Research in Brief: Orientation to the Spatial Characteristics of the Open Book

Marie M. Clay

One of the first code-breaking activities for the beginning reader concerns the arbitrary conventions of how books are presented. The orientation to the spatial characteristics of visible language was observed in 4 five-year-old identical girls through the developmental progression of their hand behavior while reading. Preliminary theoretical explanations are offered in terms of bilateral nervous systems, handedness and reading, and perceptual strategies for visual analysis of stimuli.

One of the first code-breaking activities for the beginning reader to discover concerns arbitrary conventions of how books are presented.

Where should he start?
What direction should he move?
Where should he look on reaching the end of a line?

Most discussions of beginning reading ignore this early learning of orientation to visible language, and yet a test of these "Concepts About Print" (Clay, 1972b) has discriminated reliably between children in their first six months of school instruction.

An opportunity to observe this learning was provided for the author by four identical girls. Despite an unusual degree of similarity in hereditary and environmental histories, they approached the problems of orientation to visible language on different time schedules and in different ways.

Background information was available from an earlier study of 100 children who had been observed each week during their first year at school. All behavior was recorded by the researcher as each child read his reading book for which the teacher had prepared him in the past week. A note was made of all occasions on which children pointed to the text and the direction of movement that they made. To externalize this "direction of movement," the child was asked to

Visible Language, VIII 3 (Summer 1974), 275–282

Author's address: Dept. of Education, University of Auckland, Auckland 1, New Zealand.

"Read it with your finger" after a warm-up period on two or three pages. An unexpected finding emerged. When the children were divided into progress groups, the top two quartiles used either right or left hand for pointing to texts. In 892 observations recorded at weekly intervals during the school year, 459 were right-hand responses and 423 were left-hand responses. It was as if the children were flexible in their hand approach to the printed text. The two lower quartiles (i.e., the slow progress readers) used their left hands more often and were significantly different from the top 50% in this respect ($p<.01$). Only three of the 100 children were left-handed. It happened that the reading books being used by all the children had been published with the text invariably on the left page and the pictures on the right page. Thinking of the open book as the visual field with the target to be located on the left page, the results suggested that the high progress readers approached this target with either hand, while the low progress readers used their left hands often as if drawn to this by the location of the text on the left. They matched their body response to the visual field characteristics. In the lower 50% of children, body and field seemed to be linked; in the top 50% they seemed to be independent (Table I).

These results report the summed records of hand behavior observed during the first year of instruction. It is possible that such a summary masks important changes that occur during that year.

The movement possibilities as a person with two hands approaches an English book with two pages were plotted diagrammatically. Suppose that simple text occurs on each page. Records must be kept of (1) which hand was used, (2) to move in which direction, (3) across which page. This complex orientation problem related to the

