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THE RELATION BETWEEN HAND-EYE PREFERENCE AND FIRST-GRADE READING--A FOLLOW-UP STUDY.

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THE RESULTS OF A FOLLOWUP INVESTIGATION TO DETERMINE WHETHER THE PERSISTENCE OF LEFT-LATERAL TENDENCIES OF A GROUP OF CHILDREN WAS RELATED TO FIRST-GRADE READING PERFORMANCE ARE REPORTED. THE ORIGINAL INVESTIGATION AT THE PRESCHOOL LEVEL INCLUDED 64 SUBJECTS. FORTY SUBJECTS REMAINED IN THE LOCAL SCHOOL SYSTEM THROUGH FIRST GRADE FOR THE FOLLOWUP TESTING. THE SUBJECTS WERE RETESTED FOR HAND-EYE PREFERENCE USING THE DRAWING AND CUTTING HAND TESTS AND THE MILES (1930) TEST OF BINOCULAR SIGHTING PREFERENCE. SUBJECTS WERE CLASSIFIED RIGHT- OR LEFT-HANDED IF THEY PERFORMED CONSISTENTLY IN BOTH DRAWING AND CUTTING AND MIXED IF INCONSISTENT. IN ADDITION, AN IQ ESTIMATE WAS OBTAINED WITH THE WISC VOCABULARY SUBTEST. THE RESULTS SHOW SIGNIFICANT DIFFERENCES FAVORING THE CONSISTENT RIGHT GROUP IN BOTH READING AND ARITHMETIC. EYEDNESS WAS AN IMPORTANT FACTOR IN DIRECTIONAL RELATIONS. BRIGHTER CHILDREN WITH A NATURAL MOTOR TENDENCY IN RIGHT-TO-LEFT DIRECTION ADAPTED READILY TO PERIPHERAL VISUAL DIFFICULTIES FOR WORD RECOGNITION IN ISOLATION AND IN SEQUENCE. NO EVIDENCE WAS PRESENTED TO WARRANT ATTEMPTING TO CHANGE A CHILD'S HAND-EYE STATUS. REFERENCES AND TABLES ARE GIVEN. THIS PAPER WAS PRESENTED AT THE COUNCIL FOR EXCEPTIONAL CHILDREN CONFERENCE (TORONTO, APRIL 20, 1966). (MC)

THE RELATION BETWEEN HAND-EYE PREFERENCE AND FIRST-GRADE READING: A FOLLOW-UP STUDY[1]

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In an earlier investigation (Muehl, 1963), the first author reported on the relation between hand-eye preference and visual orienting behavior of preschool children four to five years of age. Handedness was measured by six tasks which had been shown to yield consistent hand responses over time (drawing, cutting, hammering, block building, spooning marbles, throwing). Eyedness was measured by three objective tests involving sighting trials with the Miles V-scope (1930) and a sighting board. Visual orienting behavior was determined by performance on a 20-item matching task. A specific orienting response was defined by the character of the word choice. (See Table 1). For example, when the to-be-matched word was girl, the response choices were: gilr, igrl, lirg and girl. The selection of gilr defined a left orienting response since the choice apparently resulted from attending to the left letters of the word to the exclusion of the letter order at the right of the word. By the same reasoning, the selection of igrl defined a right response, lirg a middle response, and girl a correct orienting response.

Although the results of the study showed no relation between a specific type of orienting response and hand-eye preference as such, they did show that the children classified as left lateral, either in hand, eye, or both

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made more orienting errors than did children classified as consistently right-handed and right-eyed.

The present study reports the results of a follow-up investigation. The purpose was to determine whether the persistence of left-lateral tendencies in this group of children was related to first grade reading performance.

Subjects and Procedures

The original investigation at the preschool level included 64 Ss. Forty Ss, 19 boys and 21 girls, remained in the local school system through first grade for the follow-up testing. Of the 24 missing Ss, 21 had moved from the community, one was deceased and two did not have complete test scores.

Ss were originally tested in the spring of 1962. Since some Ss were four and others five years of age, the follow-up first grade reading measures were obtained in different years. The five-year-olds received a school-administered Metropolitan Achievement Test (Primary Battery) in the spring of 1964 after a lapse of two years from the preschool testing. The four-year-olds received the same test in the spring of 1965 after a lapse of three years. Metropolitan standard scores on the word knowledge, word recognition and reading subtests were averaged to obtain an overall reading score for each S. The arithmetic subtest standard score was also recorded. The mean CA at the time of Metropolitan administration was 7.17 years (SD .42).

