Studies on Tachistoscopic Recognition: I The Dominance of Recognition on Right and Left Visual Fields

STUDIES ON TACHISTOSCOPIC RECOGNITION: I. THE DOMINANCE OF RECOGNITION IN RIGHT OR LEFT VISUAL FIELDS*

By

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2 different types of material, random pattern (with Japanese letter and geometrical form), and 10-circles horizontal linear pattern were presented tachistoscopically to 10 undergraduate students. All *O*s had right-handed eyes, and none had any serious uncorrected visual defects. In random type of pattern the elements of the pattern were more readily recognized in upper visual field from the fixation-point, but no consistent result was found about "right-left difference". On the other hand, a left-field superiority was observed in both binocular and left-eye viewing conditions except in right-eye. Above all, a remarked conclusion we could derive from the 10-circles linear pattern, was that in right-eye viewing there is no superiority on either side about all variables of correct, and erroneous responses.

In a phenomenological visual field, i.e., in a static visual field measured with perimeter, for example, there is superiority or inferiority between right and left, or upper and lower visual fields. While, in a dynamic perception such as tachistoscopic recognition, there is also found such tendency as mentioned above, and above all, the right-left differences have been variously discussed. For exmaple, a number of studies have demonstrated the differences in the ease of identifying stimulus exposed tachistoscopically in the right visual field and that exposed in the left visual field. And it has been found that both the method of presenting stimuli (simultaneous or successive exposure) and the type of material used affect right-left differences.

For example, when words are exposed in both visual fields simultaneously, recognition of words is superior in right visual field (Mishkin, M. and Forgays, D.C., 1952, Hacum, E.R. and Finkel, Mary, E., 1963, Terrace, H.S., 1959, and Hirata, K. and Osaka, R., 1967). On the other hand, when both geometrical forms and nonsense ones are used as stimuli, they are recognized more accurately in left visual field than in right visual one, but in this case, there is also found some paradoxical findings or at least non-significant differences (Heron, 1957, Terrace, 1959, and Hirata and Osaka, 1967).

Therefore, it seems to be not accounted for fully from the results above mentioned, whether there should be expected any right-left difference, and what factors could

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produce this difference. Present study was conducted as an initial step toward approaching to this problem in various ways.

Experiment I

In the first experiment, the dominances of visual fields, upper or lower and right or left from the fixation-point, was studied by two different stimulus patterns.

Method: As shown in Fig. 1, a geometrical stimulus pattern (A-pattern) in Experiment I consisted of 14 disks which were equal in diameter (1.0 cm), and written in black ink. 14 disks were distributed randomly in 18×18 matrix of section paper, 7 disks of fourteen were also haphazardly selected, and filled with plus signs. Other 7 patterns were respectively produced from this pattern by rotations of the target 45° steps at the fixation. Finally, total 8 targets were thus gained. B-patterns (Fig. 2) of the target in Experiment I, were made by stamping with 7 Japanese letters of tu (つ), ki (き), ka (か), ra (ら), ri (り), mo (も), and sa (さ). Regarding to B-pattern, other 7 targets were also made by the same procedures as in A-pattern.

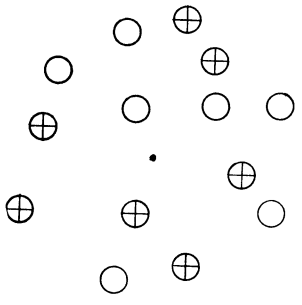

Fig. 1. A-pattern.

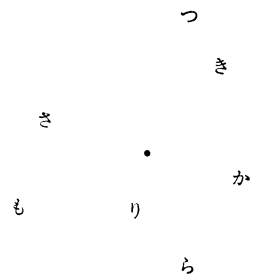

Fig. 2. B-pattern.

* The dots in the centers of Fig. 1 and 2 represent the fixation-points.

Procedure: A TKK tachistoscope was set to expose the targets for about 100 msec., at a distance of 58 cm from *O*s. The illumination of the target- and fixation-fields under continuous illumination was about 630 lux. Visual angle of a disk and a Japanese letter were about 1°0′, and 1°22′ respectively, and total visual angle of the former target was about 17°38′, and that of the latter 17°02′. 10 *O*s were undergraduate students of Department of Psychology, Tohoku University. All of them had right-handed eyes, and no serious uncorrected visual defects.

After *Os* were each first given a practice-target, to them were presented both 8 A- and B-patterns sequentially, and binocular vision employed. After each exposure of A- patterns, *O* marked his response on a sheet which is similar to the target of these A-pattern but not marked with plus signs in the disks. Therefore, *O* merely indicated which circles had been filled in the pattern. In the series of B-pattern, after each stimulus presentation, *O* recorded also his response on a sheet as in A-pattern, but now, he had to mark which circles had been located and by which Japanese letters they

were.

