Age changes in the mode of perceiving geometric forms¹

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Abstract

This experiment provides evidence that the order in which parts of a form are scanned changes in the preschool period. Geometric forms were constructed to have focal and distinguishing features, and the forms were presented tachistoscopically in two orientations. Recognition was enhanced in 3-yr.-old Ss when the form was oriented with the focal part at the top and the distinguishing feature at the bottom, whereas Ss about 5-yr.-old recognized the forms better when the distinguishing feature appeared at the top.

Introduction

Previous work has suggested that the various parts of a form are scanned (or sequentially processed) in a particular order, and further, that this order changes with age. The thought that scanning has directionality first arose in an attempt to explain the observation that preschool Ss consider geometric forms to be right-side-up when the apparently focal part of the form is in the upper part (Ghent, 1961). This preference for orientation was interpreted as deriving from a tendency to scan forms by beginning with the focal part and proceeding downwards. Recognition of a form should be facilitated when the focal part appears at the top (right-side-up), since this orientation would be congruent with the mode of scanning, and this effect was found to be marked in 3-yr.-old Ss (Ghent & Bernstein, 1961). However, later work found that 6-yr.-old children and adults appeared to scan by starting at the top of the figure (regardless of the position of the focal part), and then continued downwards (Ghent, 1963; Mandes & Ghent, 1963). That is, the preferred direction of scanning was downwards in all age groups, but the starting point appeared to change with age. This conclusion has remained tentative, however, since the stimulus figures used for the 3-yr.-olds were constructed somewhat differently from those figures used with the older Ss. The purpose of the present study was two-fold: first, to replicate the earlier findings with 3-yr.-old and older Ss using the same figures for all age-groups, and second, to ascertain more precisely the age at which the predicted change in the mode of scanning occurs.

The stimulus figures were designed to have two characteristics: a focal feature and a distinguishing feature. Two sets of figures were constructed. All members of a set shared a common focal part at one end, and identical sides; they differed only in the way the figure was closed at the other end (Fig. 1). This latter portion constituted the distinguishing part of the figure, and had to be perceived for the figure to be

identified correctly. The focal parts consisted of rounded lines or acute angles, since previous work had indicated that rounded lines and angles appeared to be focal with respect to straight lines (Ghent, 1961). These figures were tested for orientation preferences to check that the part assumed to be focal was indeed preferred at the top. In a group of 20 preschool Ss, each of the figures was considered right-side-up by at least 90% of the group when the assumed focal part was at the top.

The stimulus figures were constructed so that the orientation of the figure facilitating discrimination would vary, depending on the mode of scanning used. If 3-yr.-olds scan form by starting with the focal part and continuing downwards, presentation of the figure in the right-side-up orientation (focal part at the top) would be congruent with this mode of scanning and hence would facilitate perception of the distinguishing feature. If older Ss scan by starting at the top of the figure first, presentation of the figure in the upside-down orientation would bring the distinguishing feature to the top and hence facilitate recognition. Both predictions must be met to support the hypothesis that the mode of scanning form changes in the young child.

Method

The Ss were 36 children from a nursery school ranging in age from 3:1 to 5:1 yr. The youngest group comprised 10 Ss from 3:1 to 3:11 yr., the intermediate group 10 Ss from 4:0 to 4:5 yr., and the oldest group 16 Ss from 4:6 to 5:1 yr.

Because of the difficulty of the discrimination, preliminary training was given in which the stimuli were exposed for 1-2 sec. S was shown a single figure on a card and then required to identify it among several figures in a multiple-choice array. A series of 10 easily discriminable figures was presented first, followed by the 12 figures shown in Fig. 1, each of which

Fig. 1. Stimulus figures in the right-side-up orientation grouped according to family. The long axis of the figure subtended a visual angle of 1.75° under conditions of tachistoscopic presentation.

Fig. 2. The mean number of correct responses for stimuli presented in the right-side-up and upside-down orientations for three age-groupings. (Comparison of the absolute scores at different ages is meaningless because different exposure-durations were used for the various age-groups.)

appeared twice, once right-side-up and once upside-down, in a balanced order. When S made an error, he was usually shown the correct item, and his attention was drawn to the relevant part of the figure.

On a subsequent session, the stimuli were projected tachistoscopically within a small square outlined on a screen. Care was taken to ensure that S was looking at the square each time before the stimulus was presented. To maintain motivation, Ss were given a marble after each correct response, and five marbles were exchanged for an M & M candy. A series of geometric practice figures was presented first to accustom S to the procedure and to find an exposure-duration at which approximately half the figures were identified correctly. The exposure-durations used ranged from 1/5 sec. to 1/100 sec., the longer durations being used for the younger Ss. The exposure-duration for any S was constant during presentation of the test figures.

The 12 test figures were presented twice, once right-side-up and once upside-down; orientation was balanced by using two different orders in each age-grouping. After presentation of each stimulus, an array containing four figures from the appropriate family of figures was presented, and S selected the figure just seen. The items in the array were in the upside-down orientation for the two groups of younger Ss, and in the group of oldest Ss, half received upside-down items in the arrays, and

half received right-side-up items. Previous studies have indicated that array orientation is not a significant variable (Ghent & Bernstein, 1961; Ghent, 1963; Mandes & Ghent, 1963), but if array orientation had any effect at all, it could only bias the results against the prediction for the younger groups.

Results and Discussion

Figure 2 shows the mean number of correct responses for the tachistoscopically presented stimuli, and it is clear that the effect of orientation on recognition changed sharply with age. The 3-yr.-old Ss recognized figures presented in the right-side-up orientation better than those presented in the upside-down orientation ($t=3.19$; $p<.02$). The Ss from 4:6 to 5:1 yr., on the other hand, showed better recognition for figures presented in the upside-down orientation ($t=5.62$; $p<.001$); this effect was as strong in the subgroup presented with the multiple-choice items in the right-side-up orientation as in the subgroup presented with the multiple-choice items in the upside-down orientation. The Ss of intermediate age showed no consistent effect of orientation, presumably because the group was in a state of transition.

These results confirm the conclusion drawn from previous work that there is a marked change between 3 and 5 yr. in the processes underlying form-perception. This change appears to be interpreted best as a change in the part used as the starting point for scanning various parts of the figure—the "focal" part for 3-yr.-olds, and the top of the figure for older Ss.

Also, it might be noted that the results obtained with the oldest group (better recognition of the upside-down figures) offer no support for the view that a phenomenally right-side-up figure is recognized more readily than an inverted figure (e.g., Rock & Heimer, 1957); rather, the effect of orientation on recognition depends on the nature of the figure and the age of S.

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