Interference from configuration of a Schematic Face onto the Recognition of Its Constituent Parts

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INTERFERENCE FROM CONFIGURATION OF A SCHEMATIC FACE ONTO THE RECOGNITION OF ITS CONSTITUENT PARTS

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We investigated an interference effect of facial configuration on the recognition of facial parts using schematic faces as stimuli. In the results of the experiment 1 from 16 college students, top-half faces were recognized more slowly when they were aligned with bottom-half faces to form a complete face than when misaligned not to form a face; the finding observed for black-white photographs (Young et al., 1987) was replicated even for schematic faces. Another 16 college students in the experiment 2 recognized left-half faces more slowly when aligned with right-half faces than when misaligned; the interference effect was found for another type of composites. Further, this effect was found for both symmetrical composites and asymmetrical composites, or for both correct and incorrect composites. The implications for perceiving and rcognizing faces from the findings obtained in the present study were discussed.

Key words: face recognition, schematic faces, configuration.

It is widely held that configurational information plays an important role in perceiving and recognizing faces. There is several evidence for such a view (see for a review, Bruce, 1988; Sergent, 1989), one of which was obtained by research on the effect of facial context on the perception of the constituent parts.

Homa, Haver, and Schwartz (1976) found that the perceptibility of the constituent parts of a stimulus configuration was enhanced when the parts were arranged within a normal face pattern, which have been named "face superiority effect". They prepared three types of stimuli: schematic faces, scrambled faces and single feature faces. After one of these stimulus types was tachistoscopically presented, subjects were tasked a forced-choice of one of three inner features, i.e. eyes, a nose and a mouth. The results showed that the subjects more accurately detected a feature when it was part of a normal face than it was part of a scrambled face. Gyoba, Arimura, and Maruyama (1980) reported also an equivalent effect. They found that a pair of line segments briefly presented were identified more accurately when they were shown as

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eyebrows within a normal face than when they were shown in isolation or when in a scrambled face.

What nature of facial context is necessary for producing a face superiority effect is one of problems to be resolved. Gyoba, Arimura, and Maruyama (1980) investigated the relation of the number of components of a facial context to the face superiority effect. They found a linear decrease in the degree of facilitation with reducing the number of components. Davidoff (1986) showed that components of faces were recognized more accurately when the faces comprised normal facial features than when they comprised nonfacial features (e.g. car or telephone) except for a feature asked to recognize. However, even for the latter stimulus condition components were recognized more accurately than when they were rearranged in a scrambled face. It indicated that the spatial position of the internal features and the nature of the features contributed to facial configuration.

A face superiority effect, however, have not been always obtained. Mermelstein, Banks, and Prinzmetal (1979) showed that facial configuration facilitated detection of its constituent parts when subjects were instructed which feature of a stimulus was to be detected after the stimulus had been presented. But facial configuration interfered with detection of its components when subjects knew a feature to be detected before a stimulus was presented. According to them, if the task requires subjects to memorize a stimulus, facial configuration can help detection of a part, because good forms are easily encoded and remembered. On the other hand, if the task requires perceptual analysis of a stimuli, facial configuration can interfere with detection of its constituent parts.

Young, Hellawell, and Hay (1987) reported another type of interference effect of facial configuration on identification of constituent parts. They combined photographs of the top and bottom halves of different familiar faces to form facial composites. And then they compared naming latency for the top or bottom segment of composites to that for top or bottom segment of noncomposites, in which top and bottom segments were misaligned not to be faces. The results showed that subjects named more slowly half segments for composites than for noncomposites, indicating that the facial configuration of composites interfered with identification of constituent parts. A similar effect was found for composite faces made from parts of unfamiliar faces.

This effect seems to be consistent with the suggestion by Mermelstein, Banks, and Prinzmetal (1979), because the subject's task required perceptual analysis of a stimulus. However, in Young et al. experiment black-white photographs were used as stimuli, whereas in Mermelstein et al. experiment schematic faces were used. Further, in Young et al. experiment constituent parts to be identified had configuration as face which enabled subjects to identify them, whereas in Mermelstein et al. experiment parts to be identified was a single component. Thus, the interference effect reported by Young et al. should not be compared directly to that reported by Mermelstein et al.

