

# AGE IN THE DEVELOPMENT OF CLOSURE ABILITY IN CHILDREN

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CLOSURE IS the perception of an object or event which is not completely or immediately represented. Previous studies (1, 2, 3, 4, 5, 6, 7, 8, 9) have revealed marked individual differences in this perceptual ability, but have thrown little light on its development.

Street's use of a *Gestalt Completion Test* with school children revealed no consistent or significant differences in scores attributable to age—which later prompted Thurstone (7, p. 9) to remark that the finding was of interest "as an indication that the test involves some factors which mature at an early age, and it may be taken as indicative of some fundamental and primitive function." The study by Verville and Cameron (9) of age and sex differences in the perception of incomplete pictures by adults revealed slight differences in reaction times and perceptual set attributable to age, but did not reveal a relationship between age and perceptual ability. Street's test comprised only thirteen items in its final form; the items were not of a single class; nor could the particular percepts be presumed to be universally familiar. Verville and Cameron used only ten items, and they were checking age differences between two groups of adults—those aged 16 to 23 and those aged 35 to 56. Both studies are open to the presumption that the tests, subjects, and procedures were not adequate to reveal an association between perceptual ability and age.

The present study was undertaken to reveal, through an early age range, the likely association between closure ability and age. The procedure was designed to minimize the differential effects of prior perceptual experience through the use, on the one hand, of subjects of common social and educational background, and, on the other hand, of closure test-items representative of a single class of percepts that might be presumed to be universally familiar. In short, the aim was to correlate closure ability and age in a uni-dimensional perceptual domain.

## METHOD

### *Subjects*

Subjects were 245 school children (119 girls, 126 boys) aged 7 to 13 in these grades: II (28), II (32), III (28), IV (33), V (33), VI (31), VII (28), and VIII

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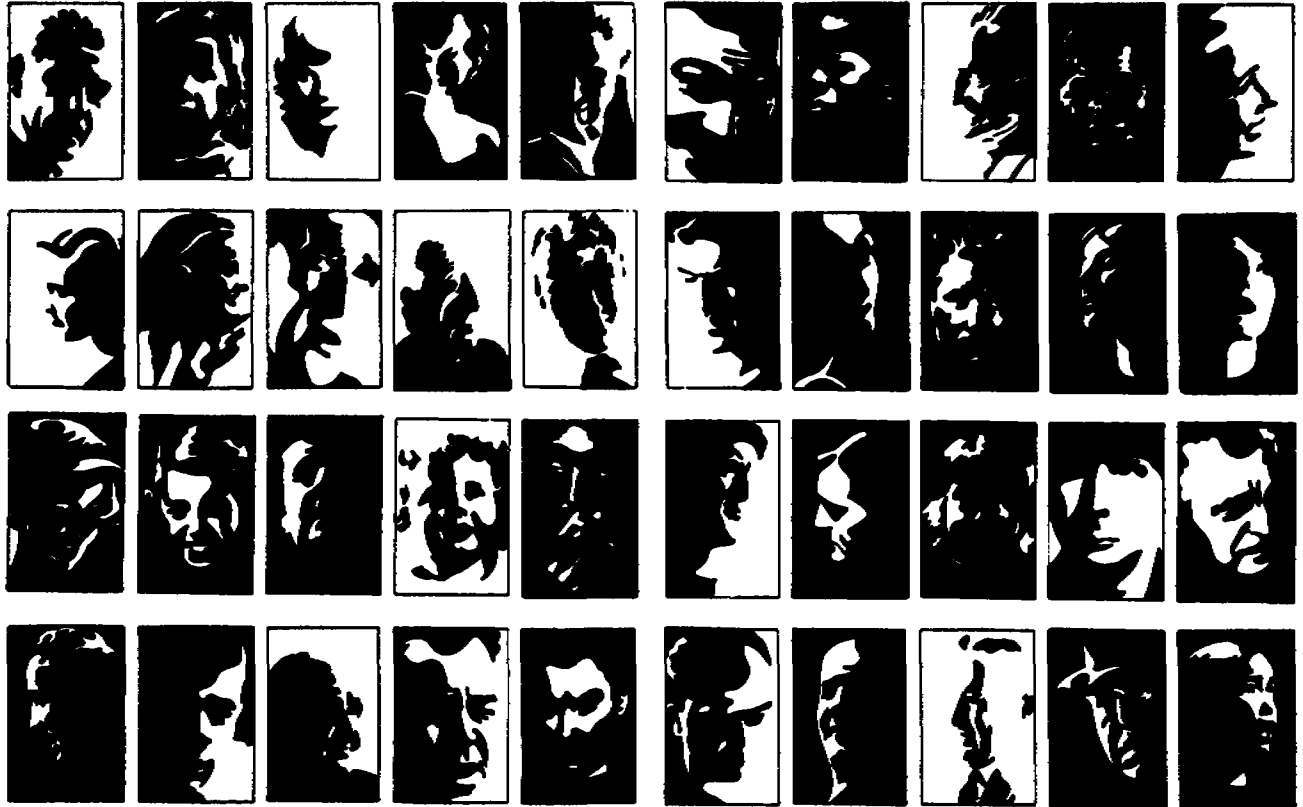


