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Short communication

MEASUREMENT OF LATERAL DIFFERENCES FOR FACES IN A TWO-RESPONSE PARADIGM

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Abstract. The experiments illustrated the effect of procedural factors in reaction time measurements on lateral differences between visual fields for faces in two-reaction paradigm. The subjects were instructed to decide whether two faces presented successively in the left or right visual field were the same or different. The two experiments differed in the situation of response buttons in horizontal line left-right (Experiment I), or in vertical line further-closer to the subject (Experiment II). Both experiments showed advantage of the right hemisphere, though in the Experiment I the differences between the left and right visual fields depended on the configuration of buttons applied. The results point to fact, that even slight procedural changes may effect the results.

In psychological studies of hemispheric asymmetry, photographes of faces are often used as a complex pattern for visuo-spatial processing, analyzed first of all by the right hemisphere. The right hemisphere advantage in recognition of faces has been confirmed by experiments conducted with lateral presentation of visual stimuli. The perception indicator for this material exposed in the right and left visual field used in this study is the number of errors (4, 6-9) or, to avoid verbalization measurement of reaction time (5, 7, 12, 13, 16, 18). In laterality studies on face discrimination concerning reaction time, comparison of two stimuli in go no-go, or two-response paradigm is often applied.

In the latter case two buttons are used and the subject must decide which of them to press depending on whether the stimuli do or do not differ (5, 10, 11). In our experiments, the two response paradigm method has shown that procedural factors even as slight as construction of the response key used for time reaction measurements may influence considerably the lateral differences between visual fields. To illustrate this, we present the results of two experiments concerning hemispheric differences in comparing faces using different key constructions.

EXPERIMENT I

Fourteen female subjects participated in Experiment I. They were all right-handed, as assessed with Briggs and Nebes questionnaire (1). All subjects had normal or corrected-to normal vision. The stimuli were 7 male faces unfamiliar to the subjects, prepared as slides and presented on the screen by means of a Kodak-Carousel 140 projector, either to the right or left of the permanent fixation point. The distance from the center of the face to the fixation point was 3°12′. The stimuli subtended visual angle of approximately 2°30′ horizontally and 3°5′ vertically. In each trial two faces were presented in succession in the same visual field. Exposure duration of a stimulus was 100 ms and interstimulus interval 1.5 s. Every trial was proceded by warning tone. The subject's task was to judge whether the second face in a pair was the same or different from the first one. The subjects responded by pressing with the thumb one of the two buttons (1 cm apart) arranged in a left-right configuration on the response box, hold in the midline of the body (Fig. 1*A*). During the presentation of the first face and the interstimulus interval the thumb was placed between the buttons. Pressing of the button stopped an electronic time counter (accuracy — 1 ms) that was started at the beginning of the second stimulus exposure. The subjects were told to respond as quickly and

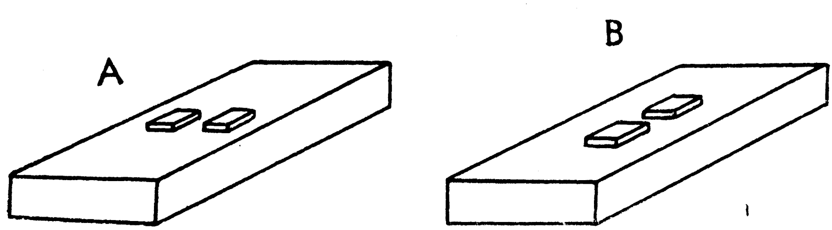

Fig. 1. Key used in measuring the reaction times in Experiment I (A) and in Experiment II (B).

accurately, as possible. Each subject participated in two sessions differing only in the meaning reversal of the response buttons. In the first session half of the subjects were instructed to press the left button when both faces in a pair were the same and the right button when the faces were different (S-D configuration). Another half of the subjects in the first session pressed the left button when the matched faces were different and the right one when the faces were the same (D-S configuration). In the second session the instruction for each subject was reversed. Each session consisted of 168 trials divided into 4 blocks of 42 trials. In each block there was an equal number of trials in the left and right visual field and an equal number of trials in which the stimuli were identical and different. Within each block the order of trials was randomized. The subjects responded with the right and left hand. The hand was changed after each block. Formal testing in each session was preceded by the practice during the subject became acquainted with operating of the buttons. During the presentation of the stimuli subject's eyes were observed with the TV camera. If the subject made an error or if a lateral eye movement was observed the trial was repeated at the end of the block. The luminance of the stimuli was chosen so as to eliminate as many errors as possible. (The mean percent of errors in this Experiment was 9.2). The errors were distributed equally between both visual fields, types of response, meaning reversal of the response buttons, and hands. This suggests that the errors may have been accidental. Hence error distribution was not analysed in the statistical part.