Ss were retested for hand-eye preference using the drawing and cutting hand tests and the Miles (1930) test of binocular sighting preference. These tests were selected from the original preschool battery. Ss were classified right- or left-handed if they performed consistently in both

drawing and cutting, and mixed if inconsistent. Based on six sighting trials, Ss were classified as right- or left-eyed if consistent on five of six trials, and mixed if inconsistent on two or more trials. In addition, an IQ estimate was obtained with the WISC vocabulary subtest.

Results

Laterality: Table 2 shows the results of the laterality retesting. When compared with results of the preschool testing of the 40 Ss, three shifts in handedness and nine in eyedness were recorded. In most instances, Ss changed to a mixed tendency which occurred probably because of the abbreviated nature of the retest. However, in three instances, Ss shifted eyedness completely. The per cent of Ss in the various hand-eye categories can be compared with Belmont and Birch's (1963) findings with similar aged Ss. Birch reported 48 per cent mixed as compared to 15 per cent in the present study. This greater per cent of mixed cases can be accounted for by the difference in tests and scoring procedures used. Belmont and Birch required complete consistency on four handedness tests; they also included eyedness measures for both binocular and monocular sighting. Research indicates that these two eye functions are not always located in the same eye (Berner and Berner, 1953; Buxton and Crossland, 1935). Such tests would tend to produce more mixed eye ratings.

Reading and Arithmetic: To control for chance differences in IQ between the laterality groups, an analysis of covariance was used. CA differences between the laterality groups were negligible. The overall IQ mean was 117.1 (SD 19.6); the overall reading and arithmetic scores were 59.7 and 61.1, respectively.

Enough Ss were available to arrange four laterality group comparisons, shown in Table 3. Two analyses of covariance were used in each comparison, one involving reading and the other arithmetic. In all comparisons, there were no reliable differences in variability of the adjusted scores.

Since significantly fewer word recognition errors were reported in the preschool study for consistent right hand-eyed children when compared with children with left lateral tendencies in either hand, eye, or both, the comparison was repeated in the follow-up study. The results are shown in comparison 1, Table 3. They indicate better performance in reading but not in arithmetic for the consistent right group.

Comparison 2, Table 3, assessed the effects of consistent versus crossed tendencies. In this comparison only right-handed Ss were included due to the small number of Ss who were consistent left hand-eyed or crossed with left hand and right eye. The results show a significant difference favoring the consistent right group in both reading and arithmetic performance.

Comparison 3, Table 3, assessed the effect of handedness as such. Included with the right- and left-handed groups were Ss with right, left and mixed eye tendencies. The results showed no reliable differences in reading or arithmetic performance.

Comparison 4, Table 3, assessed the effects of eyedness as such. Included with the right- and left-eyed groups were Ss having right, left and mixed hand dominance. The results showed a reliable difference in reading performance favoring the right-eyed S.

Discussion

The present study compared the reading and arithmetic performance of first grade children with various hand-eye preference patterns. The results

showed poorer reading performance for crossed hand-eye (right-left) and left-eyed children compared with consistent hand-eye (right-right) or right-eyed children. Due to the small number of children with crossed left-right and consistent left tendencies, it was not possible to determine whether the crossed pattern or eyedness as such was more important in the reading relationship. A difference in arithmetic performance was found in only one of the comparisons. Apparently crossed hand-eye or left-eyed patterns interacted more specifically with the reading process.

In this much researched area of laterality, two questions need investigation in relation to the present positive findings: 1) How do these findings compare to related studies? 2) What mechanisms -- psychological or physical -- can be hypothesized to mediate between lateral tendencies and reading performance?

The literature was reviewed to locate studies of unselected school children in the primary grades. Primary grade children were chosen for two reasons. One, first graders were used in the present study. Two, if such a laterality-reading relation exists, it seemed likely that it might better be observed in the beginning learner than in the older child whose experiences introduce other factors into the learning process.

Five primary-level studies were found. In four of these, the reading comparisons among various hand-eye groups failed to show differences (Balow, 1963; Balow and Balow, 1964; Hillerich, 1964; Stevenson and Robinson, 1953). However, in these studies, the methods of testing handedness and eyedness differed from those used in the present study. In the case of handedness, the tests either varied greatly in the amount of past practice or learning involved (Balow, 1963), or they were deliberately selected to minimize the

effects of past learning (Hillerich, 1964). In either case, the test results would tend to yield a different classification of handedness, particularly mixed cases, than the ones obtained in the present study. Here only highly practiced tasks were used. In testing eyedness, all studies except Hillerich's used a test battery combining binocular and monocular sighting tests. As noted earlier, the results would yield different classifications of eyedness -- again more mixed cases -- as compared to the binocular tests used in the present study.