The aim of the two experiments reported here was to investigate the phenomenon shown by Young et al. using schematic faces as stimuli. It has been suggested that there are some differences between black-white photographs and schematic or line-drawing faces. For example, Sergent (1986) indicated that schematic and line-drawing faces had a higher level of contrast than black-white photographs, which caused to some extent difference in the emergence of a lateral hemisphere advantage between the two stimulus types. However, it is clear that schematic faces are classified as face and activate the face processing system (Ellis & Young, 1989). Thus, schematic faces are useful stimuli to explore the mental representation of faces used for the initial classification of stimuli as a face, or to investigate the early stage of face processing. Further, it is necessary to examine whether the phenomenon found for photographs are found for schematic faces in order to explore the relation between the effect shown by Young et al. and a face superiority effect or the findings found by Mermelstein et al. In the first experiment, we examined whether configuration of schematic faces interfere with recognition of top-half part of them. In the second experiment, we examined whether facial configuration interfere with recognition of right-half part of them.

Experiment 1

The purpose of this experiment was to determine whether top-half schematic faces are recognized slowly when they are aligned with bottom-half faces to form a complete face than when misaligned.

Method

Stimuli : Four kinds of top-half schematic faces were used as target patterns, which comprised half of a contour, eyebrows, and eyes (Fig. 1). These were made in such a way that they could not be distinguished each other on the basis of one of the three components.

Composite faces were created by joining a target pattern to a bottom-half face, which comprised half of a contour, a nose and a mouth. Four composites were prepared of each target, so that there were 16 composite faces. Sixteen noncomposites were created by transforming each composite so that a left or right side of the top segments was positioned above the center of the bottom segments. The direction of shifting the top segment was counterbalanced across the noncomposites. Examples of the composites and the noncomposites are given in Fig. 1.

When the stimuli were prepared as slides, the center of each noncomposite was positioned in the center of the slide ; the target pattern included in noncomposites occupied the position slightly to the left or to the right of the center of each slide. The position of composites were determined so that the target of composites was presented in the same position as that of the target of the corresponding noncomposites. Slides

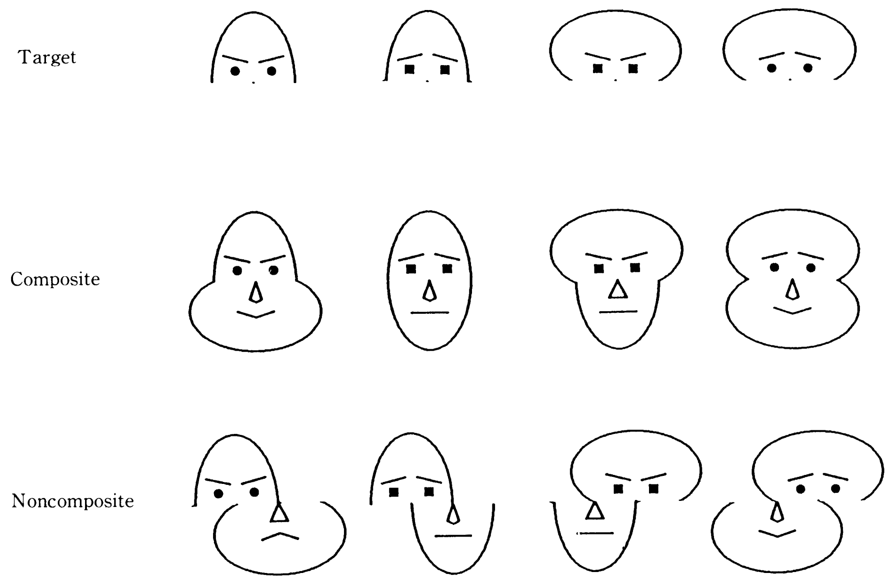

Fig. 1. The four target patterns used in Experiment 1, and examples of composite and noncomposite stimuli made from these targets.

including only a target were also prepared for the training trial. Two types of the slide were made for each target in such a manner that the target occupied the same position of that included in composites and noncomposites.

