Stimulus versus Face Recognition in Laterally Displayed Stimuli
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Source: *The American Journal of Psychology*, Vol. 100, No. 1 (Spring, 1987), pp. 117-121
Published by: University of Illinois Press
Stable URL: http://www.jstor.org/stable/1422645

AJP Forum

Stimulus versus face recognition in laterally displayed stimuli

Recent models of face recognition stress the importance of dissociating stimulus recognition from face recognition (Bruce & Young, 1986; Hay & Young, 1982; Rhodes, 1985). In line with both natural daily-life conditions and the considerations of Marr (1982) dealing with the 2.5- versus 3-dimensional representations of perceived stimuli, it appears that a face-recognition process can be assessed only when the stimulus to recognize differs from the stimulus previously stored in memory: In this condition only, the subject has to elaborate a representation of the face that is independent of the orientation and expression of the actually perceived stimulus. Thus, face recognition requires the extraction of some invariant physiognomic characteristics, whereas the recognition of an identical picture ("stimulus") can be based on a single stimulus recognition by a template-matching process. Moreover, the classical "right hemisphere superiority" for face recognition has been challenged by the results of several experiments in which this asymmetry favoring the left visual hemifield was not observed. This observation has led some authors to decompose the face-recognition process into several subprocesses, or stages, to analyze the asymmetry at each level. Because of such decomposition, various models of face recognition have been suggested (see Bruyer, in press, for a review).

In conjunction with the face versus stimulus-recognition distinction presented above, it appears that left-field superiority is produced particularly when the subject has to make a real face recognition, whereas no asymmetry emerges for stimulus recognition. Bertelson, Van Haelen, and Morais (1979) reported a left-field advantage when subjects compared two stimuli of different orientations (full face vs. three-quarter profile) but no lateral difference when both were profiles. In the present experiment, we generalized this experimental design and increased the difficulty of the task. In our procedure, the subjects were first presented a laterally displayed target and then had to match it to a centrally shown set of two different faces. Both targets and pairs were either full faces or profiles, and the four possible combinations were used in a between-subjects design. Second, complete-profile views were used, not three-quarter profiles, which increased the level of difficulty while preserving ecological conditions. On the basis of the previous data, it was hypothesized that *different* conditions, that is, conditions in which the targets and the pairs were of different orientations, would maximize the occurrence of lateral differences.

Stimuli were full face or complete profile, black-and-white photographs of 20 male and 20 female models. Posers had no particular specific details

AMERICAN JOURNAL OF PSYCHOLOGY
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and were asked to take a neutral expression. Left- and right-profile views were made by mirror-reversing the original profile photograph, so that 120 stimuli (40 posers × 3 orientations) were available. These were used to prepare 60 pairs of faces, each pair consisting of two different faces of the same sex with the same orientation and of about the same age. In addition, 80 slides were prepared as targets. There were four series of 20 targets, with 10 female and 10 male targets in each series; 20 targets were full faces shown in the left visual field (LVF), 20 were full faces shown in the right visual field (RVF), 20 were left-profile views shown in the LVF, and 20 were right-profile views displayed in the RVF. We intensively used a between-subjects design, and each target face was shown to a given subject only once. The targets were laterally displayed left or right from the fixation point (viewing distance = 130 cm). They were centered 7.9° from this point and were 8.3° wide. The faces were unfamiliar.

Subjects sat facing a screen, the head maintained by a head rest. First they were shown the target laterally displayed for 125 ms. After a 1-s interval, they were shown a pair of horizontal, centrally displayed faces; one of these was the target, and the subject had to point to it by using the hand ipsilateral to the hemifield in which the target had been displayed. In addition, subjects were asked to state the criteria used to make their decision. Within each condition (and subject), 10 trials were formed with the target shown in the LVF, and 10 with the target in the RVF. The order of trials was randomized. Four experimental conditions were used, with 10 female and 10 male subjects in each. In two conditions (*identical*), targets and pairs were taken with an identical orientation, either full face or profile; in the other two (*different*), the targets and pairs differed in orientation (full face vs. profile, or profile vs. full face). Therefore, the identical condition concerned stimulus recognition, and the different condition involved a face recognition.

Subjects were 80 young (mean age = 21.4 years), right-handed normals. Ten female and 10 male subjects were randomly assigned to each of the four experimental conditions.

The mean number of correct responses (of 10) by visual field, condition, and sex of subjects, is shown in Table 1. A three-way mixed analysis of variance (ANOVA) was used, with sex and conditions as the between-subjects factors and the visual field as the within-subjects factor. Sex did not contribute to variance, either as a main effect or in interaction. The significant main

Table 1. Scores (of 10) for each visual hemifield (LVF = left; RVF = right), kind of orientation (identical, different), and sex (means of 20 subjects in each cell of the table)

	LVF		RVF	
Subjects	Identical	Different	Identical	Different
Male	7.05	6.00	6.95	6.80
Female	6.65	5.85	7.00	6.35

effect of condition ($F = 4.85$, $df = 1, 76$, $p < .05$) showed an advantage of identical over different orientation. The significant visual-field effect ($F = 9.85$, $df = 1, 76$, $p < .01$) indicated an RVF advantage. These two factors interacted significantly ($F = 5.42$, $df = 1, 76$, $p < .05$), as illustrated by Figure 1. Post hoc comparisons with the Newman-Keuls test ($p < .05$) indicated that the RVF advantage applied for the different condition, with no asymmetry for the identical one; complementarily, the condition effect was observed in the LVF only.