FIGURE 1. 40 closure faces arranged with the most difficult 5 at upper left, next most difficult 5 at upper right, and so on down to easiest 5 at lower right.

(32). Grades II to VI were in the same preparatory school; grades VII and VIII were in a junior high-school of the same community. In addition, 30 adult soldiers selected at random were included for purposes of incidental comparison.

### *Materials*

The closure items were drawings of the heads and faces of miscellaneous people. They presented, in solid blacks and whites, only the salient shadows or high-lights, as revealed in strongly lighted photographs. Such incomplete pictures called for closure. When perceived they convincingly resembled their originals. Additional false items (similar in terms of graphic stuff but otherwise nonsensical) were used. The 50 real and 20 false items were printed on 3" × 4" cards, assembled in decks, shuffled, and boxed.

### *Procedure*

Subjects were group-tested by grades by the same experimenter in their own class-rooms. They were required to sort their decks of cards, according to a prescribed system, into 7 categories: BOY, CROWN-UP MAN, OLD MAN, GIRL, GROWN-UP WOMAN, OLD WOMAN, and—for those they could not identify—LEFT OVER. Thirty minutes were allowed.

One of the grades II and grades IV and VI were retested after an interval of two weeks.

Scoring entailed a count of correct answers. These were prescribed beforehand. For example, where degree of age was debatable but sex was not, the acceptable answer for a particular male item would be CROWN-UP MAN or OLD MAN; or, if age was clear but sex not, OLD MAN or OLD WOMAN; or, if sex and age were evident, simply BOY. Answers to 10 of the real items were randomly scattered and these were discarded. Subsequent analysis was based on answers to the remaining 40 real and 20 false items. The 40 real items are presented in Figure 1.

Items were ranked and then grouped in fives for difficulty, as shown in Figure 1, on the basis of correct answers for the total *N* (245). Thereafter two kinds of comparisons were made. The first revealed the percentage accomplishment of the successive school grades and the adult Ss with successively less difficult groups of items. The second revealed the percentage accomplishment of successively more proficient groups of Ss with these groups of items. The aim was to ascertain if the difficulty order of the items remained constant for gradations of ability and age, and to reveal the relationship between the latter two factors.

## RESULTS

The reliability of the testing procedure is indicated by the test-retest product-moment correlation coefficient of .72 (with 87 Ss from grades II, IV, and VI).

Table I provides a general picture of the perceptual performance. There is a marked improvement in performance between grades II and VIII. Notable also is the markedly greater reluctance on the part of older children to dismiss items as "not seen" and, in consequence, their tendency to categorize the false items erroneously. That this tendency is not an exclusive function of age is indicated in Table II. Here, using only the

TABLE I  
PERFORMANCE OF SCHOOL CHILDREN AND ADULTS  
WITH 40 REAL AND 20 FALSE CLOSURE FACES

| School grades | N  | Percentage correctly categorized |       | Percentage erroneously categorized |       | Percentage categorized not seen |       |
|---------------|----|----------------------------------|-------|------------------------------------|-------|---------------------------------|-------|
|               |    | Real                             | False | Real                               | False | Real                            | False |
| II            | 32 | 36                               | —     | 28                                 | 54    | 36                              | 46    |
| II            | 28 | 39                               | —     | 32                                 | 57    | 29                              | 43    |
| III           | 28 | 48                               | —     | 26                                 | 64    | 26                              | 36    |
| IV            | 33 | 52                               | —     | 25                                 | 61    | 23                              | 39    |
| V             | 33 | 51                               | —     | 26                                 | 62    | 25                              | 38    |
| VI            | 31 | 62                               | —     | 29                                 | 84    | 9                               | 16    |
| VII           | 28 | 64                               | —     | 28                                 | 85    | 8                               | 15    |
| VIII          | 32 | 72                               | —     | 23                                 | 84    | 5                               | 16    |
| Adults        | 30 | 68                               | —     | 15                                 | 63    | 17                              | 37    |

grade II children and adults as extreme but representative examples, *Ss* have been grouped from lowest scoring sixth to highest on performance with the real items; and it is evident that the more proficient *Ss* less frequently dismiss the false items as unrecognizable.