Apparatus: The slides were presented on a translucent screen (12×12 cm). There was a dot for a fixation point in the center of the screen. Subjects observed the screen at a distance of 100 cm from a chin rest. The stimuli subtended a visual angle of approximately 4.2 deg. A microcomputer (NEC PC9801VX) and JAC Timer Board (NIHON ASSEMBLER Inc.) were used for controlling the stimulus presentation and recording the subjects' response and response latency.

Procedure: Subjects were presented samples of the target patterns, which were randomly placed side by side and were numbered from the left side. Subjects were instructed to press the button which was assigned to the same number as that of the target of the presented slide, with the first and second fingers of the both hands. They were told to respond as quickly but as accurately as possible.

The training trials consisted of 4 blocks of 32 trials, totaling 128 trials. In each block, all target were presented 8 times in randomly intermixed order. The number of the training trials was determined on the basis of a pilot study so that subjects learned sufficiently the targets. The experimental trials consisted of 2 blocks of 32 trials. In each block, 16 composites and 16 noncomposites were presented randomly. In both the training and the experimental trial, the duration of stimuli was 2,500 msec regardless of subject's reaction time, and the intertrial interval was 2,500 msec. A warning

Table 1. Mean reaction times (in msec) for correct recognition of top half of composite and noncomposite stimuli (Experiment 1).

Composite	Noncomposite
941	894

tone preceded each trial by 500 msec. The order of each trial and the number assigned to the target were changed in every third subjects.

The sample of the targets was presented below the screen during the training trial. Subjects were permitted to see both the presented stimulus and the sample in order to response accurately until they memorized sufficiently the targets. However, subjects were instructed to try responding without the use of the samples, because the sample were removed in the experimental trial, which was informed the subjects again before the last block of the training period.

Subjects: Sixteen undergraduate students (three male, thirteen female) volunteered for this experiment, who had normal or correct-to-normal vision.

Results

Error rates were approximately 2% for all experimental trials and were too low to analyze. Mean reaction times for correct recognition of the targets of composites and noncomposites were calculated for each subject. The overall means are shown in Table 1. A one-factor (stimulus type) ANOVA with repeated measure revealed a main effect of stimulus type ($F=12.74$, $df=1/15$, $p<.01$); subjects responded more slowly to composites than to noncomposites.

Discussion

A top-half schematic face was recognized more slowly when it was included in a composite face than when included in a noncomposite. It was demonstrated that the facial configuration produced by two halves faces interfered with the recognition of the constituent part, and that the finding reported by Young et al. using black-white photographs was replicated using schematic faces.

Experiment 2

Young et al. showed that interference from the composite configuration onto identification of constituent parts was found not only for top-half and bottom-half face composites but also for internal and external facial feature composites. The aim of experiment 2 was to investigate another type of composites, i.e. left-half and right-half composites. Namely, this experiment was designed to determine whether left-half faces are recognized slowly when they are aligned with right-half faces to form a complete face than when misaligned. The additional aim was to investigate the symmetrical property of a facial configuration. Since faces are almost symmetrical with respect to the vertical axis, combinations of correct left-half and right-half face are symmetrical and incorrect combinations are asymmetrical. Thus, manipulating symmetry of composites, we could examine whether correctness of composition affect the interference effect of facial configuration.

Method

Stimuli : Four kinds of left-half schematic faces were used as target patterns, which comprised half of a contour, an eyebrow, an eye, half of a nose and half of a mouth (Fig. 2). They could not be distinguished each other by one of the forth components.

