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ABSTRACT

Certain asymmetries of perception in the right and left visual fields of American college students have been described as the effect of a reading habit which predisposes the subjects to scan or organize material in a left-to-right direction and thus to identify more accurately the items in the left field. The purpose of the present work was to test this interpretation by investigating subjects who read from right-to-left (Israelis whose native reading language is Hebrew). Contrary to expectations, the Israeli college students showed greater accuracy for the left visual field and tended to organize a series of items in a left-to-right direction. The investigation was extended to several groups of children, and a tentative picture of the development of an "attentiveness to the left" was obtained. (Author/LL)

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Final Report

by LILA GHENT BRAINE, Ph.D.

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U. S. Army Medical Research and Development Command

Office of the Surgeon General

Washington, D. C. 20315

THE GEORGE WASHINGTON UNIVERSITY, WASHINGTON, D. C. 20006

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Foreword

PATTERN PERCEPTION IN RELATION TO READING HABITS

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Started 1 November 1965 and completed 30 November 1966

A great debt is owed to Mrs. Leora Lassowski who carried the main burden of communicating with the subjects.

The information in this report has not been cleared for release to the general public.

The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

SUMMARY

Certain asymmetries of perception in the right and left visual fields of American college students have been attributed to the effect of a reading habit which predisposes the subject to scan or organize material in a left-to-right direction, and thus to identify items more accurately in the left field. The purpose of the present work was to test this interpretation by investigating subjects who read from right-to-left (Israelis whose native reading language is Hebrew) to see if the asymmetries were reversed.

The main procedures replicated as closely as possible the procedures previously used with American college students which yielded better recognition in the left visual field. The work began with a group of 32 Israeli college students, and continued with three groups of 32 children each from the seventh, fifth and third grades.

The Israeli college students, contrary to expectations, showed greater accuracy for the left visual field, and tended to organize a series of items in a left-to-right direction. Investigation of the development of these response patterns revealed that fifth grade children showed a strong right effect for all the tasks and the third grade a small right effect, whereas the seventh grade subjects were already beginning to show a left-to-right ordering for some of the tasks. The data suggest that the "left attentiveness" of the college student develops from an earlier pattern of "right attentiveness", a point of view which is consistent with some data on first grade American children.

The similarity in results obtained with American and Israeli college students indicates that scanning habits developed from reading are clearly not responsible for the adult subjects' greater accuracy in the left field nor for their tendency to report a series of items in a left-to-right sequence. An interpretation consistent with the present findings is that the "left attentiveness" reflects some aspect of lateralization of cerebral function. From this point of view, the developmental data would indicate that such lateralization has a long developmental history, with the adult pattern only beginning to appear around puberty.

In the course of the work just described, some data were incidentally collected on perception of vertically oriented figures, with surprising results. American subjects, at all ages tested in previous work, consistently identified the part of the figure in the upper field more frequently than that in the lower field. The youngest group of Israeli children were similar to the American children, but the "attentiveness to the top" decreased in older subjects, and a reverse effect appeared in the college group. Inspection of letter shapes in Hebrew and Latin scripts suggested a possible basis for the results. A new experiment, with 56 adult Israelis, indicated clearly that the relevant cues for reading Hebrew are in the bottom halves of the letters, whereas cues are in the top halves for English. These findings suggest that the gradual development of an "attentiveness to the bottom" shown by the Israeli subjects might occur as the result of continued exposure to shapes (letters) for which significant cues are at the bottom.

PROBLEM.

There is a small body of data available in the American literature[1] which reports that college students identify certain visual patterns more accurately in the left visual field than in the right visual field. In general, these results have been interpreted as due to the scanning habits acquired in reading which lead the subject to attend first to the left part of a visual pattern when the pattern is spread across both fields. This interpretation has been tested (in the work to be described here) by investigating pattern recognition in subjects who have acquired reading habits that go from a right-to-left, i.e., subjects whose native reading language is Hebrew. The department of psychology at the Hebrew University in Jerusalem served as host to this research project, making available office and laboratory space, helping to get the equipment through customs, maintaining the equipment, and providing the information and advice inevitably needed by a newcomer to the country.

PROCEDURE.

The main part of the experimental procedure comprised the two tasks concerned with the accuracy of identification of the parts of an item presented tachistoscopically across the left and right visual field (i.e., the fixation point was in the center of the item). In one task, families of geometric forms were used in which the members of a family were identical on all sides but one (the distinguishing feature), and the figures were oriented so that the distinguishing feature could appear in any of four fields; - left, right, top or bottom. The question asked was whether the distinguishing feature would be perceived by Israeli subjects more frequently when it appeared in the right field than when it appeared in the left field. The other tachistoscopic task employed a set of binary patterns (a pattern of filled and unfilled circles) presented across both fields, and the subject indicated which circles has been filled. This task yielded information on the accuracy of identification of the filled circles in each visual field, and information on the order in which the filled circles were reported, i.e., right-to-left or left-to-right.

