Subjective Age Estimation using Facial Images - the Effects of Gender, Expressions and Age Groups -

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Abstract. We propose a relative estimation method for subjective age, imaged by ourselves, using peoples' facial images and their chronological (real) age. We experimented with a rating scale for facial images which stimulated subjects. The subject evaluated an image as looking older than themselves with a range of responses. Finding an approximation curve of this range, the zero crossing point in the approximation curve is defined as the subjective age. The experimental result shows that the subjective age tends to be found in negative direction (tendency to estimate oneself as younger than actual). Besides, there are other trends between gender, between age groups, and between the different expressions such as ordinary and smiling.

Keywords. Subjective age, facial image, rating scales methods, estimation, chronological age, affective computing.

1. Introduction

Humans can estimate their age and gender by their experience of facial color and part of the facial features of their companions. The automated estimation of age and gender is an important factor in the study of the recognition of faces and facial expressions, however, it is difficult for this to reach the level of human estimation [1].

On the other hand, we often find ourselves being much more humble than needed, after finding a companion's actual age. Then, we often say; "I thought he was much older than me!" It can be said that we didn't estimate his age wrongly, but that we saw ourselves as younger, or older, than we really are.

Seeing our age like this is called our subjective age. In this paper, we propose a relative estimation method for subjective age, using people's facial images and their chronological age. This can be developed to further studies, such as the range of the subjective age, or, finding the cause of misunderstanding our subjective age and the chronological age, according to the generation and gender. There has been research of finding one's imaged subjective age on the basis of a questionnaire [2]. However according to the search so far conducted, we did not find any research using facial images.
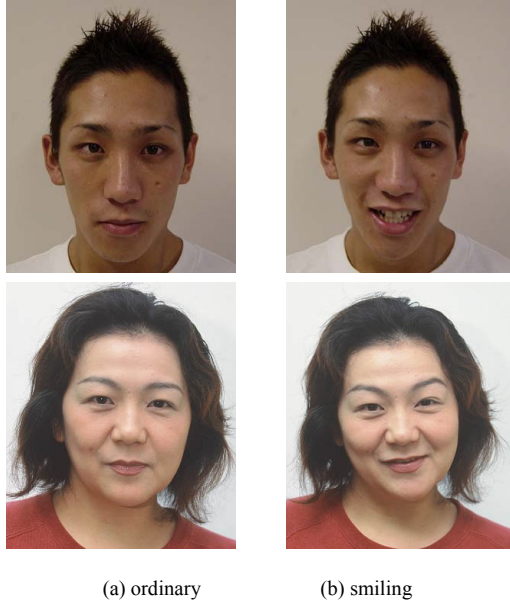
(a) ordinary   (b) smiling

Figure 1. Examples of the facial images in this database.

In this paper, we present three points; the construction of a database of facial images which is the foundation of this research, a proposal for the definition of subjective age and the estimation method, and the result of research.

2. Facial Image Database

There are total 20 classes from 20 years old to 70 years old for each gender in this database. At this moment, each class has 10 people, and a total of 400 facial images have been recorded, which include two different expressions (ordinary and smiling) for each person. Figure 1 shows examples of the facial images. Facial images are saved as high-resolution digital images by film scanning.

3. Experiment of Subjective Age Estimation

3.1. Rating Experiment

We choose facial images for both male and female subjects who were of different age and gender groups, from the same age class as the subject, and the next younger and older classes. The total number of facial images used was 60, composed of 5 images (per 1 class)

x 3 classes x 2 genders (the same and the opposite genders) x 2 expressions (ordinary and smiling) as shown in Figure 2.

Next, we experimented with a rating scale for these facial images which stimulate the subjects. The subjects were shown 60 facial images chosen by above way, and they evaluated if it looked older or younger than themselves. The evaluation had 5 ranks; "Definitely older than myself (2)", "Probably older than myself (1)", "Not able to estimate (0)", "Probably younger than myself (-1)" and "Definitely younger than myself (-2)". The reason for adopting a range of responses was not to estimate the chronological ages of the facial images, but to seek their relative position to others.

