

FORM DISCRIMINATION
AS A LEARNING CURVE IN INFANTS

by

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CONTENTS

Introduction	1
The Experiment	20
Preliminary Study	20
Main Experiment	49
Series I - V inclusive	49
Apparatus	49
Method of Procedure	51
Subjects	55
Results	57
Analysis on the basis of Achievement	57
Number of Trials	57
Percentage of Success	74
Reaction Time	81
Oral behavior	102
Vocalization	110
Affective concomitant	131
Analysis on the basis of Development	143
Total Number of Form Combinations	143
Total Number of Trials	152
Percentage of Success	152
Reaction Time	159
Oral Behavior	164

Vocalization	174
Affective Concomitant	181
Visual Regard	188
Manipulation	189
Series VI	193
Introduction	193
Apparatus	194
Method of Procedure	195
Subjects	196
Results	196
Form Preference	197
Reaction Time	216
Manipulation	217
Oral Behavior	225
Vocalization	225
Affective Concomitant	233
General Discussion	249
Space perception	249
Learning	261
Summary and Conclusions	272
Bibliography	280

FIGURES

Number		Page
1.	A General View of the Form Discrimination Apparatus	21
2.	Form blocks Used in the Preliminary Study . . .	23
3.	The Experimental board and Two Form blocks . .	26
4.	Total number of Trials Required by Each Subject in the Regular Preliminary Group in the Learning of Series I - II	30
5.	Percentage of Success Obtained by Each Subject in the Regular Preliminary Group in the Learning of Series I - II	33
6.	Total Reaction Time Required by Each Subject in the Regular Preliminary Group in the Learning of Series I - II	37
7.	Percentage of Trials in which Oral behavior Occurred with Each Subject in the Regular Preliminary Group in the Learning of Series I - II	43
8.	Percentage of Trials in which Vocalization Occurred with Each Subject in the Regular Preliminary Group in the Learning of Series I - II	44
9.	Percentage of Trials in which Different Aspects of Affective Concomitant were Observed in Each Subject in the Regular Preliminary Group in the Learning of Series I .	46
10.	Percentage of Trials in which Different Aspects of Affective Concomitant were Observed in Each Subject in the Regular Preliminary Group in the Learning of Series II . .	47

Number		Page
11.	Form Blocks Used in Series III Experiment (Showing Relative Size)	50
12.	General Plan for Series I - V Inclusive	56
13.	Total Number of Trials Required by Each Subject in the Regular Experimental Group in the Learning of Series I - V	58
14.	Average Number of Trials Required by Sub-Groups I and II respectively of the Regular Experimental Group in the Learning of Each Series from Series I to V	62
15.	Average Number of Trials Required by Sub-Groups I and II respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Each Series from Series I - V	63
16.	Percentage of Success Obtained by Each Subject in the Regular Experimental Group in the Learning of Series I - V	75
17.	Average Percentage of Success Obtained by the Sub-Groups I and II respectively of the Regular Experimental Group in the Learning of Each Series from I to V	79
18.	Average Percentage of Success Obtained by Sub- groups I and II respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Each Series from Series I - V	80
19.	Total Reaction Time Required by Each Subject in the Regular Experimental Group in the Learning of Series I - V	85
20.	Average Reaction Time for Each Series Required by Sub-Groups I and II respectively of the Regular Experimental Group in the Learning of Series I - V	91
21.	Average Reaction Time for Each Series Required by Sub-Groups I and II respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Series I - V	92

Number		Page
22.	Average Reaction Time per Trial Required by Sub-Groups I and II Respectively of the Regular Experimental Group in the Learning of Each Series from Series I - V	95
23.	Average Reaction Time per Trial Required by Sub-groups I and II Respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Each Series from Series I - V	96
24.	Oral Behavior: Percentage of Trials in which it was Exhibited by Each Subject in the Regular Experimental Group in the Learning of Series I - V	103
25.	Average Percentage of Trials in which Oral Behavior was Exhibited by Sub-groups I and II respectively of the Regular Experimental Group in the Learning of Each Series from Series I - V	105
26.	Average Percentage of Trials in which Oral Behavior was Exhibited by Sub-groups I and II Respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Each Series from Series I - V	106
27.	Percentage of Trials in which Vocalization Occurred with Each Subject in the Regular Experimental Group in the Learning of Series I - V	117
28.	Average Percentage of Trials in which Vocalization Occurred in Sub-groups I and II Respectively of the Regular Experimental Group in the Learning of Each Series from Series I - V	119
29.	Average Percentage of Trials in which Vocalization Occurred in Sub-Groups I and II respectively of the Combined Regular and Irregular Experimental Group in the Learning of Each Series from Series I - V	120
30.	Percentage of Trials in which Different Aspects of Affective Concomitant were Observed in Each Subject in the Learning of Series I - V	132

Number		Page
31.	Average Percentage of Trials in which Different Aspects of Affective Concomitant Were Observed in Sub-Groups I and II respectively of the Regular Experimental Group in the Learning of Each Series in Series I - V	136
32.	Average Percentage of Trials in which Different Aspects of Affective Concomitant Were Observed in Sub-Groups I and II respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Each Series in Series I - V	137
33.	Average Number of Form Combinations Learned per Experimental Period by Sub-Groups I and II respectively of the Regular Experimental Group at Each Age Level in the Learning of Series I - V	150
34.	Average Number of Form Combinations Learned per Experimental Period by Sub-Groups I and II respectively of the Combined Regular and Irregular Experimental Groups at Each Age Level in the Learning of Series I - V	151
35.	Average Number of Trials performed per Experimental Period by Sub-Groups I and II respectively of the Regular Experimental Group at Each Age Level in the Learning of Series I - V	154
36.	Average Number of Trials Performed per Experimental Period by Sub-Groups I and II respectively of the Combined Regular and Irregular Experimental Groups at Each Age Level in the Learning of Series I - V	155
37.	Average Percentage of Success Obtained by Sub-Groups I and II respectively of the Regular Experimental Group at Each Age Level in the Learning of Series I - V	157
38.	Average Percentage of Success Obtained by Sub-Groups I and II respectively of the Combined Regular and Irregular Experimental Groups at Each Age Level in the Learning of Series I - V	158

Number	Page
39. Average Reaction Time per Experimental Period Required by Sub-Groups I and II Respectively of the Regular Experimental Group at Each Age Level in the Learning of Series I - V	160
40. Average Reaction Time per Experimental Period Required by Sub-Groups I and II Respectively of the Combined Regular and Irregular Experimental Groups at Each Age Level in the Learning of Series I - V	161
41. Average Reaction Time per Trial Required by Sub-Groups I and II Respectively of the Regular Experimental Group at Each Age Level in the Learning of Series I - V	165
42. Average Reaction Time per Trial Required by Sub-Groups I and II Respectively of the Combined Regular and Irregular Experimental Groups at Each Age Level in the Learning of Series I - V	166
43. Average Percentage of Trials in which Oral Behavior was Exhibited by Sub-Groups I and II Respectively of the Regular Experimental Group at Each Age Level in the Learning of Series I - V	172
44. Average Percentage of Trials in which Oral Behavior was Exhibited by Sub-Groups I and II Respectively of the Combined Regular and Irregular Experimental Groups at Each Age Level in the Learning of Series I - V	173
45. Average Percentage of Trials in which Vocalization Occurred with Sub-Groups I and II Respectively of the Regular Experimental Group at Each Age Level in the Learning of Series I - V	178
46. Average Percentage of Trials in which Vocalization Occurred in Sub-Groups I and II Respectively of the Combined Regular and Irregular Experimental Groups at Each Age Level in the Learning of Series I - V	179

Number

Page

47. Average Percentage of Trials in which Different Aspects of Affective Concomitant Were Observed in Sub-Groups I and II respectively of the Regular Experimental Group at Each Age Level in the Learning of Series I - V 185
48. Average Percentage of Trials in which Different Aspects of Affective Concomitant Were Observed in Sub-Groups I and II respectively of the Combined regular and Irregular Groups at Each Age Level in the Learning of Series I - V 186

TABLES

Number	Page
1. Total Number of Trials Required by Each Subject in the Regular Preliminary Group in the Learning of Each Form in Series I . . .	31
2. Total Number of Trials Required by Each Subject in the Regular Preliminary Group in the Learning of Each Form in Series II . . .	32
3. Percentage of Success Obtained by Each Subject in the Regular Preliminary Group in the Learning of Each Form in Series I . . .	34
4. Percentage of Success Obtained by Each Subject in the Regular Preliminary Group in the Learning of Each Form in Series II . . .	35
5. Total Reaction Time Required by Each Subject in the Regular Preliminary Group in the Learning of Each Form in Series I	36
6. Total Reaction Time Required by Each Subject in the Regular Preliminary Group in the Learning of Each Form in Series II	39
7. Average Reaction Time per Trial Required by Each Subject in the Regular Preliminary Group in the Learning of Each Form in Series I	40
8. Average Reaction Time per Trial Required by Each Subject in the Regular Preliminary Group in the Learning of Each Form in Series II	41
9. Total Number of Trials for Each Series Required by Each Subject in Sub-Group I of the Regular Experimental Group in the Learning of Series I - V	60

Number		Page
10.	Total Number of Trials for Each Series Required by Each Subject in Sub-Group II of the Regular Experimental Group in the Learning of Series I - V	61
11.	Total Number of Trials, Percentage of Success and Total and Average Reaction Time Required by Each Case in regular and Irregular Experimental Groups in Learning Each Form in Series I - V (back of Dissertation)	
12.	Average Number of Trials Required by the Regular Experimental Group in Learning Each Form in Series I - V	68
13.	Total and Average Number of Trials Required by Sub-Groups I and II respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Each form in Series I - V	69
14.	Average Number of Trials for Each Form Group Required by Sub-Groups I and II respectively of the Regular and Combined Experimental Groups in the Learning of Series I - V	70
15.	Percentage of Success for Each Series Obtained by Each Subject in Sub-Group I of the Regular Experimental Group in the Learning of Series I - V	76
16.	Percentage of Success for Each Series Obtained by Each Subject in Sub-Group II of the Regular Experimental Group in the Learning of Series I - V	77
17.	Percentage of Success Obtained by Sub-Groups I and II respectively of the Regular Experimental Group in the Learning of Each Form in Series I - V	82
18.	Percentage of Success Obtained by Sub-Groups I and II respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Each Form in Series I - V	83

Number		Page
19.	Average Percentage of Success for Each Form Group Obtained by Sub-Groups I and II Respectively of the Regular and Combined Experimental Groups in the Learning of Series I - V	84
20.	Total Reaction Time for Each Series Required by Each Subject in Sub-Group I of the Regular Experimental Group in the Learning of Series I - V	87
21.	Total Reaction Time for Each Series Required by Each Subject in Sub-Group II of the Regular Experimental Group in the Learning of Series I - V	88
22.	Average Reaction Time per Trial for Each Series Obtained by Each Subject in Sub-Group I of the Regular Experimental Group in the Learning of Series I - V	89
23.	Average Reaction Time per Trial for Each Series Obtained by Each Subject in Sub-Group II of the Regular Experimental Group in the Learning of Series I - V	90
24.	Average Reaction Time Required by the Regular Experimental Group in Learning Each Form in Series I - V	98
25.	Total and Average Reaction Time Required by Sub-Groups I and II Respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Each Form in Series I - V	99-100
26.	Average Reaction Time for Each Form Group Required by Sub-Groups I and II Respectively of the Regular and Combined Experimental Groups in the Learning of Series I - V	101
27.	Average Number and Percentage of Trials in which Oral Behavior was Exhibited by Sub-Groups I and II Respectively of the Regular Experimental Group in the Learning of Each Form in Series I - V	108-11

Number

Page

28. Average Number and Percentage of Trials in which Oral Behavior was Exhibited by Sub-Groups I and II Respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Each Form in Series I - V 112-15
29. Average Number and Percentage of Trials in which Vocalization Occurred in Sub-Groups I and II Respectively of the Regular Experimental Group in the Learning of Each Form in Series I - V 122-5
30. Average Number and Percentage of Trials in which Vocalization Occurred in Sub-Groups I and II Respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Each Form in Series I - V 126-9
31. Percentage of Trials in which Different Aspects of Affective Concomitant were Observed in Each Sub-Group of the Regular Experimental Group in the Learning of Series I - V 133
32. Average Number and Percentage of Trials in which Different Aspects of Affective Concomitant were Observed in Sub-Groups I and II Respectively of the Regular Experimental Group in the Learning of Each Form in Series I - V 138-41
33. Average Number and Percentage of Trials in which Different Aspects of Affective Concomitant were Observed in Sub-Groups I and II Respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Each Form in Series I - V 142-5
34. Average Number of Form Combinations Learned per Experimental Period at Each Age Level by Three Typical Cases from Each of the Sub-Groups of the Regular Experimental Group in the Learning of Series I - V 149

Number		Page
35.	Average Number of Trials Carried out per Experimental Period at Each Age Level by Three Typical Cases from Each of the Sub-Groups of the Regular Experimental Group in the Learning of Series I - V	153
36.	Percentage of Success Obtained at Each Age Level by Three Typical Cases from Each of the Sub-Groups of the Regular Experimental Group in the Learning of Series I - V	156
37.	Average Reaction Time required per Experimental Period at Each Age Level by Three Typical Cases from Each of the Sub-Groups of the Regular Experimental Group in the Learning of Series I - V	167
38.	Average Reaction Time required per Trial at Each Age Level by Three Typical Cases from Each of the Sub-Groups of the Regular Experimental Group in the Learning of Series I - V	168
39.	Average Number and Percentage of Trials in which Oral behavior Was Exhibited at Each Age Level by Three Typical Cases in Sub-Group I of the Regular Experimental Group in the Learning of Series I - V	169
40.	Average Number and Percentage of Trials in which Oral behavior Was Exhibited at Each Age Level by Three Typical Cases in Sub-Group II of the Regular Experimental Group in the Learning of Series I - V	170
41.	Average Number and Percentage of Trials in which Vocalization Occurred at Each Age Level in Three Typical Cases in Sub-Group I of the Regular Experimental Group in the Learning of Series I - V	175-6
42.	Average Number and Percentage of Trials in which Vocalization Occurred at Each Age Level in Three Typical Cases in Sub-Group II of the Regular Experimental Group in the Learning of Series I - V	177

Number		Page
43.	Average Number and Percentage of Trials in which Different Aspects of Affective Concomitant were Observed at Each Age Level in Three Typical Cases in Sub-Group I of the Regular Experimental Group in the Learning of Series I - V	182-3
44.	Average Number and Percentage of Trials in which Different Aspects of Affective Concomitant were Observed at Each Age Level in Three Typical Cases in Sub-Group II of the Regular Experimental Group in the Learning of Series I - V	184
45.	Comparison of Sub-Group I of the Regular Experimental Group with Sub-Group I of the Control Group in Regard to Form Preference	198-9
46.	Comparison of Sub-Group II of the Regular Experimental Group with Sub-Group II of the Control Group in Regard to Form Preference	200-1
47.	Comparison of Experimental and Control Groups Regarding Form Preference (Combined Results of Sub-Groups I and II). . .	202-3
48.	Comparison of Experimental and Control Groups Regarding the Number of Times Each Form Type was Preferred (Analysis 1) . . .	205
49.	Comparison of Experimental and Control Groups Regarding the Number of Times Each Form Type was Preferred (Analysis 2) . . .	209
50.	Comparison of Experimental and Control Groups Regarding the Number of Times Each Form Type was Preferred (Analysis 3) . . .	213
51.	Comparison of Sub-Groups I and II of the Regular Experimental Group and Sub-Groups I and II of the Control Group in Regard to Total Reaction Time	218-9
52.	Comparison of Sub-Groups I and II of the Regular Experimental Group and Sub-Groups I and II of the Control Group in Regard to Average Reaction Time	220-1

Number	Page
53. Comparison of Regular Experimental Group and Control Group Regarding Total and Average Reaction Time (Combined Results of Sub-Groups I and II)	222-3
54. Comparison of Experimental and Control Groups Regarding Total Reaction Time and Average Reaction Time per Trial Required for Performing Series VI	224
55. Comparison of Sub-Group I of the Regular Experimental Group with Sub-Group I of the Control Group in Regard to Oral Behavior	226-7
56. Comparison of Sub-Group II of the Regular Experimental Group with Sub-Group II of the Control Group in Regard to Oral Behavior	228-9
57. Comparison of the Combined Sub-Groups of the Regular Experimental Group with the Combined Sub-Groups of the Control Group in Regard to Oral Behavior	230-1
58. Comparison of Experimental and Control Groups Regarding Oral Behavior (Observed in Series VI)	232
59. Comparison of Sub-Group I of the Regular Experimental Group with Sub-Group I of the Control Group in Regard to Vocalization	234-5
60. Comparison of Sub-Group II of the Regular Experimental Group and Sub-Group II of the Control Group in Regard to Vocalization	236-7
61. Comparison of the Combined Sub-Groups of the Regular Experimental Group and the Combined Sub-Groups of the Control Group in Regard to Vocalization	233-9
62. Comparison of Experimental and Control Groups Regarding Vocalization Observed in Series VI	240
63. Comparison of Sub-Group I of the Regular Experimental Group and Sub-Group I of the Control Group in Regard to Affective Concomitant	241-2

Number	Page
64. Comparison of Sub-Group II of the Regular Experimental Group and Sub-Group II of the Control Group in Regard to Affective Concomitant	243-4
65. Comparison of the Combined Regular Experimental Groups and the Combined Control Groups in Regard to Affective Concomitant . .	245-6
66. Comparison of Experimental and Control Groups Regarding Different Aspects of Affective Concomitant Observed in Series VI .	247

INTRODUCTION

There have been a number of studies on form discrimination in lower animals and human adults, but relatively little work has been done in the same field with children, especially with infants. The following represent the more significant of these latter studies.

Line (1) studied the ability to discriminate simple geometrical forms in four- to five-year-old children by means of the card-sorting method. He found that even when the test cards were compared one by one with a specimen card, his young subjects, though able to distinguish a square from a circle and, perhaps, a rectangle, could not see the irregular nature of a round form or differentiate between open and closed figures of a similar shape. He concludes that the ability to perceive form is dependent largely on the same "g" that operates in all cognitive processes, that the results of the experiment support Spearman's (2) contention that "relations furnish the very woof and warp of shapes or whole qualities," and that therefore the two-step theory is much closer to the truth than that advocated by the Berlin School.

Gellermann (3,4), having as subjects two children of two years of age and two chimpanzees, which were estimated to be five and six years of age respectively, employed a technique

very similar to that of Munn and Stiening (5) whose experiment will be discussed presently. He placed, behind the positive and the negative stimulus form respectively, two boxes, both containing food; but only the one behind the positive stimulus was left unlocked. All his subjects were sufficiently hungry during the experiment to be ready to carry out a large number of trials at each sitting. The results of his investigation show that the children were able to discriminate form--triangularity--per se independent of size, brightness (black or white), type of triangle, and mode of presentation (outlined or solid). Furthermore, they could distinguish very small differences of form--a triangle from a trapezoid which was made of the triangle with the apex slightly sawed off, and a circle from a circular figure with three somewhat flattened sides. In a second series of experiments it was found that changes in the shape of the background of either the positive or the negative stimulus did not affect the children's responses. However, when the positive form was made the background of the positive stimulus, both stimuli having the same central figure, one child responded correctly at once, the other after five trials. The apes, on the other hand, were not so successful in this respect. Gellermann attributed their inferiority to their lack of language which the human subjects used plentifully to assist their memory and their overt activity.

Concerning spatial orientation, Gellermann reported that when the triangle (positive stimulus) was turned upside down,

the children succeeded in recognizing it only after a period of hesitation during which they usually inclined their heads through an angle of sixty degrees in order, presumably, to restore as far as possible the original spatial orientation of the triangle in relation to the position of the head. However, in another series of experiments after the children had learned to select as the positive stimulus a cross horizontally and vertically orientated, they experienced the greatest difficulty in their discrimination performance when the negative stimulus was a cross rotated from the horizontal and vertical position.

Skeels (6) attempted to devise a valid measure of form discrimination in children who were too young to succeed in form board performance. The simple conditioning technique was employed. The apparatus consisted of two boards, each of which was mounted on a low table and contained four form recesses. Beneath these recesses there were four cups in one of which a reward for success--cookie or toy--was placed. The first board consisted of four simple geometrical forms and the second, four object forms of equal simplicity. During the experiment the recesses were filled with blocks which fitted them exactly, and the child was instructed to lift the block that served as the positive stimulus in order to secure the reward. If he failed, he was not rewarded until the next trial. Sixty-four children, ranging in age from fifteen to forty-eight months, served as subjects. Results indicate:

1. Genetically, the ability to discriminate form per se seemed to appear at an earlier stage of development than the ability to see the relationship between two units of the same form.

2. Position of form elements in relation to the child affected performance scores in the conditioning series. Proximity and handedness had a greater effect than did relative position of elements.

3. Order of presentation seemed to have a negligible effect on performance.

4. Association between form and reward appeared to be made up of both "positive stimulus with reward" bonds and "negative stimulus without reward" bonds. In the absence of the positive stimulus form, children made selection on a basis of negative forms.

5. Negative forms with configurations similar to the positive stimulus form caused more confusion than did changes in configurations of positive or negative forms or both in which dissimilarity still existed.

6. When the total configuration of the positive stimulus form was radically changed, a high degree of correct choices still resulted. These choices appeared to be based on either "meaning" which was intended to be the same, or upon certain parts of the original configuration which remained intact in the changed configuration.

