

Asymmetric Expression between Right and Left Hemiface of Human

Toshiaki TAKEDA, Wakako IWAMURA, Miho TOYO'OKA,
Hiromi NAKANO, Yukie AKAZAWA and Eriko SURUGA

*Laboratory of Physiological Sciences, Jichi Medical School, School of Nursing,
Minamikawachi-machi, Tochigi 329-0498, Japan
E-mail: ttakeda@jichi.ac.jp*

(Received December 15, 1999; Accepted March 8, 2000)

Keywords: Human Face, Right and Left Asymmetry, Emotional Expression, Cerebral Hemisphere

Abstract. Using image processing technique and newly developed cognitive evaluation method, asymmetry between right and left hemiface of human concerning the emotional function could be detected. Right-left asymmetry in emotional expression could be quantitatively evaluated by indices of richness and plainness scores. Most right-handed peoples (8 out of 10) showed positive and high richness scores indicating that the rich emotional expression is found in the left hemiface higher degree than in the right hemiface. The relevance of this result to the laterality of cerebral hemispheres in emotional function was discussed.

1. Introduction

Human body basically shows symmetry with regard to midline. But various form of right-left asymmetry can be found if we inspect the structural details.

For example, it is often said that human face is not completely symmetrical for right and left half (GILBERT and BAKAN, 1973; TEMPLE, 1993). Many questions arise concerning this subject. How much degree it shows asymmetry. For what feature in the face, asymmetry occurs. What factor (or brain mechanism if there) causes asymmetry. It is intended in the present study to detect right-left asymmetry in human face related to emotional expression. Methodologically, it is our advantage to be able to utilize currently available digital devices, e.g. digital camera and computer software for image processing. It is also needed to develop reasonable method to evaluate impression of human face for the study of right-left asymmetry.

Firstly, we devised an image processing method that is able to study directly the right and left half of the face. Secondly, to evaluate face expression we devised measures which are related to emotional functions utilizing a cognitive procedure. Finally, we will discuss right-left asymmetry of human face in relation to brain asymmetry of cerebral hemispheres.

2. Methods

2.1. Procedures for obtaining face samples

As objects of face samples, five volunteer students and five volunteer teachers* in our school were taken their close-up photos in calm condition with a digital camera (Olympus, CAMEDIA C-1400L with 1.4 million pixel CCD). Photo data were transferred to a Macintosh computer for image processing using Adobe Photoshop as preserving full color data. Left half of their face (left hemiface) was inverted and fused to original left half, thus makes “left face”. Similarly we obtained “right face”. Thus prepared “left face” and “right face” gave strong impression of each side of face to an observer without interference of the other side (Fig. 1), so we call this procedure “hemiface amplification method”.

All the above volunteer persons were right-handed.

2.2. Procedures for objective evaluation of face expression

Twenty students were selected as subjects (evaluator) to perform cognitive evaluation of face samples mentioned above. In a separated room, they were showed face samples one by one in following sequence, original face, “right face” and “left face” of one person. Samples from students and teachers were given alternately. The evaluators were asked to rate the “right face” and “left face” according to the criteria of the 8 terms (see below) in three grades, i.e. “not”, “yes” and “very yes”, correspondingly giving a score of 1, 2, 3,



Fig. 1. Sample face pictures of a person (teacher E). From left to right: “right face”, original face and “left face”, respectively (see text for definition). At cognitive evaluation session, each one picture, i.e. original, “right” or “left” was presented sequentially. As a result of average for all evaluators, richness score was -2 (see Table 1-B for definition) for this person. It means that the sum of score of items relating emotional expressions was larger in “right face” than in “left face”. While, plainness score was -9 . It means that the sum of score of items not relating emotional expressions (e.g. intellectual etc.) was larger in “left face” than in “right face”. It should be noted that major group of volunteer persons in the present study showed positive scores (see Table 2).

*Students and teachers represent two different generations, the former early twenties and the latter middle age (35–45 years old) respectively.

respectively. The presentation of original face was only for the sake of introductory role or priming role for next-coming object.

We selected 8 items of words which indicate face expression, i.e. 1) sociable, 2) tender, 3) grim, 4) happy, 5) sad, 6) introversive, 7) intellectual and 8) cold (Table 1-A). Among them, items 1) through 5) were selected to indicate richness of the face because these items presumably relates to emotional expression, while items 6) through 8) were selected to express plainness of the face.