A few non-tachistoscopic tasks were added to the procedure to enlarge somewhat the scope of the problem. It was only after being in Israel for a short time that I realized it was incorrect to assume that Hebrew readers

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1. (a) Harcum, E.R. Reproduction of Linear Visual Patterns Tachistoscopically Exposed in Various Orientations. Williamsburg, Va. The College of William and Mary, 1964 (Monograph).

   (b) Heron, W. Perception as a function of retinal locus and attention. American Journal of Psychology, 1957, 70, 38-48.

   (c) Mandes, E.J. and Ghent, Lila. The effect of stimulus orientation on the recognition of geometric forms by adults. Paper presented at the meetings of the American Psychological Association, 1963.

have a single, right-left scanning habit for symbolic written material, in the same way that English readers can be said to have a single left-right scanning habit. Although the reading of Hebrew letters is done from right-to-left, the "reading" of numbers (and of music) is done from left-to-right. In order to get some assessment of the variability with which sequences of items might be ordered, three small tasks were designed to gain information on the direction in which a set of items was processed. The tasks were as follows: (1) the naming of each item in a row of 6 geometric forms, (2) crossing out all instances of the number "2" in a series of numbers and crossing out all instances of the Hebrew letter "bet" in a series of Hebrew letters, and (3) arranging a set of pictures in a row to make a coherent story.

SUBJECTS.

The subject used for all the experiments considered together consisted of 76 college students, 96 school-children, and 12 Israeli adults whose native language was not Hebrew. In general, the main criterion for including a subject in the groups of college students and school children was that Hebrew was to have been the first language the subject learned to read. For the third and fifth grade children, the additional criterion was set that Hebrew was the only language read; (the seventh grade children were spending a few hours a week learning English in school). During the course of the investigation, about 20 subjects tested did not meet these criteria and they are not included in the numbers of subjects listed above. The college students were mainly volunteers obtained through the Hebrew University, and one group comprised students from a Teachers' College taking a course concerned with reading problems. The school children all came from one school in Jerusalem which drew its students from a broad social spectrum, but with a preponderance of lower middle-class children. The small group of non-native readers of Hebrew were immigrants to Israel who had spent from 3-18 years in Israel and had a very good command of both Hebrew and English.

RESULTS AND CONCLUSIONS.

During the early months in Israel, I prepared the stimulus material to be used on the different tasks, learned a little Hebrew, looked for a student assistant, and established good relations with the Ministry of Education, whose permission was required to test children in the school system. (At various times throughout the year, I served as a volunteer consultant to one of the committees in the Ministry of Education, and to a committee in the department of psychology). The testing of subjects began at the end of January 1966, and continued during most of the remaining period of the contract. The findings can best be described in two parts. The main question is concerned with the effect of reading habits on perception in the horizontal dimension, and these results will be described first. In the course of the work, some unexpected results appeared for perception in the vertical dimension, and these results, and the new experiment to which they led, will be reported second.

Perception in the horizontal dimension - Twenty-four college students constituted the first group of subjects tested, and the results were surprising, since they indicated that native-born Israeli students tended to scan material in a left-to-right direction rather than the reverse. For the two main tachistoscopic tasks, the part of the stimulus appearing in the left field was perceived more accurately than the part appearing in the right field. Since these results were unexpected, eight additional subjects were tested on the geometric figure task without a fixation point in order that the pro ure conform exactly to the way in which the American subjects had been t ted on this task. Again, recognition was better for material on the left of the figure, which was in the left visual field. For the non-tachistoscopic tasks each series of items was organized in a left-to-right order, with the exception of the one task using Hebrew letters.

The next step was to test subjects on a different developmental level in order to investigate the ontogeny of the left-to-right tendency observed in the college students; the first group of children tested was in the fifth grade. These 32 subjects showed a clear and consistent tendency to organize material in a right-to-left order. For the two tachistoscopic tasks, recognition was more accurate for the right field than for the left, and the order of reporting each item in the binary patterns was strongly in the right-to-left direction. Each of the non-tachistoscopic tasks was handled in a right-to-left order.

The marked difference in results for the college students and the fifth grade children suggested that testing be done of children two grades below, and two grades above the fifth grade. Testing the younger children necessitated some technical changes - one task was dropped because of difficulty, another because of excessive length, and a third involved the redrawing of the figures with a heavier line so that the figures would be more visible at brief exposures. On the basis of the earlier results, I predicted that the third grade children should attend to the right side of the visual stimuli and should report from right-to-left, whereas the results for the seventh grade subjects should fall between those for the fifth graders and the college students. The results for the 32 third grade subjects did not contradict the prediction, but did not provide strong support for it. On the other hand, the group of 32 seventh-grade subjects did give results that were midway between the consistent tendencies shown by the fifth graders to attend first to the right, and the tendency of the college students to attend first to the left.

The collecting of data on the school children was completed by June 30, 1966. During the summer, the scoring of the various tasks was done, and the material was collated to provide a preliminary analysis of the material. Although a few t-tests and Chi-square tests have been carried out, a formal statistical analysis of the material remains to be done. Before leaving this problem and describing the other data gathered during the year, I would like to summarize the conclusions that I think can be drawn (even at this preliminary stage of the analysis) concerning the effect of reading habits on perception in the left and right visual fields.

