Studies on Tachistoscopic Recognition : II. Right Left Difference in Visual Fields

STUDIES ON TACHISTOSCOPIC RECOGNITION: II. RIGHT LEFT DIFFERENCE IN VISUAL FIELDS

By

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1) Three experiments were performed to investigate the right-left difference of visual fields. 2) Experiment 1 demonstrated that no such difference was found in the central vision, but in the peripheral the superiority of right visual field was seen, when geometrical forms were employed as the experimental material. 3) In Experiment 2 and 3, two- and three-syllable words of 2 writing styles (vertical and horizontal writing) were adopted as the experimental stimulus. The experiment with two-syllable words indicates no remarkable finding, but in the experiment with three-syllable words it was found that vertical writing is superior to horizontal, irrespective of the visual field.

Previous study indicates the "right-left difference" in the perception of the 10-circles horizontal linear patterns (Kato, 1970). In such a pattern, the left side of visual field was superior to the right, in the correct recognition, when *Ss* fixated their eyes at the central part of the pattern. However, this superiority was impaired by the viewing conditions such as monocular or binocular vision, or shifting of the fixation point to the left or right sides of the pattern.

Present study is an attempt to examine the "right-left difference" in two visual materials of geometrical forms and words, when they were presented simultaneously to both visual fields apart from the fixation point.

Experiment 1

In Experiment 1, it was investigated whether there could be seen any right-left difference in the recognition of the "circles-patterns", when they were presented tachistoscopically on the left and right sides from the fixation. Furthermore, the factor of distances from the fixation on which the stimuli were displayed was analyzed.

Experiment 1-a Central vision

Material: As seen in Fig. 1, "circles-pattern" was figured at the locations of 1°46′ at visual angle of left and right sides from the fixation point, and this

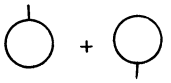

Fig. 1. Circles-pattern.

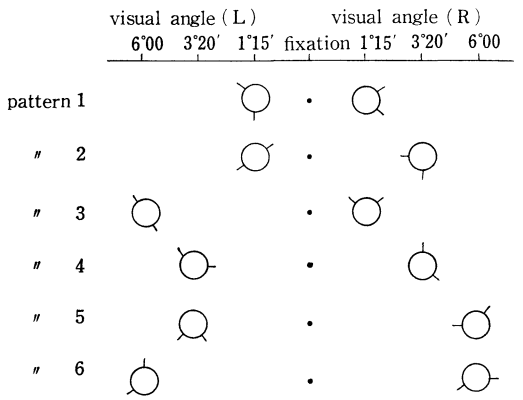

Fig. 2. 6 patterns.

pattern has a line of 21′, and its radius was 31′ at visual angle. The positions of each line were randomly selected among 8 points, which were zero, a quarter, half, and three quarters, and their bisection-points. In such way, 64 cards were figured in black ink.

Subjects: *S*s were 10 undergraduate students of Tohoku University aged from 21 to 22.

Procedure: After 10 times observations of practice cards, *Ss* were tested with experimental cards, and they were asked to check the positions of lines in each card on the given sheet. All cards were exposed for 20 msec. by a TKK Tachistoscope.

Results: Table 1 presents the mean scores of the correct responses in each visual field obtained from 10 *S*s. From the table, the right visual field seems to have a dominance over the left, but it is not significant because of the larger scores of standard deviation.

Table 1. Means of correct responses in each visual field. ($N=10$)

Stimulus	Trial	Visual fields			F	t	p
		B. f.	Left	Right			
Circles-pattern	64	38.5	7.2 (4.31)	11.1 (5.76)	7.2	1.16	ns

B. f. : Both fields, ( ) : Standard deviation

Experiment 1–b Central–peripheral vision

In Experiment 1–a, the proportion of correct response, i. e., perfect cognition in both visual fields accounted for about 60 percent. This result was obtained by the easiness of the task of Experiment 1–a. Therefore, Experiment 1–b was designed to be improved on the difficulty of experimental task. As seen in Fig. 2, the stimuli used here had two lines in each circle. The radius of a circle had 42′ of visual angle, and the length of a line attached to the circle was 24′ at visual angle. The positions of 2 lines were randomly determined as in Experiment 1–a. The second aim of Experiment 2–a was to test the difference in two viewing conditions of central and peripheral visions. The positions of the circles from the fixation point were those of 1°15′, 3°20′, and 6°00′ at visual angle with the right and left visual fields. After all, six cards were figured as presented in Fig. 2. Furthermore, in order to equate the condition of right–left visual fields, the mirror images of these six cards were drawn. All figures were drawn in black ink.