Munn and Stiening (5) report the results from one subject

only, a fifteen-month-old boy. Their apparatus consisted of a box with two glass doors hinged from the top. Form patterns to be discriminated were placed on the doors in such a way that either figure or ground could be changed at will. As a reward for success the child was given a piece of chocolate and a brightly colored ball, and as a punishment for failure he was prevented from obtaining either. The results show that the shape of the background on which the form appeared was not an effective part of the stimulating conditions, and that the child was capable of discriminating form per se, but only after an enormous number (350) of repetitions. The authors concluded that "the child responded to a part rather than to the whole configuration," which fact would seem to contradict Volkelt's (7) statement that "perception for the child is in terms of wholes from which, in the growth process, the so-called 'parts' are discriminated relatively slowly" (8, p. 751), as well as the Gestaltists' contention "to the effect that animals respond always to a total situation" (5, p. 87). The same fact likewise refutes Hunter's (6) statement that "form discrimination is always a pattern discrimination" (6, p. 332).

Volkelt and Loebenstein (7) studied form discrimination in infants by means of a method adapted from that of Rählmann (9) in the latter's genetic study of color discrimination. They used milk bottles of four different geometric forms,

namely, rectangle, triangle, oval, and violin-shape, of which only one contained a nipple with an opening. The infant was presented first with the positive stimulus only, then with one negative form, and then with two or even three negative bottles. Twenty-nine subjects, ranging in age from five to twelve months, were used. Of these nearly two-thirds gave conclusive evidence of having learned to choose the positive form as against all the others.

Among the qualitative results reported by Volkelt (7) the most illuminating seem to be those derived from a series of control experiments in which negative forms were present but the positive one was omitted. In such cases the infant unmistakably exhibited inhibition and an expectant and searching behavior. All his movements were temporarily suspended; his long disappointed glances searched the field; and his hands did not grasp. That he was aware of the absence of the positive form in the visual field was clearly obvious. Volkelt uses these data in support of his theory of the "Gesamtheit" character of early space perception.

In a series of comparison experiments which Loebenstein (7) performed with idiots between five to eight years of age, not only did those subjects require a much longer time to learn to choose correctly, but their behavior also was irregular, purposeless and stereotyped. Above all, in the control experiments in which the positive stimulus was not presented, they behaved very much the same as if it were,

showing a marked qualitative difference between the normally immature and the pathologically immature perception processes.

In addition to these experiments on form discrimination per se in children may be briefly mentioned those on the genetic development of form as related to other sensory and spatial attributes; viz., spatial orientation, size, number, color, etc.

In regard to spatial orientation in very young children there is, on the whole, agreement, namely: to a child a form is much more independent of its absolute spatial position than it is to adults [Koffka (10, p. 293); Vernon (11, p. 186); Gellermann (3,4); Bühler (12, pp. 156-157); Jersild (13, p. 236); Johnson (14, p. 256), etc.]. On the other hand, the comprehensive data of Hanfmann (15) with twenty-two slightly older subjects (four years and four months to seven years and six months) show that each change in angular position of a triangle changes the percentages of correct response (drawing) very markedly. In reproducing the various stimulus patterns (paired triangles) he found a marked tendency to change the absolute position back to a "natural" position (i.e., predominance of vertical and horizontal lines). In conclusion Hanfmann states: "Many children easily shift a given figure to a different position but only if they have any motive for doing so; and the kind of position into which the figures are shifted shows that the absolute orientation already influences the children's perception

of shape" (15, p. 328).

Rice (16) studied the orientation of plane figures in the perception of 226 children between the ages of two years and seven months and nine years and three months by means of drawing and discriminative perception tests. She found that orientation of plane figures as a factor in perception appears to rise rather suddenly between the ages of five and six years.

Apropos of size, Bühler (12) states that the capacity for appreciating sizes is developed to a high degree of perfection in the first three years. Children from two and a half to four years of age perceive size differences either at once or not at all; and only if the stimuli are simultaneously presented. Within certain limits adults conceive the sizes of objects independently of their relative distances. This has been found to be true, to a remarkable degree, for the perceptions of a two-year-old child, although it is naturally subject to the law of practice (12, pp. 153-154).

Jersild (13) says: "A young child is likely to make errors by judging objects in terms of their size rather than their form" (13, p. 237).

Koffka (10) and Stern (17) report that size plays a very insignificant rôle in the recognition of things during the first eight or nine months of life (10, p. 288; 17, p. 121).

Brunswick and Cruikshank (18) report that around four to five months of age, there seems to be a stage in the perceptual

development of the human infant at which there is but a relatively slight degree of size-constancy. At about six months a larger body far away is differentiated from a smaller one near at hand despite the equality of their retinal projective stimulus-size. This seems to indicate that there is a definite approach toward the establishment of size-constancy within the perceptual system of the human infant by the second half of the first year.

Concerning grouping Schroff (19) found that most of his subjects (six to fourteen years) were influenced by the factor of nearness of units [Wertheimer's (20) law of proximity of elements]. He also found that age differences were slight and hence concluded that experience does not play a part in perceptual grouping as such, but only in the concomitant meaning of forms.

Rush (21), studying visual grouping in relation to age, used 8,589 subjects, representing all years of schooling from the first grade through college. He found that the factors in visual grouping, arranged in the order of decreasing strength, are: (1) continuity, (2) similarity, (3) proximity, and (4) direction. He also found that age has a strong influence on the grouping, and on the absolute and relative effectiveness of each of the factors, thus indicating that "the grouping response is by no means so simple an effect of the external 'field forces' as has sometimes been supposed" (21, p. 94), and that experience has a genuine

influence on it.

In connection with the functional relationship between the units of the same form pattern, Romero's (22) experiment with eight Junior Nursery School children (thirty-eight to forty-seven months of age) shows that the three-year-old child is able to gain insight into the functional relationship between these units and, therefore, exhibits no emotional disturbances when a crucial change is introduced into this relationship.

There have been few experiments with children on "synthetic" or "masked" forms. While Crudden's (23) work primarily concerns symmetry, his technique, nevertheless, involved "abstracting" a familiar form within a context. His positive finding, that his primary school children were able to "abstract a known figure from a relatively unknown configuration" (23, p. 52) is substantiated by comparable adult experiments by Liang (24), Whiteside (25), etc.

In this experiment the color factor was deliberately kept a constant, since the consensus of opinion, despite some interesting conflict, is that hue variation, as a more primitive perceptual process, would "overwhelm" form discrimination, especially at the infant age level [Werner (26), Katz (27), Déscondres (28), Sagers (29), Bühler (12), Von Kuenburg (30), Tobie (31), Volkelt (32), Brian and Goodenough (33), Hetzer, Beaumont, and Wiehmeyer (34),

Vernon (11), Rabello (35), etc.]. These conclusions are, however, of obviously critical significance to this study in that they so emphatically imply form perception as a "higher" and ontogenetically later process than color, mass as such.

Some reference should be made here to experimental work on tactual perception of form, since (1) it is widely regarded as a more primitive and probably contributing type, (2) because it is obviously a natural factor in the spatial behavior of children. Volkelt (7), Révész (36), and Katz (37) have shown that the same forms may be about equally well discriminated tactually and visually by both adults and children. Révész stresses that the two phenomena are completely parallel in development, showing the same tendencies and obeying the same laws.

Aside from these experimental findings on the various sensory and spatial attributes as related to the genetic development of form there are a number of general statements and space perception theories from leading psychologists which are related to or dependent upon the concept of primitive form perception.

Hoffka (10) writes:

It is not the simplest of geometrical forms, but those biologically the most important, which are first evident in infantile perception. From her twenty-fifth day forward, Miss Shinn's niece took an interest in human faces, which in her second quarter-year she was able to distinguish as familiar and unfamiliar. To teach the child "simple figures" is possible only at a much later time [twelfth month], (10, p. 289).

Shinn (38) states:

From the beginning of the twelfth month, she (Miss Shinn's niece) proved able to distinguish with nicety small outline forms, as the letters of the alphabet,--at first perhaps an inch in size, on blocks or cards, but very soon anywhere that she could find them, in ordinary text..... That a child of 22 months could instantly grasp the distinction of ellipse and circle, while at the same time classing long and short oblongs together without difficulty, seems to me most noteworthy. The same cleverness in geometric perception was observable throughout the third year. It was merely visual, however, and did not include any comprehension of the numerical relations in geometric figures (38, pp. 172-3).

From these statements it is clear that Miss Shinn classifies geometric form discrimination as an ontogenetically late "higher" mental process.

Arlitt (39) states: "Correct perception of form appears to develop relatively late" (39, p. 131).

Curti (40) says: "In dealing with objects in everyday play, very little children give evidence of faulty perception of distance, form, and size" (40, p. 223).

Vernon (11) writes:

We have referred from time to time to the fact, first emphasized by the Gestalt psychologists, that the perceptions of young children may differ considerably from those of adults, and may resemble more closely those of animals, especially of the primates. Particularly are children likely to perceive the field as a series of undifferentiated meaningful wholes. Thus in some ways the configurational tendencies operate more strongly in them than in adults; children tend to ignore detail, and their perceptions are vague, fluid, inaccurate, and liable to modification in accordance with subjective tendencies (11, p. 178).

In describing the development of perception Koffka (10) divides the process into two distinct stages:

- (1) The configuration of things.
- (2) The configuration of causality.

The second stage transcends the first as soon as the child sees a thing, or some one of its characteristics, as an effect, and is thus led to ask after its cause (10, pp. 300-1).

Stern (17) divides the development of perception as follows:

- (1) "General condition of blended sensibility" (17, p. 102).

- (2) "It is no longer indistinct and shapeless like a veil of mist, but rather contains spots distinguished by a certain quality (color, noise, hardness), by certain boundary lines, by a sudden appearance and disappearance.... Yet the simple existence of such marked spots in the general sensorial condition does not yet mean any real perception.... Gradually they assume thus a character opposed to merely subjective experiences, they point outward to things--in short, they become perceptions. Only this process is a very gradual one" (17, pp. 103, 106).

- (3) "The singling out of objects from their surroundings becomes more distinct, whilst in the inner structure one feature is more emphasized and others unessential pushed back--in fact, it is really individual activity in its general course that first creates the "form"--"formative" activity indeed" (17, p. 106).

With more specific reference to space as such, Stern

classifies development in three successive stages.

(1) The development of "own space" perception. Here the individual body as a whole--the head at least--is the starting place.

(2) The development of "near space" perception. The principal organic contributors to this development are mouth, hand and eye, especially hand. The senses of smell and hearing take a secondary place in this development.

(3) The development of "distant space" perception. The "distant space" perception starts to develop after the first three months when convergence and accommodation for a distance of several meters begin. It is only really mastered when it is connected or translated into "near space," and this is done by the child's own power of motion (17, pp. 114-24).

Werner (26) repeatedly emphasizes the contrast between nature and primitive space perception. The perception of the young child, the primitive man, and lower animals all show the qualities of diffuseness, vagueness, lack of specific inter- and intra-relationship, wholeness or "homogeneity," from which specific relationships are only slowly abstracted.

Werner (41) essentially agrees with Stern (17) in his theory of space perception. His developmental periods are:

- (1) Primitive physiognomic and physiological stage,
- (2) Higher level of function, i.e., perceptual interpretation of size, form, distance, color, which develops

slowly, with its peak at 15 years.

(3) "Conceptual" stage.

Bühler (12) divides the development of space perception into the following stages:

(1) Mundraum (first three months of life)

(2) Greifraum (three to six months)

(3) Fernraum (from six months on)

He points out that vision has little to do with early stages of development of space perception. Like all leading psychologists, he stresses the importance of experimental knowledge in this field. Thus, he writes:

Aus allerhand Erfahrungen des täglichen Lebens geht hervor, dass das Kind schon im ersten Lebensjahr gewisse Dinge an ihrer Form wiedererkennt; eine für diese Frühzeit brauchbare Untersuchungsmethode aber ist noch nicht ausgebildet (12, p. 154).

Lewin (42) stresses the topological relations of objects in space perception and states that change of detail will alter perception of the whole.

Volkmann (7), while apparently somewhat surprised at the various discrimination performances (size, form, transposition, etc.) in his two-year old subjects, nevertheless stresses the "Gesamtkontur" of these perceptions. "Die Dominanz der übergreifenden Ganzheiten ist im Grundung des primitiven Seelenlebens."

Wheeler and Perkins (43) describe the development of space perception as follows: First, the infant's awareness of

space is general and undifferentiated, having to do merely with its extendedness or expansiveness. At the outset it is a space-frame, having no up or down, no right or left, no breadth versus depth. Objects within the field have no recognized position. Knowledge of right and left, up and down, here and there, specific size, form and location of objects, distance of objects from the child, and the movements of objects, all come about by expansion and individuation processes going on within this space-frame. The only way space relations can be learned is by proceeding from the whole to its parts (43, p. 143).

Finally, the fundamental importance of the ontogenetic approach to the basic problems of space perception is illustrated by Gottschallit's (44) statement, that the problem of primitive space perception is the nucleus problem of all psychological development (44, p. 147). Again he states that few experiments are so important as those which try to determine the visual space development of the child.

In view of these statements and the experimental findings reviewed earlier, there seem to exist at least three conflicting views with regard to genetic facts and theories of the factor of form discrimination in visual space perception.

(1) Are the finer capacities in form discrimination, i.e., specific geometric detail as opposed to "mass"

differences, present at very early age levels? Or are they, as so frequently labelled, an "advanced" form of mental activity which emerges "relatively late" from a more primitive, "diffuse" state? What is the bearing of such data on the nativistic and empirical concepts of space perception?

(2) How minute may these objective differences (sensory cues) be? Or conversely how easily may they be obscured by a "primitive" level of perception, "vague, fluid, inaccurate and liable to modification in accordance with subjective tendencies" (11, p. 178)? What is the genetic evidence for the "Law of Prägnanz" as stated by Wertheimer (20), Hoffke (10), Werner (26), etc.?

(3) Is the nature of the infant's discrimination of geometric form (1) sufficiently inexperienced, or (2), sufficiently "vague, diffuse and homogeneous" to be easily affected by changes in such collateral "topological," "geographical" space attributes as orientation, position, size, number, sequence, etc.?

To summarize the problem in more general form:

(1) Is genetic form discrimination a primitive, innate, immediate and relatively "absolute" process determined primarily by differences of cue in the sensory image (stressing sensory maturation and topological organization)?

(2) Is it a "derived" and therefore delayed process dependent primarily on the maturation of a "g" factor or some analogous capacity of perceiving the functional

relationships of contours (stressing central processes)?

(3) Has it in earlier stages essentially the qualitative and quantitative genetic differences so widely ascribed to it in psychological theories of space perception?

The present investigation is an attempt to contribute toward a solution of these conflicting views by systematic and intensive experimentation at early human age levels. It is fourfold in its purpose:

(1) To determine the nature and extent of geometric form discrimination in infants with special reference to the collateral factors of sequence, position, orientation, number, size, synthesis ("masking") and functional relationship.

(2) To study the efficacy of such discrimination as a cue in the various phases of the learning process, with special reference to simple habit formation, retention and recall, inhibition, individual differences, transfer, etc., in a relatively simple situation such as has been set up in the genetic psychology laboratory of the University of Michigan.

(3) To analyze quantitatively, for the first time, all those dynamic concomitants of a specific response which are so urgently stressed by contemporary theories of "integrative" or "whole" behavior [Gottschaldt (44), Werner (26), Neffke (10), etc.].

(4) To trace, by continuous longitudinal experimentation, as opposed to the sampling method, the finer phases of

chronological maturation as related to the foregoing processes.

THE EXPERIMENT

A. Preliminary Study

I. Purpose

The purpose of the preliminary study was to test out the practical feasibility of the experimental procedure at the infant level, since so much professional opinion was entirely skeptical of any results at these early age levels. In order to test at once "basic" individual limitations of the problem, a group of readily available negro infants of lower and middle socio-economic status and "normal" intelligence (Gesell score range: 1 to 3-) were utilized in the preliminary study. Since these results emerged in an orderly and comprehensive manner, entirely justifying the feasibility of problem and technique, they are recorded here as an integrally valuable part of the total experiment.

II. Apparatus

The apparatus consisted of:

- a. An experimental cubicle walled with one-way vision screens so that the subject in the crib within could not see the observers without, while the latter could easily obtain a full view from any angle of the subject's behavior (see Figure 1 on page 21).

Figure 1 - Form Discrimination Apparatus



In the foreground is the wire recording apparatus. Directly behind it is the one-way vision cubicle, inside of which are the experimental cell, the experimental form, and two form blocks.

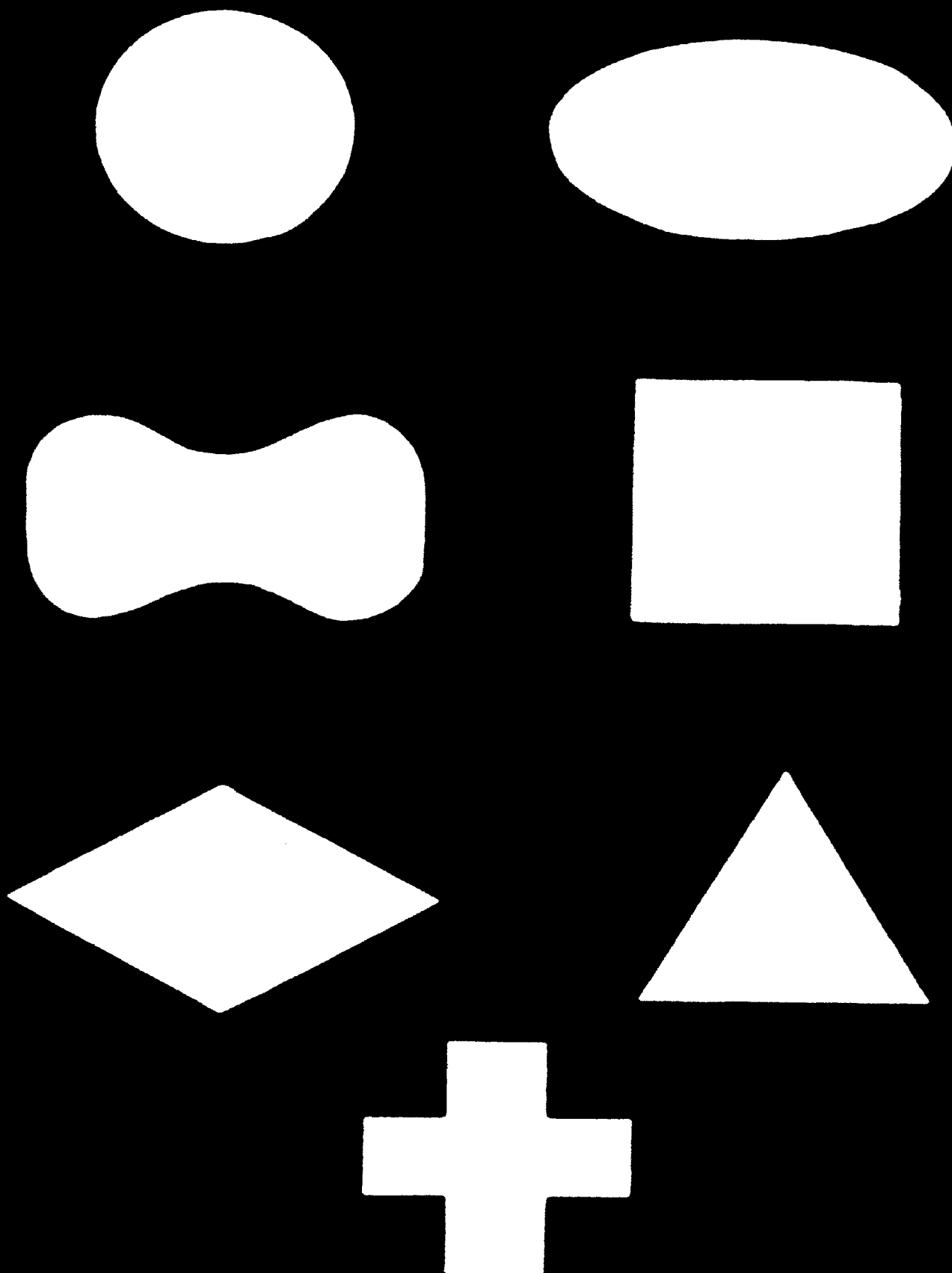
b. A regular hospital crib, on one end of the railing of which was placed a gray oblong board, 89 cm. by 50.7 cm. by 2 cm. in dimension. Thirty-five and seven tenths centimeters from the left and the right sides of the board, and 33.2 cm. from the farther and 15.7 cm. from the nearer edge in the longitudinal direction were drilled two small circular holes, 1.6 cm. in diameter and 15.1 cm. from each other. (The position of the two circular holes is described with reference to the position of the subject.) Directly beneath these holes were two metal devices by means of which the stimulus blocks could be fastened to the board at will. The subject was seated immediately in front of the board with the blocks within easy natural reach and grasp. Between the infant and the stimulus blocks was a one-way vision wire screen which was suspended from the top rails of the experimental vehicle. By means of an articulated lever this screen could be swung back and forth and adjusted at will, thus covering or uncovering the stimuli according to the nature of the experimental trial (see figure 1 on page 21).

c. A series of geometric form blocks, of equivalent area or radius, consisting of circles, ovals, double circles, squares, diamonds, triangles, and crosses. All these blocks were given several coats of bright yellow enamel paint with a glossy finish. The forms represented gradual but nevertheless definite increases in "difference" of optical image, i.e., degree and number of "angle" cues (see Figure 2 on page 23). All

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Form Books Used
in the Preliminary Study

- All Blobs One Half Inch Thick.



blocks were kept continuously sterilized by means of 0.1 % HgCl_2 . As a means of reinforcing the manipulative motivation by additional gustatory motivation, the blocks were immersed in a strong saccharine solution and dried before each experimental sitting.

d. A time recording apparatus, consisting principally of two electrically operated pens. One of these pens was attached to an electric metronome which beat every half-second. The other was connected with a key by means of which the various data could be accurately recorded. A stop watch was simultaneously used to double check all time records (see Figure 1 on page 21).