Figure 3 shows an example of the chooser screen of the subjective age estimation system. This system is constructed by Java. The size of the facial images is 300*350 pixels. Before starting experiences, subjects were directed to make their decisions speedy based on intuition and not to mind the facial images of a same person.

3.2. Definition of Subjective Age and Method of Estimation

To quantify the result of the estimation, we plotted the results in a two-dimensional plane with the x-axis being the relative age (the chronological age of the facial image minus the chronological age of the subject) and the y-axis was the estimation result, as shown in Fig. 4. The x-axis is from –9 to 9, because the subjects evaluated the facial data with a 9 year difference as a maximum (For example, in Case A the subject was 34 years old, he was shown facial data from 3 classes; 25-29 class, 30-34 class and 35-39 class). Thus, the data with the range of upper-right direction was obtained.
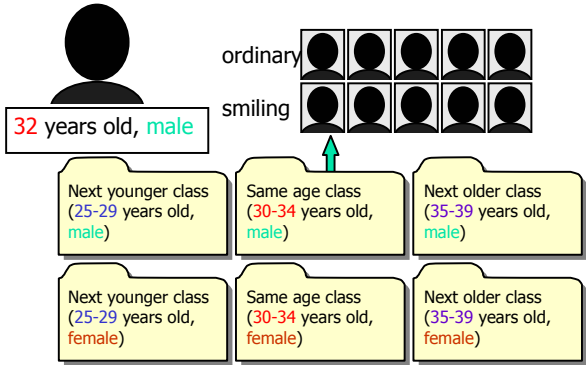

Figure 2. How facial images were chosen.

Figure 3. An example of the choosing screen of the subjective age estimation system.

This range shows the subjective age of the group of subjects. Finding an approximation curve of this range, the zero crossing point in the approximation curve is defined as the subjective age [3].

Since we assume the curve to have a sigmoid function (nonlinear, continuous, monotone increasing function), here we adopt a logistics function [4], which is a kind of sigmoid function. Then a logit transformation to allow linearization can be applied as:

$$Y = \ln\left(\frac{y}{1-y}\right) \qquad (1)$$

This results in the problem of the linear approximation of the transformed data. That is to say, the zero crossing point in the approximation line can be defined as the shift of the subjective age. The subjective age is considered to give us a kind of standard of the relative position (age) for a companion or in a group.
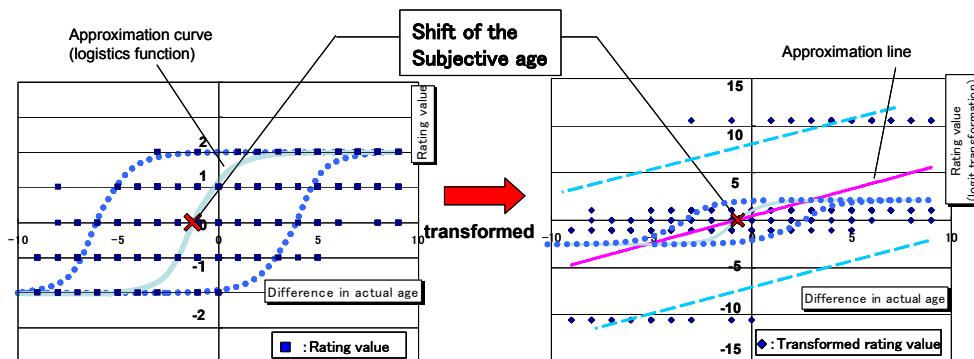
Figure 4. Method of estimating subjective age.

3.3. Results of Research

According to the above method, we treated the results obtained from research by showing ordinary and smiling facial expressions to a total of 156 male and female subjects who were between 25 and 54 years old. The zero crossing point of the approximation line of the entire data set after applying the logit transformation was found at -2.17 from the formula; $y = 0.5357x + 1.1602$. This is the shift of the subjective age of the subjects group from this research.

For comparison, three cases were adopted: the effect of gender, the effect for expression and the effect of age.

First, figure 5 gives the shift of the subjective ages of the male and the female subjects. Male subjects showed an unexpectedly lower (younger) value of -2.69, as compared with a value of -1.57 in the female subjects.