Procedure: All cards were briefly presented in random order by a TKK Tachistoscope. Each card was exposed for 50 msec. *S*s were asked to check the 2 lines′ positions attached to the circles in response sheets on which only a circle was drawn on the left and right sides from the fixation points.

Subjects: 15 female college students.

Results: The results were summarized in Table 2. In the table, mean total scores of correct responses of 15 *S*s are presented. Correct response means that 2 lines of a circle were reproduced correctly, and therefore, if only a line out of two was correct in its location, it was treated as incorrect response. 8 *S*s out of 15 gained more higher scores in the right visual field than in the left, and 3 *S*s made no difference in both fields. It can be seen from the table that in the central vision no difference of the two fields is seen, but as it shifts of the field to the more peripheral areas, the superiority of the right visual field appears significantly. χ^2– test for the scores of three visual fields (from central field to peripheral) gives the scores of 0.49,

Table 2. Means of correct responses at three visual angles in two visual fields. ($N=15$)

Visual field \ Visual angle	1°15′	3°20	6°00′
Right	65.0%	63.3%	45.0%
Left	72.5	45.8	26.7
Dominance	L≒R	L≦R	L＜R
p	ns	$p<0.1$	$p<0.02$

3.36, and 5.63 respectively. The score of peripheral field of 6°00′ shows significant superiority of the right visual field.

Experiment 2 and 3 (Words)

The object of this experiment was to examine whether the accuracy of recognition of the words was affected by the word length and its arrangement (horizontal and vertical writing) in relation to the right-left difference of the visual fields. When words are used as the experimental material, it must be noticed that as the factors affecting the word recognition, the physical conditions of syllable length as well factors of experience should be counted: such as meaningfulness, frequency, and familiarity of the words. As the latter factors, meaningfulness and familiarity were adopted in this experiment.

Experiment 2-a Two-syllable noun (Vertical writing)

Material : The stimulus consisted of 10 pairs of two-syllable noun cited from meaningfulness of 200-209 (Sonohara, 1967). The horizontal and vertical distances of a letter subtended a visual angle of approximately 1°30′, and the distance from the fixation to the center of the word subtended also 5°00′. 10 pairs of the words were changed in their arrangements of right-left visual field, and after all, 20 pairs of the word lists were used as the material. The lists were presented in Table 3.

Table 3. Pairs of 2-and 3-syllable Japanese nouns.

2 syllable	3 syllable
1. Seki - Ishi	Taore - Hatsuni
2. Ahi - Kamo	Sawari - Okan
3. Asu - Oya	Masui - Matoi
4. Kusu - Yuka	Fumetsu - Kaseki
5. Shimo - Tasu	Aota - Okara
6. Niki - Kitsu	Hashika - Hatsuhi
7. Kisu - Shito	Sumie - Sanyo
8. Take - Nami	Teishi - Irome
9. Koma - Tou	Kōho - Takase
10. Uri - Tsura	Kisen - Kitoku

Procedure: *S* was seated before a TKK Tachistoscope. Before each exposure, he was asked to fixate a dot in the pre-exposure field which corresponded to the fixation point on the stimulus field. In the experiment, a practice period consisting of 5-6 exposures preceded experimental session. After each exposure during the

practice peridod, *S* simply reported what he had seen, and *E* determined exposure time of the experimental session. During the experimental session, *S* wrote his responses on the given paper. Exposure time differed with *Ss*, and it ranged from 30 to 70 msec.

Subjects: 8 female college students.

Results : The data were presented in Table 4. In this table, "both fields" mean the words of two visual fields were perfectly recognized, and also "failure" means that *Ss* failed in their recognitions of the words in whole or part. However, the perfcet failure of the word recognition was observed in only 6 cases out of 160 card presentations, so most of the responses were partial failures of recognition. Table 4 indicates that the left visual field is superior to the right, and this result is supported by the fact that 5 *Ss* out of 8 give higher scores in the left visual field, and none have higher score in the right field.

Table 4. Means of responses in the recognition of 2-syllable nouns written in vertical writing. (N=8)

	Visual field			Failure	Total
	Left	Right	Both fields		
Number	72	21	33	34	160
%	45.0	13.1	20.6	21.3	100.0

Failure: Partial or perfect failure of recognition in two visual fields.