III. Method of Procedure

a. Preliminary Procedure

Prior to admission to the genetic psychology laboratory, the subject was given a very thorough pediatric examination by a member of the University Hospital staff. Then he was given a Gesell (45) test, which was repeated every month thereafter in order to obtain a general picture of the subject's development, both mental and physical. Specific socio-economic and general hereditary background were as carefully ascertained as possible, through home visits and case history records.

b. Experimental Procedure

The subject was seated in the experimental crib in front of the experimental board described above. After an adequate

period of general adaptation, usually unexpectedly brief, a signal was given by the experimenter, whereupon the assistant started the time recording apparatus and swung back the screen at the same time, thus exposing to the subject two bright yellow blocks, a circle and a cross. (see Figure 3 on page 26). At the time of the presentation, both blocks were in position on the experimental board. The circle (positive stimulus) was not fastened to the board, while the cross (negative stimulus) was; therefore, the subject was unable to pick up the latter, whereas the former would yield to his grasp and would taste sweet if put into his mouth. Careful qualitative and quantitative records were kept concerning visual regard, selection (i.e., the block reached for), reaction time, handedness, type and direction of grasp, selective or "dynamic" behavior of the subject before and after the correct response, and the affective attitude (including vocalization) accompanying the reaction. As soon as the subject succeeded in picking up or at least definitely dislodging the positive stimulus (circle), the screen was swung forward to its original position and the trial was considered completed. During the succeeding trials, the relative position of the blocks was varied in a pre-arranged random order so that the subject might not get a cue from the positional factor to aid him in the discrimination. Care was also taken to see that there was no difference in time between the trials in which the series

called for a change in the position of the stimuli and the trials in which the stimuli remained in the same position. Nine correct choices out of ten successive trials were arbitrarily set up as the standard for perfect discrimination performance.

Due to the very young age levels of the subjects, no attempt was made to limit the number of trials carried out during each sitting. The infant was allowed to continue in his experiment as long as his interest held. Each child was brought to the laboratory at regular bi-weekly intervals.

When the subject had succeeded in meeting the standard for perfect discrimination, the cross (negative stimulus) was replaced by a triangle and the experiment repeated. This was continued until the subject had learned to choose the circle as against the cross, triangle, diamond, square, double circle and oval. This completed the Series I Experiment.

In Series II the procedure differed from the previous series only in one respect, i.e., the preceding experimental condition was reversed so that now the circle was presented as the negative stimulus and each of the other forms in turn became a positive stimulus. This was done to study the possible types of inhibition and the subject's ability to recondition a habit firmly established through numerous repetitions in a carefully controlled environment.

IV. Subjects

Fourteen subjects, ranging in age from six to twelve

months, participated in this preliminary study which lasted seven months. All were normal infants both physically and mentally. Of the total 14 subjects only four concluded the entire experiment; therefore, those data only are included here.

V. Results

Altogether, 2,549 trials were carried out by those four subjects who completed the entire study and who constituted the Regular Preliminary Group. These data are presented here, under the following headings: (1) Number of Trials, (2) Percentage of Success, (3) Reaction Time, (4) Oral Behavior, (5) Vocalization, and (6) Affective Concomitant. The records include three more headings, i.e., Handedness, Manipulation, and Total Sensori-motor Reaction to the stimulus pattern, leading to and including the final correct movement. Because of the very large mass of data for the limited space available, these last three items are omitted from our present paper and referred to a later publication.

In all of the tables presenting data on the learning of form combinations by the preliminary cases, Form 1= circle versus cross, Form 2= circle versus triangle, Form 3= circle versus diamond, Form 4= circle versus square, Form 5= circle versus double circle and Form 6= circle versus oval. In the same tables the ages of the subjects are expressed in terms

of weeks and days. Thus, 28:2 means 28 weeks and 2 days.

a. Number of Trials

Figure 4 (see page 30) shows that while the total number of trials required by each subject in the learning of the entire experiment do not differ markedly from one another, the relative proportions of the numbers of trials spent in mastering Series I and Series II reveal two distinct types; namely, Cases Alpha and Delta found Series II easier than Series I, whereas the reverse seemed to be true with cases Beta and Gamma.

Tables 1 and 2 (see pages 31 and 32) show clearly the marked individual differences in the ability to master each of the twelve different stimulus situations.

b. Percentage of Success

Percentage of success is obtained by dividing the number of correct trials by the total number of trials.

Figure 5 (see page 33) shows relatively slight variations when compared with Figure 4 (see page 30). Furthermore, there seems to be a general trend for the percentages to be lower for Series II than for Series I.

Tables 3 and 4 (see pages 34 and 35) show two important points: (1) with two exceptions all the scores are above chance (i.e., 50%); (2) individual differences are conspicuous even though not so marked as in Tables 1 and 2 (see pages 31 and 32).

FIGURE 4 Total Number of Trials
 required by each subject in the regular
 preliminary group in the Learning of Series I & II

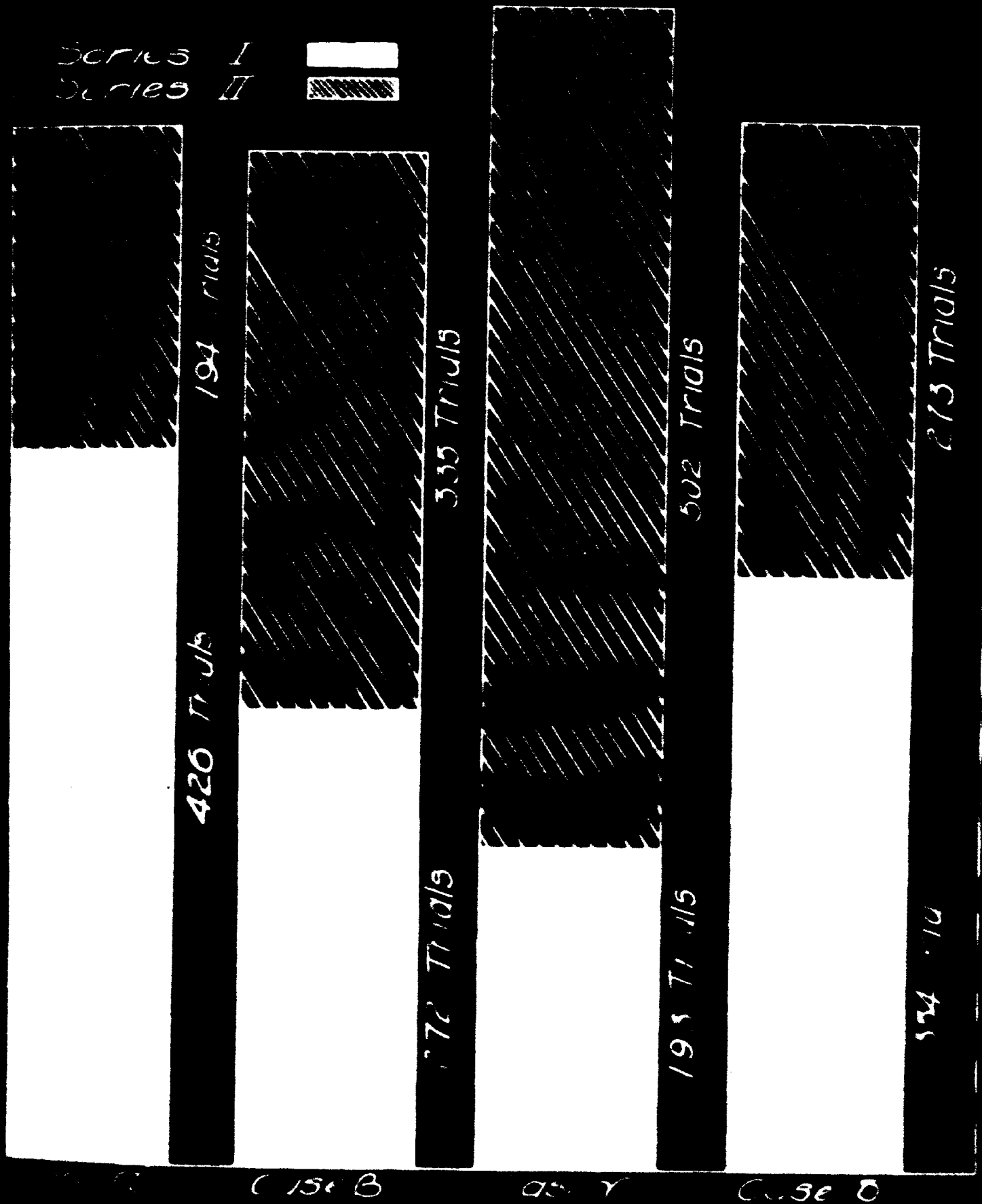


Table 1

Total Number of Trials Required by Each Subject in the Regular Preliminary Group

in the Learning of Each Form in Series I

Case Number	Ages and Trials	Form 1	Form 2	Form 3	Form 4	Form 5	Form 6
Alpha	Age	29:2 to 30:6	30:5 to 32:4	33:2 to 35	35 to 35:3	35:3 to 42:4	42:4 to 50:2
	Trials	50	53	71	20	82	170
Beta	Age	39:2 to 42:6	42:6 to 45:2	45:5 to 46:3	46:3 to 51:6	51:6 to 52:2	52:2 to 52:5
	Trials	70	37	25	73	46	21
Gamma	Age	41:3 to 46:2	46:2 to 48:2	48:2 to 49	49	49:6 to 50:2	49:6 to 50:2
	Trials	41	49	22	16	10	55
Delta	Age	41 to 49	49 to 54	54 to 54:2	55:2 to 58	59:1 to 61:1	61:1 to 61:3
	Trials	110	53	13	32	107	39

Table 2

Total Number of Trials Required by Each Subject in the Regular Preliminary Group

in the Learning of Each Form in Series II

Case Number	Ages and Trials	Form 1	Form 2	Form 3	Form 4	Form 5	Form 6
Alpha	Age	50:4 to 51:2	51:4 to 52:4	52:6	53:2	53:2	53:5
	Trials	39	87	30	16	10	12
Beta	Age	52:5 to 55:3	58:5	59 to 59:5	59:5 to 60:3	60:3 to 60:5	62:3 to 64:3
	Trials	109	11	69	24	46	76
Gamma	Age	53 to 53:3	54 to 59:1	59:1 to 59:6	59:6 to 60:3	60:6 to 61:1	61:1 to 69:4
	Trials	32	94	24	76	24	262
Delta	Age	62:1 to 64	64 to 68	68 to 68:2	68:2 to 69	69:2 to 70:4	70:4
	Trials	53	71	26	37	76	10

FIGURE 5. Percentages of Success
Obtained by Each Subject in the Regular
Preliminary Group in the Learning of Series
I-II.

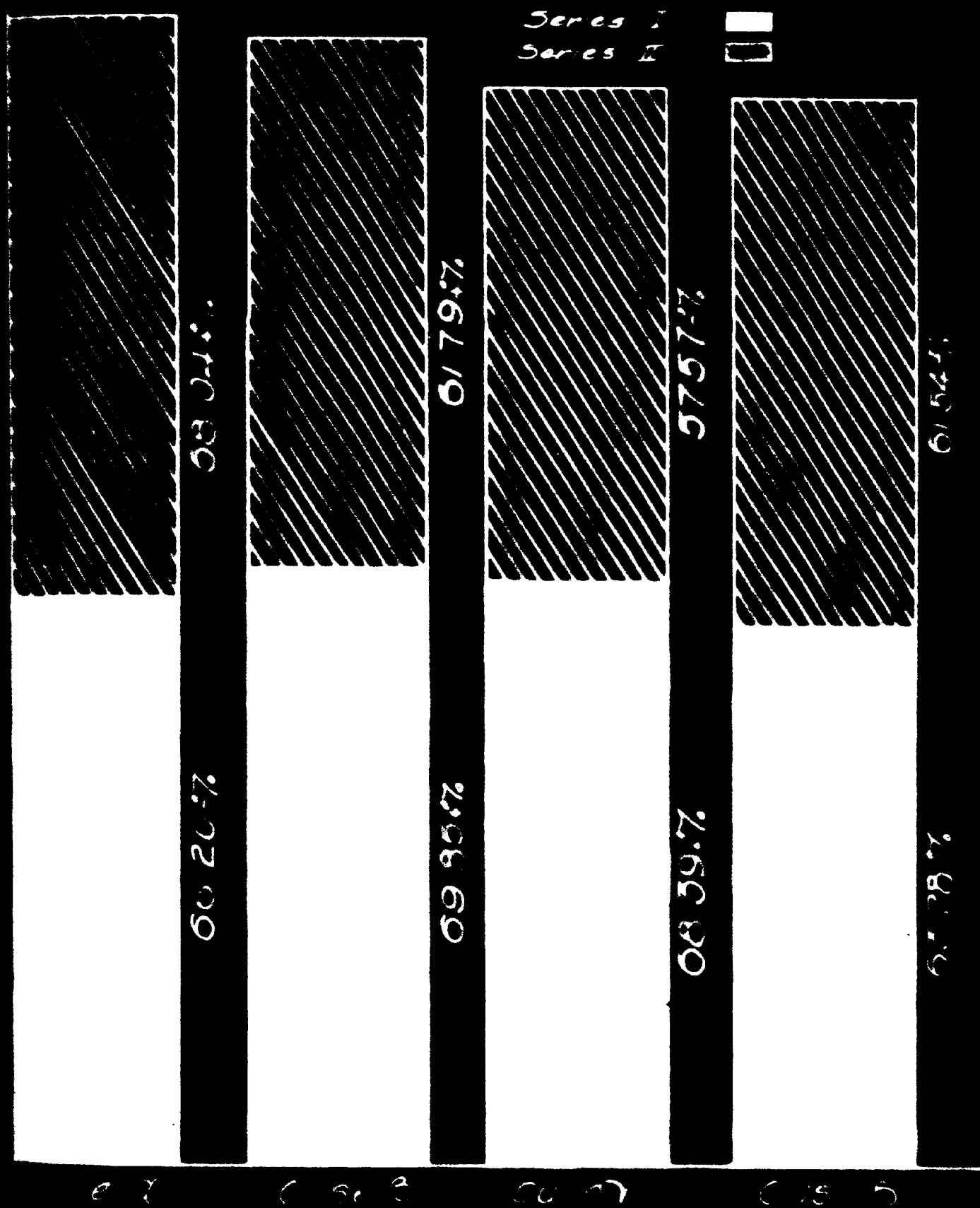


Table 3
Percentage of Success Obtained by Each Subject in the Regular Preliminary Group

In the Learning of Each Form in Series I

Case Number	Ages and Percentages	Form 1	Form 2	Form 3	Form 4	Form 5	Form 6
Alpha	Age	29:2 to 30:6	30:6 to 32:4	33:2 to 35	36 to 36:3	36:3 to 42:4	42:4 to 50:2
	Percentage	76 %	72.73-%	69.01-%	76 %	67.32-%	64.12-%
Beta	Age	39:2 to 42:6	42:6 to 46:2	46:6 to 46:3	46:3 to 51:6	51:6 to 52:2	52:2 to 52:6
	Percentage	72.96-%	76.38-%	60 %	68.42-%	65.22-%	71.43-%
Gamma	Age	41:3 to 46:2	46:2 to 48:2	48:2 to 49	49	49:6 to 50:2	49:6 to 50:2
	Percentage	68.29-%	67.35-%	72.73-%	87.50 %	90.00 %	58.18-%
Delta	Age	41 to 49	49 to 54	54 to 54:2	56:2 to 58	59:1 to 61:1	61:1 to 61:3
	Percentage	67.27-%	66.04-%	69.23-%	68.75 %	66.14-%	64.10-%

Table 4
Percentage of Success Obtained by Each Subject in the Regular Preliminary Group
in the Learning of Each Form in Series II

Case Number	Ages and Percentages	Form 1	Form 2	Form 3	Form 4	Form 5	Form 6
Alpha	Age	50:4 to 51:2	51:4 to 52:4	52:6	53:7	53:2	53:5
	Percentage	66.67-%	60.92-%	73.33-%	81.25-%	90-%	75-%
Beta	Age	52:5 to 53:3	53:5	53 to 54:5	53:5 to 60:3	60:3 to 60:5	62:3 to 64:3
	Percentage	57.10-%	61.92-%	66.67-%	75.17-%	71.74-%	48.68-%
Gamma	Age	53 to 53:3	54 to 54:1	53:1 to 59:6	59:6 to 60:3	60:6 to 61:1	61:1 to 69:4
	Percentage	40.63-%	64.86-%	73.17-%	65.79-%	75.00-%	60.79-%
Delta	Age	62:4 to 64	64 to 68	68 to 68:2	68:2 to 69	69:2 to 70:4	70:4
	Percentage	58.49-%	57.75-%	76.92-%	75.63-%	81.32-%	90.00-%

c. Reaction Time

Average reaction time per trial is obtained by dividing total reaction time by total number of trials.

Figure 6 (see page 37) shows the wide individual differences in the amount of time required by each subject to master the entire experiment. However, there is a similarity between Cases Beta and Gamma on the one hand, and Cases Alpha and Delta on the other, in the relative proportions of time spent in the learning of Series I and II. These similarities imply that reaction time is positively correlated with the number of trials as related to Series I and Series II.

Tables 5, 6, 7, and 8 (see pages 38, 39, 40, and 41), like Tables 1 and 2 (see pages 31 and 32), show the wide individual differences in the length of time required for the learning of the 12 different stimulus patterns.

d. Oral Behavior

by oral behavior is meant all the activities, exclusive of vocalization, of the mouth with reference to the stimulus blocks. The significance of oral behavior is widely emphasized by genetic psychologists on the basis of three general hypotheses:

1. Stern (17), Kévész (36), and others include it as a genetically elementary form of tactual manipulation in which the sensitive tactual reactions of the lips and mouth at first combine with, and are only very gradually superseded by, those of the hands and fingers. This universally long period of "mouthing" objects in infancy is thus interpreted as a form of tactual space experience rather than purely gustatory or a "sensitive zone" satisfaction (in the Freudian sense).
2. Oral activity is also widely regarded as a diagnostic overflow phase of behavior of two types, (a) chronic nervousness of a general constitutional type.

FIGURE 6

Total Reaction Time
Required by Each Subject in the Regular
Preliminary Group in the Learning of Series I & II

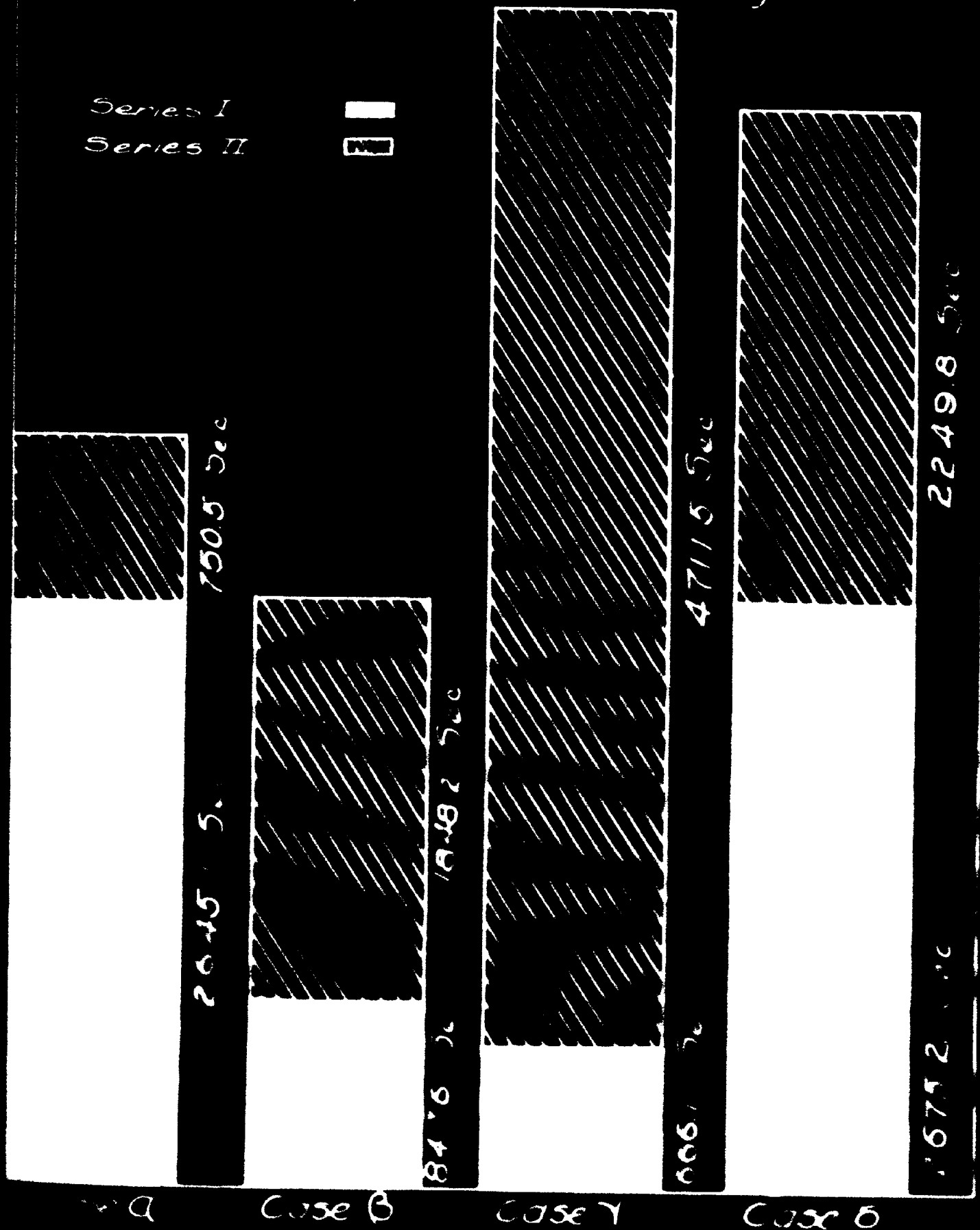


Table 6

Total Reaction Times Required by Each Subject in the Regular Preliminary Group

In the Learning of Each Form in Series I

Case Number	Area and Time	Form 1	Form 2	Form 3	Form 4	Form 5	Form 6
Alpha	Area	29:2 to 30:5	30:5 to 32:4	33:2 to 36	36 to 36:3	36:3 to 42:4	42:4 to 50:2
	Time	468.6	61.2	665.1	112.0	229.2	1189.1
Beta	Area	39:2 to 42:6	42:6 to 45:2	45:5 to 46:3	46:3 to 51:6	51:6 to 62:2	62:2 to 62:6
	Time	222.4	92.7	66.4	243.4	172.3	61.4
Gamma	Area	41:3 to 46:2	46:2 to 48:2	48:2 to 49	49	49:6 to 50:2	49:6 to 50:2
	Time	252.2	143.9	114.1	27.2	16.7	132.0
Delta	Area	41 to 49	49 to 54	54 to 54:2	55:2 to 58	59:1 to 61:1	61:1 to 61:3
	Time	390.2	437.6	65.0	308.8	1052.6	417.1

*Reaction time in seconds.

