An Analysis on the Difference of Processing Mode between Upright and Inverted Faces in Their Similarity Judgment

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AN ANALYSIS ON THE DIFFERENCE OF PROCESSING MODE BETWEEN UPRIGHT AND INVERTED FACES IN THEIR SIMILARITY JUDGMENT

By

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Two experiments were conducted to 50 different *S*s, under the same method as employed in the previous paper (1988), to investigate the differences of processing mode between the upright and inverted faces, and the following main results have been obtained.

(1) The cue saliency in the inverted faces, unlike in the upright, changed the order of the contour and eyebrows, and the facial internals of eyes and eyebrows were salient. It can be said that the global processing regresses in the inverted face.

(2) In the inverted faces the interaction between features which exists in the upright did not appear. It can be stated that the way of integrating features in the inverted faces also regresses.

(3) The interaction between features means to regress the efficiency of different eyebrows due to the same eyes and the same contours and hence to raise a little the similarity of faces. Such effect appeared only in the upright faces and their types were confirmed to be almost the same with those presented in the previous paper : the agency from eyes to contour and eyebrows, and the mutual agency between contour and eyebrows.

As a result, it was verified that the wholistic-integrative processing takes place in the perception of upright face, while in the inverted face this kind of processing regresses and the piecemeal one is likely to be taken.

Key words : face perception, inverted face, MDS (INDSCAL)

Problem

In our previous paper (1988), we have made 16 kinds of diagrammatic faces through combining the two features of eyes, contour, eyebrows and mouth, respectively, and the pairs of these were shown to 52 subjects who were instructed to rank their dissimilarity. For analysis of data, MDS (INDSCAL) was employed and the following results were manifested.

(1) The dissimilarity of paired faces advanced as a function of the number of not-same features.

(2) Cue saliency in the upright face was in the order of eyes, contour, eyebrows

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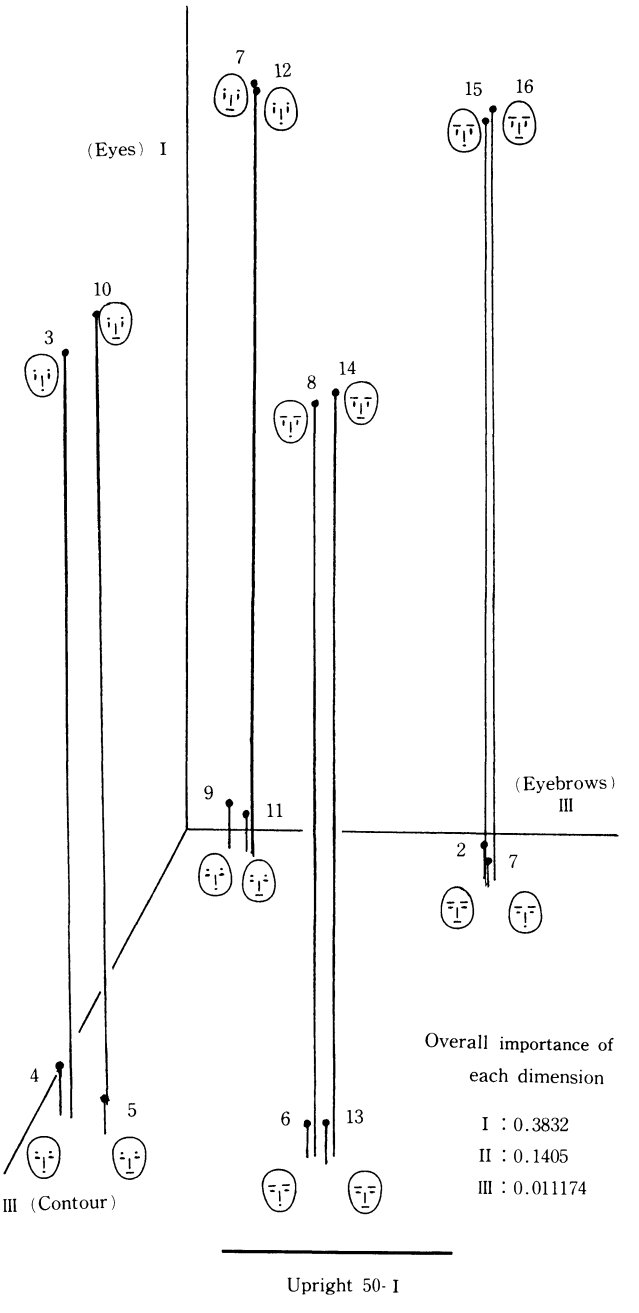