By contrast, Koos (1964) reported a significant difference in primary grade reading performance for children with IQs under 125 when comparing groups with crossed and consistent hand-eye tendencies. The difference favored the consistent group. Comparing similar groups with IQs above 125, she found no difference. Koos used a monocular test only to classify eye preference. She did not indicate the composition of the crossed and consistent groups. For this reason, it is again impossible to determine whether the crossed or the left-eyed tendency as such is the critical feature.

In answer to the first question, how do the present findings relate to earlier studies, they do not. Although the research cited was more or less comparable in age level studied, laterality tests were different. This difference as reflected in hand-eye classifications may account for the differing relations with reading.

What mechanism can be hypothesized to mediate the laterality-reading relation found in Koos and the present study? Leavell and Fults (1943) studied the relation between directional movement in drawing and laterality in elementary children. They found a tendency in right hand-eyed children to draw in a left-to-right direction as compared to a right-to-left direction

for left-eyed children regardless of hand preference. The authors concluded that eyedness was the important factor in this directional relation. Stevenson and Robinson (1953) also found the same directional tendencies in comparing consistent right with right hand-left eyed groups in kindergarten. On follow-up, however, they found that the right-to-left tendency had disappeared by the end of first grade. These children had IQs averaging over 125. LaGrone and Holland (1943), investigating the accuracy of peripheral vision in relation to laterality in second graders, reported a consistent tendency for left hand-eyed children to make better recognition scores in the right visual field and for consistent right children to make better scores in the left visual field.

Is the difference in peripheral vision accuracy related to the differing directional tendencies for right- and left-lateral children? One could speculate on a cause and effect relation in either direction. More to the point, we would speculate that these tendencies, in some combination, may be a part of the mechanism underlying the poorer reading performance of left-eyed children. Reading requires a left-to-right eye movement. The child with a natural motor tendency to move in a right-to-left direction would have to learn to overcome this tendency to successfully recognize words in isolation and in sequence. However, if learning is involved, then intelligence would serve as a psychological mechanism interacting with the basic motor tendency. Brighter children would presumabley have less difficulty in learning the necessary left-to-right tendency.

Support for this interaction hypothesis is found both in Stevenson and Robinson (1953) and Koos (1964). Although the former authors found a right-to-left directional tendency in left-eyed children before reading instruction

the tendency had disappeared by the end of first grade. Further, no reading differences were found between their consistent right and right hand-left eyed groups. Koos (1964) also found no reading differences between her consistent and crossed groups high in IQ. She did find a difference in reading ability comparing similar groups with lower IQs.

In conclusion, since the research findings in this area are not consistent and since the mechanism to account for positive findings is highly speculative, we are not prepared to suggest routine hand-eye testing for beginning readers. The practical point seems to be that the teacher should be alert for the child having directional problems in attacking words and sentences. No matter what his lateral status, he will need extra attention and practice to learn the correct left-to-right direction. We wish to state strongly that there is no evidence in this paper or in any other research at the present time to warrant attempting to change a child's hand-eye status.

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TABLE 1

Sample Block of Matching Sets
for Preschool Word Recognition Task

Word-to-be Matched	Response Choices			
girl	gilr	igrl	lirg	girl
look	look	kool	olok	loko
jump	ujmp	jupm	jump	pumj
rose	eosr	rose	roes	orse

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TABLE 2

Laterality Groups for
First Grade Follow-up

Groups (Hand-eye)	N	(Percent)
Consistent:		
RR	21	(52)
LL	2	(5)
Crossed:		
RL	8	(20)
LR	3	(8)
Mixed:		
RM	2	
MR	2	(15)
LM	1	
ML	1	
Total	40	

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TABLE 3

Reading and Arithmetic Means (Adjusted)
for Four Laterality Group Comparisons

	Laterality Groups (Hand-eye)	N	Means (Adjusted) Reading	Arithmetic
1)	Consistent (RR)	21	61.81	62.47
	vs		*	ns
	Left (RL, LR, LM, ML)	15	56.92	59.40
2)	Consistent (RR)	21	61.96	62.53
	vs		*	*
	Crossed (RL)	8	54.73	58.61
3)	Right hand (RR, RL, RM)	31	59.44	61.22
	vs		ns	ns
	Left hand (LL, LR, LM)	6	59.52	60.17
4)	Right eye (RR, LR, MR)	26	61.52	61.99
	vs		**	ns
	Left eye (LL, RL, ML)	11	55.95	59.39

* $p < .05$
** $p < .01$