Responses were counted for an element that was reported correctly, and the response scores was compared among 4 quarters, upper half and lower, and right and left of the visual fields. All stimuli in A- and B-pattern were presented to each visual field in totaly equal time.

Results: Correct responses for exposures of total 8 targets of both A- and B-patterns, are summarized in Table 1, 2, 3, and 4. It can be seen that total correct scores of both patterns per exposure are similar. These scores are then assigned to each visual field, i.e., to 4 quarters visual fields, to right and left, and to upper and lower. Significant differences among them are shown in both A- and B-patterns (A-pattern: $\chi^2=14.35$, $df=3$, $p<0.005$, B-pattern: $\chi^2=48.96$, $df=3$, $p<0.001$, see Table 1 and 3), but a particular quarter of visual fields does not always show the highest score. On the other hand, the difference between right and left visual fields, does not also produce consistent tendency (see Table 2 and 4). That is, in A-pattern, left visual field is superior to right ($\chi^2=5.05$, $df=1$, $p<0.005$), but in B-pattern, the superiority is not seen ($\chi^2=2.64$, $df=1$, $0.20>p>0.10$). Regarding to the difference between "upper and lower", it can safely be said that "upper" is always superior to "lower" in both patterns (A-pattern: $\chi^2=9.45$, $df=1$, $p<0.005$, B-pattern: $\chi^2=45.56$, $df=1$, $p<0.001$, see Table 4).

Table 1. Means of correct responses per exposures in 4 quarters of visual fields. (A-pattern) (N=10)

IIQ 32.9 %	IQ 26.2 %
IIIQ 23.8 %	IVQ 17.1 %

Total score: 286 (51.1 %) ; Maximum score: 560

Table 2. Means of correct responses per exposures between 2 visual fields (A-pattern) (N=10)

Visual field			
Left	Right	Upper	Lower
56.6 %	43.4 %	30.1 %	20.8 %

Total score: 286 ; Maximum score: 560

Table 3. Means of correct responses per exposures in 4 quarters of visual field (B-pattern) (N=10)

IIQ 34.4 %	IQ 36.7 %
IIIQ 10.6 %	IVQ 18.4 %

Total score: 256 (45.7 %) ; Maximum score: 560

Table 4. Means of correct responses per exposures between two visual fields (B-pattern) (N=10)

Visual field			
Left	Right	Upper	Lower
44.9 %	55.1 %	71.1 %	28.9 %

Total score: 256 (45.7%); Maximum score: 560

Experiment II

The purpose of this experiment was especially to examine a dominance between right and left visual fields in a tachistoscopic recognition of circles in a 10-circles horizontal linear pattern, such as in Fig. 3.

Method: Apparatus is the same as in Experiment I.

Material: Each test pattern was formed by graying some of circles in a 10-circles horizontal linear pattern. Total 20 test-patterns of 5 graying circles out of ten consisted of 10 arbitrary patterns and their mirror images. A circle was 0.6 cm in diameter (36′ in visual angle) and separated by 0.4 cm spaces (24′ in visual angle). Total visual angle of a target was 9°36′.

Fig. 3. A 10-circles linear pattern. (*g*s in circles mean the grayed ones)

Procedure: Exposure time was about 100 msec. The fixation-point coincided with the center of the stimulus-pattern, i.e., between 5th circle and 6th from the left end of the pattern. Both monocular and binocular visions were employed. The *O*s were 10 undergraduate students with normal visions of Department of Psychology, Tohoku University. They had all right-handed eyes. 10 *O*s were first tested in the binocular vision, and another day, 5 *O*s out of these *O*s were assigned to monocular viewing (with each eye). In all visual conditions, *O*s were first given a practice-target, and then to them always each of 20 patterns was presented in haphazard order. After each exposure, *O* marked his response on a sheet with 10-circles horizontal linear pattern. He merely checked which circles had been grayed. The number of correct answers, and errors as to grayed circles was respectively counted for an element that was reported correctly or incorrectly.

Results: The means of correct responses, and errors for binocular, right-eye and left-eye viewing, are shown in Fig. 4, 5, and Table 5 respectively. The results are remarkably consistent under these three viewing conditions. Generally speaking, in binocular, and left-eye conditions, more correct responses are made among the elements appearing to the left of fixation-point. Although in right-eye condition, there is no significant difference between right and left visual fields, other two conditions produced marked superiority on the left side from the fixation (binocular: $p<0.05$, left-eye: $p<0.001$, by *chi-square test*).