Table 6

Total Reaction Time* Required by Each Subject in the Regular Preliminary Group
in the Learning of Each Form in Series II

Case Number	Ages and Time	Form 1	Form 2	Form 3	Form 4	Form 5	Form 6
Alpha	Age	50:4 to 51:2	51:4 to 52:4	52:6	53:2	53:2	53:6
	Time	112.7	267.6	160.6	73.2	40.6	96.1
Beta	Age	52:6 to 58:3	58:6	59 to 59:6	59:6 to 60:3	60:3 to 60:6	62:3 to 64:3
	Time	839.7	44.0	403.3	56.8	146.7	367.7
Gamma	Age	53 to 53:3	54 to 59:1	59:1 to 59:6	59:6 to 60:3	60:6 to 61:1	61:1 to 69:4
	Time	74.80	487.8	39.6	678.4	905.2	2525.7
Delta	Age	62:4 to 64	64 to 68	68 to 68:2	68:2 to 69	69:2 to 70:4	70:4
	Time	646.6	486.7	123.0	174.0	846.1	75.4

*Reaction time in seconds.

Table 7

Average Reaction Time* per Trial Required by Each Subject in the Regular Preliminary Group
in the Learning of Each Form in Series I

Case Number	Age and Time	Form 1	Form 2	Form 3	Form 4	Form 5	Form 6
Alpha	Age	29:2 to 30:5	30:5 to 32:4	33:2 to 35	35 to 35:3	35:3 to 42:4	42:4 to 50:2
	Time	9.37	2.46+	7.90-	5.6	2.80-	6.99+
Beta	Age	39:2 to 42:6	42:6 to 45:2	45:5 to 46:3	46:3 to 51:6	51:6 to 52:2	52:2 to 52:5
	Time	3.16-	2.24-	2.62-	3.33+	3.75-	2.92+
Gamma	Age	41:3 to 46:2	46:2 to 48:2	48:2 to 49	49	49:6 to 50:2	49:6 to 50:2
	Time	5.66+	2.94-	5.19-	1.70	1.67	2.40
Delta	Age	41 to 49	49 to 54	54 to 54:2	55:2 to 58	59:1 to 61:1	61:1 to 61:3
	Time	3.55-	8.25+	5.31-	9.65	9.84-	10.69+

*Reaction time in seconds.

Table 8

Average Reaction Time per Trial Required by Each Subject in the Regular Preliminary Group

in the Learning of Each Form in Series II

Case Number	Age and Time	Form 1	Form 2	Form 3	Form 4	Form 5	Form 6
Alpha	Age	50:4 to 51:2	51:4 to 52:4	52:6	53:2	53:2	53:6
	Time	2.89-	3.07+	5.36	4.58-	4.05	8.01-
Beta	Age	52:5 to 58:3	58:5	59 to 59:6	59:5 to 60:3	60:3 to 60:5	62:3 to 64:3
	Time	7.70+	4.0	5.84+	2.37-	3.19-	4.71-
Gamma	Age	53 to 53:3	54 to 59:1	59:1 to 59:6	59:6 to 60:3	60:6 to 61:1	61:1 to 69:4
	Time	2.34-	6.19-	1.65	8.93-	37.72-	10.02+
Delta	Age	62:4 to 64	64 to 68	68 to 68:2	68:2 to 69	69:2 to 70:4	70:4
	Time	10.29+	6.84+	4.73+	4.70+	11.13+	7.54

*Reaction time in seconds.

(b) nervousness normally produced by and in proportion to the difficulties within a problem task, especially where fine discrimination may tax perceptual equipment.

3. -It is also widely regarded as being universal evidence of the mass-activity pattern of normal behavior characteristic of early infancy [Lewin 1946].

Figure 7 (see page 43) shows: (1) the very great individual differences in the amount of oral activity during the entire experiment, and (2) the relatively close correspondence among the results of Series I as against the wide scatter of the data in Series II.

e. Vocalization

As with the general type of oral activity discussed earlier, so vocalization is likewise widely regarded by genetic psychologists as an important diagnostic clue to behavior processes. For example, Gesell [48], and Kuhler [18] include it as an item in their developmental tests. Bajans [47, 48] makes it one of her main criteria in analyzing distances as a spatial "vector" in infant reactions to a specific goal. Hellermann [3, 4] goes still further in regarding it as a specific aid in form discrimination. All observers agree that it is at least an important clue to the emotional character of the situation.

Figure 8 (see page 44, on vi), with one exception (i.e., Series I of base lemma), reveals uniformity among the members of the Regular Preliminary Group in the percentage of trials in which vocalization occurred. It further reveals a general trend toward more vocalization in Series II as compared to Series I. However, a more detailed analysis of the data for each form shows that the amount of vocalization observed is not correlated either positively or negatively with any specific form pattern in

GUR 7
 In which the behavior of the series is
 determined by the Regular Preliminary
 Group of the Learning of Series I II

Series I 
 Series II 

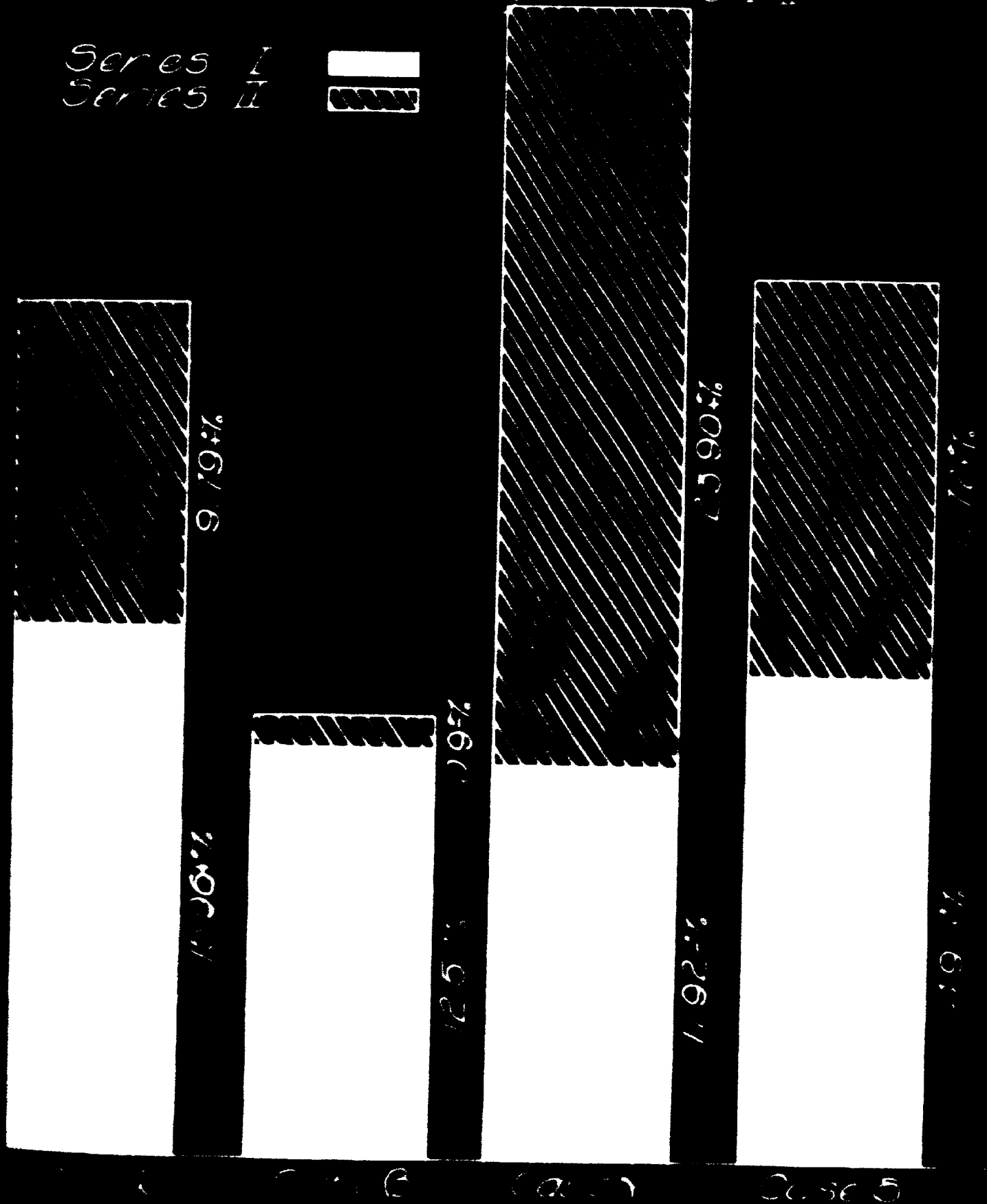
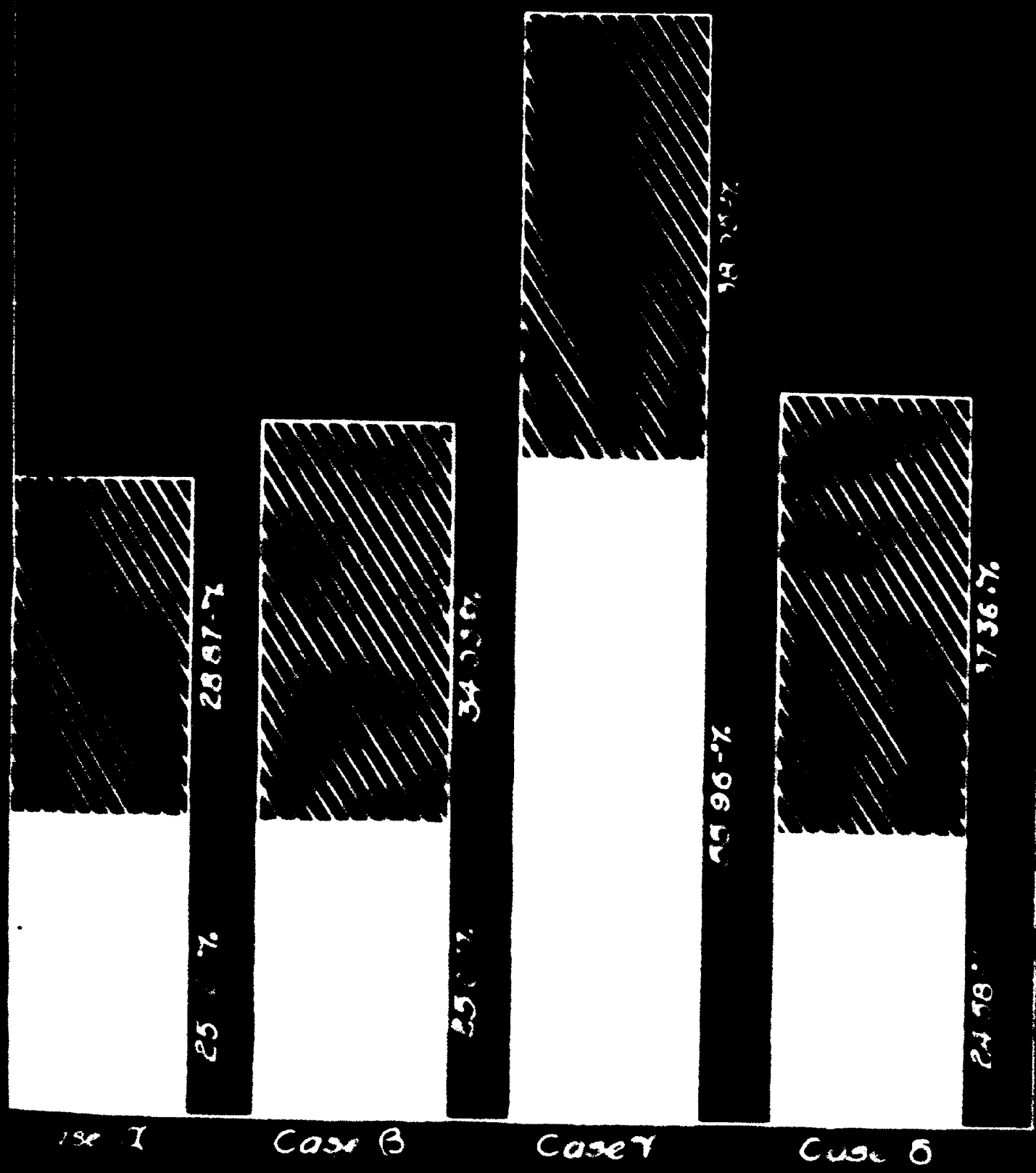


Figure 8. Comparison of the
 results of the test of the effect of the
 degree of the negativity of the Group
 membership of Series I II

Series I 
 Series II 



either series.

f. Affective Concomitant

The term "affective concomitant" seems self-explanatory both in meaning and importance. For convenience, data are quantitatively classified in five orders of decreasing pleasantness.

Figures 9 and 10 (see pages 46 and 47) show the striking resemblance among the subjects in the relative expression of affective concomitant. In decreasing frequency occur pleasant, unpleasant, very pleasant, neutral, and very unpleasant responses.

Further analysis shows that there is no consistent positive correlation between different aspects of affective concomitant and total number of trials required, percentage of success obtained, or total amount of reaction time spent in the learning of any specific form or series.

VI. Tentative Conclusions

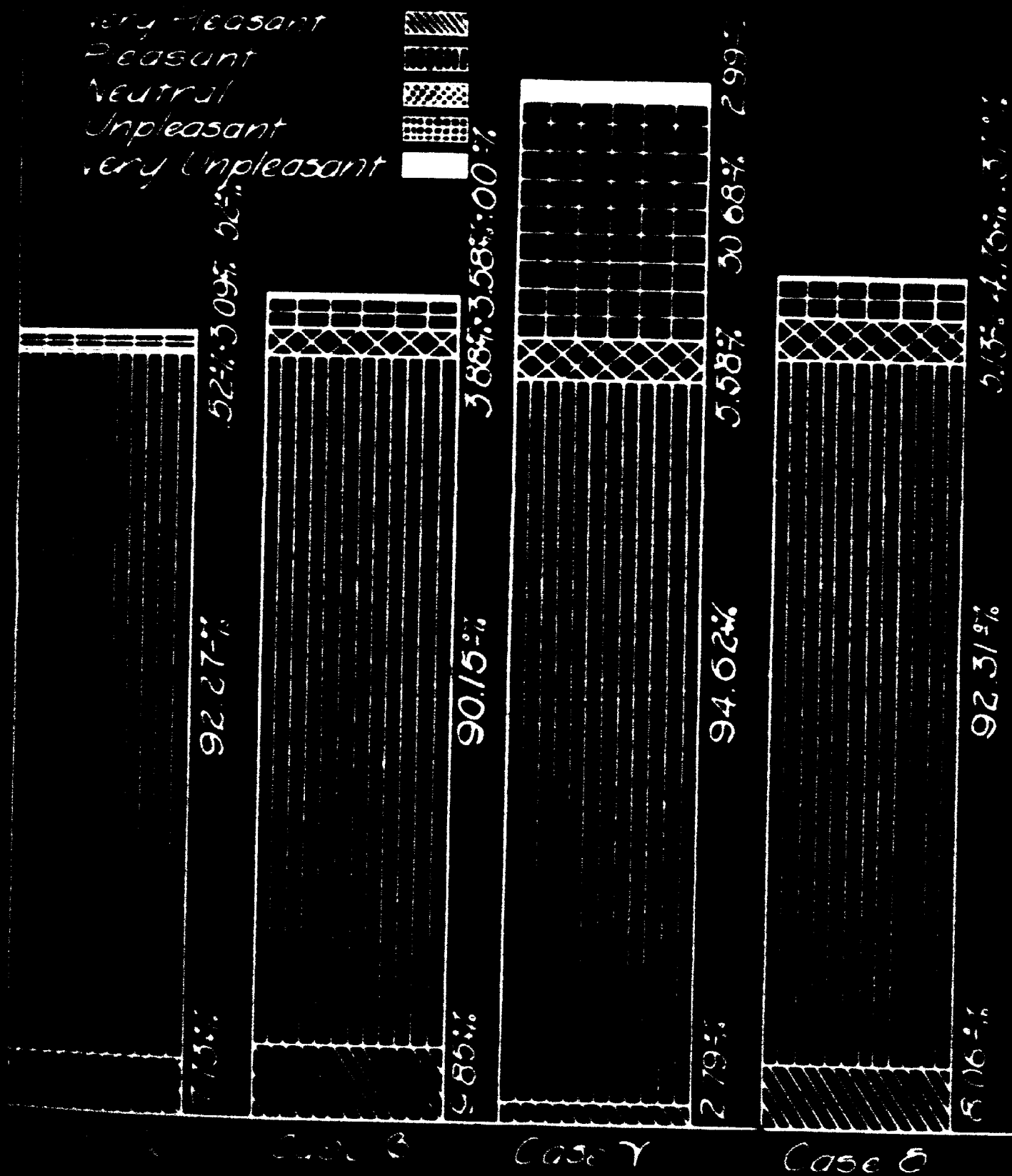
From the above results of the preliminary experiment the following tentative conclusions have been reached:

a. All available evidence seems to indicate that the human infant is able to discriminate between simple geometric forms not later than twenty-nine weeks and two days, the minimal age for the preliminary group.

b. At this age level the human infant is also capable of using form discrimination as a learning cue in a "rigid" experimental situation involving a definite positive choice



FIGURE 10. Percentage of Total Number of Items Aspects of Affective Comfort were Observed in Each Subject in the Regular Preliminary Group in the 1st Year of Series II



of one block as against any other.

c. Sudden reversal of experimental condition in Series II causes both temporary inhibition, or confusion in approach-and-choice behavior, and temporary change in affective concomitant on the part of the subject. However, such disturbance very soon subsides, and the infant then shows very definite signs of his adaptive ability to recondition the deeply-rooted habit of choice and avoidance.

d. Individual differences are marked, both in the infants' ability to use form discrimination as a learning cue in the selective response to different geometric patterns, and in the speed and effectiveness with which they recondition a given established habit.

e. Individual differences in all the "dynamic" aspects of discrimination and learning processes are marked. But in general, all subjects show a surprising elasticity in adaptation to the tedious demands of the experiment.

Viewed as a whole, these "longitudinal" data seem to indicate the value of the experiment as a new genetic contribution to (1) the problems of human space perception, (2) the nature of human learning, and (3) the validity of a rigid experimental technique at the infancy age levels.