Next, figure 6 shows the shift of the subjective ages between 3 age groups (25-34, 35-44, 45-54). The results indicate that the older the subjects are, the nearer the subjective ages get to the real ages. Only the difference in the shift values of male subjects as they get older was not so greater than that of female subjects.

Moreover, figure 7 shows the difference in the subjective ages by 2 expressions (ordinary and smiling) and 3 age groups. The subjective ages for smiling expressions show higher values than those for ordinary expressions for subjects of less than 34 years old. On the contrary, the subjective ages for ordinary expressions give higher values than those for smiling expressions for subjects of more than 35 years old.
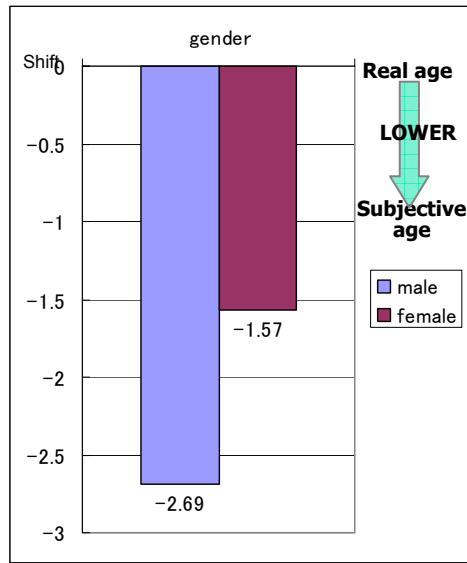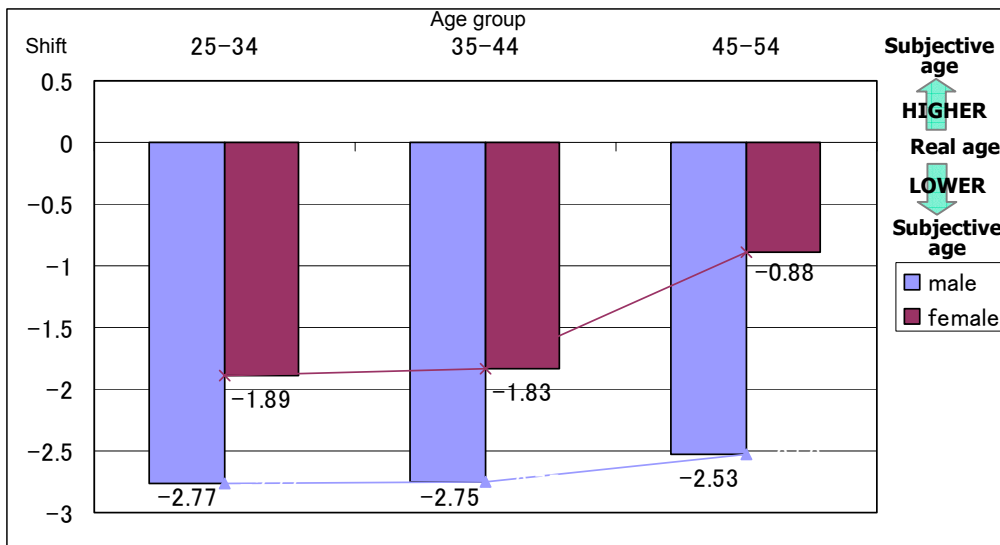
Figure 5. Shift of the subjective age by gender.