Experiment 2-b Two-syllable noun (Horizontal writing)

Material and procedure were the same as in Experiment 2-a. *Ss* were 22 male undergraduate students, and 4 female college students. Scoring of the data is also the same as in Experiment 2-a.

Results : The result suggests that no right-left difference can be seen.

Table 5. Means of responses in the recognition of 2-syllable nouns written in horizontal writing. (N=26)

	Visual field			Failure	Total
	Left	Right	Both fields		
Number	139	130	135	111	440
%	26.7	25.0	26.0	22.3	100.0

Experiment 3 (Three-syllable noun)

Experiment 3-a Three-syllable noun (Vertical writing)
Experimentt 3-b Three-syllable noun (Horizontal writing)

Material: The stimulus materials of 20 were randomly selected from the list of Koyanagi et al. (Koyanagi, et al., 1960), and the value of familiarity of these words was 2.50–2.99. The list of the words was presented in Table 3.

Procedure: The length of a word subtended a visual angle of 4° 30′, and the distance of a word from the fixation point to the center of it was 5°00′ at visual angle. Exposure time of the stimuli was different with *Ss*, but the range of it was from 50 to 80 msec. In Experiment 3-a, *Ss* were 6 female college students, and in Experiment 3-a, *Ss* were 6 female college students, and in Experiment 3-b, they were also 15 female college students. Other points of procedure were the same as in the precedent experiment.

Results: Scoring of responses was the same one as in Experiment 2. That is, when the material was recognized as a word, it was treated as correct response. These results were summarized in Tables 6 and 7. From the tables, it is safely said that there is no difference between vertical and horizontal writing, however, it is found that there are more responses of error in the latter arrangement of word than those in the former.

Table 6. Means of responses in the recognition of 3-syllable nouns of vertical writing. (N=6)

	Visual field			Failure	Total
	Left	Right	Both fields		
Number	38	41	15	26	120
%	31.7	34.2	12.5	21.6	100.0

Table 7. Means of responses in the recognition of 3-syllable nouns of horizontal writing. (N=15)

	Visual field			Failure	Total
	Left	Right	Both fields		
Number	89	95	1	115	300
%	29.7	31.7	0.3	38.3	100.0

Experiment 3-c Three-syllable noun (Horizontal vs vertical writing)

Material : The list of the words was the same one as in the precedent experiment. 20 cards out of 40 were paired as to put the vertical writing in the left visual field, and those of horizontal in the right, and then, the remains of 20 cards were reversed in their locations of left-right fields.

Subjects: *S*s were 22 of male undergraduate and female college students aged from 18 to 22.

Results : Summary of the data is presented in Table 8. The data from this experimental group indicate that the superiority of writing style to right-left visual field is seen. That is, in the exposure condition that the words written in horizontal writing to the left side, and those done in vertical writing to the right are recognized more accurately in the latter arrangement (see Table 8, column a). And when this display condition was reversed, the percentage of correct responses in both fields also reversed.

Table 8. Means of responses in the recognition of 3-syllable nouns (horizontal vs vertical). (N=22)

		Visual field			Failure	Total
		Left	Right	Both fields		
(a)	(Left) (Right)	87	194	50	109	440
	Horizontal × Vertical	19.8%	44.0	11.4	24.8	100.0
(b)	Vertical × Horizontal	141	88	95	116	440
		32.1%	20.0	21.6	26.3	100.0

Summary and Discussion

Table 9 summarizes all experimental results. That is, 1) when "circles-pattern" was exposed simultaneously to the right and left visual fields, no right-left difference was found in the central vision, but in the peripheral the right visual field is superior to the left. 2) If the words written in the same writing style were given to both fields, no right-left differene was found in all syllable words except two-syllable nouns in vertical writing. 3) In three-syllable word material, no right-left difference was seen in the condition in which the words of

the same writing style were presented to both visual fields. However, when words of different writing styles were exposed to these fields, the superiority of vertical writing over the horizontal and the visual field was found.

Table 9. Summarized table of all experiments.