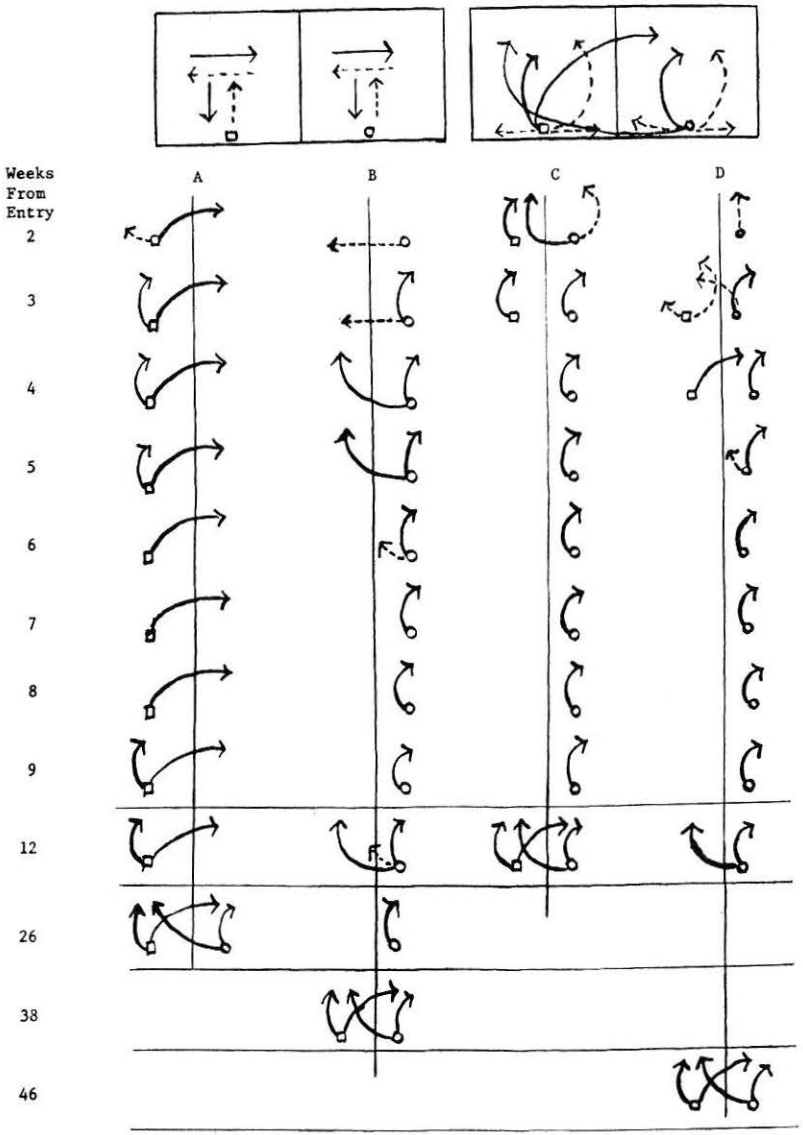
Table I. Pointing Behavior during Reading Observations

Quartile	*Right-hand pointing*	*Left-hand pointing*	χ^2	*Significance at ·01 level*	*Interpretation*
H	216	206	0·24	ns	Independent of perceptual field
HM	243	217	1·47	ns	
LM	163	284	32·75	yes	Dependent on perceptual field
L	157	235	15·52	yes	

acquisition of the directional schema for the printed form of a particular language is not covered by the simple question, "Which hand does the child prefer to use?" In the diagram at the top of Figure 1 the solid arrows plot several appropriate movements using a left hand or a right hand, and the dotted arrows show a few of the inappropriate movements. My research records show that observations close to the onset of reading instruction will produce each of these movements and others even more strange.

The diagram records some behavior that can occur when either

Figure 1. Hand used to point to text. □ = left hand; ○ = right hand.



hand is used on either page in either of two horizontal and two vertical directions. Constraints on such variety must be established. Are there any common factors as the child comes to behave within these constraints?

This problem was explored further with a longitudinal record of change in identical quadruplets. Observations were made at intervals during their first year at school. The girls obtained average intelligence test scores and average scores on visual perception tests. Baseline observations of handedness during the first week at school showed that one subject was left-handed and three were right-handed in self-selected classroom activities. This was explained in the medical history by the fact that a later subdivision of cells could produce one mirror pair. During the first year at school many observations of finger-pointing to simple texts were recorded.

After two weeks at school one right-handed subject B and one left-handed subject A were consistently using one hand for pointing to caption book texts. The other two right-handed subjects, C and D, took four and five weeks respectively to reach this stage. This behavior was not specifically trained in the classroom program. After that period the subjects used their preferred hand consistently and without lapse to point to both right and left pages; an asymmetrical response to the directional schema of English had been established on the basis of hand behavior. Variety occurred in the text stimuli and its placement on a page; consistency occurred within the individuals' orientation to that stimuli.