B. Main Experiment

I. Series I - V Inclusive

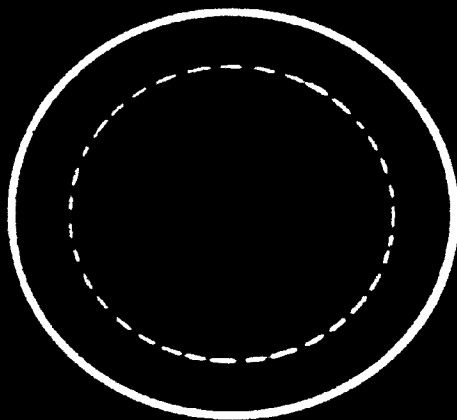
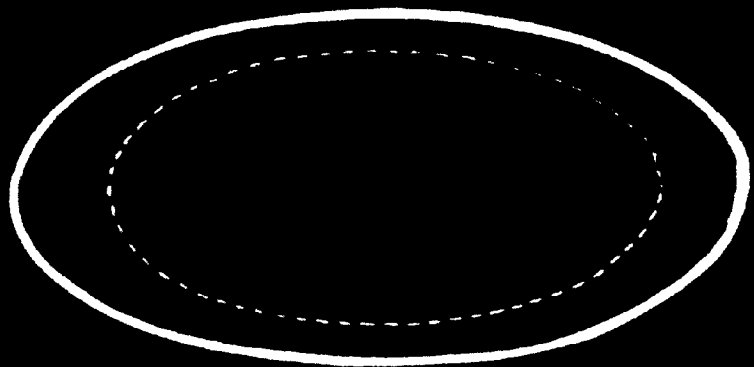
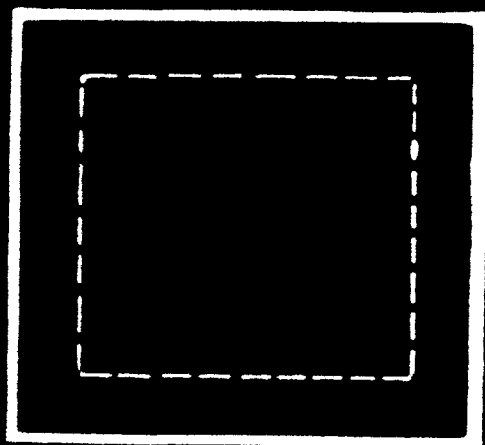
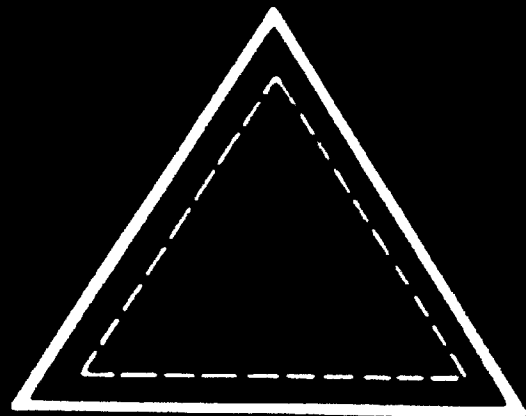
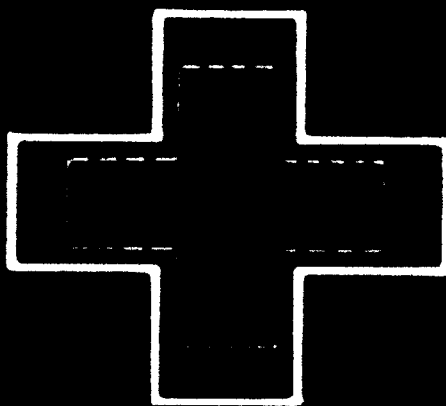
a. Apparatus

1. The one-way vision experimental cubicle (see A, II, a on page 30).

2. The experimental board and crib. (For description see A, II, b on page 22.) The only modification introduced was that three additional circular holes of the same diameter were drilled in the board. Together with the original two, these holes formed a semicircle with the concave side facing the subject. They were equidistant from the infant as well as from one another, and were 27.5 cm. from the left and right sides of the experimental board and 31.5 - 35.5 cm. from the farther, and 16.5 - 18.5 cm. from the nearer edge in the longitudinal direction. (The position of the five circular holes in relation to the experimental board is described with reference to the position of the subject.) During the experiment, any of these holes not covered by the form blocks were stopped with thin cardboard disks painted with the same gray paint used for the experimental board so that they were rendered invisible.

3. A series of yellow geometric form blocks, standard size and large size, consisting of circles, ovals, squares, triangles and so on (see also figure 11 on page 22; for further description see A, II, c on pages 22-4).

FIGURE 11 Form Blocks Used in Series III Experiment (Showing Relative Size)
 Dotted Lines indicate the sizes of Standard Blocks.
 Solid Lines indicate the sizes of Large Blocks
 (Each Full Size) * All blocks are half inch thick



4. The time recording apparatus (see A, II, d on page 24).

b. Method of Procedure

1. Preliminary Procedure

Pediatric examinations, Gesell (45) tests, case histories, etc. (for description see A, III, e on page 24).

2. Experimental Procedure

This part of the experiment consisted of five series. Series I ("Forward Learning") was the same as the corresponding series in the preliminary study (see pages 24-27) with three exceptions:

(a) Each subject was brought to the laboratory three times a week at regular intervals, instead of twice a week.

(b) As a way of expediting more intra-series variations the length of the series was shortened by omitting the double-circle and diamond. Thus only four form combinations were left to be learned. These were:

- | | |
|--------|------------------------|
| Form 1 | Circle versus Cross |
| Form 2 | Circle versus Triangle |
| Form 3 | Circle versus Square |
| Form 4 | Circle versus Oval |

(c) Eight, instead of nine, correct choices out of ten successive trials were set up as the standard for perfect discrimination performance.

In the light of the preliminary study Series I seemed a

little too long and a standard of nine out of ten trials unnecessarily high. This was especially true for subjects of less than one year because of the brief and shifting attention, the lack of fine motor co-ordination, and the rapid fatigue and loss of interest in any form of activity lasting for a relatively long period of time.

The same general procedure for Series I was used in the next three series of experiments. Each contained, however, a specific modification, designed to test a specific phase of the general problem. In Series II "Change in Spatial Orientation of Negative Stimuli", all the negative blocks were turned a certain number of degrees to the right prior to the presentation: cross and square, 45° ; oval, 90° ; and triangle, 180° . This was to determine whether or not the subject used absolute spatial orientation as a cue. In Series III "Change in Relative Size", the relative size of both the positive and negative stimuli was varied in order to see if size might play a critical part in the form discrimination of a human infant. In Series IV "Increase in Number", the number of blocks presented simultaneously was increased from two to three, to four, and finally to five. In this last series, for the three-block situation, the standard for perfect discrimination performance was seven correct choices out of ten successive trials; for the four-block situation, six out of ten; and for the five-block situation, five out of ten. This was done to

offset partially a disproportionate increase in the difficulty of the discrimination brought about by the arithmetical increase in the number of the blocks simultaneously presented.

This series was to determine whether or not increase in the number of stimuli (i.e., complexity of the total visual pattern, or "field organization") rendered the task of discrimination more difficult for the child; or, in terms of Gestalt theory, whether this new pattern, altered in "Komplexqualitäten" and Ganzqualitäten" and, therefore, in "Gestaltqualitäten," will significantly alter the discrimination reaction and, therefore, the learning of the infant. In all these last three series a brief review of what the subject had learned in Series I preceded the experiment proper.¹ This was done not only to check the permanency of the subject's habits, as established in Series I, but also to make certain that in case of failure, it was not due to the fact that he had forgotten his original learning, but rather that he had been relying heavily on some particular spatial cue or combination of cues.

In Series V ("Backward Learning") the procedure was the same as in the previous series except in one respect, i.e.,

¹In all the review experiments (known as Series II Standard, Series III Standard, and Series IV Standard) the criterion for perfect discrimination performance was either four correct choices out of five successive trials--if the subject fulfilled the requirement during the first five trials--or eight out of ten. This alternative was introduced to shorten the review sections of the experiment.

the preceding experimental condition was reversed so that now the circle became the negative stimulus and each of the other forms a positive stimulus. This was done to study (1) the qualitative and quantitative aspects of readjustment, inhibition, etc., as conceived by the Conditioned Reflex School; and (2) to find evidence for or against "abstraction" at this age level in the sense of "insight," into the transfer of functional relationship between two geometric forms.

As soon as the subject had learned a given form combination in Series V, the positive stimulus (cross, triangle, square, or oval) was turned a certain number of degrees to the right (cross and square 45°; oval, 90°; and triangle, 180°). This section of the experiment, known as Series V Modified, was designed to determine whether or not change in the spatial orientation of the positive form (cf. Series II on page 52) would affect the discrimination performance of the subject. Opinion of this factor is about equally divided, between those who believe that young children excel adults in perceiving form per se as an "absolute," and those who assert that because of the "diffuse wholeness" of early spatial experience even a slight change in orientation will confuse or inhibit correct discrimination.

This section of the experiment had, as criterion for success, either four correct choices out of five successive trials--if the subject fulfilled the requirement during the first five trials--or eight out of ten. This alternative was

introduced to prevent the unnecessary prolongation of Series V for those subjects who gave convincing proof of being unaffected by the change in the spatial orientation of the positive stimulus. (For summary see Figure 12 on page 56.)

c. Subjects

Over fifty infants, ranging in age from six to twelve months, selected at random from high, medium and low socio-economic status, and including both the white and negro races, participated in the main study, which lasted fourteen months. Unfortunately, for reasons of illness, change of residence, etc., only twenty-six infants gave quantitatively complete (i.e., longitudinal) data. With the exception of Case F, who was, as shown by a sequence of Gesell (45) tests, definitely immature both posturally and manipulatively, all the subjects were normal or supernormal children, both in their mental and physical development. Case F was continued in order to suggest such specific behavior deviations as might later be used in setting up a similar experiment for immature and retarded infants.

For the purpose of comparing the relative difficulty of the four different stimulus patterns in each series from the standpoint of form discrimination, the twenty-six subjects were evenly divided into two sub-groups. Sub-group I learned to discriminate forms in an ascending order of difficulty; i.e., from the most dissimilar in geometric

FIG 12 GENERAL PLAN FOR SERIES I-V INCLUSIVE

Series Form Stimulus		Series Form Stimulus		Series Form Stimulus		Series Form Stimulus			
Number	No. Pattern	Criterion	Number	No. Pattern	Criterion	Number	No. Pattern		
I	1	● + 8 Correct	III	IS	● + For all 5s 4 Correct	IV	BM	● + ▲ of 10 Successive Trials	
	2	● ▲ out of 10		IM	● + Out of 5		Continued	CS4	● For Each of 3M's, see Footnote Below
	3	● ■ Successive Trials		2S	● ▲ Successive Trials or 8		CM	● + ▲	
	4	● ● Trials		2M	● ▲ Correct out of 10 Successive Trials		V	IS	● + For all 5s 8 Correct
II	IS	● + For all 5s 4 Correct		3S	● ■ 5s Trials		IM	● × out of 10 Successive Trials	
	IM	● × Out of 5		3M	● ■ 8 Correct		2S	▲ For all M's 4 Correct	
	2S	● ▲ Successive Trials or 8		4S	● ● correct out of 10 Successive Trials	Backward	2M	▼ out of 5 Successive Trials or 8 Correct	
	2M	● ▼ correct out of 10 Successive Trials		4M	● ● correct out of 10 Successive Trials	Learning	3S	■ For all M's 4 Correct	
Changes in Spatial Orientation	3S	● ■ Successive Trials	IV	AS1	● + For all 5s 4 Correct		3M	◆ For all M's 4 Correct	
	3M	● ◆ Successive Trials		AS2	● ▲ 4 Correct		4S	● For all M's 4 Correct	
	4S	● ● Out of 10 Successive Trials		Increase in					
	4M	● ● Successive Trials		AM	● + Successive Trials or 8		4M	● For all M's 4 Correct	
			Number	BS3	● ■ Correct out				

IVAM 7 Correct out of 10 Successive Trials
 IM 6 Correct out of 10 Successive Trials
 CM 5 Correct out of 10 Successive Trials

contour, as circle versus cross, to the most similar, as circle versus oval. Sub-group II learned in a descending, or opposite, order of difficulty.

Ten infants in Sub-group I and eight in Sub-group II completed the entire study. These are referred to as the Regular Experimental Cases. The rest of the twenty-six subjects--three in Sub-group I and five in Sub-group II--learned only certain portions of the experiment. They are called the Irregular Experimental Cases.

1. Results

Altogether 14,852 trials were carried out with the twenty-six Regular and Irregular Experimental Cases. These data were analyzed, both qualitatively and quantitatively, first on the basis of achievement, then on the basis of development. The former analysis was further divided into six subheadings: (1) Number of Trials, (2) Percentage of Success, (3) Reaction Time, (4) Oral behavior, (5) Vocalization, and (6) Affective concomitant (see Preliminary Study). The latter analysis consisted of: (1) Number of Form Combinations, (2) Number of Trials, (3) Percentage of Success, (4) Reaction Time, (5) Oral Behavior, (6) Vocalization, (7) Affective concomitant, (8) Visual Regard, and (9) Manipulation.

1. Analysis on the Basis of Achievement

a) Number of Trials

Figure 13¹ (see page 56) shows graphically the very marked

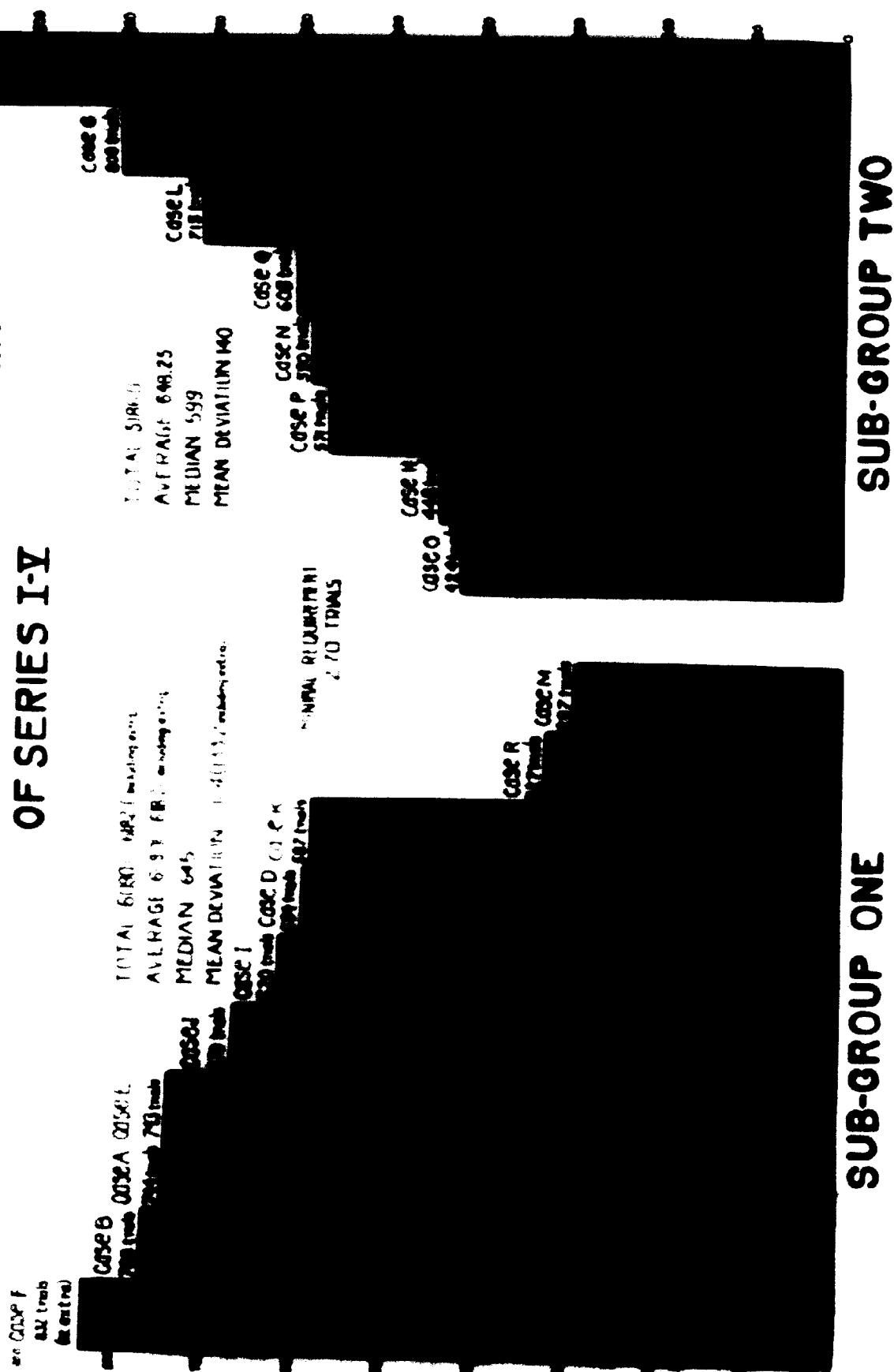
¹Case F learned Series I, Form 1 technically in 228 trials, i.e., met the standard for perfect discrimination performance on the 228th trial. However, his total behavioral pattern during the

FIG. 13

TOTAL NUMBER OF TRIALS

**REQUIRED BY EACH SUBJECT IN THE REGULAR
EXPERIMENTAL GROUP IN THE LEARNING**

OF SERIES I-V



individual differences among the members of the same group in their ability to learn Series I - V, as against the relatively small differences in the same ability between Sub-groups I and II as a whole. Their ability is measured by the differences in size between the (1) averages, (2) medians, and (3) mean deviations of the respective groups.

When the same data were analyzed in terms of the total number of trials required by each subject in the learning of (1) each series and (2) each form, the same tendency stood out clearly. This is shown in Tables 9, 10, and 11 (see pages 60, 61, and back of dissertation).

Figures 14 and 15 (see pages 62 and 63) show that:

1) Sub-group II learned Series I in appreciably fewer trials than Sub-group I. However, careful examination of the scores obtained by each individual subject in the two groups in the learning of each form constituting Series I (see Table 11, back of dissertation) revealed the fact that the total numbers of trials required by Cases F and J respectively

(Footnote continued from page 57)
 last ten trials was such that the experimenter was in doubt as to the reliability of the score; therefore, five more trials were given as a check, and the percentage of success obtained during these trials was sixty, twenty below the criterion for successful learning. As a consequence, the same experiment was continued until the subject had carried out altogether 320 trials on Series I, Form 1, before he gave convincing proof of having mastered the form. In the quantitative analysis of the results, in order to render the scores from Case F in the form in question technically comparable to those from other cases, they were presented both with and without the inclusion of the ninety-two extra trials ($320 - 228 = 92$). This was done in this figure as well as in the other figures and tables in which Case F's data on Series I, Form 1 were included.

Table 9

Total Number of Trials for Each SeriesRequired by Each Subject in Sub-Group I of the Regular Experimental GroupIn the Learning of Series I - V

Case Number	Series I	Series II Standard	Series II Modified	Series III Standard	Series III Modified	Series IV Standard	Series IV Modified	Series V Standard	Series V Modified	Total
A	184	95	82	73	42	37	89	122	20	744
B	213	69	56	76	68	42	53	171	35	768
D	216	61	40	48	44	30	37	84	34	594
E	183	155	87	32	81	32	50	91	32	743
F	322 414**	80	74	20	44	45	32	66	57	740 832**
I	160	123	72	33	56	56	30	60	25	620
J	187	93	47	59	83	44	34	73	45	670
K	67	82	46	86	57	72	44	108	25	587
M	46	20	40	20	40	20	30	61	30	297
R	67	20	40	27	40	20	37	50	26	327
Total	1645 1302* 1737**	793	584	474	550	398	436	881	329	
Avg.	164.5 140.1* 173.7**	79.3	58.4	47.4	55.	39.8	43.6	88.1	32.9	
Grand Total										6090 5747* 6182**

*These figures are obtained by excluding the results of Cases F and J in Series I, Form 1.