Fig. 1. Three dimensional arrangements of 16 faces (INDSCAL solution) at upright and
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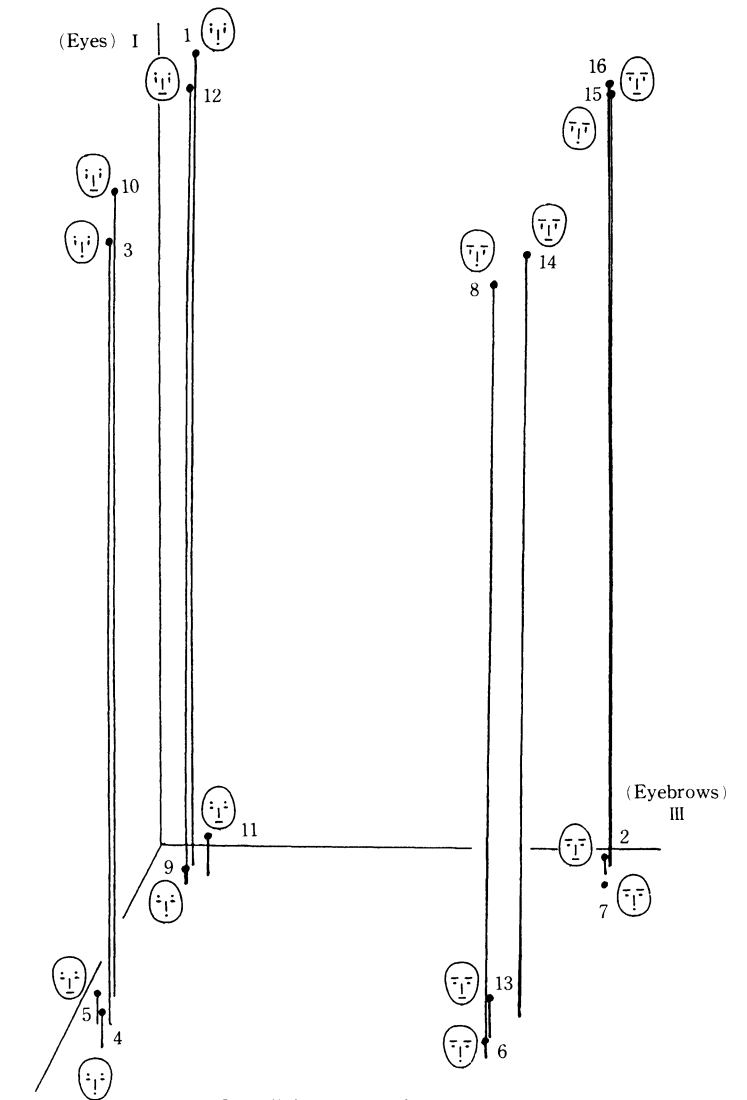

Overall importance of each dimension

I : 0.3658

II : 0.0909

III : 0.1456

Inverted 50- I

inverted condition (50-I series). Distances between each face represent the degree of dissimilarity.