We analyzed the criteria explicitly mentioned by the subjects following each response.[1] A first Sex × Condition × Visual Field ANOVA on the total number of criteria evidenced a significant main sex effect ($F = 7.37$, $df = 1, 76$, $p < .01$). Men furnished more criteria than women (9.74 vs. 8.26). Moreover, the three factors interacted significantly ($F = 3.97$, $df = 1, 76$, $p < 0.05$). Post hoc comparisons (Newman-Keuls test, $p < .05$) revealed no visual-field effect in each Sex × Condition arrangement, no condition effect in each Sex × Visual Field combination, and an advantage of male over female subjects for the identical orientation in the RVF and for the different orientation in the LVF. Another three-way ANOVA was applied to the difference between the amount of global criteria and the number of analytical ones (global minus analytic). Only the main condition effect was significant ($F = 10.29$, $df = 1, 76$, $p < .01$). The global criteria were largely used in the different condition, whereas no clear preference emerged for the identical one. Finally, the same ANOVA was applied to correct trials, that is, those trials in which we may assume the criteria had been effective. An identical conclusion was reached (condition effect: $F = 7.72$, $df = 1, 76$, $p < .01$).

Within a larger program of research, the identical condition involving only full faces was also submitted to a sample of 10 female and 10 male, elderly, right-handed normals (mean = 67.5 years). Their scores were compared with the corresponding sample of 20 young subjects in a mixed, Age × Sex × Visual Field ANOVA that did not evidence any significant effect.

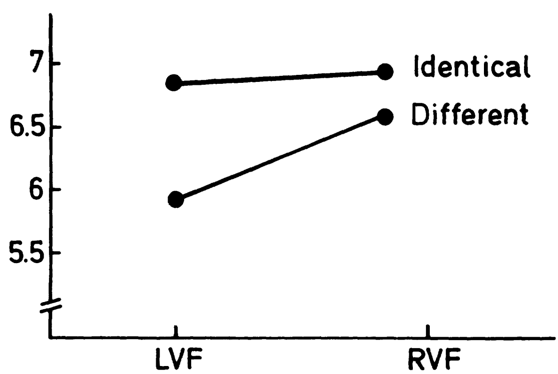

Figure 1. Scores (of 10) for each visual hemifield (LVF = left; RVF = right) and kind of orientation (means of 40 subjects by kind of presentation)

The elderly subjects clearly preferred global criteria, whereas no clear preference appeared for young subjects. This applied when all the trials were considered (age effect: $F = 7.77$, $df = 1, 36$, $p < .01$) as well as when only correct responses were retained ($F = 4.93$, $df = 1, 36$, $p < .05$). Finally, when effective global criteria were analyzed, a significant Age × Sex × Visual Field interaction appeared ($F = 6.6$, $df = 1, 36$, $p < 0.05$). The number of effective global criteria was higher (a) in the LVF than in the RVF for both young and elderly female subjects; (b) for male than for female subjects (whatever the age) when the RVF was considered; and (c) for elderly than for young subjects in the four Sex × Visual Field combinations. This effect did not appear for analytic criteria.

Returning to our main experiment, we note that the task was difficult enough to avoid ceiling effects and, as expected, that face recognition was more difficult than stimulus recognition. Another observation was expected, namely that only face recognition (i.e., the different condition) induced lateral differences. This conclusion is in agreement with that of Bertelson et al. (1979). However, the direction of this asymmetry was unexpected: An RVF advantage appeared for face recognition, and there were no differences between face and stimulus recognition in the RVF. In other words, the task was particularly hard when a face recognition had to be made in the LVF. This result cannot be explained by the physical properties of the input. Indeed, the stimuli were relatively great, as was their eccentricity. According to Sergent (1983), these conditions should have favored a right-hemisphere (LVF) strategy. However, task requirements can account for this observation. In each trial, the subject had to choose between two faces that were matched for age, sex, and orientation; thus, the stimuli presented on the recognition board were difficult to discriminate. In addition, the subject was asked to match a full-face target with a complete profile, which is difficult. Consequently, this unexpected pattern of asymmetry could be linked with the task difficulty (Sergent & Bindra, 1981): Left-hemisphere visuospatial competences seem to be reinforced when the difficulty increases. With this line of interpretation, we note that subjects tended to prefer global criteria in the different condition. Such a strategy may seem strange, because an analytic approach would be more appropriate for the different, difficult matching task. Therefore, we suspect that the unexpected pattern of asymmetry results from an inadequate strategy. However, this strategy was perhaps imposed by the full face/complete profile matching. In sum, when target and test faces differed in orientation, subjects used the global strategy that is typical of the right hemisphere (LVF) but that is less effective than the analytic one. As a supplementary argument, we note that such a strategy was highly effective in the RVF, as no condition effect appeared. Although the accuracy of elderly subjects did not differ from that of young subjects in the identical condition, the elderly people preferred to use global criteria even in this condition. This strategy could be the best one, because it was more effective in the old than in the young subjects, whatever the stimulated hemifield. In addition, in this stimulus-recognition task, global criteria were particularly effective for stimuli shown in the LVF, at least for female subjects.

Three conclusions are suggested by the present study. First, cerebral asymmetry is reinforced when an actual face recognition is needed. Second, the direction of this asymmetry depends on the task difficulty. In the difficult task used here, a left hemisphere advantage appeared. Finally, the construction of an adequate processing strategy may not be achieved in young adult subjects and needs a long time to be optimalized.

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Notes

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1. Sometimes, several criteria were mentioned after a single trial by the subjects, so the means can be higher than 10, by experimental condition and hemifield. The criteria have been classified into three categories: global criteria concerning the face but not specific facial features (size, general impression, likeability, agreeableness, etc.); analytic criteria concerning specific facial features (nose, eyes, mouth, chin, complexion, etc.); "other" criteria which were rare and did not concern the face per se (orientation, neck, etc.).

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