Observations continued. At twelve weeks right-handed subject C —who was making the best progress in reading—began to use either hand again. This behavior was different in several respects from the initial behaviors at the beginning of the study. The approach was always correct, and either hand could be used to produce this correct response despite variation in the stimulus or visual field. The change was in the direction of flexibility. Variety in the stimuli could now be consistently and correctly approached from either of two asymmetric responses in the individual. Would this be true of the other three subjects?

Left-handed subject A, making good progress in reading, reached this flexibility stage at 26 weeks. The other two subjects arrived at a similar state at 38 and 46 weeks respectively, although they showed occasional lapses from consistent performance.

In this particular group of five-year-olds a developmental progression in the orientation to the spatial characteristics of written language was recorded.

1. There was a period of orienting to print and the difference between subjects would probably be due to past or concurrent learning.
2. There was a period in which an asymmetrical hand response was consistently applied.
3. There was a later movement to alternate use of either hand whatever the format of the text.

The sequence held true for both right- and left-handed subjects, and the timing of acquisition differed for individuals of identical heredity and similar environmental histories.

The subjects of this study were learning to operate effectively within the directional conventions of written language. They were bilateral humans seeking to master an arbitrary directional approach to a bilateral source of stimuli. They could use either of two hands, but must read one of two pages first and move horizontally, not vertically in a left-to-right direction only, with a return sweep rather than returning right to left.

Theoretical explanations of the observed behavior touch on bilateral systems, handedness and reading, and perceptual strategies for visual analysis of stimuli.

The bilateral symmetry of the nervous system in animals creates difficulty for discriminating between forms and displays and their mirror images (Corballis and Beale, 1971). If one is to develop asymmetry in a symmetrical system (that is, a preference for one particular type of response rather than an alternative one), then one may learn a tilt of the head to one side, the predominant use of one hand, or a particular directional approach to surveying print. Asymmetrical responding is most obvious in man's vehicle driving. He does not sit in the centre of the road and respond randomly to any possibilities. His responding is constrained to one of two sets of rules, keeping to the left or keeping to the right. Returning to the example of written language, the directional constraints to be learned are a starting position, sequential movement along (or down) a line, and a return on the diagonal to a new starting point. This is quite arbitrary and the directional schema for Hebrew or Japanese are quite different

from the schema for European languages. Each requires the establishing of asymmetrical responding in the interests of efficiency.

It therefore appears that if one is a young child, the learning of an arbitrary directional convention for approaching written language may be a matter of movement or placement of one's body relative to the visual field. There is a motor component to the learning. If the approach is made by eye scanning movements only, it is still a motor activity though less easy to observe (Elkind and Weiss, 1967). Eventually it becomes a brain scan, so that during a fixation of the eyes sequential attentional scanning without apparent movement gives little sign of the motor activity which was probably necessary during the acquisition stage.

If the school entrant has a firm preference for a particular hand, one could predict that such an asymmetrical response would be used to guide the asymmetric eye scan movement needed in reading. Either hand could be used to orient the body and so bring the eyes to the appropriate starting position (Clark, 1973).

For a long time there has been repeated reference in the literature on learning to read to left-handedness and its possible link with reading difficulties. Once such a notion appears in print, there occurs a selective referral problem. Children referred to the clinician or neurologist are children who have the characteristics which the literature describes. The specialist is then able to say with some certainty that the children he sees with reading difficulty have handedness or laterality differences. When a sample of children from the whole community is studied rather than a clinical sample, such a selection bias disappears. Clark (1973) has found in community surveys of handedness and reading difficulties that the association does not hold up. If 4% of the population are left-handed and 33% are left-eyed, there must be a large group of the population of mixed laterality, and many are successful readers.

The school entrant to a reading program in English has to learn how to approach an open book.

The child may scan the pictures as he scans the world, from a focal point of high interest or information in a criss-cross of visual search patterns as he links up ideas (Luria, 1966). Perhaps by such "open search" he first locates the print of the text. Russian developmental psychologists have been interested in the development of eye and hand searching as young pre-school children explore novel stimuli

(Lynn, 1966). Before the age of five they found that children attended better to the stimuli if the tracing of new shapes involved hand and eye together, and that it was only the older children who were able to carry out effective exploration of new shapes with their eyes alone.