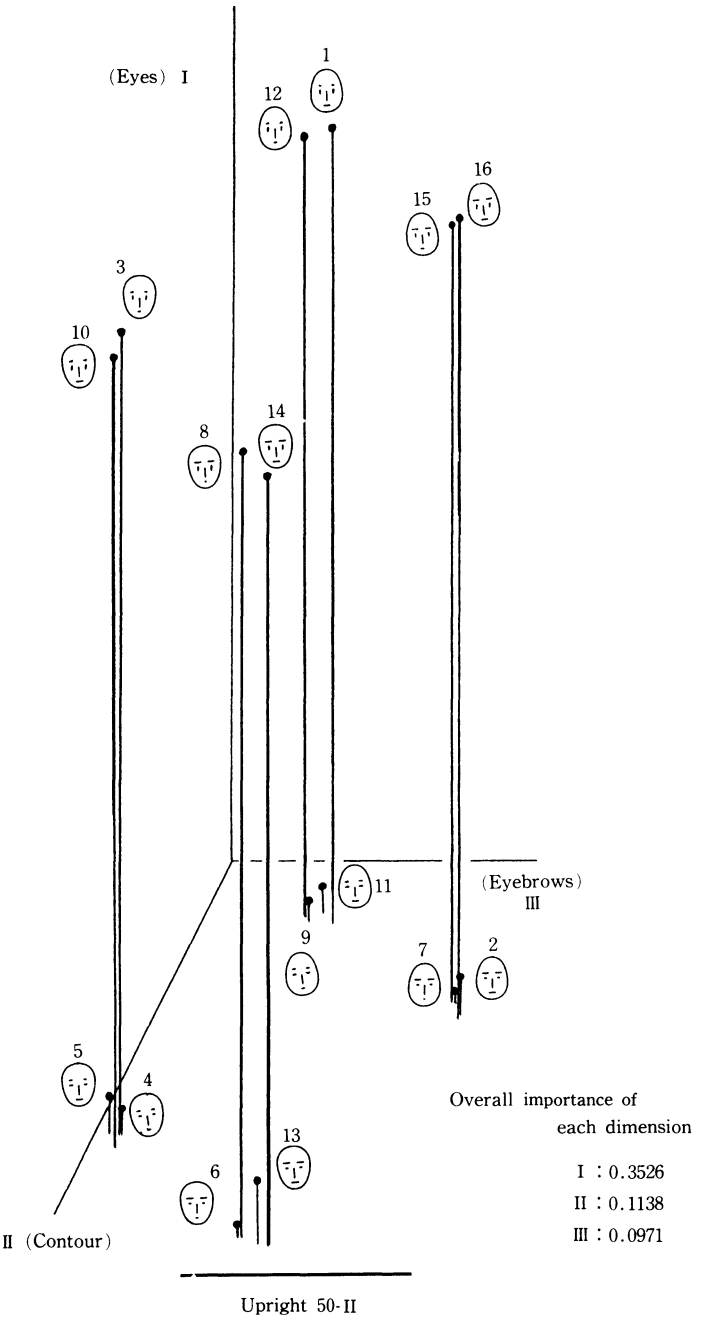

Fig. 2. Three dimensional arrangements of 16 faces (INDSCAL solution) at upright and

