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Age, IQ Effects and Reliability of a Stereoscopic Test for Field Dominance

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Age, IQ Effects and Reliability of a Stereoscopic Test for Field Dominance[1]

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SYNOPSIS: Results support findings by Bechtoldt and Colliver for temporal dominance of the visual field. The test-retest reliability of the stereoscopic procedure for assessing dominance of the nasal or temporal visual fields was found to be significant for both left and right temporal fields. Furthermore, the test results appear to be unaffected by age or by level of intellectual functioning. Further research is in order both to evaluate competing theories of binocular rivalry and suppression and to assess optical processes at cortical and subcortical levels.

Recent investigators of binocular rivalry have focused on observed differences in choice of stimuli presented in the nasal and temporal visual fields. In two studies Bechtoldt and Colliver (1968) presented evidence that dominance of the stimuli presented in the temporal field is a function of the angular deviation of the stimuli from the center of the visual field. They interpreted their results as implying first, that suppression and fusion are different mechanisms that may interact in certain situations, and second, that an initial selection mechanism acts in favor of the temporal field stimulus. In their study the evidence points to a relative dominance of crossed neural fibers as compared with uncrossed fibers in the optic system (Figure 1). The stimuli presented to the two eyes, which differed only with respect to the second letter of the stimulus words (Table 1), were positioned in the visual fields of a stereoscope so as to fall at corresponding points of the two retinas, the nasal hemiretina of one eye and the temporal hemiretina of the other. When the stimuli were presented in the left temporal field *Ss* tended to report the word presented to the nasal hemiretina of the left eye (Figure 2) and when presented to the right temporal field *Ss* tended to report the word exposed to the nasal hemiretina

TABLE 1. EXAMPLE OF STIMULUS WORD-PAIRS ARRANGED IN COLUMNS AS ON EXPERIMENTAL STEREOGRAMS

Left Eye			*Right Eye*		
Wand	Cost	Dick	Wind	Cast	Duck
Live	Just	Come	Love	Jest	Came
Cull	Malt	Dusk	Call	Melt	Desk
Deck	Hung	Sand	Dock	Hang	Send
Pick	Till	Mess	Puck	Toll	Moss
Mole	Fall	Core	Mule	Fill	Cure
Fall	Belt	Peck	Fell	Bilt	Pick
Well	Hint	Halt	Will	Hunt	Hilt
Rust	Held	Bull	Rest	Hold	Ball
More	Most	Dive	Mare	Must	Dove

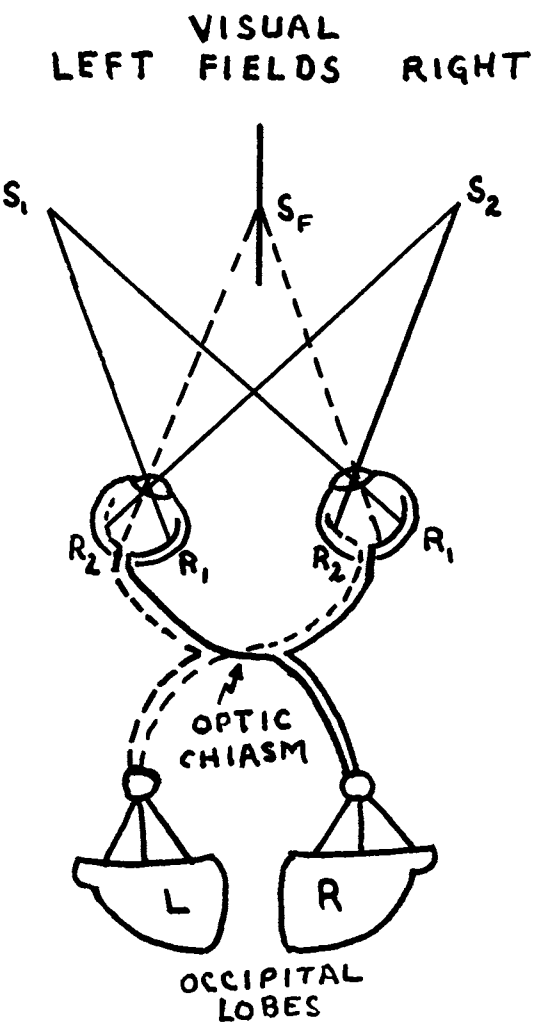

Figure 1. Schematic diagram of visual fields and pathways.

If a person fixates on S_F, information to the left of the midline (S_1) will be transmitted only to the right hemisphere and information about S_2 will be transmitted only to the left hemisphere.

