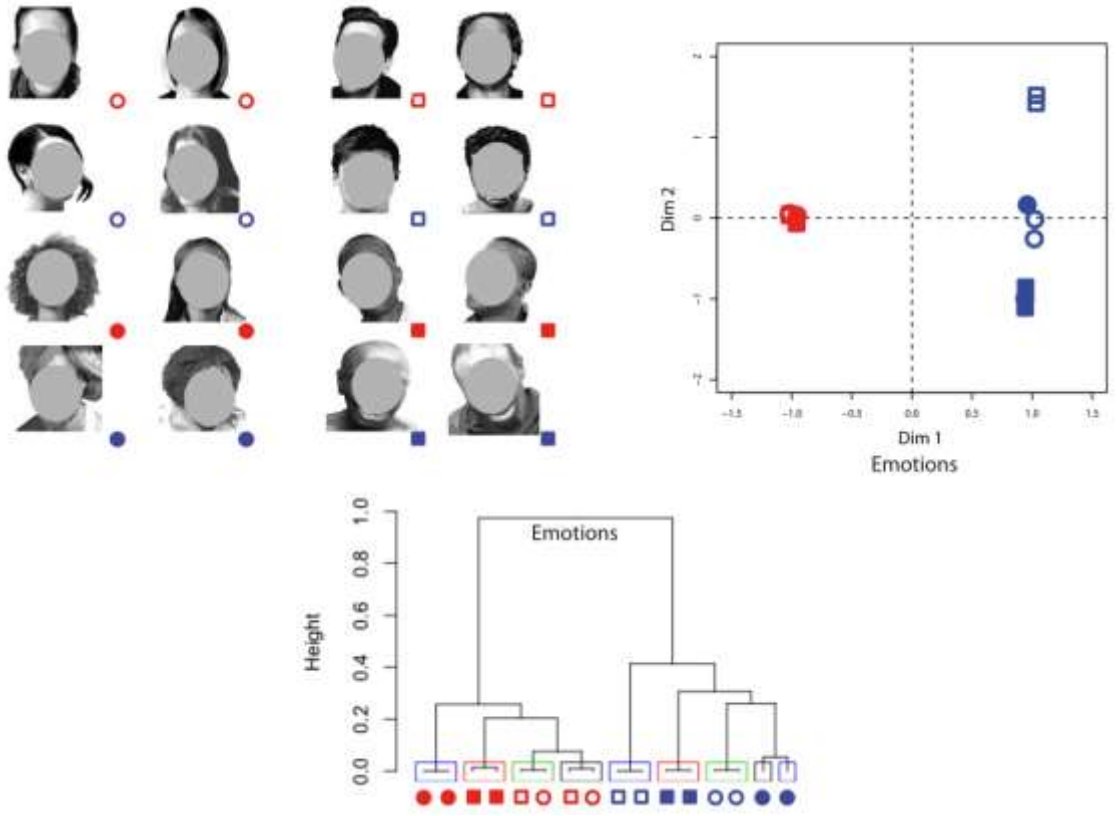
Word cloud

In the group of subjects who performed visual face categorization with this set of stimuli, according to the subjects' comments on the created categories, the most used criterion was emotions (in 100% of subjects), then Age (55% of subjects), then Gender (35% of subjects). The raw data concerning the comments can also be visualized with Word clouds (Sup. Figure 5).

Emotions/Gender/Ethnicity (African-Caucasian), Experiment 4b

In this case, the most used criterion in the comments to the created categories was Emotion in 100% of participants, then Gender (45% of subjects), then Ethnicity (25% of participants). In MCA maps, emotions remained again the main categorization factor (1st dimension, 28.6% of variance) followed by Gender (2nd dimension, 14.5% of variance, and the 3rd dimension, 13.3% of variance). The Ethnicity factor was associated with Gender in the next dimensions: dimension 5 reflected ethnicity in men (9.15% of variance) and dimension 6 ethnicity in women (8.26% variance).

Supplementary Figure 2. Effect of different Ethnicity on emotions and Gender.



Square – male, Circle – female; Red – laugh, Blue – cry; Filled - African, Unfilled –Caucasian. Faces hidden for publication. Emotions remained again the main categorization factor (1st dimension, 28.6% of variance, 95% of participants) followed by Gender (2nd dimension, 14.5% of variance, 85 and the 3rd dimension, 13.3% of variance).

