The relationship among facial features, facial impression, and recognition memory for faces

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The present study investigated relationships among physical features, impressions, and recognition memory for faces. The stimuli were pictures of male and female faces. First, the sizes, lengths, and angles of physical features of the faces were measured, and then a principal components analysis was performed. Second, 108 university students evaluated the impressions of the faces by the semantic differential technique, and then a factor analysis was performed. Third, 80 university students performed recognition memory tasks for the faces. Subsequently, the analyses of correlations, partial correlations, and ANOVA were performed on the principal component scores of the physical features, the factor scores of impressions, and the recognition performance. The results of the analyses showed that: (a) the impression of facial uniqueness formed from eyes and eyebrows facilitated recognition memory for the faces and (b) the physical features of a small mouth and a round jaw facilitated recognition memory.

***Key words**: physical features, impression, recognition memory for faces, uniqueness, the lower features of faces.*

Introduction

We memorize people's faces using various informations. In this study, we took up the informations of facial impressions and facial features.

As to the facial impressions, the previous studies have showed that the impression of attractiveness or likability influenced memory for faces (Mueller, Heesacker, & Ross, 1984; Shepherd & Ellis, 1973). However, these influences might be mediated by the effects of uniqueness (e.g. Going & Read, 1974). Also, other personality characteristic impressions might influence memory for faces.

As to the facial features, McKelvie (1976) reported that masking the eyes caused more difficulty on facial recognition than masking the mouths. This result showed that the upper features including the eyes were important in recognition memory for faces.

As observed above, the previous studies examined the relationships between the facial features or the facial impressions and recognition memory for faces, respectively. However the facial impressions were formed by the facial features and so the influences of impressions might be mediated by facial features.

Thus, the purpose of the present study was to investigate relationships among facial features, impression, and recognition memory for faces together using the analyses of correlation, partial correlation, and ANOVA. As to the facial impressions, we examined facial uniqueness as well as personality characteristics.

Materials

60 females and 60 males posed for color pictures for inclusion in the database (Ogawa & Oda, 1998). All pictures were head-and-neck and full face shots. Male were clean-shaven, and females were requested not to wear a lot of makeup. None had glasses and accessories.

Measurement of physical features of the faces

Methods 83 points in the full-face views were recorded for each face in the database. We calculated the areas within any points, the lengths between any two points and the angles subtended between any three points. The 14 sizes, 38 lengths, and 11 angles of physical features of the faces were measured.

The calculation of the principal component scores A

principal components analysis was performed using 63 measurements. 5 principal components were extracted （accounting for 62.3% of the variance） . Each component was named “global size”, “vertical length”, “upper features (e.g. eyes. eyebrow)”, “lower features (e.g. mouth, jaw)” and “length between nose and mouth”, respectively. The 5 component scores of each face were calculated.

Rating facial impressions for faces

Subjects 108 university undergraduate and graduate students (47 males and 61 females) served as subjects.

Rating Scale A scale for rating facial impressions (personality characteristics and facial uniqueness) included 17 traits. According to studies by authors, these traits were selected.

Procedure Subjects were required to rate facial impressions of the faces on a 7-point scale by the semantic differential technique.

The calculation of factor scores A factor analysis was performed, and then 4 factors were extracted（accounting for 61.5% of the variance） . These 4 factors were named “activity”, “social desirability”, “intelligence”, and “uniqueness”, respectively. This result showed that these factors were independent identically. The factor scores of each face were calculated by sex of subjects.

Recognition memory for faces

Subjects 80 university undergraduate students (40 males and 40 females) served as subjects.

Materials 120 pictures of faces (60 male faces and 60 females faces) served as targets and distractors. 36 pictures of faces (18 males and 18 females) served as filler faces.

Procedure Subjects were not informed that they would be tested for memory of the faces. They were showed the list including 30 target faces. The list began and ended with 9 filler faces. The pictures of the faces were presented one after another for 10 sec. 5 minutes after presentation (during which an unrelated filler task had completed), the same subjects were presented with 30 targets and 30 distractors. Subjects were required to give confidence rating for each face on a 6-point scale ranging from “definitely not seen before” to “definitely seen before”.

The calculation of the A’ The hit rate (targets rated 4, 5, or 6) and the false alarm rate (distractors rated 1, 2, or 3) of each face were calculated by sex of subjects. And then A’ was calculated using the hit rate and the false alarm rate.

Results

The analyses of correlations and partial correlations To investigate the linear relationship among facial features, facial impressions, and recognition memory for faces, the analyses of correlations and partial correlations were performed on the principal component scores of the physical features, the factor scores of impressions, and the A’.

The results of these analyses showed that there were two liner relationships.

One was that correlation between the principal component scores and the factor scores were significant, and partial correlation between the factor scores and the A’ controlling for the principal component scores were significant, but between the principal component scores and the A’ controlling for the factor scores were not significant. This relationship was shown in male faces (male and female subjects). “The upper features” was positively correlated with “uniqueness”, further, “uniqueness” was positively correlated with the A’.

Another was that correlation between the principal component scores and the factor scores were significant, but neither between the factor scores and the A’ nor between the principal component scores and the A’ were significant. There were different results between male faces and female faces. For example, “Global size” was positively correlated with “activity” in male faces, but not female faces. “Lower features” were positively correlated with “social desirability” in female faces, but not male faces.