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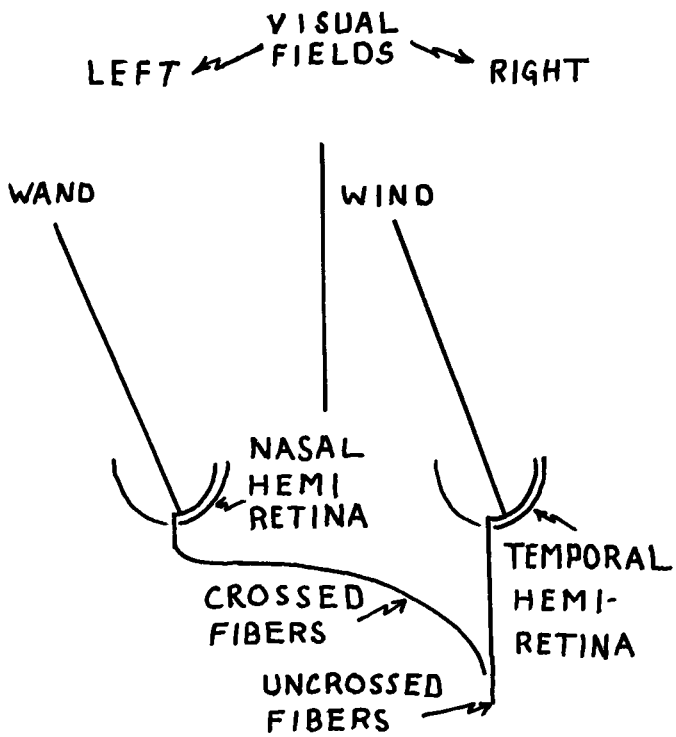

Figure 2. Schematic diagram of crossed and uncrossed pathways for stimuli in left visual field.

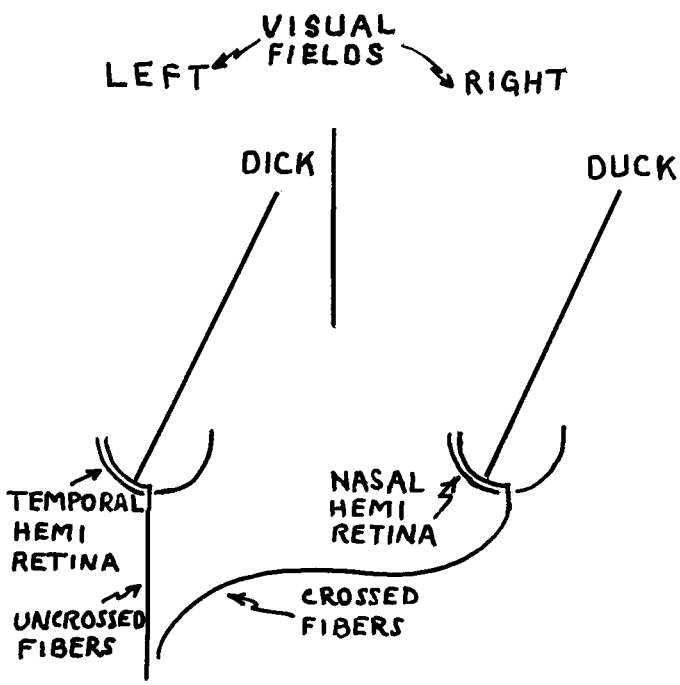

Figure 3. Schematic diagram of crossed and uncrossed pathways for stimuli in right visual field.

of the right eye (Figure 3). The neurotransmission pathways for the nasal hemiretinas are through the optic chiasm and thus are termed crossed fibers in contrast with temporal hemiretinas which do not cross over but have pathways to the occipital lobe which are ipsilateral to the eye of origin (Figure 1). Bechtoldt and Colliver (1968) hypothesize that the basic nasal-temporal selection mechanism is unlikely to operate at the level of the retina but well may result from cortical and subcortical processes.

The present study is intended to estimate the test-retest reliability of the stereoscopic procedure and the effects of age and level of intellectual functioning on the rivalry test results.

METHOD

Subjects were 157 paid volunteers 5-16 years of age (mean age = 11.8 years) who participated in a neuropsychology experiment.