**These figures are obtained by including 92 doubtful trials of Case F.

Table 10

Total Number of Trials for Each Series

Required by Each Subject in Sub-Group II of the Regular Experimental Group

in the Learning of Series I - V

Case Number	Series I	Series II Standard	Series II Modified	Series III Standard	Series III Modified	Series IV Standard	Series IV Modified	Series V Standard	Series V Modified	Total
C	131	323	102	95	49	84	44	167	29	1024
G	180	192	89	110	52	30	30	81	29	806
H	84	76	45	31	45	20	32	64	51	448
L	157	143	91	70	70	53	51	48	32	715
N	115	25	40	105	73	58	75	69	25	590
O	134	35	47	28	40	30	37	53	20	424
P	128	63	40	40	90	40	47	73	50	571
Q	115	109	95	30	67	41	63	50	29	608
Total	1044	966	552	521	498	300	379	605	265	
Avg.	130.5	120.75	69.	65.13-	62.25	44.5	47.38-	75.63-	33.13-	

Grand Total

5186

Figure 14
Average Number of Trials Required by
Subgroups I and II Respectively of the
Regular Experimental Group in the Learning
of Each Series from Series I to V

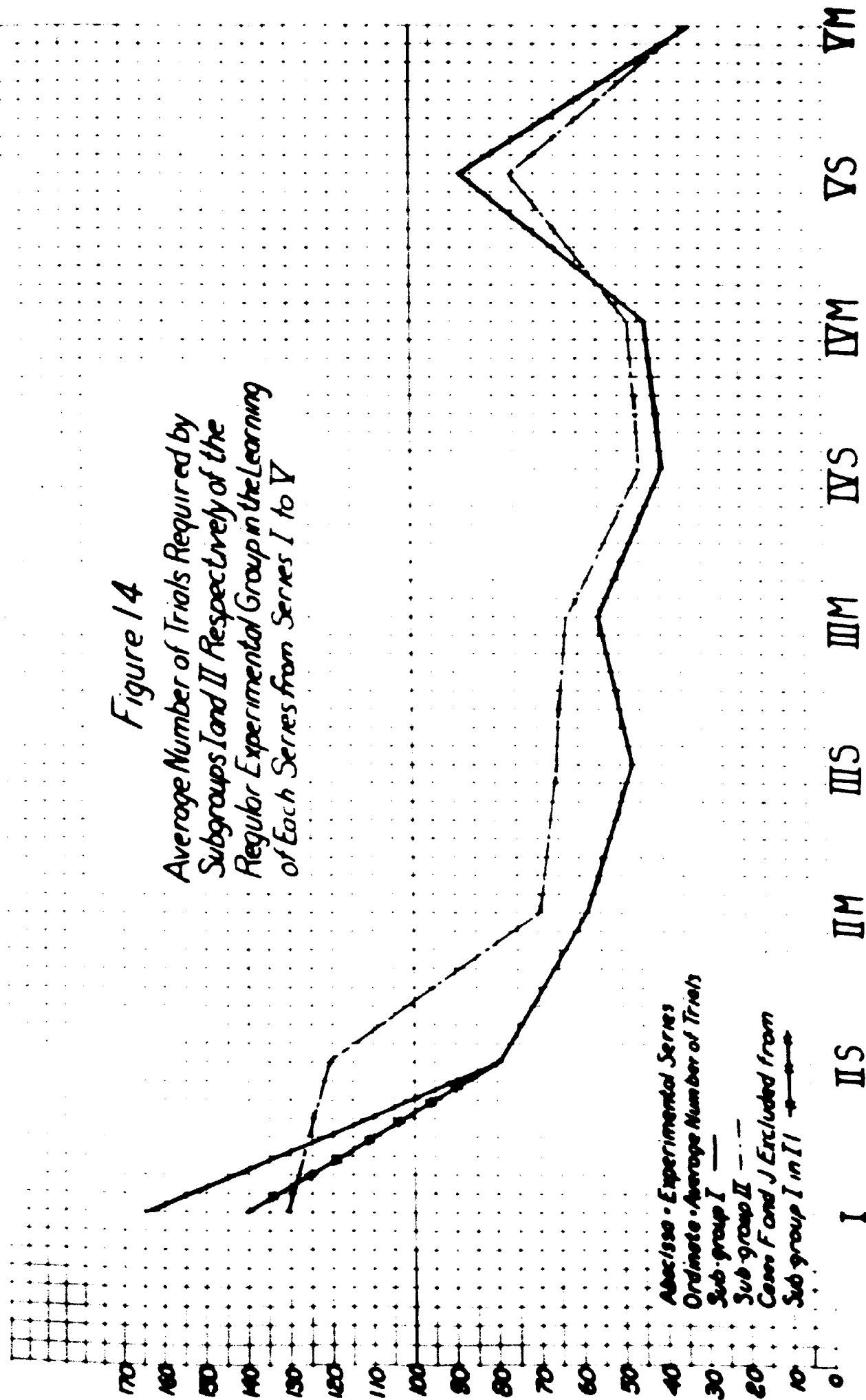
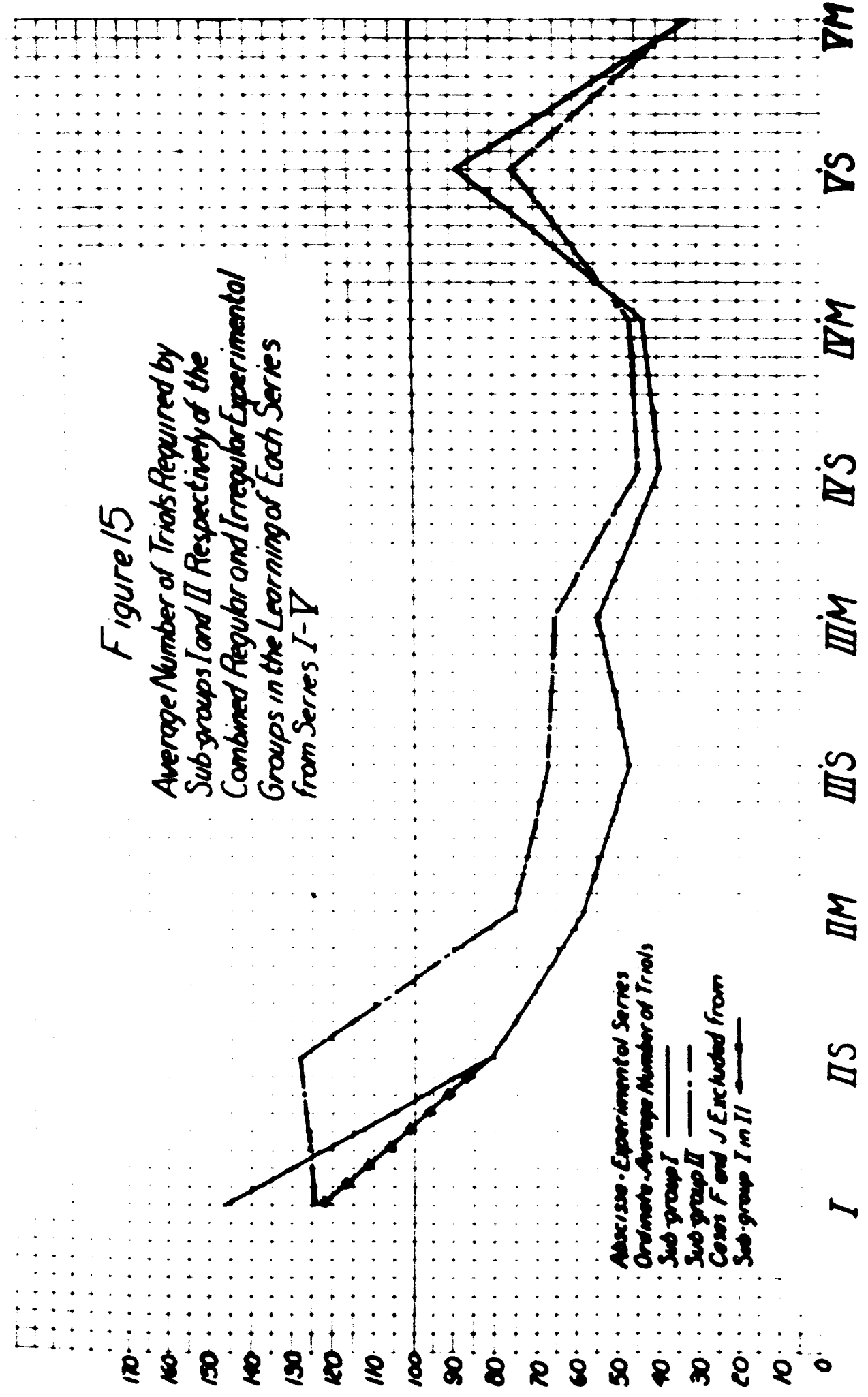


Figure 15
Average Number of Trials Required by
Sub-groups I and II Respectively of the
Combined Regular and Irregular Experimental
Groups in the Learning of Each Series
from Series I-V



Abbrev: Experimental Series
Ordinate: Average Number of Trials
Sub-group I ———
Sub-group II - - -
Cases F and J Excluded from
Sub-group I in II

of Sub-group I in the learning of Form 1 are unusually large and deviate very significantly from the norm for the group. Since no such deviations appear in the scores of the two subjects for any other form, it seems highly probable that the abnormally high scores in this case are due to some other reasons, such as unusually slow initial adjustment to the general experimental situation, than that directly connected with the form discrimination and learning ability of the subjects. Consequently it seems justified, in comparing various types of results of the two sub-groups, to exclude the scores of Cases F and J from the means of Sub-group I. When this was done in the present case, the scores for the two sub-groups were not far apart. In Figure 14 (see page 62) the difference is 9.6 trials fewer with Sub-group II; in Figure 15 (see page 63) the difference is only 1.08 trials fewer with Sub-group I.

2) In Series IIS, IIIS, and IVS (the three review experiments in which Series I was relearned) Sub-group I showed consistent superiority over Sub-group II. It is also interesting to note here that the discrepancy between the two sub-groups in the number of trials required to learn a given series decreases consistently in size as one goes from Series IIS to IIIS and then to IVS.

3) In Series IIM, IIIM, and IVM ("Change in Spatial Orientation of Negative Stimuli," "Change in Relative Size" and "Increase in Number") Sub-group I again showed superiority over Sub-group II. Furthermore, the difference between the

two sub-groups again diminishes consistently (from 10.6 to 3.8 trials for the Regular Experimental Group and from 18.0 to 3.8 trials for the Combined Regular and Irregular Experimental Groups) as one goes from IIM to IIIM and then to IVM. This implies that in spite of the exactly opposite order of presenting the geometric combinations, some common general factor in the experience begins to operate very early and very permanently. At the same time, however, these reduced group differences remain internally consistent enough to indicate that the specific factor, order of presentation (sequence), does affect the scores in discrimination performance.

4) Series VS ("Backward Learning") is a very conspicuous example of this latter effect. In this series Sub-group II showed a decided superiority over Sub-group I (difference, 12.47 trials). However, this difference is reduced to a minimum (0.23 trials) in Series VM ("Change in Spatial Orientation of Positive Stimuli"), implying at once that of the two factors in discrimination, change of functional relationship, as such, seems much more critical than change of orientation, as such.

5) Turning now from dissimilarities to similarities between the curves for the two groups, it is significant that they both start very high (164.5 trials for Sub-group I and 130.5 trials for Sub-group II of the regular Experimental Group; 147.08 trials for Sub-group I and 124.10 trials for Sub-group II of the Combined Regular and Irregular Experimental

Groups). This is obviously the result of general adjustment to the whole experimental situation. From there on, the curves descend steadily in spite of the various types of specific changes and all the possibilities of confusion introduced in Series IIM and IIIM. In Series IVM ("Increase in Number") the curves remain low; however, as there were here only three form combinations as against four in IIM and IIIM, the situations in these three series were not strictly comparable. Had there been also four form combinations in Series IVM, the curves would undoubtedly have risen to some extent at this point. Then the proportionate lowering of the standard of success for this series (see pages 52-53) in an attempt to offset partially a disproportionate increase in the difficulty of the discrimination brought about by the arithmetical increase in the number of blocks simultaneously presented may have contributed also.

At VS both curves rise abruptly and significantly (from 39.3 to 38.1 trials for Sub-group I and from 44.5 to 75.63 trials for Sub-group II). This seems plainly due to the very drastic change in the experimental task at this point (exchanged functional relationship between positive and negative figures), a result reminiscent of Skeels' (6) major conclusion (see page 4). The curves drop to a new low at VM (32.9 trials for Sub-group I and 33.13- trials for Sub-group II), showing that the subjects were undisturbed by the change in the spatial orientation of the positive stimulus in this last

series.

Tables 12, 13 and 14 (see pages 68, 69 and 70) show that:

1) Both groups of subjects spent the largest number of trials in learning the first form combinations presented to them (Sub-group I, circle-cross combination; Sub-group II, circle-oval combination). Then for Sub-group II the number of trials required for the learning of each of the other three form combinations became increasingly smaller in the direct order in which these combinations were exposed. The same was true for Sub-group I until it came to the circle-oval combination. The number of trials here immediately rose from 76 to 113.6. At least two explanations are possible for this discrepancy. The first is as follows: Sub-group II was presented, at the outset, with the two forms (circle and oval) which were the most geometrically similar of those used in the present study; therefore, the subjects were forced to notice rather fine differences from the start (training of finer attention processes). As the experiment progressed, this initial training carried over marked "practice" effects, and thus, fewer and fewer trials were necessary to discriminate between each successive combination of forms. Sub-group I, on the other hand, started out with a circle and a cross which were very different in geometrical contour. This was indeed a much grosser geometric difference than that between a circle and an oval; therefore, the subjects were not forced to

AVERAGE NUMBER OF TRIALS REQUIRED BY THE REGULAR EXPERIMENTAL GROUP IN LEARNING EACH FORM IN SERIES I-Y

STIMULUS STIMULUS GROUP		STIMULUS STIMULUS GROUP		STIMULUS STIMULUS GROUP	
SITUATION PATTERN I	I	SITUATION PATTERN I	II	SITUATION PATTERN I	I
I 1	7390 2438 (8310)	● +	● +	1520 1738	IVBM ● + ▲ 1040 1975
I 2	3150 2450	● ▲	● +	1450 1275	IVCS4 ● ● 990 963
I 3	2030 3488	● ■	● ▲	800 900	IVCM ● + ▲ 1540 1425
I 4	3880 4025	● ●	● ▲	1240 1463	VIS ● + ● 3220 1275
II 1	3090 1613	● +	● ■	1070 1325	VIM ● × ● 880 713
II 2	1550 1713	● ×	● ■	1440 1413	V2S ▲ ● 1620 1163
II 3	1510 1758	● ▲	● ●	1350 2550	V2M ▼ ● 870 950
II 4	1390 1613	● ▼	● ●	1370 2075	V3S ■ ● 2490 1388
III 1	1160 3138	● ■	● +	1440 1450	V3M ◆ ● 860 725
III 2	1280 1613	● ◆	● ▲	930 1113	V4S ● ● 1480 3738
III 3	2170 4038	● ●	● +	1780 1338	V4M ● ● 680 925
III 4	1620 2475	● ●	● ■	620 925	

* The figure within the parenthesis is obtained by including the 32 double trials of Case 1

TABLE 12

The average number of trials required by the regular experimental group in learning each form in series I-Y

Total and Average Number of Trials Obtained by Sub-Groups I and II
Respectively of the Combined Regular and Irregular Experimental
Groups in the Learning of Small Num. in Series 1 - 7

Stimulus Pattern	Sub-Group I		Sub-Group II	
	Total	Average	Total	Average
1	671	21.33♦	671	21.33♦
2	671	21.33♦	671	21.33♦
3	671	21.33♦	671	21.33♦
4	671	21.33♦	671	21.33♦
5	671	21.33♦	671	21.33♦
6	671	21.33♦	671	21.33♦
7	671	21.33♦	671	21.33♦
8	671	21.33♦	671	21.33♦
9	671	21.33♦	671	21.33♦
10	671	21.33♦	671	21.33♦
11	671	21.33♦	671	21.33♦
12	671	21.33♦	671	21.33♦
13	671	21.33♦	671	21.33♦
14	671	21.33♦	671	21.33♦
15	671	21.33♦	671	21.33♦
16	671	21.33♦	671	21.33♦
17	671	21.33♦	671	21.33♦
18	671	21.33♦	671	21.33♦
19	671	21.33♦	671	21.33♦
20	671	21.33♦	671	21.33♦
21	671	21.33♦	671	21.33♦
22	671	21.33♦	671	21.33♦
23	671	21.33♦	671	21.33♦
24	671	21.33♦	671	21.33♦
25	671	21.33♦	671	21.33♦
26	671	21.33♦	671	21.33♦
27	671	21.33♦	671	21.33♦
28	671	21.33♦	671	21.33♦
29	671	21.33♦	671	21.33♦
30	671	21.33♦	671	21.33♦
31	671	21.33♦	671	21.33♦
32	671	21.33♦	671	21.33♦
33	671	21.33♦	671	21.33♦
34	671	21.33♦	671	21.33♦
35	671	21.33♦	671	21.33♦
36	671	21.33♦	671	21.33♦
37	671	21.33♦	671	21.33♦
38	671	21.33♦	671	21.33♦
39	671	21.33♦	671	21.33♦
40	671	21.33♦	671	21.33♦
41	671	21.33♦	671	21.33♦
42	671	21.33♦	671	21.33♦
43	671	21.33♦	671	21.33♦
44	671	21.33♦	671	21.33♦
45	671	21.33♦	671	21.33♦
46	671	21.33♦	671	21.33♦
47	671	21.33♦	671	21.33♦
48	671	21.33♦	671	21.33♦
49	671	21.33♦	671	21.33♦
50	671	21.33♦	671	21.33♦
51	671	21.33♦	671	21.33♦
52	671	21.33♦	671	21.33♦
53	671	21.33♦	671	21.33♦
54	671	21.33♦	671	21.33♦
55	671	21.33♦	671	21.33♦
56	671	21.33♦	671	21.33♦
57	671	21.33♦	671	21.33♦
58	671	21.33♦	671	21.33♦
59	671	21.33♦	671	21.33♦
60	671	21.33♦	671	21.33♦
61	671	21.33♦	671	21.33♦
62	671	21.33♦	671	21.33♦
63	671	21.33♦	671	21.33♦
64	671	21.33♦	671	21.33♦
65	671	21.33♦	671	21.33♦
66	671	21.33♦	671	21.33♦
67	671	21.33♦	671	21.33♦
68	671	21.33♦	671	21.33♦
69	671	21.33♦	671	21.33♦
70	671	21.33♦	671	21.33♦
71	671	21.33♦	671	21.33♦
72	671	21.33♦	671	21.33♦
73	671	21.33♦	671	21.33♦
74	671	21.33♦	671	21.33♦
75	671	21.33♦	671	21.33♦
76	671	21.33♦	671	21.33♦
77	671	21.33♦	671	21.33♦
78	671	21.33♦	671	21.33♦
79	671	21.33♦	671	21.33♦
80	671	21.33♦	671	21.33♦
81	671	21.33♦	671	21.33♦
82	671	21.33♦	671	21.33♦
83	671	21.33♦	671	21.33♦
84	671	21.33♦	671	21.33♦
85	671	21.33♦	671	21.33♦
86	671	21.33♦	671	21.33♦
87	671	21.33♦	671	21.33♦
88	671	21.33♦	671	21.33♦
89	671	21.33♦	671	21.33♦
90	671	21.33♦	671	21.33♦
91	671	21.33♦	671	21.33♦
92	671	21.33♦	671	21.33♦
93	671	21.33♦	671	21.33♦
94	671	21.33♦	671	21.33♦
95	671	21.33♦	671	21.33♦
96	671	21.33♦	671	21.33♦
97	671	21.33♦	671	21.33♦
98	671	21.33♦	671	21.33♦
99	671	21.33♦	671	21.33♦
100	671	21.33♦	671	21.33♦

The figures within the parentheses are obtained by dividing the total number of trials by the number of identical trials of Series 1.

*These figures are obtained by dividing the total number of trials by the number of identical trials of Series 1 and 2 in Series 1, Norm 1.

Table 14

Average Number of Trials for Each Form Group Required
by Sub-Groups I and II Respectively of the Regular and Combined Experimental Groups

in the Learning of Series I - V

Subjects	Circle-Cross Group	Circle-Triangle Group	Circle-Square Group	Circle-Oval Group
Regular Sub-Group I	II, IIIa, IIIb, IIIc, IIIdm, IVAs1 164.4 140.0* 173.6** (1)	II, II2a, II2b, II12a, II12b, IVAs2 50.2	IS, IS3a, IS3b, II13a, II13b, IVBs3 76	IV, IV6a, IV6b, II14a, II14b, IVCs4 113.8
Regular Sub-Group II	98.27 (4)	(3) 38.77	(4) 119.39	(2) 176.76
Combined Sub-Group I	146.64 125.44* 152.72** (1)	(3) 56.75	(2) 73.43	(1) 116.08
Combined Sub-Group II	95.36 (4)	(3) 38.16	(4) 128.84	(2) 181.70

The figures within the parentheses indicate the rank order (descending) of the figures directly above.

*These figures are obtained by excluding the results of Cases F and J in II.

**These figures are obtained by including 92 doubtful trials of Case F.

notice fine differences until they came to the circle-oval combination. There they were confronted with an apparently more difficult situation than that for which their previous combinations had prepared them, so the requisite number of trials went up considerably at this specific point, making Series I, Form 4 uniquely though not insurmountably difficult for the subjects of Sub-group I. If the above interpretation is correct, then we might infer that the circle-oval combination is perceptually or "behaviorally" [Koffka (49)] more difficult to discriminate than the other form combinations, an opinion which will be later re-enforced by analysis of the results on reaction time. When it comes to each of the other form combinations, the available data do not seem to indicate any such clear-cut difference in relative difficulty.

A second possible explanation is as follows: Sub-group II, deprived of using sharp angle cues in its first learning, did not primarily rely on these in the subsequent form combinations where they appeared. The behavior of Sub-group I, on the other hand, implies that the sudden disappearance of these angular cues as such in the last form combination to be learned was a profoundly disturbing factor. [Hanfmann (15) stresses the use of a "symbolic" angle as the critical cue in geometric form perception, and states that this occurs only with younger children.]

2) Variations in the relative size of the forms did not affect detrimentally the discrimination performance of either group of subjects; nor did the pronounced orientation change

in the optical image (e.g., $\square \rightarrow \diamond$) of a major unit in the total pattern affect this total organization to the detriment of internal discrimination. From these data it seems very clear that neither spatial orientation of a unit as such nor size as such is the primary cue in any of the many learning series of this experiment, as reflected in the achievement scores. In other words, it seems that even at these very early age levels, there is a "form-constancy" which is of a very elementary perceptual nature. However, as will be seen later, such qualitative aspects of achievement as reaction time, etc., show clearly some influence from changes in the spatial orientation or size of a major unit in the total stimulus pattern.

3) Increase in the number of blocks presented simultaneously caused an increase in the total number of trials required for the learning of these "synthetic" patterns [Krasnogorski (50)]. However, the amount of increase was not directly proportional to the increase in the number of blocks (see Tables 12 and 13 on pages 68 and 69). Furthermore, it was appreciable but not marked, thus indicating that increased complexity of pattern by numerical addition rendered the task of form discrimination more difficult, but not impossible, for the subjects of either group [cf. Gottschaldt (44)]. In other words, the infants' discrimination, while somewhat affected, was never completely masked by any combination or "synthesis" of units in these given patterns. This implies

that neither (1) configuration complexity in terms of multiple separate units, nor (2) possible "geographical" synthesis [Wertheimer (20)], nor (3) synthesis through "trace" or familiar factors [Hanawalt (51)] of certain forms within the total pattern appears completely to mask the discrimination of form per se as evidenced in achievement scores. On the other hand, regardless of interpretation, a multiple geometric pattern (viz., five units) is much more difficult than a simple geometric pattern (viz., two units) at this age level.