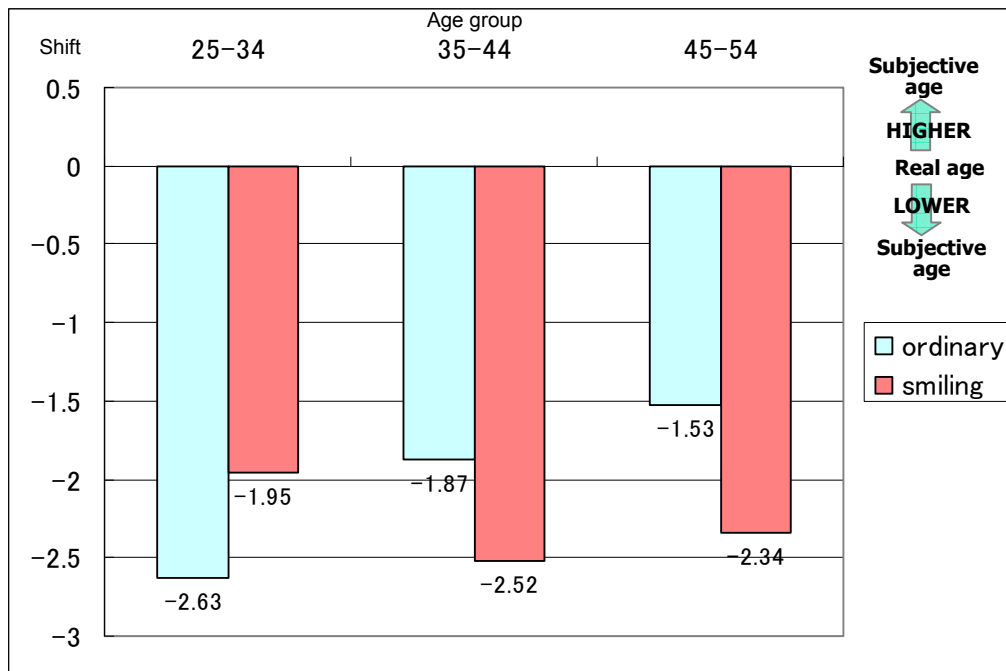Figure 6. Shift of the subjective age between age groups.

Figure 7. Shift of the subjective age by expressions and age groups.

3.4. Discussion

In the experimental result, subjective age was generally found to be in the negative direction (tendency to estimate younger than actual) as a tendency. Although we see our own faces everyday, there is no opportunity to evaluate our face relative to others. So, we tend to see a past record, such as a photograph, as being the same as we look now. For instance, everybody has had the experience of being sneered at after sending in an old photograph, in which we see little change, when submitting our picture for official purposes. It is presumed that this tendency comes from a kind of conviction that we never get old.

Next, there are also other interesting trends between the gender and between the age groups. The results indicate that the shift value of male subjects is lower than that of female subjects, and the older the subjects are, the nearer the subjective ages get to the real ages. In other words, the more the subjects view themselves objectively. It can be explained that men generally place themselves in a more complex society than women, and they have to rise in higher social rank and acquire their confidence with age.

There are also different tendencies between the different expressions of ordinary and smiling. These may be related to various factors such as psychological, physiological and social factors. Smiling expressions commonly look younger than ordinary expressions. It is

supposed that the reason why this is that cheerful is replaced by youth in young generation. It can also be thought that the psychological distance gets shorter by smiling expressions. Therefore the subjective ages for smiling expressions must show higher values than those for ordinary expressions. However unusual results were obtained in over 35 years age groups. We suppose that it was affected by wrinkles in their faces when smiling.

In the future, we will carry out further research of the different tendencies based on age and gender, facial expressions, texture of skin, makeup, and on occupation, and with more images and subjects. In addition, we are now considering the possibility of collecting the examination data through a public website. We believe this will be possible if the issue of the rights to the portraits can be settled. On the other hand, by the method with 'average facial image' [1], we can stimulate subjects with "average facial images of 25 years old male or 42 years old female", so that we can prevent the unevenness of the stimulation. Furthermore, there would be no problem of the rights to the portraits.

4. Conclusions

As a foundation into the research of subjective age with facial images, we have built up a facial image database, and have introduced of a definition of subjective age and an estimation method. The result shows that the tendency of the subjective age is younger than actual age and changes by stimulus.

The subjective age represents the relative position to others in a society. Such research becomes more and more important from the viewpoint of self-recognition in the field of HCI and e-learning.

In the future, we will improve the facial image database, and will further examine the estimation method of subjective age. In addition, we are planning to examine objective age, which is appearance age judged by others. We are also considering adopting other stimuli, for example, images of eye or texture of skin and so on.

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