Table III summarizes a check made for possible sex differences. Twenty items were so chosen that ten represented male and ten female faces; these were rigorously scored—that is, only one of the six answer categories was accepted as correct. There are no significant differences between boys and girls in total performance or in their handling of items in terms of sex.

TABLE II  
PERCEPTUAL COMMITMENT WITH 20 FALSE CLOSURE  
FACES IN TERMS OF ACCOMPLISHMENT ON  
40 REAL BY SEVEN-YEAR-OLD CHILDREN AND ADULTS

|                               |              | <i>Ss</i> grouped by sixths for accomplishment with real items |     |     |     |     |     |
|-------------------------------|--------------|--|-----|-----|-----|-----|-----|
|                               |              | 1st  | 2nd | 3rd | 4th | 5th | 6th |
| Grades II<br>( <i>N</i> = 60) |              | (percentages)  |     |     |     |     |     |
|                               | Real seen    | 13   | 23  | 31  | 38  | 51  | 68  |
|                               | False "seen" | 24   | 39  | 60  | 44  | 71  | 92  |
| Adults<br>( <i>N</i> = 30)    |              | 38   | 53  | 69  | 74  | 83  | 93  |
|                               | False "seen" | 31   | 54  | 59  | 60  | 78  | 90  |

TABLE III  
 PERCENTAGE ACCOMPLISHMENT OF BOYS AND GIRLS  
 WITH 10 MALE AND 10 FEMALE CLOSURE FACES

| Closure<br>faces   | Grade<br>II   |              | Grades<br>III, IV, V |              | Grades<br>VI, VII, VIII |              | Total          |               |
|--------------------|---------------|--------------|----------------------|--------------|-------------------------|--------------|----------------|---------------|
|                    | Girls<br>(27) | Boys<br>(33) | Girls<br>(47)        | Boys<br>(47) | Girls<br>(45)           | Boys<br>(46) | Girls<br>(119) | Boys<br>(126) |
| 10 Male            | 27            | 22           | 38                   | 39           | 50                      | 46           | 40             | 37            |
| 10 Female          | 26            | 15           | 36                   | 33           | 54                      | 49           | 41             | 34            |
| Male and<br>female | 27            | 19           | 37                   | 36           | 52                      | 48           | 40             | 36            |

TABLE IV  
 DISTRIBUTION OF SCORES ON CLOSURE FACES TEST  
 BY GRADE SCHOOL CHILDREN AND ADULTS

| Score intervals |          | Grades |     |    |    |    |     | Adults |      |
|-----------------|----------|--------|-----|----|----|----|-----|--------|------|
|                 |          | II     | III | IV | V  | VI | VII |        | VIII |
| 39              | 40       |        |     |    | 0  | 1  | 0   | 2      | 4    |
| 37              | 38       |        |     |    | 1  | 0  | 1   | 3      | 1    |
| 35              | 36       |        |     |    | 1  | 2  | 0   | 3      | 4    |
| 33              | 34       | 1      | 1   | 1  | 1  | 5  | 2   | 5      | 1    |
| 31              | 32       | 0      | 1   | 1  | 0  | 5  | 2   | 5      | 1    |
| 29              | 30       | 1      | 1   | 1  | 2  | 1  | 4   | 4      | 6    |
| 27              | 28       | 3      | 4   | 5  | 1  | 5  | 4   | 7      | 3    |
| 25              | 26       | 5      | 3   | 3  | 4  | 1  | 4   | 0      | 1    |
| 23              | 24       | 2      | 2   | 5  | 5  | 3  | 7   | 4      | 1    |
| 21              | 22       | 4      | 3   | 4  | 3  | 7  | 3   | 2      | 2    |
| 19              | 20       | 1      | 1   | 0  | 3  | 2  | 1   | 0      | 1    |
| 17              | 18       | 2      | 2   | 4  | 5  | 1  | 1   | 0      | 3    |
| 15              | 16       | 9      | 1   | 2  | 2  | 2  | 1   | 1      | 1    |
| 13              | 14       | 5      | 2   | 3  | 2  | 0  | 0   | 1      | 1    |
| 11              | 12       | 8      | 1   | 2  | 1  | 1  | 0   | 0      | 1    |
| 9               | 10       | 7      | 0   | 0  | 2  |    |     |        |      |
| 7               | 8        | 7      | 3   | 2  | 0  |    |     |        |      |
| 5               | 6        | 1      | 2   | 0  | 0  |    |     |        |      |
| 3               | 4        | 2      | 1   | 0  | 0  |    |     |        |      |
| 1               | 2        | 2      | 0   | 0  | 1  |    |     |        |      |
|                 | <i>N</i> | 60     | 28  | 33 | 33 | 31 | 28  | 32     | 30   |

