

Running Head: FACES—A DATABASE ...

FACES—A Database of Emotional Facial Expressions in Young, Middle-Aged, and Old
Women and Men: I Description

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Abstract

Faces—neutral and emotional—are a unique and widely used category of experimental stimuli in various research fields, and interest in the development of their perception and processing is growing. Only few collections of facial stimuli are available until now. Even more importantly, none of the existing collections systematically varies the faces' age and emotional expression. Consequently, most research to date has used young faces, often only displaying neutral facial expressions, and was therefore restricted in investigating hypotheses concerning various age groups and emotions. We created the FACES database comprising a large number of naturalistic faces of young, middle-aged, and old women and men, each person displaying six facial expressions (*neutrality, sadness, disgust, fear, anger, happiness*). This new FACES database offers access to an age range of faces with different facial expressions that is wider than that of any other face database, and therefore more appropriate for the investigation of developmental research questions. Information on how to acquire the FACES database for research purposes can be obtained from <http://www.xxx.de>.

(167 words)

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FACES—A Database of Emotional Facial Expressions in Young, Middle-Aged, and Old Women and Men: I Description

Faces with neutral or emotional expressions are frequently used experimental stimuli in a wide array of research areas, including perception, attention, memory, social reasoning, emotion, infant and adult development, and neuropsychology. One reason for this broad interest in faces as research stimuli is that they constitute a unique category of objects. From very early on in life, all sighted individuals have much experience with faces. Some evidence suggests that faces, in contrast to other visual objects, are uniquely processed in specific sites in the fusiform gyrus (Gross, Rocha-Miranda, & Bender, 1972; Haxby et al., 1994; Kanwisher, McDermott, & Chun, 1997; Puce, Allison, Gore, & McCarthy, 1995). That is, certain neuroanatomical sites seem to be specialized for processing faces (but Toveé, 1998).

A number of studies have shown that the type (e.g., age, gender, or race) of a face used as stimulus can influence how well a face is processed and remembered (Bäckman, 1991; Brigham & Barkowitz, 1978; Golby, Gabrieli, Chiao, & Eberhardt, 2001; Mason, 1986). Faces more similar to the face of the individual studying them are remembered and discriminated better than faces that are different. Evidence for an “own-age bias” in face recognition and person identification, for instance, suggests that adults of different ages, but especially so old adults, are more likely to identify and recognize faces and persons of their own age group compared to faces and persons of other ages (Anastasi & Rhodes, 2006; Bartlett & Fulton, 1991; Lamont, Stewart-Williams, & Podd, 2005; Wright & Stroud, 2002). This “own-group bias” is generally thought to be due to the amount of exposure an individual has to certain classes of faces, the idea being that people typically see faces similar to their own more frequently and are therefore more familiar with them.

This effect may impair the interpretation of most to date available age-comparative behavioral and neuroimaging studies that have used facial stimuli. Due to a lack of appropriate material, these studies have not systematically varied the age of the presented

facial stimuli. Consequently, old adults, compared to young adults, may have been at a disadvantage when, for instance, asked to process and recognize young faces. For future studies, it is therefore of crucial importance to use faces of different ages when testing different age groups.

A first major step to overcome this lack of appropriate facial stimuli has been undertaken by Minear and Park (2004) who have recently created a new large set of faces representing a wide range of different age groups: the CAL/PAL Face Database. This lifespan database of adult facial stimuli includes over 1000 color (and black and white) photographs of young, middle-aged, and old adults ranging from ages 19 to 93. The faces can be downloaded for research purposes from <http://agingmind.cns.uiuc.edu/facedb/>. This database contains neutral facial expressions for each individual face. For some of the faces, there are also happy expressions as well as images of profiles. Even though, just recently, the authors have added sad, angry, annoyed, grumpy or disgusted, and surprised facial expressions for some of the faces, so far this database does not comprise a comprehensive collection of different facial expressions for each individual face.

Other databases exist that cover various different facial expressions for each individual face. Examples are the Pictures of Facial Affect (PoFA; Ekman & Friesen, 1976), the Karolinska Directed Emotional Faces System (KDEF; Lundqvist, Flykt, & Ohman, 1998), the Yale Face Database (<http://cvc.yale.edu/projects/yalefaces/yalefaces.html>), or the Psychological Image Collection at Stirling (PICS; <http://pics.psych.stir.ac.uk/>). None of these databases, however, contain images of faces of different age groups, and especially so of old adults.