Visual condition	Dominance field
1. Circles-pattern	1°46′
a. Central vision	L = R
b. Peripheral vision	1°15′·····3°20 ·····6°00′ L=R L≦R L<R
2. Word (Cursive syllabory)	
a. 2 syllable noun	L>R (Vertical) L=R (Horizontal)
b. 3 syllable noun	L=R (Vertical) L=R (Horizontal)
c. 3 syllable noun	L<R L>R (L-H vs R-V) (L-V vs R-H)

L(R)-H : Left(Right)-Horizontal, L(R)-V: Left (Right)-Vertical

4) *Ss'* response processes in the word recognition : Since it is not clear how *Ss* perceived the words in this continuous presentation, some examples of them are figured in Fig. 3-7. These examples were voluntarily selected from each experimen-

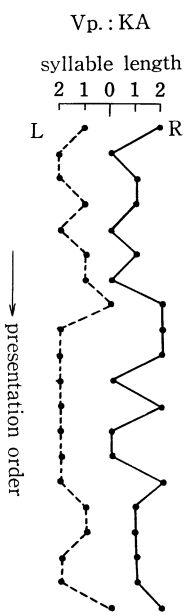

Fig. 3.

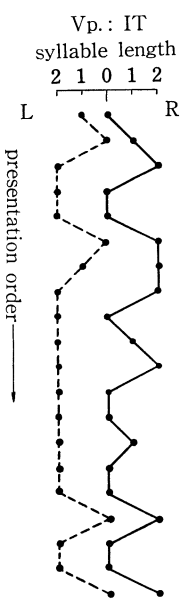

Fig. 4.

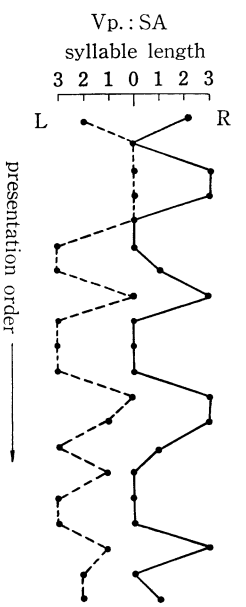

Fig. 5.

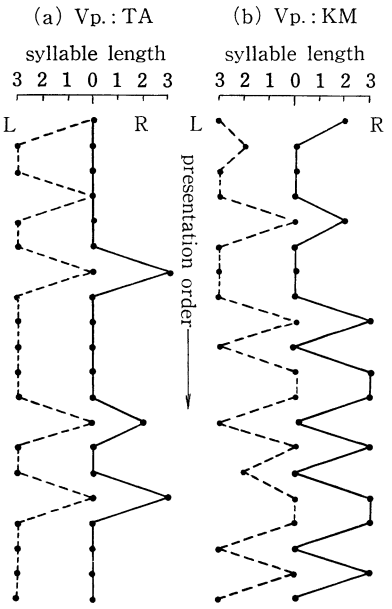

Fig. 6-a, b.

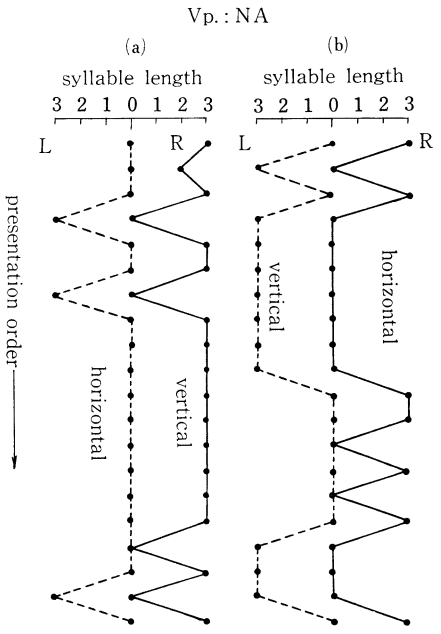

Fig. 7.

tal group, and some of them were the representatives of the experimental results, and the others had the opposite tendency to the present results.

It is seen from these figures that there is no case who perceived only one side of two visual fields, and generally *S*s perceive the cards zig zag (from right visual field to left and vice versa) in one experimental series. According to *S*s' introspections, they reported that they had made efforts to recognize both visual fields, but when they succeeded in perceiving only one side, they intended then to attend much more to the other side and not to recognize the side which they had seen. In such a situation, they fell into a dilemma. The profiles of such "zigzag" patterns of perception process is debted to *S*s' individual characters, but they were not always conscious to its process. Therefore, if *S*s were asked to introspect such process, they felt some kinds of perplexity.

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