For each subject the stimuli were three stereograms with three columns of 10 four-letter stimulus words on each stereogram. The stimuli for the left and right eyes were identical except for the second letter of each word which in all instances was a vowel. Thus, a stimulus for the left eye, WAND, was matched with a stimulus for the right eye, WIND (Table 1). Presented stereoscopically, the subject sees three columns of words. For the standard stimuli (ST) the lateral columns were displaced 2.75 degrees from center whereas in the lateral only condition (LO) and the lateral

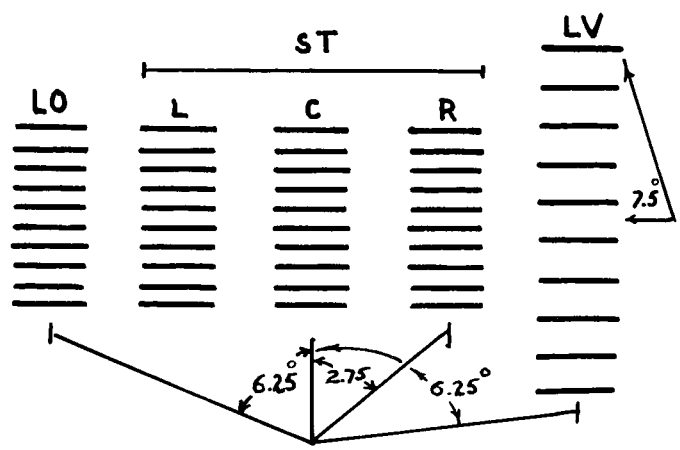

Figure 4. Schematic of stimulus word arrays in ST, LO, and LV conditions.

and vertical (LV) conditions, the lateral columns were displaced 6.25 degrees from the midline. Furthermore, on the LV stimuli, the spaces between the words in the columns were increased so that the top and bottom words of each column were 7.5 degrees from the horizontal plane (Figure 4). The four-letter words subtended a visual angle of approximately 20 degrees in the horizontal plane. Apparently, the effect of vertical dispersion alone is minimal and per-

formance is similar to that in the ST condition (Bechtoldt and Colliver, 1968). The two-factor LV condition was included here to evaluate whether the vertical component minimizes the effects of temporal dominance.

This stereoscopic procedure provides a test of the effects of temporal dominance as related to variations in the angular deviation from the center of the visual field since the displacement of the lateral columns from the midline in the horizontal plane may be manipulated. Thus, when all columns are approximately in the medial plane the temporal dominance effect is minimal or nonexistent and eye-dominance and binocular rivalry factors are likely to determine the stimulus word reported.

However, the hypothesis derived from the temporal dominance theory is that as the angular deviation of the columns from center is increased *Ss* will report an increased number of words presented to the eye ipsilateral to the position of the column in the visual field.

The subject was instructed to read down the left, center, and right columns in order. The analyses involved the number of words in each column that were read with the right eye. Thus, for each subject there are three scores, the sum of the words on the three stereograms read with the right eye in the left (L), center (C), and right (R) columns with a score of 30 possible for each column.

The stimuli were presented in a Realist Stereoviewer, Model 2062, with illumination adjusted to approximately 3.5 foot-candles. The viewer rested on a stand which was adjusted for comfortable viewing.

Procedure. Subjects were assigned alternately in order of appearance to the ST, LO, or LV condition. In this way data were obtained from 54 subjects in the LV group, 53 subjects in the LO group, and 50 subjects in the ST group. For each subject the test was immediately readministered upon completion of the first administration.

TABLE 2. TEST-RETEST MEANS FOR LEFT, CENTER, RIGHT COLUMNS IN THREE STIMULUS CONDITIONS

Condition		Test L	Test C	Test R**	Retest L	Retest C	Retest R	N
LV*	X	12.8	18.1	24.1	13.9	19.0	23.2	54
	SD	12.0	10.6	8.5	12.0	10.8	9.9	
LO*	X	10.8	15.8	21.2	11.0	15.9	22.9	53
	SD	11.4	11.1	10.6	12.1	11.1	10.3	
ST	X	15.0	15.6	17.0	14.6	15.9	19.0	50
	SD	11.7	11.7	11.4	11.5	11.4	10.9	

*Difference between each pair of means in initial administration, L-C, L-R, and C-R, is significant at $p < .05$.

**Difference between R means of LV and ST groups significant at $p < .05$.

RESULTS

For each subject six scores represented the frequency of response for the right eye on each of two trials (test-retest) for each of three columns of stimuli. Inspection of Table 2 shows that for the LV, LO, and ST groups separately the mean scores are similar on the two trials for each of the L, C, and R conditions. The nine coefficients of the product-moment correlations between the scores on the first and second administration are significant (Table 3).