Reaction times of correct responses (RTs) of each subject were analysed by Dixon test to reject RTs which were incomparably long

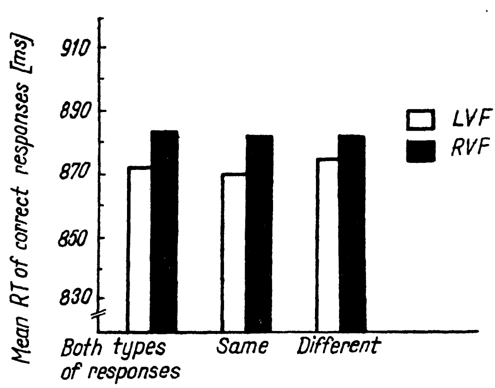

Fig. 2. Mean reaction times in the left and right visual field: for both types of responses and for same and different responses separately.

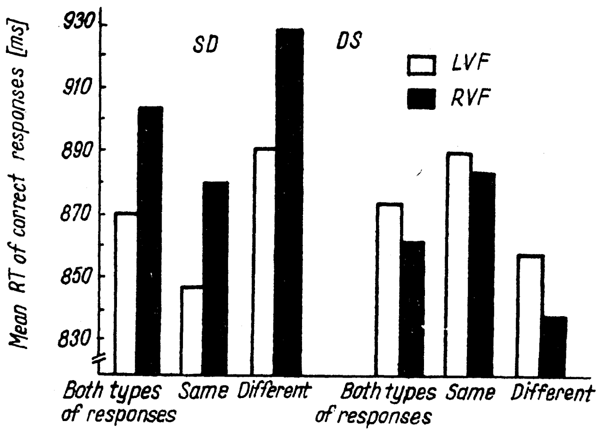

Fig. 3. Mean reaction times in the left and right visual field: for both types of responses and for same and different responses separately, for S-D (i.e., where the left button signified same faces and the right one different ones), and D-S (i.e., where the left button signified different faces, and the right one same ones) configuration of the response buttons.

or short. The mean RTs are presented in Figs. 2 and 3. The data were analyzed by the 4-way analysis of variance to determine the effects of the side of visual field (left, right), type of response (same, different), hand (left, right) and meaning reversal of the buttons (S-D, D-S). The analysis showed only one main effect, that of visual field ($F = 7.1$, $df = 1.13$, $P < 0.025$). In the left visual field mean RT (872.2 ms) was shorter than in the right visual field (883.4 ms). Two interactions involving meaning reversal of buttons were also significant: visual field × meaning reversal of buttons ($F = 13.63$, $df = 1.13$, $P < 0.005$) and type of response × meaning reversal of buttons ($F = 10{,}68$, $df = 1.13$, $P < 0.01$). The former interaction showed that for the S-D configuration RTs in the left visual field (870.2 ms) were shorter than in the right visual field (904.8 ms) ($P < 0.01$ Duncan test). For the D-S configuration RTs in the right visual field (862 ms) were shorter than in the left visual field (874.1 ms), this difference, however, did not reach the value of statistical significance (Duncan test). The latter interaction (type of response × meaning reversal of buttons), resulted from faster "same" responses (864.6 ms) than "different" responses (910.4 ms) for S-D configuration ($P < 0.05$ Duncan test) and shorter RTs for different responses (848.7 ms) than for same responses (887.6 ms) for D-S configuration (tendency, nonsignificant — Duncan test). Hence, the right hemisphere advantage in processing of faces observed on data averaged from both experimental sessions occured only in half way through those the session where the configuration of buttons was S-D (i.e., when the left button signified same faces, and the right one different ones). Conversely, in the meaning reversal — D-S (i.e., where the left button signified different faces, and the right one same ones) no significant differences occurred with a tendency towards the left hemisphere's advantage. This led to the investigation of whether the result obtained on general data really signified the right hemisphere's advantage in processing information contained in the face, or whether it was only the effect of averaging two very different experimental sessions S-D and D-S.

EXPERIMENT II

This experiment differed only in the position of the buttons. They were placed in a vertical line, farther — closer to the subject on the same box as in previous experiment, held on the midline of the body (Fig. 1*B*). The distance between the buttons was 1 cm. In the first session, half of the subjects pressed the button nearer to them when the faces were the same and the one more distant when they were different (configuration D/S). The second half of the subjects pressed the button nearer to them when the faces were different, and that more distant when they were the same (configuration S/D). In the second session the configuration was reversed. The methods in the Experiments I and II were identical. Fourteen new women were tested in the Experiment II.