The aim of our project was to extend existent databases of adult facial stimuli by creating a large set of images of naturalistic faces of young, middle-aged, and old women and men displaying each of six facial expressions: neutrality, sadness, disgust, fear, anger, and happiness. To accomplish this in maximal image quality, we cooperated with a model agency

for recruiting participants, with a professional photographer for taking the pictures in a photo studio set up for this reason at the Max Planck Institute for Human Development in Berlin (MPIB), as well as with a professional digital media designer for post-processing and editing the images.

Method

Face Models

Face models were sixty-one young ($M = 24.3$ yrs., $SD = 3.5$, range: 19–31 yrs.), 60 middle-aged ($M = 49.0$ yrs., $SD = 3.9$, range: 39–55 yrs.), and 58 old ($M = 73.2$ yrs., $SD = 2.8$, range: 69–80 yrs.) extras, specials, or actors who were recruited through a model agency (*wanted agency*; <http://agentur-wanted.de/index/de/html>). Age and gender information of these persons are summarized in Table 1. To be considered as face model, a person needed to be Caucasian and have an “average-type” of look without displaying any prominent, eye-catching features such as beards, tattoos in the face or on the neck, piercing, extreme hairstyles, or braces. Furthermore, he or she had to be able to identify text and pictures presented in a 1 to 1.5 meter distance without wearing glasses.

Prior to the photo-shooting session, the model agency informed the persons on the phone or via E-mail or fax that the aim of the project was to set up a facial database that comprises portraits of young, middle-aged, and old adults displaying six different facial expressions (neutrality, happiness, anger, sadness, fear, and disgust) for use in scientific research. Persons were only recruited as models when they stated that they were able to express each of the six different faces (with the help of a “face training” and with the support of a trained research assistant). They were then assigned dates for the photo session (each face model was booked for up to three hours), informed about the general procedure during the session, and asked not to put on make-up or to wear clothing that sticks out around the neck (e.g., a turtleneck) on the day of photo shooting.

Procedure and Materials

Photo-shooting sessions took place at the MPIB between December 2005 and May 2006 in a studio specifically set up for this purpose. Face models arrived at the MPIB and were led to the reception room of the studio. A trained research assistant then informed them about the general aim of the project and today's session as well as the specific procedure in the photo studio. They were told that they would be photographed various times showing each of the six facial expressions, starting with neutral faces, followed by sad, disgusted, fearful, angry, and happy expressions. The photographer and the photo assistant would help them display these facial expressions with a newly-developed procedure that comprised three phases: (1) an "emotion-induction" phase aimed at triggering the spontaneous experience of the respective emotion, (2) a "personal-experience" phase aimed at inducing the emotion idiosyncratically through imaging personally relevant events that had elicited the respective emotion in the past, and finally (3) a "controlled-expression" phase in which the models would receive instructions on how to hold specific facial muscles to optimally represent the respective emotion. Face models were told that, for this latter phase a "face training" would take place prior to the photo session. They then signed an informed consent document permitting the use of their pictures for psychological research. At the end of the introduction, gender and age was recorded, and a personal code assigned to ensure anonymity.

Following that, the persons completed the "face training." With the help of a manual, which had been developed based on Ekman and Friesen (2003), the research assistant explained the position of the muscles around the eyes, the nose, and the mouth for an optimal representation of each of the six facial expressions. The manual also contained sample pictures of a young man's face taken from the PoFA (Ekman & Friesen, 1976) displaying each of the facial expressions in a very prototypic way. Even though evidence suggests that facial expression of an emotion triggers experience of the emotion (Coan, Allen, & Harmon-Jones, 2001; Duncan & Laird, 1980; Strack, Martin, & Stepper, 1988), face models were told that the aim was not necessarily to actually experience the emotion, but rather to optimally

show it on the face so that other persons could recognize it. They were instructed to display each facial expression as intensively as possible but in a natural looking way.

Next, the research assistant led the persons to the adjacent training room. Here, they were asked to take off their jewelry and glasses, remove make-up and any clothing that sticks out around the neck, and to put on a standard gray shirt that was provided in different sizes. They then had up to 30 minutes time to practice each of the facial expressions in front of a mirror on their own with the help of the “face training” manual and large printouts of the prototypic PoFA face. After 10 to 15 minutes, the research assistant joined again for feedback and further instructions on how to improve and optimize each of the facial expressions.

After this training phase, the persons entered the photo studio where they were received by the photographer and the photo assistant. They were then seated in front of a neutral gray (color type Smoke Gray) background provided by a portable projection screen on a height adjustable chair and instructed to look directly onto the teleprompter during photo shooting. The photographer stood behind the teleprompter and the camera. The photo assistant stood either next to the photographer in face contact with the face model or behind the computer next to the camera to operate the text and picture presentation on the teleprompter. Continuously during the session, both the photographer and the photo assistant gave instructions and feedback.

