A Physical Factor Explaining the Effect of Smiling on Gender Perception

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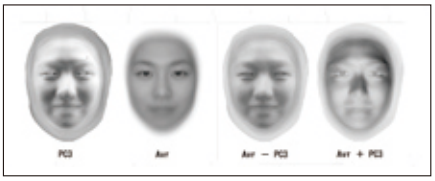
Previous studies found that smiling faces are perceived to be more feminine than neutral faces. This effect could be explained by several factors. One possible factor explaining this effect is a factor due to a perceiver. That is, people might have a tendency to recognize that a smiling face implies a female face. Another possible explanation involves a physical resemblance between women's faces and smiling faces. This study has a two-fold purpose: (1) to replicate the effect of smiling on the assignment of gender by conducting a psychological experiment and (2) to examine whether this effect might be due to the latter possibility, i.e., the physical commonalities between a smiling face and a woman's face, by applying a computational analysis to facial images. The same set of facial images was used in both the psychological experiment and the computational analysis. The models for the facial images were 96 students (48 men and 48 women). Photographs of both smiling and neutral facial expressions of each model were captured using a digital camera; a total of 192 facial images were obtained. In the psychological experiment, the 192 photographs were divided into two subsets of 96. For each of the subsets, either a neutral or a smiling face of each of the models was randomly selected, such that the number of images in each of the four categories (defined by gender (male vs. female) and facial expression (neutral vs. smiling)) was 24. One of the two subsets was assigned to one observer of a pair of observers, and the other subset to the other member of the pair. Consequently, each pair of observers together rated all the 192 images once. The observers' task was to rate the masculinity of men's faces and the femininity of women's faces. The results showed that smiling significantly reduced the perceived masculinity of men's faces, whereas no effect of smiling on femininity ratings was obtained for the women's faces.



A principal component analysis (PCA) was conducted on the same 192 facial images used in the rating experiment to examine whether principal components were common to the identification of both gender and facial expression. Initially, the pixel luminance values for each facial image were represented by a vector. The principal components, principal component scores (PC scores), and the rates of explained variance were calculated by applying PCA to a matrix of the dimension of each vector multiplied by the number of images. Through this process, the vector of each facial image can be represented as a linear summation of the principal components weighted by the PC scores. Principal components can be said to correspond to the largest common elements across faces. The explained variances are relatively large for the first five principal components. Among these, the third principal component accounted for variance in both face gender and facial expression judgments, whereas no other principal component contributed to the prediction of these variables. The result of the PCA suggests that the principal component involved in distinguishing the smiling faces from neutral faces is also the principal component that represents face gender. Therefore, a smiling face may give the perceiver an impression of the person being less masculine (or more feminine) because women's faces typically share certain common physical characteristics with smiling faces. These PCA results corresponded very well with those of the rating experiment. Furthermore, composite images constructed from the principal component vectors can pictorially illustrate the parallel relationship between perceptual effects and the statistical results of the PCA. A face-like image can be generated by transforming the values of the elements of an obtained principal component into luminance values, and plotting them at their original coordinates. The image labeled "PC3" in Fig. 1 is comprised of images reconstructed by the third principal component. Its perceptual meaning can be speculated upon when the component is compounded with the averaged face. The averaged face, labeled as "Avr" in Fig. 1, can be constructed by plotting the averaged luminance values in each pixel across all the 192 images. The images labeled "Avr – PC3" and "Avr + PC3" in Fig. 1 were constructed by subtracting or adding the third principal component to the averaged image (Avr). The image "Avr – PC3" appears to be a woman's face, as well as a smiling one. In contrast, the image "Avr + PC3" appears to be a man's face, one that is not smiling. These pictorial representations also suggest that the third principal component distinguishes both women's faces from men's faces and smiling faces from non-smiling ones. The findings of the psychological experiment and the PCA analysis cooperatively provide some clear evidence that the effect of facial expression on the assignment of gender depends on the physical relationship between the expression and gender contained in the face itself.

Superstructure-Dependent Optical and Electrical Properties of an Unusual Face-to-Face, π-Stacked One-Dimensional Assembly of Dehydrobenzo[12]annulene in the Crystalline State

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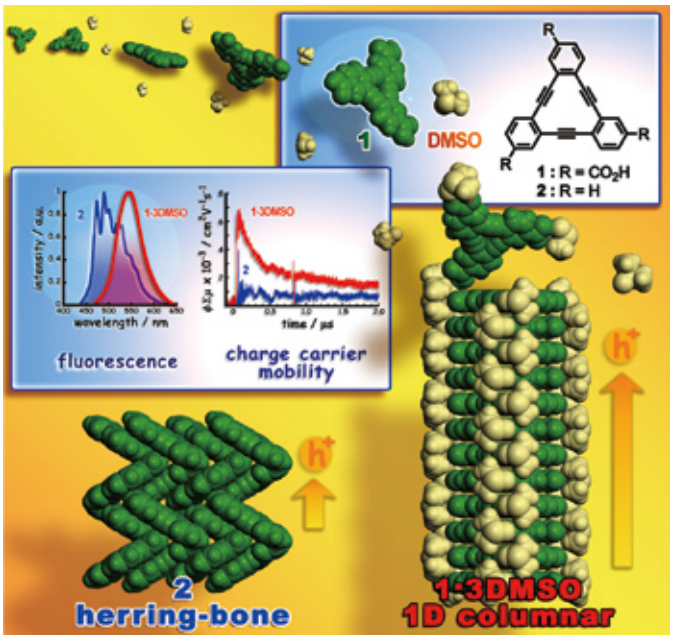

Among various molecular arrangements observed in supramolecular assemblies, a π-stacked one-dimensional (1D) assembly is one of the most fundamental and fascinating ones because the interactions between the π-orbitals of the stacked molecules provide the pathway for charge or exciton migration to exhibit functional properties. In this context, we successfully constructed a face-to-face π-stacked 1D assembly based on a triangular dehydrobenzoannulene (DBA) **1** core in the crystalline state and revealed its superstructure-dependent optical and electrical properties.

The parent compound **2** is known to crystallize in a herringbone fashion. Thus, to modulate the molecular arrangement, we introduced carboxyl groups into its periphery, because the groups can easily interact with other hydrogen-bondable compounds, to modulate the DBA arrangement. DBA **1** co-crystallized with dimethyl sulfoxide (DMSO), giving crystal **1**·3DMSO, in which a face-to-face π-stacked 1D assembly was achieved. Interestingly, DMSO molecules, bonding with the DBA through the hydrogen bonds, formed well-fitted scaffolds through self-complementary CH•••O=S hydrogen bonds, preventing the DBA cores from CH/π interactions or slipped stacking. This is the first example of the DBA to stack completely orthogonal to the columnar axis.

The powdered crystals of **1**·3DMSO provides a red-shifted, broadened, weakened fluorescence spectrum (λ_{max} = 545 nm, ϕ_F = 0.01) compared to unambiguous spectrum of **2** (λ_{max} = 491 nm, ϕ_F = 0.12) due to strong interactions between the π orbitals of the stacked molecules, although they showed the similar spectral profiles in the solutions. The charge-carrier mobility measurements of the single crystal of **1**·3DMSO, as well as **2**, by flash photolysis time-resolved microwave conductivity (FP-TRMC) technique revealed that **1**·3DMSO had the significantly-anisotropic mobility ($\mu = 1.5\times10^{-1}$ $cm^2V^{-1}s^{-1}$) along the columnar axis, which is 12 times larger than that along the orthogonal axis and 5 times larger than that of **2**.