The results were elaborated analogically to the Experiment I. Likewise, there were few errors (8.5%). They were equally distributed between the two visual fields. The analysis of variance showed a statistical significance in two factors: visual field — $F = 6.37$, $df = 1.13$,

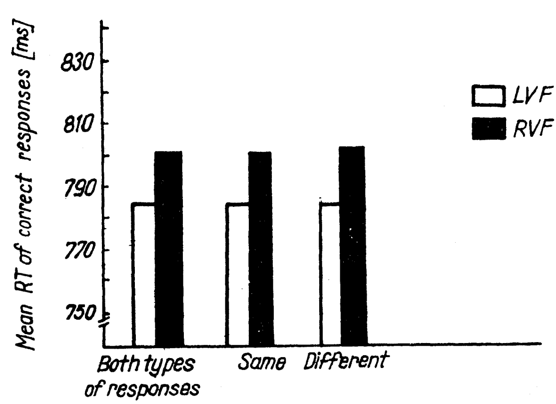

Fig. 4. Mean reaction times in the left and right visual field: for both types of responses and for same and different responses separately.

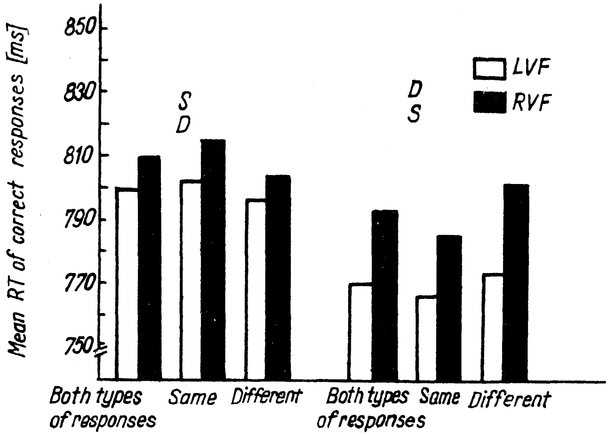

Fig. 5. Mean reaction times in the left and right visual field: for both types of responses and for same and different responses separately, for D/S (i.e., where the nearer button signified same faces, and the one more distant different ones) and S/D (i.e., where the nearer button signified different faces, and the one more distant same ones) configuration of the response buttons.

$P < 0.025$ and hand — $F = 4.92$, $df = 1.13$, $P < 0.05$. In the left visual field the mean RT (784.5 ms) was shorter than that in the right visual field (801 ms). Moreover, the mean RT for the right hand (784.8 ms) was shorter than that for the left hand (801 ms). None of the interactions reached the level of statistical significance. The mean RTs are given in Figs. 4 and 5.

The results of both our experiments confirmed the right hemisphere's advantage in processing of faces, observed in many experiments (4, 5-8, 14, 18). In the Experiment II, the right hemisphere's advantage appeared in both configurations of buttons (S/D, D/S), whereas in the Experiment I it was evident only in the S-D configuration. In the D-S configuration, we observed a tendency towards shorter RTs for stimuli exposed in the right visual field both when the projected faces were the same and when they differed, irrespective of the hand used by the subject. Thus in both situations shorter RTs were obtained for stimuli exposed in the visual field situated on the same side as the "same" button. Similar results were obtained in other experiments conducted in our laboratory on verbal material (3). Shorter RTs in the visual field ipsilateral to the "same" button may have resulted from the spatial compatibility between that button and the visual field ipsilateral to it. Several authors (2, 10, 16, 17) described a similar type of spatial compatibility between the situation of the stimulus and the situation of the response. It was expressed by shorter RTs when the stimulus and the reaction button were situated on the same side as when they were situated opposite each other. In the Experiment I, however, the spatial compatibility appeared only in case of the "same" button. It may be supposed that this button was to some extend privileged for the subjects. This may have resulted from certain culture stereotypes prevailing in the language, such as: top-bottom (and not bottom-top), plus-minus, day-night, and same-different. It may follow that the S-D configuration fosters shorter RTs in the left visual field, and the D-S configuration fosters shorter RTs in the right visual field. The differences in the RTs between the right and left visual field in Experiment I resulted from two factors: the left visual field superiority in discrimination of faces and a superiority of the visual field ipsilateral to the button intended for same responses. For S-D configuration both factors operated in the same direction for D-S configuration the effect of both factors was opposite. Another interaction, observed in Experiment I, between change of the configuration of buttons and type of response needs to be explained. This interaction resulted from significantly shorter RTs for same response than for different ones in the S-D configuration of buttons, whereas the D-S configuration was characterized by a tendency to shorter "different" reactions. In this case, too, different results can be ascribed to the typical direction in analysing elements in space, from left to right, acquired when learning to read and write. In the S-D configuration, the "same" button was situated on the left, i.e. the privileged position with regard to the direction of analysing of elements in space. This may have caused shorter RTs for "same" responses as for "different" ones. In the D-S configuration, the left button privileged with regard to the above direction, was connected with different responses. The above attempt to interprete the effect of the meaning reversal of buttons is a hypothesis which require an experimental verification.