To evaluate emotional contribution to the face expression in each side, we used two indices, the “richness score” and “plainness score” whose definitions are shown in Table 1-B.

The “richness” is a score of index to evaluate how left hemiface shows high emotional expression compared to the right hemiface. Richness of a person’s face was defined as the sum of the scores of item 1) through item 5) of the “left face” minus those of “right face”. Scores were finally used as the summation for all evaluators (Table 2).

The “plainness” is a score of index to evaluate how right hemiface racks emotional expression compared to left hemiface. Scores were used as the summation for all evaluators similarly.

3. Results

Table 2 shows the results of evaluation in the form of “richness” and the “plainness”. Four out of five faces showed positive score of richness both in students and teachers (80%), which indicates that the left hemiface show richer emotional expression compared to the right hemiface. The deviation was larger in students than in teachers. The plainness showed positive value in four out of five faces both in students and teachers, which indicates that the right hemiface has more plain expression compared to left hemiface. It is noted that faces showing the positive richness scores also had positive plainness scores. This indicates the validity of present dichotomy of terms by emotional richness and

Table 1. Terms relating face expression (A) and definitions of scores to evaluate the “richness” and the “plainness” of a person’s face (B).

	Terms for expression of emotion in the present study	Synonyms
A.	1) sociable	sociable, companionable
	2) tender	tender, gentle, kind sweet tempered
	3) grim	grim, angry
	4) happy	happy, cheerful, joyous, merry
	5) sad	sad, sorrow
	6) introversive	introversive
	7) intellectual	intellectual, intelligent
	8) cold	cold, chill
B.	Scores evaluating face	
	b1) richness (of the face) = left [1 + 2 + 3 + 4 + 5] – right [1 + 2 + 3 + 4 + 5]	
	b2) plainness (of the face) = right [6 + 7 + 8] – left [6 + 7 + 8]	

Table 2. Scores of cognitive evaluation summated for 20 evaluators.

Sample offerer	Richness score	Plainness score
Student-A	32	49
Student-B	37	34
Student-C	7	49
Student-D	26	36
Student-E	-15	-18
Mean	17.40	30.00
S. D.	21.38	27.74

Sample offerer	Richness score	Plainness score
Teacher-A	14	22
Teacher-B	6	28
Teacher-C	21	32
Teacher-D	10	10
Teacher-E	-2	-9
Mean	9.80	16.60
S. D.	8.61	16.55
	($p > 0.1$)	($*p < 0.05$)

plainness and also indicates that this dichotomy worked to correlate the expression of left hemiface to emotional role.

These above results can be interpreted to indicate that the left side of ones face showed emotional richness compared to right side of the face in 80% person. It is intriguing that 20% both in the student and teacher showed the result of reversed score, i.e. rich emotional expression in the right hemiface.

When we preliminarily compared the different generations, two groups, students and teachers, showed no significant differences in “richness”. “Plainness” was higher in students than in teachers ($p < 0.05$).

In order to study the difference between right and left face in view of each evaluation terms described in Table 1, averaged scores of each terms for either right or left side for 20 evaluators were shown in Fig. 2. It is noted that scores of terms having positive emotional feeling, “sociable”, “tender” and “happy”, showed higher points in the left hemiface than in the right. In contrast, scores of terms having negative emotional feeling such as “grim”, “sad” and “cold”, showed reversed results.

4. Discussion

In the present study, we described the method of hemiface amplification and developed a cognitive procedure to evaluate difference of right and left hemiface in emotional expression. As a result, we have shown that the left hemiface of most right-handed people (80%) have stronger relevance to emotional function. To the contrary, right hemiface showed less relevance for emotion, but showed high scores for some intellectual items.

Then, it is interesting to discuss these above results in relation to current knowledge of functional differentiation of cerebral hemispheres.

Cerebral hemispheres show remarkable asymmetry in both morphological and functional aspects. Size asymmetry between temporal plane (which is known to conduct a part of language function) of right and left side in human temporal lobe has been clearly described (MIZUNO, 1991). Asymmetry in functional characteristics of each hemisphere in various aspects, i.e. language function and spatial recognition, has rich history of investigation. Recent finding of the difference of right and left hemisphere in emotional function evolve important neurological and psychological study area. Because face expression is strong indicator for human emotion and also because hemispherical control for body is segregated by crossed innervation as a rule, it is interesting to consider present results in the light of hemispherical dominance.