To warm up, the session started with the expression of neutral faces. This was then followed by sad, disgusted, fearful, angry, and, finally, happy faces. To support the models in the optimal display of facial expressions, a three-step procedure was followed, separately for each facial expression. The persons were continuously photographed during all three phases (on average, 150–200 pictures were taken per person). In the “emotion-induction” phase, emotional pictures taken from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 1998) were presented on the teleprompter. These pictures had been pre-selected to optimally trigger the experience of the respective emotion in support of the facial

expression of this emotion. Face models were instructed to just watch the pictures, to experience the emotion it elicited, and to spontaneously show it in the face. The photo assistant controlled the presentation time of the pictures. Pictures were shown for neutrality ($n = 5$ pictures), sadness ($n = 5$ pictures), disgust ($n = 8$ pictures), fear ($n = 7$ pictures), and happiness ($n = 4$ pictures). As the pre-selection resulted in no adequate pictures to induce anger, angry faces were only photographed in phases 2 and 3, as described next.

After this spontaneous “emotion-induction” phase, face models were asked to select the IAPS picture that they personally experienced as optimally triggering the respective emotion and that would help them best to express the emotion in their face. This specific picture was then presented as a freeze image while participants were asked to think of, and relive a situation in which they personally had experienced the emotion, and to express it as strongly as possible in their face. As no supporting IAPS pictures were available to support the experience of anger, face models were in this instance asked to think of, and relive a situation in their personal past in which they had felt anger and to display it as strongly as possible on their face. Pre-piloting had shown that inducing sadness was rather difficult. Face models, therefore, in this case additionally watched a movie sequence from “The Champ” by Franco Zeffirelli taken from a set of clips developed to induce different emotions by Hagemann et al. (1999) while the photographer took pictures of their sad faces.

Finally, in the third phase, the “controlled-expression” phase, face models again saw the prototypic face of the respective emotion by the young man taken from the PoFA on the teleprompter. Additionally, the photo assistant read aloud the specific instructions regarding the position of the muscles around the eyes, nose, and mouth to optimally display (in a highly controlled way) the emotion as it had been practiced during the “face training.” The photographer and the photo assistant provided continuous feedback until the desired expression was achieved. Following that, and depending on the quality of the facial expressions already taken and on the amount of time left, the photo shooting continued using

components of all three phases to individually optimize the display of the respective facial expression.

After the photo shooting, face models were led back to the training room, where the research assistant received them, and where they could change again and put back on their jewelry and glasses. They were then reimbursed € 60 (approximately \$ 76) and thanked for participation in the project. Typically the session took 90 minutes.

Technical Information

Digital high-quality color photographs were taken with a Sony DSC-F828 camera using the flash (1500 WS) and a resolution of 2835 x 3543 pixels. All pictures were color photographs (color mode sRGB). The lighting conditions were +20° frontal lighting from diagonally above, with 185 cm striplight for a soft and smooth illumination, -20° brighteners from below and white balance on neutral gray. The photographs were taken through a teleprompter (custom product for photography; color neutral with special glass, -0.8 aperture stops, 15" picture diagonal). The horizontal lens axis was set on the tip of the nose. Focal distance was 120mm on 35mm. At the end of each session, all images of a person were downloaded to a computer and given filenames indicating personal code, age, and gender, the facial expression, and the phase in which the picture was taken.

Selection Procedure

The aim of the selection process was to identify and select the two images for each person that best represented each of the six facial expressions. In a first step, the photo assistant conducted a pre-selection on the basis of photographic aspects, such as image definition. Images were also dropped when the shoulders or the heads were overly tilted from the vertical, when the faces were not forward-facing, when other body parts such as hands or fingers were in the picture, or when the facial expression deviated strongly from the pre-established guidelines. Seven trained raters then rated the remaining pictures (around $N = 23,000$; approximately 130 pictures per person).

To standardize the rating procedure, the ratings were conducted on the basis of a rating manual. All raters participated in a “rater training” to become familiarized with the rating manual. The manual contained information about the central aim of the rating as well as specific instructions about the rating procedure. It described the position of the muscles around the eyes, the nose, and the mouth for an optimal representation for each of the targeted facial expression (cf. Ekman & Friesen, 2003). Additionally, it provided four sample faces taken from the PoFA displaying the facial expressions in very prototypic ways. The manual also contained a note on the occurrence of blend emotions, comprising two or more facial expressions, to make raters aware of this phenomenon.