Composite faces were created by joining a target pattern to a right-half face, which comprised of the same components as that of the targets. Three composites were prepared of each target: one of them was symmetrical and the others were asymmetrical, in which only one of features was symmetrical. Noncomposites were created by transforming each composites so that the left and right segments were misaligned each other by 5/12 of the vertical length. The two types of noncomposites were

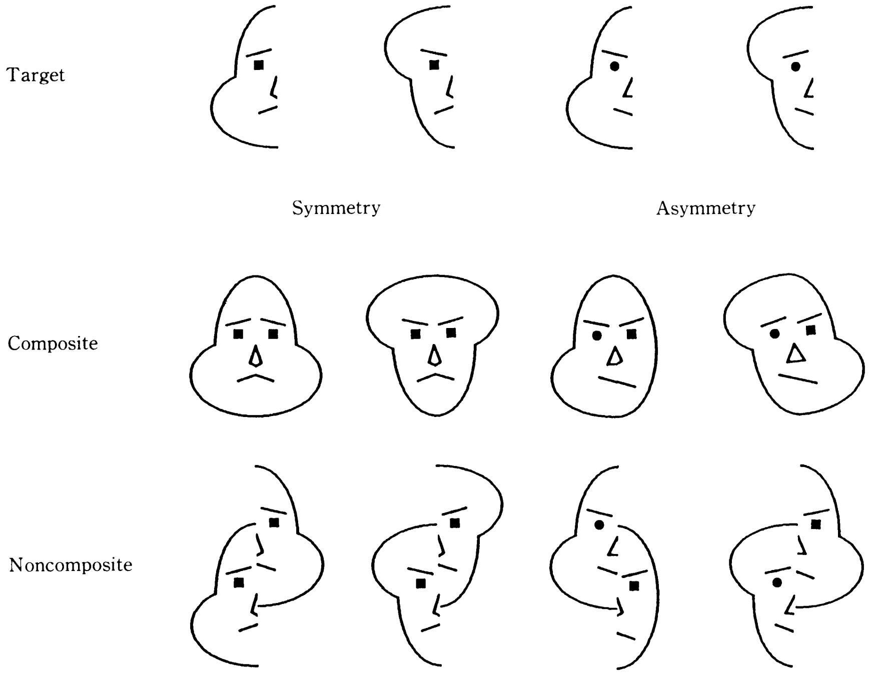

Fig. 2. The four target patterns used in Experiment 2, and examples of composite and noncomposite stimuli made from these targets.

constructed by each symmetrical composites: the left segment positioned above relative to the right segment and vice versa. One of the two type of noncomposites were constructed by each asymmetrical composites. Thus, 16 noncomposites were made. Examples of composites and noncomposites are given in Fig. 2.

When the stimuli were prepared as slides, each noncomposite was centered on the slide; the target pattern of noncomposites occupied the position slightly to the above or to the below of the center of each slide. In order to counterbalance the position of the targets across stimuli, two types of slide of composite were made: composites were moved slightly above or below from the center of each slide. The two types of slide were prepared of the symmetrical composites. One of the two types of slide was prepared of the asymmetrical composites. Thus, 16 slide of composites were prepared. Slides for the training trials were also prepared in a similar manner to that used for the symmetrical composites.

The stimuli subtended a visual angle of approximately 4.6 deg.

Apparatus: This was as for experiment 1.

Procedure: The same procedure as that of experiment 1 was used, except for the stimuli.

Subjects: Sixteen undergraduate students (one male, fifteen female) volunteered for this experiment, who had normal or correct-to-normal vision. All did not take part in the previous experiment.

Results

Error rates were approximately 4% for all experimental trials. These data were not considered further. Mean reaction times to recognize correctly the targets in each stimulus type (composite or noncomposite, and symmetry or asymmetry), were calculated for each subject. The overall means are shown in Table 2.

The data for correct recognition were subjected to a two-factor ANOVA (two stimulus type, i.e. composite or noncomposite, symmetry or asymmetry) with repeated measures. The main effect of the former stimulus type (composite or noncomposite) was significant ($F=39.02$, $df=1/15$, $p<.001$). The main effect of the latter stimulus type (symmetry or asymmetry) was marginally significant ($F=3.53$, $df=1=/15$, $.05<p<.10$). And the interaction between both the stimulus type factors was also significant ($F=10.12$, $df=1/15$, $p<.01$). Further analysis revealed the simple effect

Table 2. Mean reaction times (in msec) for correct recognition of left half of composites and noncomposites for symmetrical and asymmetrical stimuli (Experiment 2).