The advantage of the right hemisphere in both experiments substantiates the hypothesis of the hemispheric differences. The differences observed in the final results rise from asymmetry of these parts of the brain hemispheres that, are connected with the perception of faces, and not only from unification of the configurations of buttons. It is common in the experiments conducted with the two response paradigm to reverse the meaning of buttons during the experiment or to instruct one group of subjects with a reverse meaning of buttons than the other. The description of the methods, however, does not usually contain a detailed description of the procedure. Also, the influence of the change of the configuration of buttons is never mentioned in the analysis of results. There are some methodological conclusions that may be drawn from our experiments. In the experiments where RTs are measured during a choice, application of buttons arranged in a vertical line seems better, because it excludes the influence of the buttons configuration. It is essential, therefore to counterbalance all types of variables that could influence the existing hemispheric dominance pattern.

1. BRIGGS, G. G. and NEBES, R. D. 1975. Patterns of hand preference in a student population. Cortex 11: 230-238.
2. COTTON, B., TZENG, O. J. and HARDYCK, C. 1980. Role of cerebral hemispheric processing in the visual half-field stimulus-response compatibility effect. J. Exp. Psychol. Hum. Percept. Perform. 6: 13-23.
3. CZACHOWSKA-SIESZYCKA, B., SZELĄG, E. and JASTREBOFF, P. 1985. Right hemisphere versus left hemisphere superiority for word matching. Polish Psychol. Bull. 16: 87-99.
4. ELLIS, H. D. and SHEPHARD, I. W. 1975. Recognition of upright and inverted faces presented in the left and right visual fields. Cortex 11: 3-7.
5. GEFFEN, G., BRADSHAW, J. L. and WALLACE, G. 1971. Interhemispheric effects on reaction times to verbal and nonverbal stimuli. J. Exp. Psychol 87: 415-422.
6. HILLIARD, R. D. 1973. Hemispheric laterality effects on a facial recognition task in normal subjects. Cortex 9: 246-257.
7. KLEIN, D., MOSCOVITCH, M. and VIGNA, C. 1976. Attentional mechanisms and perceptual asymmetries in tachistoscopic recognition of words and faces. Neuropsychologia 14: 55-66.
8. LEVINE, S. C. and CAHN, A. 1979. Lateral asymmetries in the recognition of words, familiar faces and unfamiliar faces. Neuropsychologia 17: 619-635.
9. MARZI, C. A. and BERLUCCHI, G. 1977. Right visual field superiority for accuracy of recognition of famous faces in normals. Neuropsychologia 15 751-756.
10. MOSCOVITCH, M., SCULLION, D. and CHRISTIE, D. 1976. Early versus late stages of processing and their relation to functional hemispheric asymmetries in face recognition. J. Exp. Psychol. Hum. Percept. Perform. 2 401-416.
11. RAPACZYŃSKI, W. and EHRLICHMAN, M. 1979. Opposite visual hemifield superiorities in face recognition as a function of cognitive style. Neuropsychologia 17: 645-652.
12. REYNOLDS, D. M. and JEVEES, M. A. 1978. A developmental study of hemisphere specialization for recognition of faces in normal subjects. Cortex 14: 511-520.
13. RIZZOLATTI, G., UMILTA, C. and BERLUCCHI, G. 1971. Opposite superiorities of the right and left cerebral hemispheres in discriminative reaction time to physionomic and alphabetical material. Brain 94: 431-442.
14. SERGENT, J. 1982. About faces: Left-hemisphere involvement in processing physiognomies. J. Exp. Psychol. Hum. Percept. Perform. 8: 1-14.
15. SIMON, J. R. and RUDELL, A. P. 1967. Auditory S-R compatibility: The effect of an irrelevant cue on information processing. J. Applied Psychol. 51: 300-304.

16. SUBERI, M. and MCKEEVER, W. F. 1977. Differential right hemispheric memory storage of emotional and nonemotional faces. Neuropsychologia 15: 757-768.
17. WALLACE, R. J. 1971. S-R compatibility and the idea of a response code. J. Exp. Psychol. **88**: **354-360.**
18. ZOCCOLOTTI, P. and OLTMAN, P. K. **1978**. Field dependence and lateralization of verbal and configurational processing. Cortex 14: **155-163.**

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