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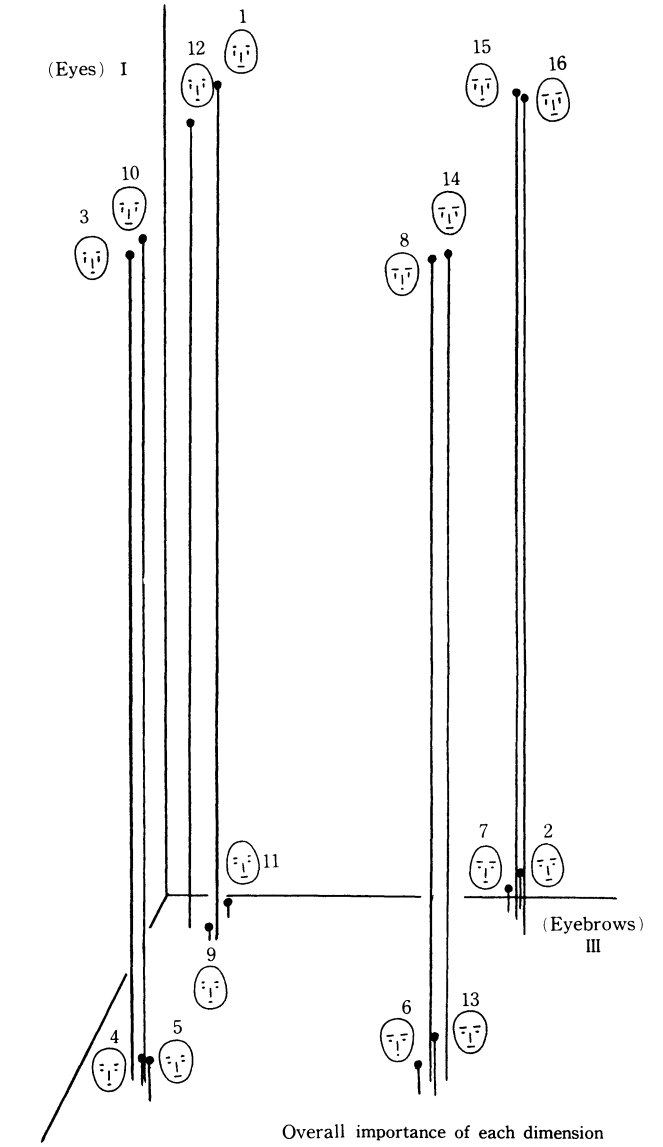

inverted condition (50-II series). Distances between each face stand for the degree of dissimilarity.

and then mouth.

(3) There has been exhibited the peculiar interaction between features which describes as that at the face pairs having same eyes as well as contours, the similarity of faces is enhanced to some extent by the not-sameness of eyebrows is suppressed.

As can be observed in Thatcher illusion (Thomson, 1980), it is well known that in the inverted faces the processing of face is greatly checked. As a consequence, this research is to investigate the characteristics of processing of inverted faces by utilizing the diagrammatic faces as well as the method employed in the previous experiment and by making comparison with the upright faces. In more detail, we want to investigate how the order of cue saliency will change and to see whether the interaction of features will be shown up.

Method

The diagrammatic faces and procedure employed here were the same as those in the previous experiment. After ranking the upright faces the inverted faces have been also grouped to 6 steps-rank order (Exp. I).

In order to verify the results of Exp. I, we have also performed Exp. II with the same procedure. The subjects in the two experiments are 50 different university students, respectively. The series of upright and inverted in Exp. I will denote Upright 50-1, and Inverted 50-I, and those in Exp. II, Upright 50-II and Inverted 50-II, respectively. The series imposed in the previous experiment will be called Upright 52.

Results and Discussion

INDSCAL method of MDS (ordinal scale) has been applied to the data of results.

Figure 1 (Upright 50-I and Inverted 50-I) and Fig. 2 (Upright 50-II and Inverted 50-II) show the mean arrangement of dissimilarity distance of each face obtained from the solution by INDSCAL. In order to compare the results with these of Upright 52, dimension I, II, and III have been set as Upright 52 to express eyes, contour and eyebrows, respectively.

The two sets of data of Fig. 1 and 2 show good agreement as to the essential aspect of results. Then, we will describe the results in a lump.

In all of the cases, the Stresses have a little exceeded 0.2 and therefore, the

Table 1. Stress and RSQ of MDS (INDSCAL) in each of 4 experimental series.

	Upright 50-I	Inverted 50-I	Upright 50-II	Inverted 50-II
Stress	0.203	0.214	0.219	0.220
RSQ	0.641	0.602	0.564	0.583

reliability is narrow. However, the following main results can be concluded.