TABLE V  
 PERCENTAGE ACCOMPLISHMENT ON CLOSURE FACES  
 TEST BY DIFFERENT AGE GROUPS WITH  
 SUCCESSIVELY EASIER GROUPS OF ITEMS

| Item groups | Grades |            |               | Adults | All |
|-------------|--------|------------|---------------|--------|-----|
|             | II     | III, IV, V | VI, VII, VIII |        |     |
| 1           | 16     | 25         | 41            | 37     | 30  |
| 2           | 22     | 35         | 57            | 52     | 41  |
| 3           | 29     | 37         | 59            | 60     | 45  |
| 4           | 35     | 48         | 62            | 77     | 53  |
| 5           | 37     | 58         | 72            | 67     | 59  |
| 6           | 45     | 64         | 74            | 75     | 64  |
| 7           | 51     | 65         | 79            | 87     | 69  |
| 8           | 62     | 74         | 84            | 90     | 76  |
| All         | 37     | 51         | 66            | 68     | 55  |

The distribution of results by grades is given in Table IV. The correlation coefficient is .546 and the correlation ratio is .585. The latter is a significantly better (beyond .01 level) measure of the degree of association, since the regression deviates slightly but significantly (.01 level) from linearity. Since the data are subsequently presented in ratio form, they become essentially linear when appropriately transformed to a normal probability scale.

The main findings are most simply presented in Tables V and VI. The forty items have been grouped from the five most difficult to the five

TABLE VI  
 PERCENTAGE ACCOMPLISHMENT ON CLOSURE FACES  
 TEST BY DIFFERENT SCORING GROUPS WITH  
 SUCCESSIVELY EASIER GROUPS OF ITEMS

| Item groups | Score intervals |      |       |       |       | All |
|-------------|-----------------|------|-------|-------|-------|-----|
|             | 1-8             | 9-16 | 17-24 | 25-32 | 33-40 |     |
| 1           | 5               | 9    | 23    | 42    | 71    | 30  |
| 2           | 9               | 15   | 36    | 59    | 82    | 41  |
| 3           | 8               | 24   | 38    | 61    | 88    | 45  |
| 4           | 12              | 30   | 53    | 67    | 84    | 53  |
| 5           | 18              | 35   | 61    | 74    | 91    | 59  |
| 6           | 20              | 40   | 64    | 82    | 93    | 64  |
| 7           | 14              | 46   | 69    | 89    | 96    | 69  |
| 8           | 30              | 61   | 79    | 89    | 95    | 76  |
| All         | 15              | 32   | 53    | 70    | 87    | 55  |

easiest. Subjects have been grouped by grades in Table V, and by levels of accomplishment in Table VI. Table V shows the percentage accomplishment of different age groups at the different levels of item difficulty. Table VI shows the percentage accomplishment of Ss of different levels of ability at the different levels of item difficulty. Absolute differences between these S groups, and the constant relative increases between S groups at different levels of item difficulty, are significant (.01 level), as checked by analysis of variance and goodness of fit tests.

### DISCUSSION

The perceptual competence entailed in this kind of closure exercise is positively and significantly associated with age. That it is not exclusively associated with age is evident from the fact that the ranges of subject differences and of item difficulties remain as marked at later ages as at early ones.

The constant order of difficulty of the items, for all age or ability levels, suggests that the forty items define a single perceptual domain, and that they differ in some quality determinative of the class of percepts called for.

The constant increases in competence—along either the age or ability dimensions—at successive levels of item difficulty, along with the consistent over-all increases with successive increments of age, suggest the probable basis of the age-ability association—namely, that all Ss have an identical, uniformly repeated, year-by-year experience with this perceptual domain.

There then remain two distinct parameters which are basically independent of age. These are differences among Ss in inherent ability, and differences among test-items in inherent difficulty.

### SUMMARY

This study was designed to reveal the relationship between age and ability in perceptual closure. It laid down as critical requirements the testing of a large number of children differing in age but of similar social and educational background with an ample number of a single class of percepts that could be presumed to be universally familiar.

A test composed of 40 incomplete black and white representations of the heads and faces of particular kinds of persons was given to 245 children in grades II to VIII in a single community, and to 30 adults.

The analysis of scores in terms of correct perceptions revealed a constant range of item difficulty at all age and ability levels, and a positive and significant association between perceptual ability and age.

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