TABLE 3. TEST-RETEST COEFFICIENTS FOR LEFT, CENTER, RIGHT COLUMNS IN THREE STIMULUS CONDITIONS

Condition	L	C	R
LV*	.87	.92	.85
LO*	.85	.79	.80
ST*	.88	.88	.63

*Each coefficient is significant beyond the .001 level.

For the initial administration only the data were further analyzed in a treatment x replications analysis of variance. The F-ratio for the test of interaction effects was significant ($F\ 4,308 = 12.46$; $p < .05$); thus it was inferred that the means in the L, C, and R columns were affected differently for the LV, LO, and ST conditions (Figure 2). In order to reduce the probability of Type I errors, the S-method (Hays, 1963) was used to test the difference between each pair of means separately for the LV, LO, and ST conditions. The observed value of t exceeded the critical value of $S = 2.47$ for each combination of means in the LV and LO conditions; thus, it is inferred that for the LV and LO groups the mean for each of the three columns, L, C, and R, differed significantly from each of the other two means. The three values of t in the ST condition were not significant; thus, the observed differences were inferred to be due to chance. Inspection of Figure 5 shows that the effects of lateral displacement of the columns yielded effects consistent with the hypothesis; however, only the observed difference between the means of the LV and ST groups for the R column was significant at the .05 level.

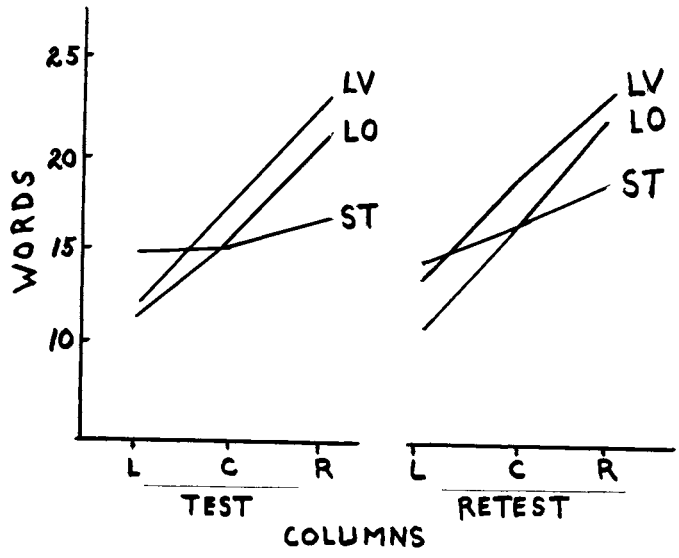

Figure 5. Mean scores for L, C, and R columns in LV, LO, and ST conditions.

DISCUSSION

Findings in this study indicate the reliability of the stereoscopic procedure is high even when subjects are children and adolescents. Further evidence of reliability is found in the coefficient for the scores obtained from 19 subjects after a one-year interval; the coefficients of .55, .52, and .56 were each significant at the .05 level. It is assumed that these results are attentuated due to a confounding that resulted from comparing scores from the same subjects assigned to different LV, LO, or ST groups for the two administrations. Thus, it is hypothesized that the correlations would be higher for subjects in the same treatment groups on both occasions.

Present findings directly support the empirical results described by Bechtoldt and Colliver (1968). According to present results the effect of temporal dominance is a function of stimulus dispersion from the center of the visual field. Thus in the present study, when the noncentral stimuli are displaced in the horizontal plane (LO) or horizontal and vertical plane (LV) the effect of temporal dominance is greater than when the stimuli are more central (ST). Apparently, the addition of vertical dispersion to horizontal displacement does not yield results significantly different from the effects of horizontal displacement alone.

Apparently scores on the stereoscopic procedure are unaffected by differences in age or level of intellectual functioning. Available data were analyzed by correlating scores for the L, C, and R conditions with the ages of subjects in the LV, LO, and ST groups separately. None of the nine coefficients was significant.

A similar analysis of the relationship between IQ as estimated by pro-rated full-scale IQs on the Wechsler Intelligence Scale for Children yielded a significant r only for the relationship between scores for the C group in the LO condition and IQ (.29, $p<.05$). This finding was attributed to chance since inspection of the data and the other relationships indicated no systematic variation in the values that would account for the result. In this connection it was observed that the obtained value for r was not significant at the .02 level. Thus it was inferred that age and IQ did not significantly influence scores for this procedure.

The reliabilities demonstrated here for adolescents appear to justify further explorations with the stereoscopic procedure in the assessment of cortical and subcortical functioning, both for purposes of explanation and for evaluation of patients with cerebral disease as in the case of the stereopsis procedure (Carmon and Bechtoldt, 1969; Benton and Hecáen, 1970).

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