For the case of upright faces

(1) In the discrimination of faces dissimilarity, the eyes serve as the most important cue, next is the contour and the last the eyebrows. The not-sameness of mouths have played little part. This statement of cue saliency is absolutely the same as in the case of Upright 52.

(2) The dissimilarity of faces rises as a function of the number of not-same features by way of adding different contours into different eyes and further adding different eyebrows. The degree of dissimilarity is in correspondence to the sides, plane diagonal and cubic diagonal of the rectangular solid, respectively. This result is completely the same as in the case of Upright 52, too.

(3) In both 50-I and 50-II, there is shown the obliquity effect of rectangular cube (more clearly in 50-II) at the upright faces. This result, unlike Upright 52, does not appear except in II-III quadrant as shown in Fig. 3.

For the case of inverted faces

(1) In the ordinal sequence of cue saliency, the eyebrows and contour, unlike in the upright faces, have changed their respective order. It is said in the inverted faces that the internal parts of face (the eyes and eyebrows) become dominant. But, since the contour is also functional as the external cue, it must be said that the global view takes place in the processing of inverted face. Yet the local views comparatively dominate in comparison with the case of upright faces. Because in the upright faces the difference of contours plays a comparatively important role in determining the overall impression of face, it is obvious that the wholistic-integrative view is taken.

(2) The displacement effect of rectangular cube does not appear at all.

For the obliquity effect in the upright faces

The obliquity effect formalized in Fig. 3 is explained as the compound factor of coordinates in axes II (contour) and III (eyebrows). That is to say, the contour is the cue to the coordinate in axis II and further the eyebrows also makes its contribution

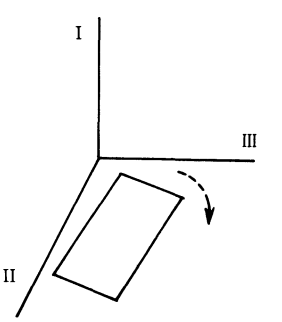

Fig. 3. Illustration of obliquity at plane including II and III dimensions, observed in the inverted series of Figs. 1 and 2.

(contour+eyebrows). And axis III is the eyebrows with the controur added (eyebrows+contour).

In other words, even though the faces which give the dissimilarity distance of sides along axis II have the not-same contours but the *same eyebrows*, the distance is expressed as having not-same contours and *not-same eyebrows*. That is to say, a little not-same eyebrows have been added into the not-same contours (adding ⊿eyebrows-not-same). From another point of view the above statement is nothing but adding ⊿eyebrows-not-same into the sides for its slight extention and hence completing the four corners because the sides are short and/or the diagonals are too long. The diagonals can not be shortened (because INDSCAL can not describe it in the space arrangement). Thus, it is assumed that the INDSCAL offered the solution of making the rectangular cube which gives the most approximate to the raw data, in that way.

Likewise at axis III, ⊿contours-not-same is added to the not-sameness of eyebrows.

Adding ⊿not-same-features means at axis II reducing the agency of contour's difference by the sameness of eyebrows to some extent and hence to raise the similarity of faces. It can be said that there exists a certain agency of eyebrows upon contours (eyebrows (same) → contours (not-same)). At axis III, the agency of eyebrows (not-same) ← contours (same) is also deduced.

As a result, we can summarize the above interaction between features as illustrated in Fig. 4.

Now in Fig. 4 the agency diagram of eyes → contours and eyes → eyebrows does not exhibit, but from the view point of saliency dynamics, this is unconvincing matter. Though INDSCAL operates the results from mathematical view point, but its solution must be mediated by a certain course of perceptual functioning. Based on the investigation described in the previous paper, this agency should be considered to be involved potentially in the obliquity.

Therefore, the paradigm of the interaction between features in Upright 50-I, II of the experiment is estimated to be expressed by Fig. 5. And we must predict the raw data with high validity through the paradigm of Fig. 5 than that of Fig. 4.