	Composite	Noncomposite
Symmetry	1091	1016
Asymmetry	1165	1022

of the former stimulus type for both symmetrical and asymmetrical stimuli (symmetry; $F=9.30$, $df=1/15$, $p<.01$: asymmetry; $F=33.45$, $df=1/15$, $p<.01$). The simple effect of the latter stimulus type for composite was also found ($F=6.07$, $df=1/15$, $p<.05$), but not for noncomposite ($F<1$). It showed that responses were faster to noncomposites than to composites for both symmetrical and asymmetrical stimuli and that the difference between response to composites and those to noncomposites was greater for asymmetrical stimuli than that for symmetrical ones.

Discussion

A left-half schematic face was recognized more slowly when it was included in a composite face than when included in a noncomposite. The interference effect of facial configuration on the recognition of the constituent parts was found even for left-half and right-half face composites.

This effect was observed for both symmetrical and asymmetrical composites, or for both correct and incorrect composites. Since symmetrical composites comprised redundant pairs of half faces, the emergence of the interference effect for these composites reflects compelling effect of facial configuration. Asymmetrical composites are deviate from a general facial prototype, but these have unique and definite facial configurations (as in Fig. 2), making it difficult to pay attention to constituent parts. However, this finding may not be surprising, because faces are exactly asymmetrical and their actions are often asymmetrical (Campbell, 1986).

A greater interference effect was found for asymmetrical composites than that for symmetrical ones. This result may be caused by the fact that subjects observed each stimulus of symmetrical composites more frequently than that of asymmetrical ones: four times for each symmetrical composite and two times for each asymmetrical composite. Thus, at present, it is not clear whether there are any difference in the degree of interference between symmetrical and asymmetrical composites. This issue needs to be examined in future research.

General Discussion

We investigated an interference effect of facial configuration on recognition of facial parts using schematic faces. It was found that configuration of schematic faces interfered with recognition of top-half (Experiment 1) and left-half (Experiment 2) part of them.

In the present experiments, subjects performed so many training trials, i.e. 32 times for each target, totaling 128 times, that they might overlearn the targets, which might influence the results. In order to examine the problem, mean reaction times for each block of the training trials were calculated for each subject. For 13 of 32 subjects in the two experiments, the fastest mean latency was found for the third block. For 16 subjects, the fastest mean latency was found for the last block. It suggested that about a half of subjects needed at least 3 blocks of the training trial in order to learn sufficiently the targets, and that another half of subjects needed 4 blocks or more for learning them. Thus it can be said that the number of the training trials was adequate for the aim of sufficient training.

In Young et al. experiments, difficulty in identifying the parts of composites was found both for stimuli made from photographs of familiar faces and for those made from photographs of unfamiliar faces. In the present experiments, an equivalent effect was found for stimuli of schematic faces. Thus, this effect could be observed for all stimuli that were classified as face. It showed that configurational information is quite salient property of faces.

The findings obtained in the present study could lead us to some interesting researches. We could investigate the relationship between the interference effect reported here and a face superiority effect or the findings reported by Mermelstein, Banks, and Prinzmetal (1979) with use of same schematic faces, which will provide important implications for the interaction of configurational and featural informations in perceiving and recognizing faces.

Interference effect of configuration of asymmetrical composites on recognition of left-half segments could be important cue to explore the mental representation of faces used for the initial classification of stimuli as a face, because asymmetrical composites are deviate from a general facial prototype as mentioned before. It will be necessary to investigate the degrees of this interference effect when asymmetry of composites are manipulated in steps. We also have to examine how the interference effect of configuration made from left and right halves composites is affected by a lateral hemisphere advantage in recognizing faces (see for a review, Ellis, 1983).

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