Two raters, who had not had contact with the person on the picture during photo shooting, rated each picture. The presentation of faces, one face at a time in a randomized order, was controlled using Psy-Point (Steinkraus & Ebner, 2006) on Apple Power Mac G5 1.8 GHz computers. Raters judged for each of seven facial expressions (i.e., neutrality, happiness, sadness, disgust, surprise¹, fear, anger) whether it was present in the face ($j = \text{yes, is displayed}$ vs. $n = \text{no, is not displayed}$). Blending of emotions could be indicated by positively responding to more than one of the facial expressions. If raters responded that a specific facial expression was depicted in the face, they were also asked to rate its intensity on a 3-point rating scale (“*How pronounced is this specific facial expression?*”; 1 = *not very pronounced*, 2 = *moderately pronounced*, 3 = *very pronounced*).

Following that, those images were selected on which both raters agreed in terms of their judgments of (1) “purity of facial expression” (i.e., both raters agreed on the type of facial expression displayed in the picture and did not rate any other expressions as present in the picture) and of (2) “high intensity of facial expression” (i.e., both raters agreed that this one facial expression was very pronounced). From this reduced set of pictures, the two most prototypical images per person and expression were chosen for the final database in consensus sessions of two or three raters.

Editing and Standardization of the Pictures

With the aim to optimize the quality of the pictures and to produce greater uniformity within each set of pictures of a person as well as across all persons, pictures were post-processed by the photographer and the photo assistant as well as by a digital media designer. First, a cut-out was selected to standardize the size of the head in the picture in that equal distances were set for the upper head, the ears, and the cuff of the shirt to the image borders (there were slight deviations due to differences in size of heads, length of necks, and height of hairstyles). Simultaneously, the heads were optimally aligned with respect to the image borders to neutralize tilted positions. A fixed gray was set for all faces to standardize the colors. Final digital picture editing included retouching (of prominent details such as moles, pimples, gold teeth), color matching, and changing or removing details, such as strands of hair in the face. To ensure the same brightness, all pictures were matched to a predetermined standardized matrix-image. Picture editing was done in Adobe Photoshop CS on Apple Macintosh. Finally, pictures were resized to 819 x 1024 pixel resolution and saved in JPEG format. The original images in JPEG/sRGB format (size 2835 x 3543) were also kept.

Results and Discussion

Out of the 179 young, middle-aged, and old face models originally photographed, 58 young ($M = 24.2$ yrs., $SD = 3.4$, range: 19–31 yrs.), 56 middle-aged ($M = 49.0$ yrs., $SD = 3.9$, range: 39–55 yrs.), and 57 old ($M = 73.2$ yrs., $SD = 2.8$, range: 69–80 yrs.) women and men were selected for the final database ($N = 171$). Table 2 presents the total number of persons in the final database broken down by age group and gender. Eight persons (one young man, two young women, two middle-aged men, two middle-aged women, and one old man) were not included in the final database for reasons such as low quality of facial expressions or prominent features (e.g., bald heads, braces). As we selected two images per person and facial expression, each face model is represented with two sets of six facial expressions (set A and set B) in the FACES database. Pictures of a given facial expression were randomly assigned

to one of these two sets. In all, the FACES database thus includes 2,052 individual images. The FACES database² is freely available for use in scientific research along with the FACES-Viewer, a computer software developed to assist researchers in the selection of images for their study purposes. Information on how to acquire the FACES database can be obtained from <http://www.xxx.de>.

To summarize, FACES is a database of female and male faces of three different age groups displaying each of six different facial expressions: neutrality, sadness, disgust, fear, anger, and happiness. The FACES database constitutes a unique source of high-quality, color photographs of naturalistic faces. By having created this new database of adult emotional facial stimuli and in making it freely available to the research community, we hope to remove the lack of available facial stimuli as an impediment when studying age-related differences in, for instance, face perception, face memory, or emotion regulation, and we hope to spur further research in various different fields of research using facial stimuli.

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Footnote

¹ As fear and surprise are often blended in facial expressions (cf. Ekman & Friesen, 2003), we decided upon taking surprise into consideration for the rating as seventh facial expression.

² As the standard, the images are delivered in the resized resolution of 819 x 1024 pixels in JPEG format on the FACES-CD. On special request, the images in their original size (2835 x 3543 pixels; JPEG format) can be obtained on a DVD.

Table 1.

Total Number of Face Models in the Study Broken Down by Age Group and Gender

Gender	Age		
	19–31 yrs.	39–55 yrs.	69–80 yrs.
Male	30	31	29
Female	31	29	29

Table 2.

Total Number of Face Models in the Final Database Broken Down by Age Group and Gender

Gender	Age		
	19–31 yrs.	39–55 yrs.	69–80 yrs.
Male	29	29	28
Female	29	27	29