At this stage, based on the shortening of the side due to the interaction diagram shown in Fig. 5 and on the extending of the cubic diagonal due to the summation effect in three different features, which can be estimated on the basis of the same discussion presented in the previous paper (the detail is omitted), we can obtain the following

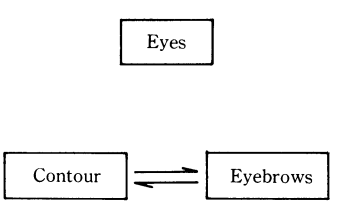

Fig. 4. Illustration of explicit information in INDSCAL solution (obliquity) about interaction paradigm between features. Arrows show "same → not-same effect".

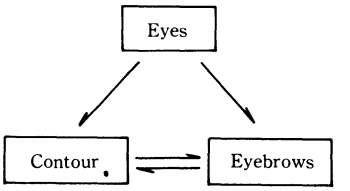

Fig. 5. Illutration of forms of interaction between features deduced from explicit as well as implicit information in INDSCAL solusion (obliquity). Arrows show not "not-same → same" but "same → not-same effect".

expectations for the rectangular cubic arrangement of raw data.

(1) The horn exhibiting (too long) of plane diagonal in quadrant II-III has to be accepted.

(2) In other plane diagonals (quadrant I-II and I-III) the horn exhibiting can be expected, also but among them there are some cases where no horn is appearing.

(3) The horn exhibiting of cubic plane can be expected as well.

After confirming the above expectation through adopting the mean raw data, there did appear as expected the horn exhibiting and the plane diagonal having few horn exhibiting of (2) was found at the diagonal of quadrant I-III.

We can summarize the obliquity effects mentioned above as follows.

(1) When same two features overlap in such a way that the eyes and contour are the same, the effective power of the not-sameness of eyebrows on discrimination of faces is weakned similarity of faces raised a little (summation effect of sameness of eyes and contours).

(2) Likewise in case of the same eyes and same eyebrows the summation effect of these features that enchances the similarity of faces to some extent, and hence the not-sameness of contours is suppressed (summation effect of sameness of eyes and eyebrows).

(3) However, the eyes are not governed by these agencies from the contour and eyebrows.

(4) In the faces in which all features of the eyes, contour and eyebrows are different the summation effect appears and the dissimilarity of face is raised a little.

(5) With respect to interaction paradigm between features, only difference between Upright 52 (Fig. 7 in the previous paper) and Upright 50-I, II (Fig. 5 in the present experiment) is that the agency of eyebrows (same) → eyes (not-same) does not exist in upright 50-I, II. As a consequence, it can be stated that except this point, the obliquity effect has no difference between the two experiments.

It is considered that the saliency of eyebrows has acted more strongly in Upright 52 than in Upright 50-I, II, and hence the agency of eyebrows → eyes took place in Upright 52.

Therefore, in conclusion almost the same paradigm of interaction between features has been verified in Upright 52 and Upright 50-I, II. It can be said that the validity of Upright 52 has been confirmed.

Conclusion

Based on the above discussion, the following can be induced with regard to the difference of processing mode between the upright and inverted faces.

(1) In the inverted faces the saliency of contour regresses when compared with that in the upright. Therefore, the internals of the eyes and eyebrows are dominant. The fact that the subtle difference of contours does not contribute strongly to the integration of the facial overall impression is estimated to be due to the reason that the wholistic integration in the inverted becomes weak.

(2) The interaction between features can not expect in the inverted face, while it appears in the upright. These interaction and summation effect of sameness or not-sameness between features yield the slight enhancement of similarity or dissimilarity of faces.

These effects are considered to be the appearance of the integrative functionning.

As a consequence, the following remarks can be concluded. In the upright face there appears the effect of integrative function which describes that the facial overall impression including the contour can be processed and the effect of relating the features acts also. While in the inverted face, not only the mode to integrate widely but also the way of relating the features regress and the piecemeal processing is likely to appear.

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