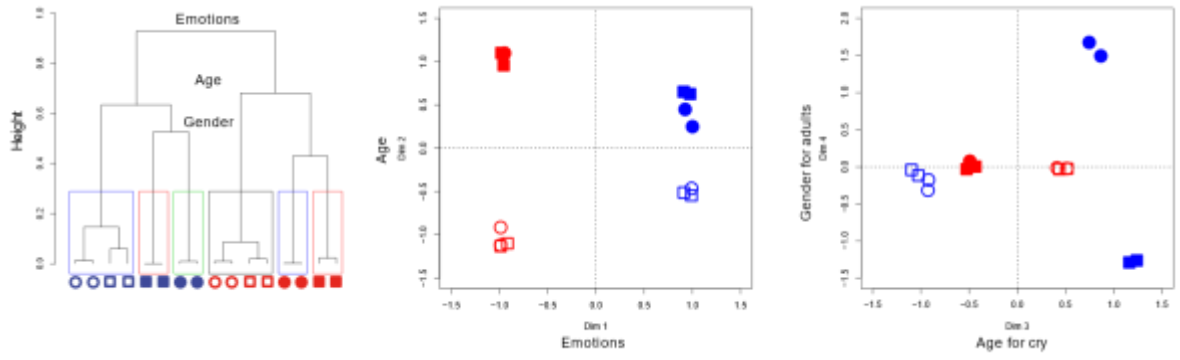
The fact that the categorization organization is not as clear as in the previous protocols is probably due to the fact that some subjects censored themselves from applying a choice based on Ethnicity while others did not.

Age/Gender/Emotions in voices, Experiment 3b

An auditory free sorting task was proposed to a new group of participants. Sounds were presented in stereo, with Sennheiser HD 280 pro headphones, at a subjectively comfortable level adjusted for each participant. The sixteen voice sounds were represented on the computer by sixteen numbered and colored squares without any image. Sounds were played by using the PC mouse to double-click on each square. Participants were asked to run a sound categorization task, creating categories by dragging and positioning squares together on the screen. There was no limit on the amount of time given to complete the test or the number of times a specific sound could be listened to (the number of playbacks).

Concerning voices, the approach to the rating according to some factors was more lenient due to the natural resemblances of pitch: the voices of boys and girls are hardly distinguishable (rating of Gender for children voices 4.7±0.5, SD), while the distinction of Gender in adult voices is high: (gender rating 6.9±0.2). This constitutes a certain limitation of the auditory study. Table 1 presents the average value between the adult and children's voices (5.8±1.8).

Supplementary Figure 3. Voice categorization with Emotion-Age-Gender factors

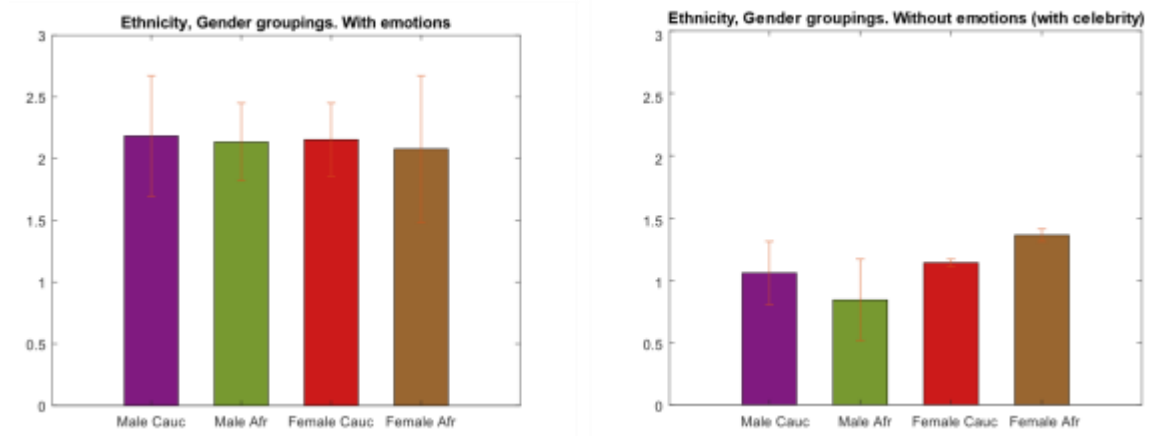


Results of categorization for voices: a dendrogram and the MCA maps for the 4 dimensions.
Square – male, Circle – female; Red – laugh, Blue – cry; Filled - old, Unfilled –young. Emotions have the most important distinction, followed by Age and Gender, in the same way as for the visual stimuli. However, in children, there is no distinction between genders in voice.

Euclidian distances for different factors within the groups

To measure the grouping of points, Euclidian distances between all the points were calculated for the first three dimensions for categorization results. These distances were compared for all the categories in the categorization results.

Supplementary Figure 4. Effect on categories grouping



On the left are the distances between stimuli in the presence of emotional expressions. On the right are the distances between the stimuli of the same categories for the neutral faces. In each category, the distances between the images were smaller in the absence of emotions ($p<0.05$, bootstrap).