The observation that American college students identify geometric figures and binary patterns more accurately in the left visual field than in the right field, and that they order their report of a series of items in a left-to-right

sequence, is clearly not unique to a population that reads and writes in a left-to-right direction. It is likely that the left-to-right reading habit enhances the consistency of "left responsiveness" in adults, since the Israeli college students showed greater variability than did American college students, but the reading habit is clearly not responsible for the fact that the ordering starts at the left. The basis for an "attentiveness" to the left is difficult to discern; the finding that this effect begins around the seventh grade suggests that physiological changes associated with puberty constitute a relevant factor.

Perception in the vertical dimension - The data on this question were gathered at the same time as the other testing was done, with the exception of one new experiment to be described later. In presenting the geometric figures in the tachistoscopic task, the figures were oriented with the distinguishing feature at the top or the bottom as well as to the left or the right. The subject made his response on this task by selecting the figure seen from a multiple-choice array of geometric figures. For half the subjects, the figures in the multiple-choice were oriented with the distinguishing feature at the top, and for half the subjects, the multiple-choice figures were oriented with the distinguishing features at the bottom, although for all subjects, the stimulus figures were presented in both orientations. This work on recognition in the vertical axis was included in order to replicate the procedure used with the American subjects, and it was anticipated that the Israelis would (like the American subjects) show better recognition when the distinguishing feature was at the top than when it was at the bottom.

The results obtained from the Israeli subjects differed from those of the American subjects in two ways. First, there appeared to be a shift in attentiveness from the top to the bottom of the figure with increasing age, whereas no age changes appeared in the American subjects. The third grade Israeli subjects identified the distinguishing feature more often when this portion appeared at the top (as did the American subjects). This effect decreased at higher age levels, finally resulting in better recognition by the college students when the distinguishing feature appeared at the bottom of the figure. Secondly, identification of a stimulus figure in a particular orientation interacted with the orientation of the multiple-choice figures in the Israeli subjects, but not in the American subjects. That is, accuracy was enhanced in the Israeli subjects when the orientation of the stimulus figure was the same as that of the multiple-choice figure. This interaction precludes any unitary description of the processes underlying differential attentiveness to parts of the vertical axis, and also raises the question of why this interaction appeared in the Israeli subjects, but not in the American subjects.

The shift with age in Israeli subjects from "attentiveness" to the top to "attentiveness" to the bottom was very striking when compared to the American data, where subjects of 5 years, 7 years and college age showed an approximately equally strong tendency to identify the figure more frequently when the distinguishing feature was at the top. The problem is why the results for the American and Israeli subjects diverge with age, and here it seemed that some characteristics of written Hebrew might be relevant. First, vowels are represented in the language by symbols placed underneath the letters, which

might train some attentiveness to the bottom of the figure. Secondly, an analysis of the individual letters suggested that the parts that distinguished one letter from another were more often found in the lower half of the figure, which again would direct attention to the lower part of the figure. The last experiment done in Israel was concerned with establishing whether Hebrew letters are identified more readily when only the bottom halves of the letters are viewed than when only the top halves are viewed, and further, whether the situation is reversed for English letters.

There were a number of technical problems in setting up the test material, but the stimuli were finally available for use in mid-September, 1966, and they were presented to 56 adult subjects, sometimes in a group and sometimes individually. The results were very clear-cut:-Israeli college students identified Hebrew letters more frequently when the bottom halves of the letters were visible. These same subjects, some of whom were very good English readers, showed only a slightly reversed effect for English (lower case) letters. Another group of Israeli citizens, but native readers of English, were tested with both Hebrew and English letters, and this group showed the predicted effects to a significant degree in both languages. This latter finding suggests that the Israeli students did not show the "English effect" to a significant degree primarily because they were not sufficiently sophisticated readers of the language.

Publication plans - The experiment concerned with letter recognition is sufficiently different from the rest of the material to warrant seperate publication as a small paper, either in Psychonomic Science or the American Journal of Psychology. The results for the college students on the left-right problem are sufficiently surprising (and can readily be compared with a large body of data on American college students) to warrant seperate publication as well, and I plan to prepare the material for publication in Psychonomic Science because of the short publication lag. The main body of the data, which provides a developmental analysis, will be prepared for publication as a unit, as a long article or monograph.

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13. ABSTRACT

Certain asymmetries of perception in the right and left visual fields of American college students have been attributed to the effect of a reading habit which predisposes the subject to scan or organize material in a left-to-right direction, and thus to identify more accurately the items in the left field. The purpose of the present work was to test this interpretation by investigating subjects who read from right-to-left (Israelis whose native reading language is Hebrew). Contrary to expectations, the Israeli college students showed greater accuracy for the left visual field, and tended to organize a series of items in a left-to-right direction. The investigation was extended to several groups of children, and a tentative picture of the development of an "attentiveness to the left" was obtained.

In addition, some incidental data were gathered on recognition in the top and bottom visual fields, and for this dimension, the Israeli and American college students were surprisingly different. Further work suggested that the difference may be related to some characteristics of the written forms of Hebrew and English.

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