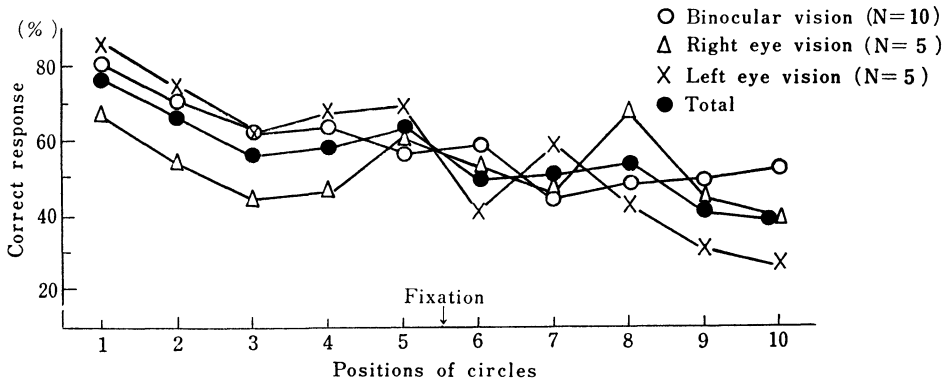

Fig. 4. Means of correct responses per exposure.

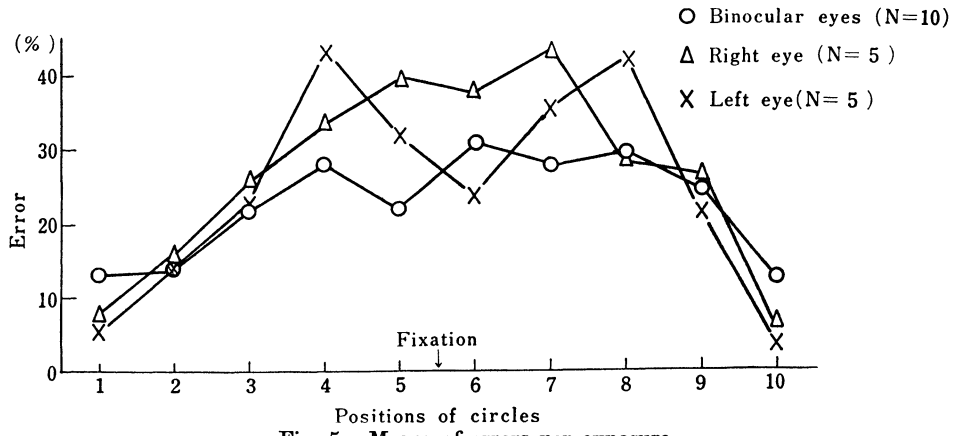

Fig. 5. Means of errors per exposure.

Table 5. Mean percentages per exposures of all variables in three viewing conditions. (N=10)

(%)

Eye	Correct response		Error	
	Visual field		Visual field	
	Left	Right	Left	Right
Binocular	33.6	26.6**	9.8	12.5***
Total	59.6		22.3	
Right	27.4	26.0	12.4	14.2
Total	53.4		26.6	
Left	36.2	20.8*	12.0	13.0
Total	57.0		25.0	

* $p<0.001$, ** $p<0.05$, *** $p<0.10$

Regarding to error, only in binocular viewing, somewhat superior tendency on the right side is seen, while omissions of responses are significantly more on the right side of both in binocular and in left-eye conditions at the level of $p<0.001$. Furthermore, they are gradually increasing when they shift from left to right end of the elements. A marked conclusion which can be derived from the data is that only in right-eye viewing condition, there are no superiorities on either side about all variables of correct and erroneous responses.

Discussion

Generally, it is a common procedure to examine a "right-left" difference of visual field in tachistoscopic recognition, when stimuli are presented simultaneously or successively to the both sides of fixation. However, as seen in Experiment I, stimulus patterns which distributed the elements around a fixation-point, present no right-left difference, but they may rather produce significantly "upper-lower" one. This finding must be reconfirmed in some other ways. While stimulus patterns such as in Experiment II, that is, when geometrical materials are presented linearly to a horizontal direction, these are more easily recognized on left side of visual fields, regarding to all viewing conditions but right-eye. These results are in agreement with those of Hacum and Dyer (1962). It should be noted, however, that right-eye viewing does not show any significant right-left difference in any variables. A further study of this must be also made.

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Zusammenfassung

2 verschiedene Typen der experimentellen Materie bestehen aus den mit geometrischen Formen und japanischen Buchstaben zufällig formierten Mustern, und aus den 10-Kreise Mustern, die waagerecht aufgestellt sind. Sie wurde augenblicklich mit Tachistokop 10 Studenten vorgezeigt. Aus den Versuchsergebnissen folgt: In dem ersteren Versuch wurden die Elemente des Musters in dem oberen visuellen Feld von der Fixierung leichter anerkannt. Keine konstante Differenz von "recht-link" aber wurde gefunden, während in dem letzteren wurde die Überlegenheit des linken Feldes im binokularen und linken-Sehen beobachtet.

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