Effect on categories segregation

As for the distances between the groups, they were modified by emotions only for the Gender (between males and females) and for the Ethnicity (between Africans and Caucasians) factors. However, the between-group separation is only an indirect estimation because the distances in MCA maps mainly reflect the grouping level: the points are close as they are placed in the same group by many subjects.

In addition, if we consider Emotion only, the grouping for this factor is similar to other factors in the experiments with emotions; however, the grouping for emotions is less pronounced than for different factors (Age, Gender, Ethnicity, Celebrity) in the experiments without emotions. Thus, in the experiments with emotions, all the categories are less grouped together than in the experiments without emotions.

Supplementary Figure 5. Word clouds for the comments made by the subjects for the categories.

Emotions, age, gender

Exp.3

Emotions, age, gender, in voices

Exp.3b

Emotions, gender, different ethnicity

Exp.4

Emotions, gender, same ethnicity

Exp.4b

Emotions, gender, familiarity

Exp.5

Emotions, gender, same ethnicity

Exp.1

Gender, familiarity, same ethnicity

Exp.2

In the experiments with facial emotions present, they are the most frequent words used in the comments on the formed groups. Emotional descriptors were not used to describe the groups in the experiments without facial emotions.

Go/no Go Discrimination task and Reaction time for social categories

A supplementary set of 12 subjects who did not participate in the FST were recruited (7 women, Age 26±6 (SD)) to perform a discrimination task of facial attributes corresponding to the 3 main social categories previously used, namely Gender, Ethnicity, and Age.

The visual stimuli were a set of 96 human faces obtained from the American Multiracial Faces Database (Chen et al., 2021). The set consisted of adult or children faces of African or Caucasian Ethnicity, making 48 male and 48 female, 48 children, and 48 adults, and 48 African and 48 Caucasian altogether. All images were normalized for contrast and luminance and were presented twice for each task in a random order resulting in 192 presentations for each task.

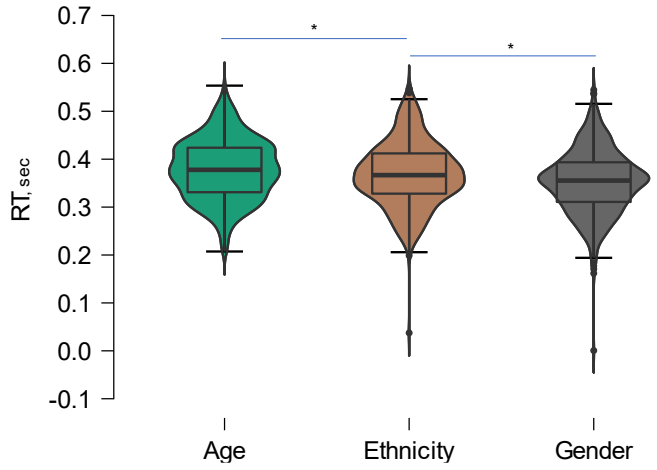
The task is a Go/no Go discrimination task in which the subjects had to press a button as fast as possible when the face corresponds to the Go criteria. In the first task, the Go criterion was the Gender (press if the face is a man); in the second task, the Go criterion was the Age (press if the face is a child); in the third task, the Go criteria was the Ethnicity (press if the face is a Caucasian). The order of the Go criteria (Age, Gender, and Ethnicity) was randomly balanced for each subject as well as the target (men vs. women, children vs. adults, African vs. Caucasian).

Images were presented on a monitor screen for a duration of 50 ms, with a maximum time of 500 ms to respond and 700 ms of inter-trial delays. Anticipation trials (RTs values lower than 20 ms) were excluded from the analysis.

The analysis showed that Gender is the most recognized criterion (56,5% Hits), followed by Ethnicity (48,7% Hits) and Age (47,1% Hits). Using the linear model with repeated measures (lme4 package in R) estimated by Anova (car package in R) with Tukey post hoc tests, we found a significant difference between Gander and Ethnicity ($p<0.001$) as well as between Gender and Age ($p<0.001$).

Similarly, we observed a statistical difference between the RTS for each criterion, gender discrimination being the faster (0.35 ms) compared to Ethnicity (0.37 ms) and Age (0.38 ms). Using the linear model with repeated measures (lme4 package in R) estimated by Anova (car package in R) with Tukey post hoc tests, we found a significant difference between Gander and Ethnicity ($p<0.001$), Age, and Ethnicity ($p<0.05$), as well as between Gender and Age ($p<0.001$).

Supplementary Figure 6. Reaction times for Age, Gender and ethnicity



When subjects have to discriminate between Age, Gender, and Ethnicity, it appears that Gender is the fastest, while age discrimination is the slowest, with Ethnicity being intermediate.

References

Chen, J.M., Norman, J.B., Nam, Y., 2021. Broadening the stimulus set: Introducing the American Multiracial Faces Database. Behav Res 53, 371–389. https://doi.org/10.3758/s13428-020-01447-8