4) The results of the Series V, Form 1, Standard experiment show that the subjects of both groups were at first profoundly disturbed when the positive stimulus was abruptly made negative and one of the negative stimuli positive for the first time. The total number of trials required for learning this reversed functional relationship increased from an average of 14.40 to 32.20 for Sub-group I and from 9.63- to 37.36- for Sub-group II. However, these marked disturbances lasted a surprisingly brief period and affected only the scores for the first form combination of Series V. After a period of marked confusion, both perceptual and emotional, both groups soon detected the change in relationship and were able at once to readjust themselves successfully to the new situation. This is shown by the abrupt return to normal size of the numbers of trials required for the learning of all other form combinations in Series V. Qualitatively, the results of Series V seem to show (1) a degree of plasticity in readjust-

ment (reconditioning) unexpected at this "primitive" age level [Krasnogorski (50)], (2) a primitive form of "insight" [Köhler (52), Koffka (10)], and (3) evidence of "abstracting" a relationship to the extent of inhibiting future use of a thoroughly established motor habit.

b) Percentage of Success

Figure 16 (see page 75) shows that:

1) The difference between the grand percentage of success for Sub-group I and that for Sub-group II is very insignificant (0.59%).

2) The individual differences among the members of the same group in the learning of Series I - V are appreciable but not marked (cf. Figure 13 on page 58).

When the same data were analyzed in terms of the percentage of success obtained by each subject in the learning of (1) each series and (2) each form, the individual differences became much more marked. This is shown in Tables 15, 16 (percentage of success for each series) and 11 (percentage of success for each form), (see pages 76 and 77 and back of dissertation).

When the individual scores in percentage of success as shown in Figure 16 (see page 75) were correlated with those in total number of trials presented in Figure 13 (see page 58), a negative coefficient of $.89 \pm .033$ was obtained. It is interesting to note, in this connection, that cases with very high or very low percentages of success have, as a rule, very small or very large total numbers of trials, respectively; the two types of scores bear a very significant negative relationship for

Figure 16 Percentage of Success

Obtained by Each Subject in the Regular Experimental Group
in the Learning of
Series IV

Sub Group I

Grand Percentage - 64.24-%
(63.96%)

Sub Group II

Grand Percentage - 64.83-%

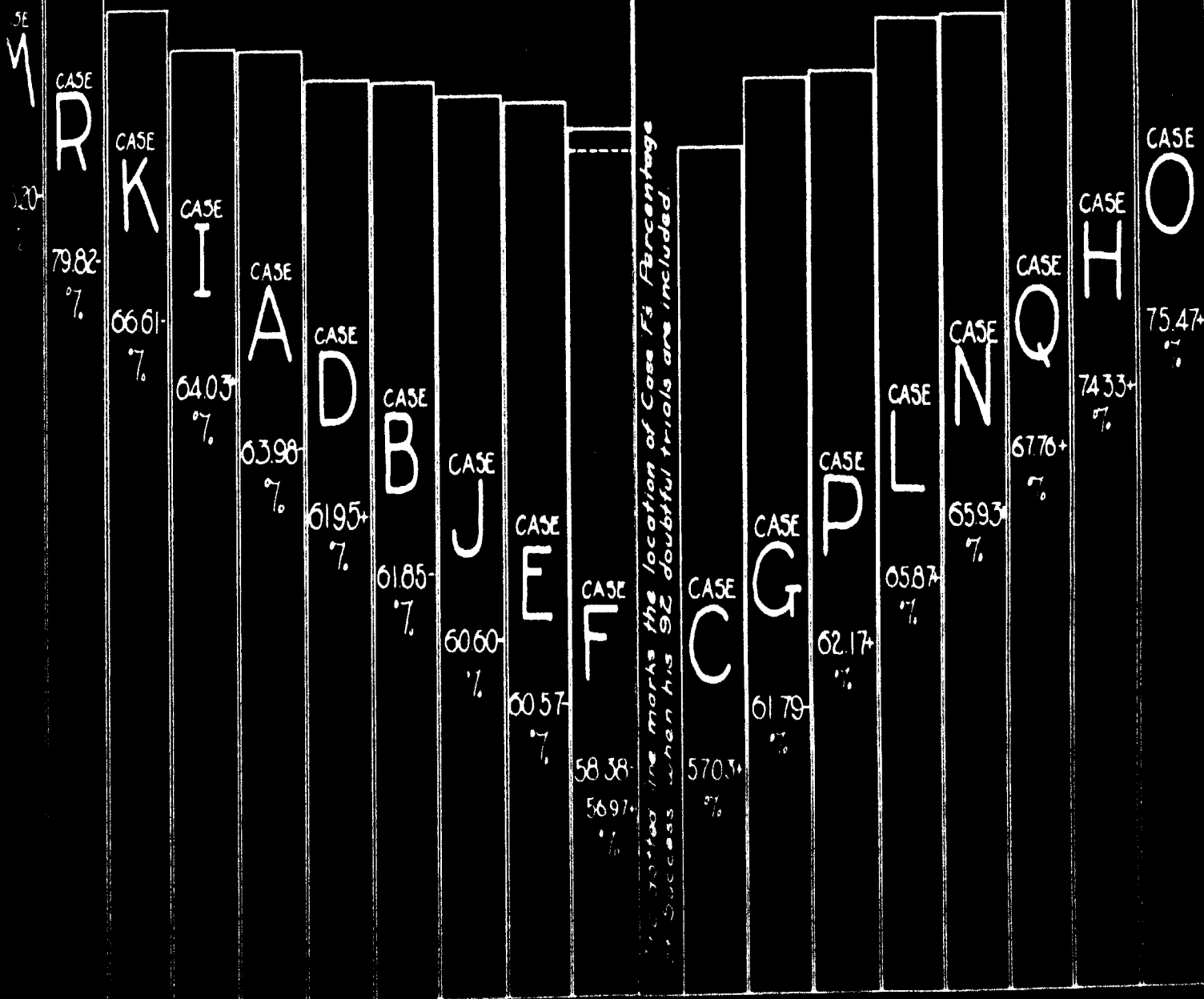


Table 16

Percentage of Success for Each Series

Obtained by Each Subject in Sub-group I of the Regular Experimental Group

In the Learning of Series I - V

Case Number	Series I	Series II Standard	Series II Modified	Series III Standard	Series III Modified	Series IV Standard	Series IV Modified	Series V Standard	Series V Modified	Average
A	60.33-%	60.00 %	73.17-%	63.49-%	86.71-%	78.38-%	43.31-%	60.66-%	80.00 %	63.98-%
B	66.61-%	67.90 %	69.64-%	64.47-%	69.54-%	78.67-%	45.40-%	68.48-%	74.29-%	61.86-%
D	48.15-%	70.43-%	90.00 %	64.68-%	84.09-%	63.33-%	51.35-%	54.76-%	73.41-%	61.96-%
E	49.13-%	56.77-%	67.82-%	71.58-%	70.57-%	75.00 %	64.00 %	60.44-%	66.75 %	60.57-%
F	42.86-%	57.50 %	75.68-%	90.00 %	77.27-%	77.78-%	71.38-%	68.13-%	64.91-%	58.38-%
	43.49-%									66.97-%**
I	56.25-%	60.94-%	65.28-%	72.73-%	76.79-%	67.86-%	70.00 %	58.33-%	84.00 %	64.03-%
J	49.66-%	59.14-%	76.60-%	67.90-%	66.27-%	66.15-%	64.71-%	61.64-%	64.44-%	60.60-%
K	74.63-%	65.85-%	82.61-%	66.14-%	77.19-%	62.80 %	54.56-%	59.26-%	88.00 %	66.61-%
M	80.43-%	95.00 %	92.60 %	90.00 %	95.00 %	100.00 %	86.67-%	74.51-%	76.67-%	86.20-%
R	76.12-%	85.00 %	87.50 %	80.48-%	92.50 %	80.00 %	59.46-%	76.00 %	80.77-%	79.82-%
	53.68-%	62.67-%	75.86-%	66.57-%	77.27-%	74.62-%	58.49-%	61.63-%	74.16-%	
	57.22-%									
Avk.	53.25-%									
Grand Percentage										65.67-%
										63.96-%**

*These figures are obtained by excluding the results of Cases F and J in Series I, Form 1.

**These figures are obtained by including 92 doubtful trials of Case F.

Table 16

Percentage of Success for Each SeriesObtained by Each Subject in Sub-Group II of the Regular Experimental Groupin the Learning of Series I - V

Case Number	Series I	Series II Standard	Series II Modified	Series III Standard	Series III Modified	Series IV Standard	Series IV Modified	Series V Standard	Series V Modified	Average
C	52.67%	48.30%	61.76%	61.05%	79.59%	70.24%	61.36%	62.10%	89.66%	57.03%
G	54.44%	55.21%	67.42%	64.66%	71.19%	60.00%	66.67%	61.73%	79.31%	61.79%
H	64.29%	67.11%	68.89%	83.87%	77.78%	95.00%	75.13%	70.31%	74.61%	74.33%
L	56.05%	64.34%	62.64%	72.86%	75.71%	69.81%	60.78%	77.08%	78.13%	66.87%
N	61.74%	84.00%	90.00%	69.56%	60.26%	67.24%	44.00%	71.01%	80.00%	66.93%
O	62.69%	71.43%	82.98%	89.29%	92.80%	83.33%	86.49%	67.92%	85.00%	75.47%
P	56.25%	63.49%	87.10%	65.00%	56.67%	67.50%	55.32%	57.53%	72.00%	62.17%
Q	61.74%	60.55%	62.24%	80.86%	60.60%	76.61%	61.90%	76.00%	79.31%	67.76%
Avg.	58.14%	57.66%	70.83%	69.67%	71.89%	73.31%	61.48%	63.47%	78.49%	

Grand Percentage

64.83%

the same individual. Cases whose percentage of success scores fall somewhere in the median range generally have medium scores in total number of trials, but those scores do not bear such a clear-cut negative correlation.

Figures 17 and 18 (see pages 79 and 80) show that Sub-group I exceeded Sub-group II in percentage of success in Series IIS (5.01% for the Regular Experimental Group and 5.26% for the Combined Regular and Irregular Experimental Groups), IIM (5.03% for the Regular Experimental Group and 7.98% for the Combined Regular and Irregular Experimental Groups), and IIK (5.38% for the Regular Experimental Group and 5.88% for the Combined Regular and Irregular Experimental Groups), while Sub-group II showed superiority over Sub-group I in Series IVM (2.99%), VS (1.84%) and VM (4.33%). In Series IIS and IVS the two groups were practically equal. In Series I when the curve for Sub-group I was left uncorrected by including the data from Cases F and J on Form 1, Sub-group II obtained a higher percentage of success than Sub-group I; but after the same data were excluded, the two groups were only .92 (for the Regular Experimental Group) to .33 (for the Combined Regular and Irregular Experimental Groups) apart in their respective percentages of success for Series I.

Turning now from differences to similarities between the two curves it is significant that the general shape of these curves confirms the points brought forth on pages 65-67, with one exception: the abrupt descent at IVM (Figures 17 and 18 on pages 79 and 80) as against the very slight rise for total

Abscissa: Experimental Series
 Ordinate: Percentage of Success
 Sub-group I ———
 Sub-group II - - -
 Cases Ford J Excluded from
 Sub-group I in II —•—

80

75

70

65

60

55

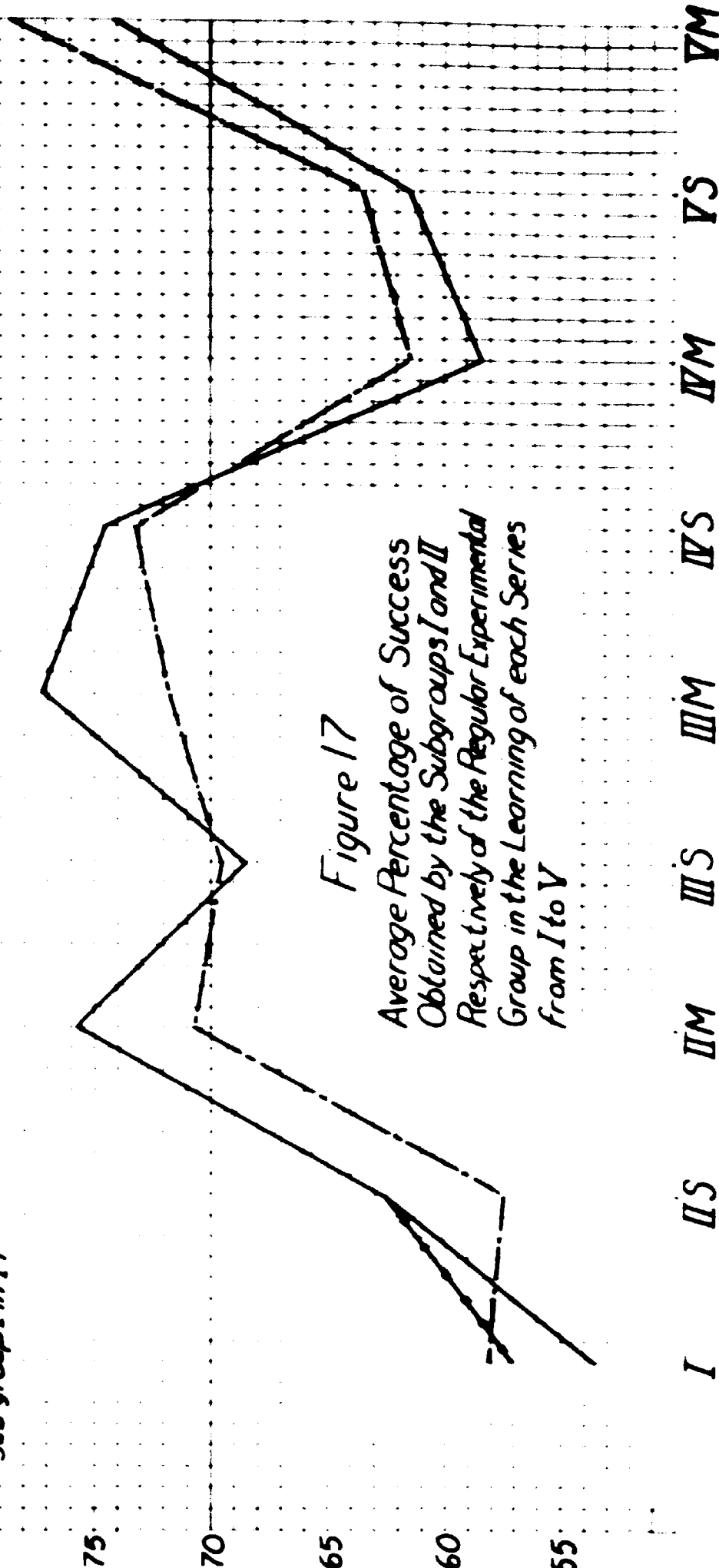


Figure 17

Average Percentage of Success
 Obtained by the Subgroups I and II
 Respectively of the Regular Experimental
 Group in the Learning of each Series
 from I to V

I

II

III

IV

V

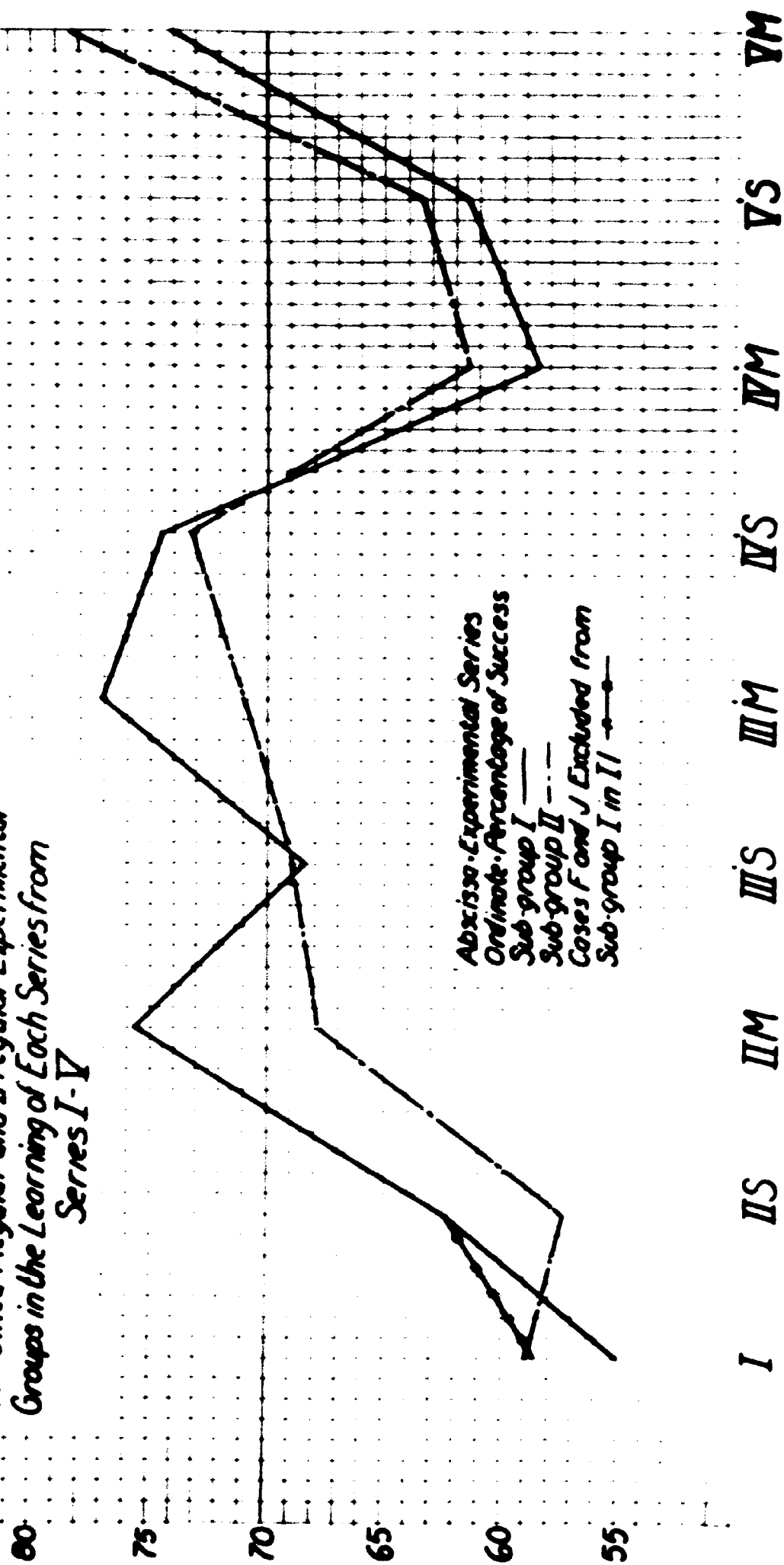
VI

VII

VIII

IX

Figure 18
Average Percentage of Success Obtained
by Sub-groups I and II Respectively of the
Combined Regular and Irregular Experimental
Groups in the Learning of Each Series from
Series I-V



number of trials (Figures 14 and 15 on pages 62 and 63). This marked fall in the former curves is obviously attributable to the interplay of two divergent factors discussed earlier: increase in the difficulty of the task (numerical complexity of the stimulus pattern) and a proportionate lowering of the standard for perfect discrimination (see pages 52-53). But why is the rise of the total number of trial curves (see Figures 14 and 15 on pages 62 and 63) not so marked? For it seems logical to suppose that whatever factor or factors caused the percentage of success to decrease significantly should likewise have caused the total number of trials to increase equally. As far as the present writer can see, there were at least two factors responsible for this discrepancy. First, it will be remembered that there were only three form combinations in Series IVX instead of four as in all the other experimental series. That naturally reduced, to some extent, the total number of trials required for this series. At the same time, it did not raise the percentage of success scores. Second, the proportionate lowering of the standard of success reduced the scores under both criteria.

Tables 17, 18 and 19 (see pages 82, 83, and 84) confirm, on the whole, the results shown in Tables 12, 13 and 14 (see pages 68, 69 and 70).

c) Reaction Time

Figure 19 (see page 85) shows:

- 1) Marked individual differences among the members

Table 17

Percentage of Success Obtained by Sub-Groups I and II Respectively
of the Regular Experimental Group
in the Learning of Each Form in Series I - V

Experiment Number	Sub-Group I	Sub-Group II
I ₁	47.09% (46.93%)* 55.05%*	55.90%
I ₂	59.68%	62.76%
I ₃	67.49%	59.86%
I ₄	54.12%	55.61%
II _{1a}	58.96%	62.76%
II _{1b}	78.06%	83.15%
II _{2a}	62.91%	59.56%
II _{2b}	76.98%	75.94%
II _{3a}	76.72%	57.77%
II _{3b}	83.59%	72.73%
II _{4a}	65.13%	54.78%
II _{4b}	66.67%	60.61%
III _{1a}	65.79%	65.31%
III _{1b}	73.79%	81.37%
III _{2a}	75.00%	84.72%
III _{2b}	81.45%	72.65%
III _{3a}	69.16%	72.64%
III _{3b}	77.08%	74.54%
III _{4a}	67.41%	67.18%
III _{4b}	77.37%	63.86%
IV _{a1}	70.14%	64.66%
IV _{a2}	76.34%	76.40%
IV _{a3}	64.04%	76.64%
IV _{b3}	79.03%	77.03%
IV _{b4}	65.38%	51.90%
IV _{c4}	76.77%	79.22%
IV _{c5}	47.40%	60.53%
V _{1a}	51.86%	77.45%
V _{1b}	73.86%	80.70%
V _{2a}	69.75%	74.19%
V _{2b}	72.41%	75%
V _{3a}	64.26%	71.17%
V _{3b}	73.26%	79.31%
V _{4a}	69.59%	52.51%
V _{4b}	77.94%	79.73%

The figures within the parentheses are obtained by including 92 doubtful trials of Case F.

*This figure is obtained by excluding the results of cases r and j in Series I, Form 1.