The child must first learn something about the placement of his body in relation to an open book (Benton, 1959).

The child reading English must learn to locate the left side of the text and proceed left to right according to the directional schema of the English he is reading. This learning is relative rather than fixed because of the placement of texts in books changes in size and layout. Detailed study of the emergence of this directional control has shown that children demonstrate all manner of variations in learning these arbitrary conventions, but that within about six months of entry into formal instruction the *average* child has become consistent in the use of an appropriate asymmetrical response. The quick learner may take less than a month; the slow learner may take a year to stabilize an appropriate schema or set of responses.

Although a child beginning to grasp this directional learning may operate within the general pattern required by printing conventions, he may not read a left page before a right page or he may not scan the letters within the word from left to right even though he sweeps along the line in the correct direction (Clay, 1972a).

How is the hand action related to visual scanning? The mechanisms of perceptual analysis are duplicated within each cerebral hemisphere, although visuo-spatial functions relate primarily but not uniquely to the right hemisphere. Dimond (1972) believes that "it would appear to be misleading to attribute the capacity for analyzing the events of the three-dimensional world to one hemisphere only." He has studied performance when both the right and left hand were required to respond at the same time and has devised a model according to which an asymmetrical pointing response to print would not mean that the brain organization on one side had exclusive control over the behavior. He proposed a centrencephalic movement system receiving instructions from either the right or left cortex and passing impulses back to hemispheric control of muscular activity.

How does this relate to the observations on the identical subjects reported above? Interpreting these observations ontogentically in relation to Dimond's model, "cortical instructions" to point to print were perhaps executed at first by the preferred hand and an estab-

lished motor localization pattern. Over time the subjects came to perform as if a centrencephalic movement system had been created, possibly by cross-talk between hemispheres, so that the organized response pattern could initiate the response to print by *either* hand.

Such a view is consistent with Luria's position (1966) that "writing and reading are functional systems of complex composition . . . (and) the psychophysiological composition of these acts changes in the successive developmental stages. . . ." The differential timing of the acquisition of this behavior implies that the apparently similar environments produced different learning histories in the subjects and points to a differential interaction of subjects with environmental opportunities.

The technique of asking a child to "Read it with your finger" will only reveal the directional orientation to the gross schema of line scanning. Beyond this there must be some very important visual perception learning relating to the attentional scanning of letters and clusters of letters. One might anticipate that further steps in the developmental progression described above occur, but some further devices for externalizing what is happening would be needed to observe these. A closer analysis of motor activity in the young child's orienting to print and its relation to attentional scanning during fixations of the eyes seems warranted.

REFERENCES

Benton, A. L. *Right-left Discrimination and Finger Localization.* New York: Paul B. Hoeber, 1959.

Clark, Margaret M. *Reading Difficulties in Schools.* Penguin Papers in Education; Harmondworth: Penguin, 1970.

Clay, Marie M. *Reading The Patterning of Complex Behaviour*, Auckland: Heinemann Educational Books, 1972a.

Clay, Marie M. *The Early Detection of Reading Difficulties: A Diagnostic Survey.* (Test Booklet is entitled "Sand"). Auckland: Heinemann Educational Books, 1972b.

Corballis, M. C. and Beale, I. L. On telling left from right. *Scientific American, 96,* 1971.

Dimond, S. *The Double Brain.* London: Churchill Livingston, 1972.

Elkind, D. and Weiss, J. Studies in perceptual development III: perceptual exploration. *Child Development,* 1967, *38,* 553–561.

Luria, A. R. *Higher Cortical Functions in Man.* London: Tavistock, 1966.

Luria, A. R. The functional organization of the brain. *Scientific American,* March, 1970.

Lynn, R. *Attention, Arousal and the Orientation Reaction.* New York: Macmillan, 1966.