In right handed people, it is said that 96% show dominance of left hemisphere, which means that the center for language is located in the left cerebral hemisphere (BRANCH *et al.*, 1964). Because emotional function is strongly mediated by the right hemisphere in right-handed (TEMPLE, 1993), it is reasonable that rich emotional expression is found in the left hemiface which is under the motor control of right hemisphere.

As seen in Table 2, this is the case for 80% of persons in both student and teacher group. Conversely, 20% of persons showed reversed result, rich emotional expression in their right hemiface.

It is intriguing that in small population of right-handed people (4%) show reversed hemispherical dominance, i.e. language center in the right (BRANCH *et al.*, 1964). Our volunteers (two out of 10) who showed negative scores of richness and plainness, although evidence is premature, may represent small population with such reversed hemispherical

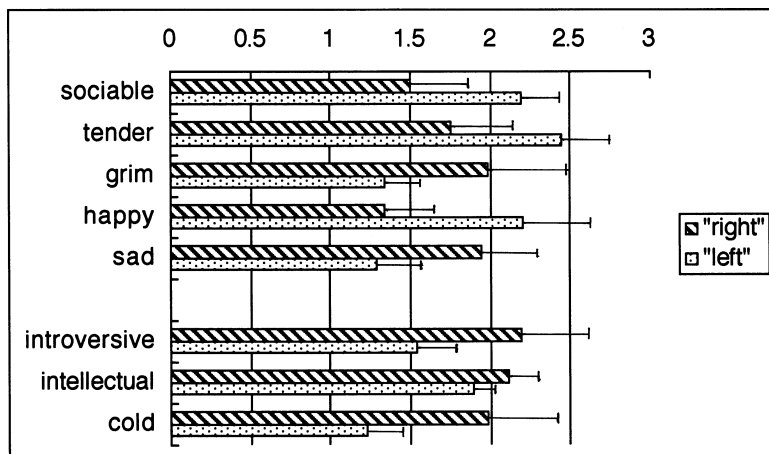


Fig. 2. Scores averaged for 20 evaluators in order to compare the scores in "right" and "left" face. Scores were averaged for 8 volunteers (four students and four teachers) who showed positive richness and plainness. The values of axis correspond to the score grade of each items. These values for each term were significantly different ($p < 0.02$) as for right and left. Error bars show standard deviations.

dominance.

On the other hand, another way of brain effect can be possible. According to KOH-HARA (1991), symmetry of body motion can be observed in situations in which emotional mind is prevailing, while right-left asymmetry of body motion can be seen in a situation in which intentional and volitional mind is prevailing. The latter case is evidenced in such case as a gesture, a sign, a bitter smile, a cynical smile, a chuckle, a ridicule, an embarrassed feeling, a contradictory feeling and when speaking evil. Because human volition is said to prevail from dominant (left) hemisphere, such action may cause some volitional deformation of expression in the right hemiface in right handed people. Thus, right-left asymmetry in face expression can be caused either by positive bias (emotional pressure to the left hemiface) or negative bias (volitional pressure to the right hemiface).

REFERENCES

- BRANCH, C., MILNER, B. and RASMUSSEN, T. (1964) Intracarotid sodium amytal for the lateralization of cerebral speech dominance: Observations in 123 patients, *J. Neurosurg.*, **21**, 399–405.
- GILBERT, C. and BAKAN, P. (1973) Visual asymmetry in perception of faces, *Neuropsychologia*, **11**, 355–362.
- KOH-HARA, Y. (1991) Left-right asymmetry in view of action, in *Origin of Left-Right Asymmetry and the Brain* (ed. K. Kubota), Asakura-shoten, Tokyo, pp. 96–116 (in Japanese).
- MIZUNO, N. (1991) Anatomical left-right asymmetry of the brain, in *Origin of Left-Right Asymmetry and the Brain* (ed. K. Kubota), Asakura-shoten, Tokyo, pp. 143–166 (in Japanese).
- TEMPLE, C. (1993) *The Brain: An Introduction to the Psychology of the Human Brain and Behaviour*, Penguin Books Ltd., London.