The analyses of variance To investigate the nonlinear relationship among facial features, facial impressions,

Table 1
Correlation coefficients and partial correlation coefficients between the components scores and the factor scores or A'

face	subjects	the components	activity	social disirability	intelligence	uniqueness	A'
male	male	global size	0.269 *	0.292 *	-0.050	0.125	0.137
		vertical length	-0.214	0.102	-0.126	0.077	-0.114
		upper features	0.187	0.113	0.260 *	0.288 *	-0.112
		lower features	0.039	0.078	-0.041	-0.114	0.107
		length between nose and mouth	0.071	-0.027	0.064	-0.044	-0.138
	female	global size	0.300 *	0.212	0.003	0.118	0.027
		vertical length	-0.093	0.126	-0.235	-0.030	-0.161
		upper features	0.271 *	0.137	0.302 *	0.294 *	0.042
		lower features	0.148	0.231	-0.066	-0.018	0.120
		length between nose and mouth	0.010	-0.002	0.243	-0.152	0.059
female	male	global size	0.202	0.170	0.152	0.105	0.220
		vertical length	-0.017	-0.150	-0.273 *	0.204	0.063
		upper features	0.139	0.106	0.061	0.114	0.062
		lower features	0.029	0.345 **	0.067	-0.116	0.016
		length between nose and mouth	0.200	0.031	0.080	0.205	0.070
	female	global size	0.176	0.183	0.123	0.041	-0.251
		vertical length	0.053	-0.163	-0.183	0.218	0.081
		upper features	0.134	0.126	0.153	0.088	-0.199
		lower features	0.051	0.374 **	0.055	-0.083	-0.019
		length between nose and mouth	0.325 *	0.168	0.131	0.168	-0.002

* p<.05, ** p<.01.
The under line indicates the partial correlation coefficient controlling for the factor scores of "uniqueness"

Table 2
Correlation coefficients and partial correlation coefficients between the factor scores and A'

face	subjects	activity	social desirability	intelligence	uniqueness
male	male	0.023	-0.011	-0.024	0.348 **
	female	0.251	0.007	0.039	0.397 **
famale	male	0.285 *	-0.074	-0.127	0.400 **
	female	0.140	-0.106	-0.229	0.251

* p<.05 ** p<.01
The under line indicates the partial correlation coefficient controlling for the component scores of "the upper features"

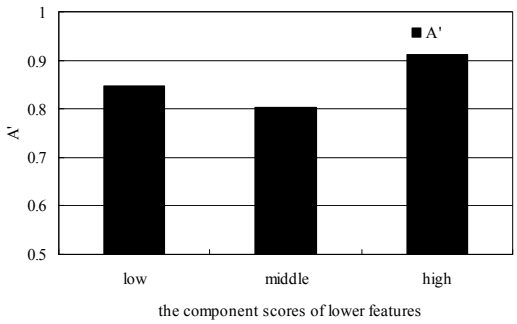

Figure 1. The A' of facial recognition by the component scores of "lower features".

and recognition memory for faces, the one-way analyses of variance were performed. Independent variables were the component scores and the factor scores. Dependent variables were the factor scores and the A'. There were 3 levels ("high", "middle", and "low") in the independent variables.

First, the data of the factor scores were subjected to ANOVA with the independent variables of the components of facial features. The ANOVA produced reliable main effects of the components of "the upper features" for the factor scores of "social desirability" (in male faces $F(2, 27)=4.389$, $p<.05$(male subjects), $F(2, 27)=6.749$, $p<.005$(female subjects); in female faces $F(2,27)=5.769$, $p<.01$(male Ss), $F(2,27)=4.794$, $p<.05$(female Ss)). Also, only in female face (male Ss only), the main effect of the components of "the lower features" for the factor scores of "uniqueness" was significant (F (2, 27) =4.164. $p<.05$).

Second, the data of A' were subjected to ANOVA with the independent variables of the factors of facial impressions. The results showed that the main effects of the factors of "social desirability" in male faces (female Ss only, F (2, 27) =5.243, $p<.05$) and "intelligence" in female faces (female Ss only, F (2, 27) =4.179, $p<.05$) were significant.

Finally, the data of A' were subjected to ANOVA with the independent variables of the components of facial features. The results showed that the main effects of the components of the "lower features" in male faces (male Ss only, F (2, 27) =3.463, $p<.05$). This result was inconsistent with the previous studies reported that the upper features including the eyes were important in recognition memory for faces (McKelvie, 1976). This was because the previous studies examined the effect of masking the facial features but the present study examined the effect of the size, lengths, and angles of the features.

Discussion

The purpose of the present study was to investigate the relationships among the facial features, the facial impressions, and the recognition memory for faces. The principal finding of this study was that there were two ways how to affect the recognition memory for faces. The results of the analyses showed that the uniqueness formed from upper features facilitated recognition memory for male faces and the physical features of a small mouth and a round jaw facilitated recognition memory for female faces (male Ss only). These results indicated that the facial recognition process was divided into two processes; one was processing the facial features and the other was processing the facial impressions formed from facial features.

However, it was not clear that why the process was divided into two processes and what determined which process to select in this study. Future studies should

focus on these issues.

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