Table 18

Percentage of Success Obtained by Sub-Groups I and II Respectively
of the Combined Regular and Irregular Experimental Groups
in the Learning of Each Form in Series I - V

Experiment Number	Sub-Group I	Sub-Group II
I ₁	48.54% (48.23%) 54.98%*	58.11%
I ₂	61.17%	63.40%
I ₃	69.51%	59.75%
I ₄	55.21%	57.63%
II _{1a}	57.99%	62.82%
II _{1b}	79.43%	82.35%
II _{2a}	64.60%	60.27%
II _{2b}	78.79%	76.22%
II _{3a}	77.69%	58.59%
II _{3b}	83.33%	65.88%
II _{4a}	61.22%	53.75%
II _{4b}	66.67%	58.70%
III _{1a}	65.79%	64.58%
III _{1b}	73.79%	77.78%
III _{2a}	75.00%	82.02%
III _{2b}	81.45%	72.14%
III _{3a}	69.16%	72.39%
III _{3b}	77.08%	71.71%
III _{4a}	67.41%	64.88%
III _{4b}	77.57%	64.77%
IV _{a1}	70.14%	64.66%
IV _{a2}	76.34%	76.40%
IV _{a3}	64.04%	76.64%
IV _{b3}	79.03%	77.03%
IV _{b4}	65.38%	51.90%
IV _{c4}	76.77%	79.22%
IV _{c5}	47.40%	60.53%
V _{1a}	51.86%	77.45%
V _{1b}	73.86%	80.70%
V _{2a}	69.75%	74.19%
V _{2b}	72.41%	75.00%
V _{3a}	64.26%	71.17%
V _{3b}	73.26%	79.31%
V _{4a}	69.59%	52.51%
V _{4b}	77.94%	79.73%

The figures within the parentheses are obtained by including 92 doubtful trials of Case F.

*This figure is obtained by excluding the results of Cases r and J in Series I, Form 1.

Table 19
Average Percentage of Success for Each Form Group Obtained
by Sub-Groups I and II Respectively of the Regular and Combined Experimental Groups

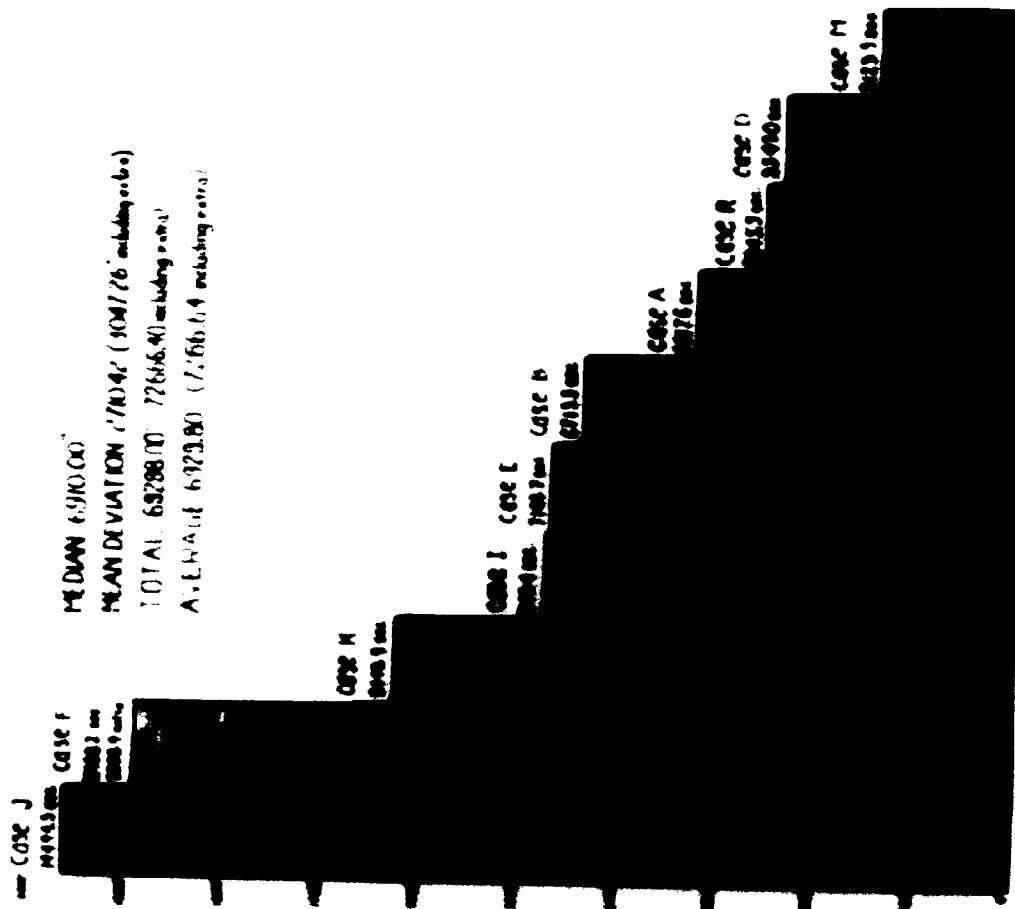
In the Learning of Series I - V

Subjects	Circle-Cross Group	Circle-Triangle Group	Circle-Square Group	Circle-Oval Group
Regular Sub-Group I	11, 111s, 111m, 1111s, 1111m, IVAs1 57.97% 62.64% 57.32% (1)	12, 112s, 112m, 1112s, 1112m, IVAs2 68.96% (3)	13, 113s, 113m, 1113s, 1113m, IVBs3 74.61% (4)	14, 114s, 114m, 1114s, 1114m, IVCs4 83.97% (2)
Regular Sub-Group II	66.16% (3)	69.24% (4)	65.65% (2)	60.03% (1)
Combined Sub-Groups I	58.90% 63.64% 58.22% (1)	69.53% (3)	70.22% (4)	63.69% (2)
Combined Sub-Groups II	66.63% (3)	69.07% (4)	64.21% (2)	59.34% (1)

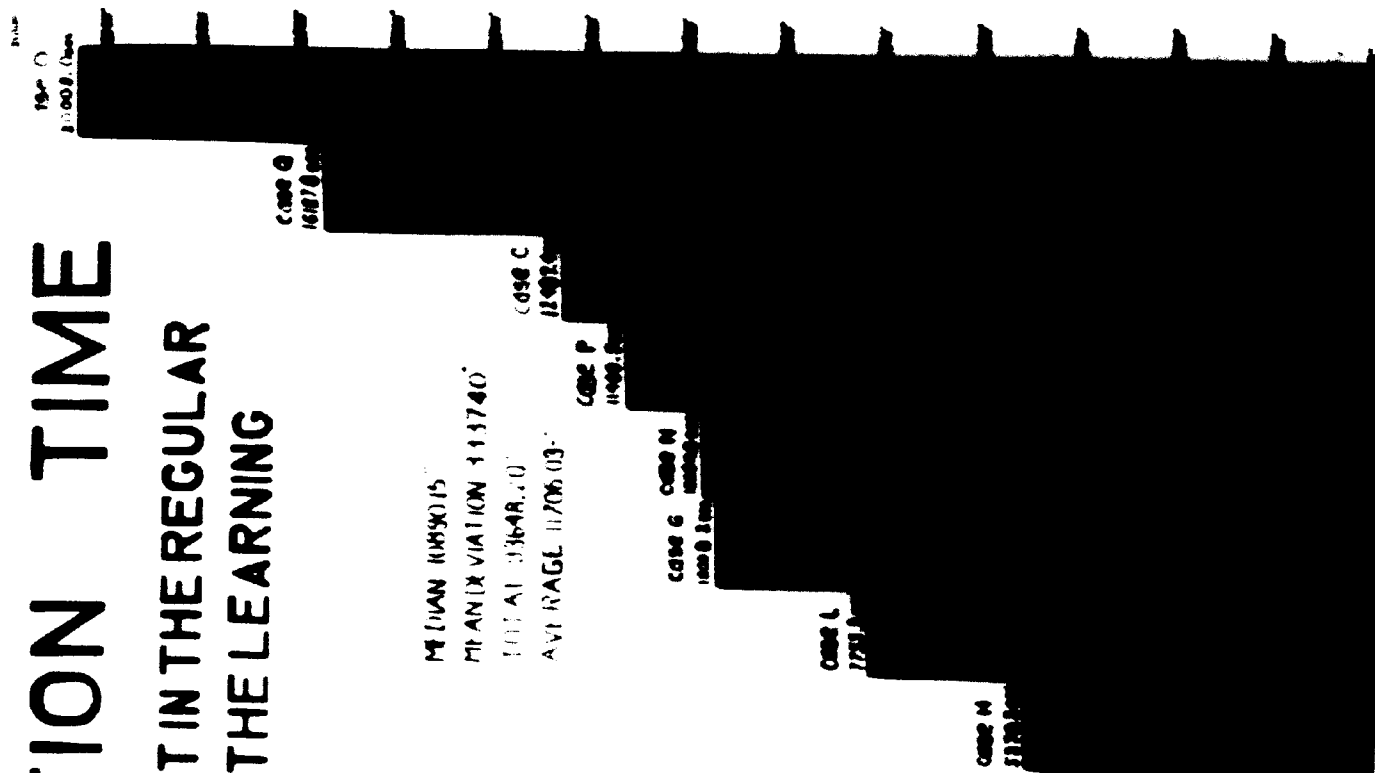
The figures within the parentheses indicate the rank order (ascending) of the figures directly above.
 eThese figures are obtained by excluding the results of Cases F and J in II.
 **These figures are obtained by including 92 doubtful trials of Case F.

FIG 19 TOTAL REACTION TIME

REQUIRED BY EACH SUBJECT IN THE REGULAR
EXPERIMENTAL GROUP IN THE LEARNING
OF SERIES I-V



SUB-GROUP ONE



SUB-GROUP TWO

of the same group in the total amount of reaction time required to learn Series I - V.

2) A decided difference between the two sub-groups of the Regular Experimental Group in the total reaction time as shown by (1) averages, (2) medians, and (3) mean deviations of the respective groups.

When the same data were analyzed in terms of total reaction time and average reaction time per trial required by each subject in the learning of (1) each series and (2) each form, the same tendencies stood out clearly. These are shown in Tables 20, 21, 22, 23, and 11. (See pages 87, 88, 89, 90 and back of dissertation.)

When the individual scores in total reaction time as shown in Figure 19 (see page 85) were correlated with those in total number of trials presented in Figure 13 (see page 58), a positive coefficient of only $.25 \pm .15$ was obtained. This was to be expected, because even though there were a number of subjects who were both fast and efficient learners, or both slow and inefficient learners, there were also many others who were either slow but thorough, or fast but superficial, in their learning. A notable example of the former type was Case O who had first place in total number of trials and last place in total reaction time. A good example of the latter type was Case L.

Figures 20 and 21 (see pages 91 and 92) show that:

- 1) Sub-group II spent decidedly much more time than

Table 20

Total Reaction Times* for Each Series

Required by Each Subject in Sub-Group I of the Regular Experimental Group

in the Learning of Series I - V

Case Number	Series I	Series II Standard	Series II Modified	Series III Standard	Series III Modified	Series IV Standard	Series IV Modified	Series V Standard	Series V Modified	Total
A	1500.1	280.4	650.6	265.3	264.6	168.1	706.5	989.0	93.	4917.6
B	2818.9	202.5	357.2	334.6	286.7	333.6	616.1	1654.3	210.5	6713.3
D	1259.50	298.40	183.7	177.0	313.2	74.5	204.0	898.2	138.6	3647.0
E	1326.8	1816.9	1392.0	175.9	755.9	138.1	507.0	665.4	331.8	7106.7
F	5789.4	1134.8	836.1	152.5	260.5	134.5	641.7	401.7	648.6	10059.8
I	9157.8***									13428.2***
J	1305.8	1378.10	1074.30	272.0	763.2	878.0	622.2	627.2	228.6	7149.4
K	2095.0	1748.2	1135.4	1323.8	3093.1	666.6	626.0	2101.5	1206.7	14494.3
L	970.2	1356.8	809.4	1191.5	1226.6	872.0	720.8	2018.4	276.2	9440.9
M	417.4	71.8	204.9	73.4	150.7	71.0	337.4	594.6	393.4	2123.5
R	1279.4	203.4	653.0	205.8	256.7	65.9	451.4	505.4	224.5	3845.6
Total	13762.5	8490.3	7236.5	4670.7	7310.2	3462.2	5332.1	10253.7	3749.8	
	13695.0**									
	22130.9***									
Avg.	1876.25	849.03	720.55	467.07	738.02	346.22	833.21	1025.37	374.98	
	1486.36***									
	2213.09***									

Grand Total

Grand Average

6939.8
6433.06**
7266.64***

*reaction time in seconds.

**These figures are obtained by excluding the results of Cases F and J in Series I, Form 1.

***These figures are obtained by including 32 doubtful trials of Case F.

Table 21

Total Reaction Time for each SeriesRequired by Each Subject in Subgroup II of the Regular Experimental GroupIn the Learning of Series I - V

Case Number	Series I	Series II Standard	Series II Modified	Series III Standard	Series III Modified	Series IV Standard	Series IV Modified	Series V Standard	Series V Modified	Total
C	1747.5	4112.0	1585.6	954.4	537.9	923.1	693.1	1585.4	348.4	12487.4
G	5444.4	1163.5	732.7	530.1	508.2	127.8	382.9	488.8	229.8	10068.2
H	566.6	610.5	1033.6	627.6	436.6	134.4	360.6	489.1	1112.2	5370.2
L	1352.2	1402.3	1483.4	805.1	910.2	486.8	915.	209.3	182.2	7765.3
N	4028.3	321.1	341.5	1440.2	1679.4	373.0	1360.6	560.6	296.1	10290.8
O	17643.6	288.7	439.4	156.8	198.6	285.8	463.0	355.8	187.4	20009.0
P	5744.0	805.0	344.0	236.6	1607.0	609.4	1033.0	667.5	655.0	11489.5
Q	4258.4	4811.5	3090.2	325.0	1413.4	221.0	1920.3	213.1	235.9	16187.8
Total	40783.9	13002.6	9100.4	6475.8	7192.3	3170.1	7118.5	4569.6	3245.0	
Avg.	5097.99-	1625.33-	1137.55	884.48-	899.04-	396.23+	889.81+	569.95	405.63-	

Grand Total

93648.2

Grand Average

11706.03-

*All reaction time in seconds.

Table 22

Average Reaction Times per Trial for Each Series

Obtained by Each Subject in Sub-Group I of the Regular Experimental Group

in the Learning of Series I - V

Case Number	Series I	Series II Standard	Series II Modified	Series III Standard	Series III Modified	Series IV Standard	Series IV Modified	Series V Standard	Series V Modified	Average
A	8.15*	2.96*	7.93*	3.63*	6.50	4.54*	7.24-	8.11-	4.65	6.61-
B	13.23*	3.43*	6.38-	4.40*	4.56*	7.94*	9.72-	9.67*	6.01*	8.74*
D	5.83*	4.89*	4.69*	3.69-	7.12-	2.43*	5.51*	10.69*	4.07*	6.97*
E	7.25*	11.72-	16.00	5.49*	9.33*	4.32-	10.14	7.29*	10.37-	9.56*
F	17.98-	14.19-	11.30-	7.63-	5.92*	4.32*	20.06*	6.59-	11.38-	13.59*
22.12*										16.14-
I	8.16*	10.77-	14.92*	8.24*	13.63-	15.63-	20.74	10.45*	9.14*	11.83*
J	11.20*	18.90-	24.16-	30.99*	37.27-	15.16	16.41*	26.94*	26.79*	21.63*
K	14.48*	16.55-	17.60-	13.85*	21.52-	12.11*	16.38*	18.69-	11.01-	16.08*
L	9.07*	3.59	5.12	3.67	3.99*	3.55	11.25-	7.74-	13.11*	7.15-
R	19.10-	10.17	16.33-	7.82*	6.42-	3.30-	12.20	10.11-	8.63*	11.78-
Aug.	11.41-	10.71-	12.49*	9.36*	13.42-	3.70-	12.23-	11.64-	11.40-	
•••10.52-										
•••12.74*										
Grand Average										
										11.40-
										11.19***
										11.77****

* All reaction time in seconds.

**These figures are obtained by excluding the results of Cases F and J in Series I, For a 1.

***These figures are obtained by including 92 doubtful trials of Case F.

Table 23

Average Reaction Time* per Trial for Each SeriesObtained by Each Subject in Sub-Group II of the Regular Experimental GroupIn the Learning of Series I - V

Case Number	Series I	Series II Standard	Series II Modified	Series III Standard	Series III Modified	Series IV Standard	Series IV Modified	Series V Standard	Series V Modified	Average
C	13.34-	12.73+	15.55-	10.05-	10.98-	10.99-	15.75+	9.49+	12.01+	12.19+
G	30.25-	6.06-	8.79+	8.02-	8.61+	4.26	12.76+	6.03+	7.32+	12.48-
H	6.78+	8.03+	22.79-	20.25-	9.70+	6.72	11.27-	7.64+	21.91-	11.99-
L	8.61+	9.81-	16.30+	11.60+	13.00+	9.33+	17.94+	4.36+	5.69+	10.95-
N	36.03-	12.84+	8.64-	13.72-	20.25-	6.45+	18.14+	7.98-	11.84+	17.44+
O	131.67-	8.25-	9.35-	5.60	4.97-	9.55-	12.24+	6.71+	9.37	47.19+
P	44.98-	9.41+	8.6	5.92-	17.96-	15.24-	21.98-	9.14+	13.1	20.12+
Q	37.08-	41.39-	31.65+	9.05-	21.11+	5.39+	30.43+	4.26+	8.07-	26.62+
Avg.	39.07-	13.46+	16.49-	10.01+	14.44+	8.90+	18.78+	7.54-	12.25-	

Grand Average

18.06-

*All reaction time in seconds.

Figure 20

Average Reaction Time for Each Series
Required by Sub-groups I and II Respectively
of the Regular Experimental Group in the
Learning of Series I-V

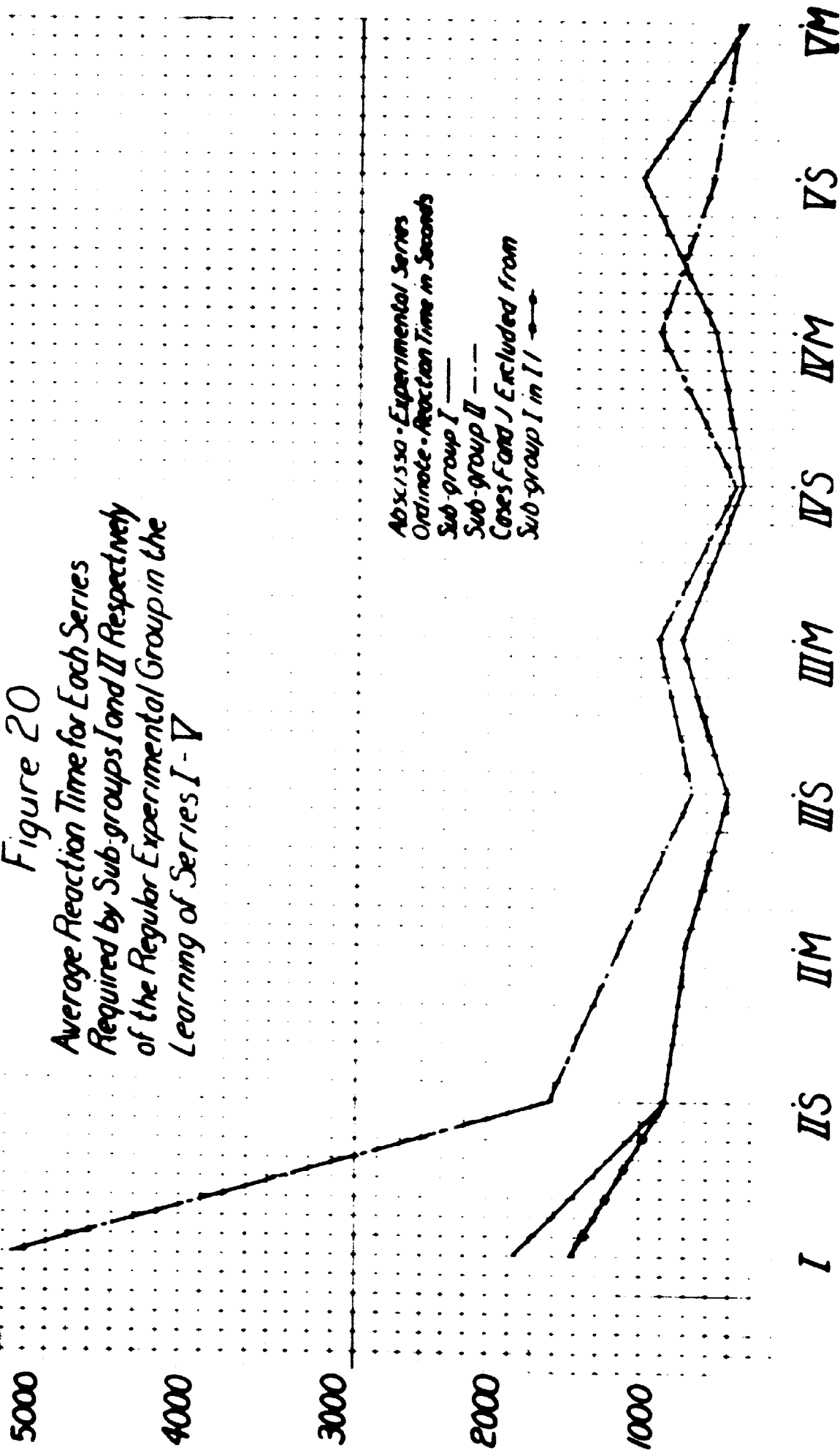
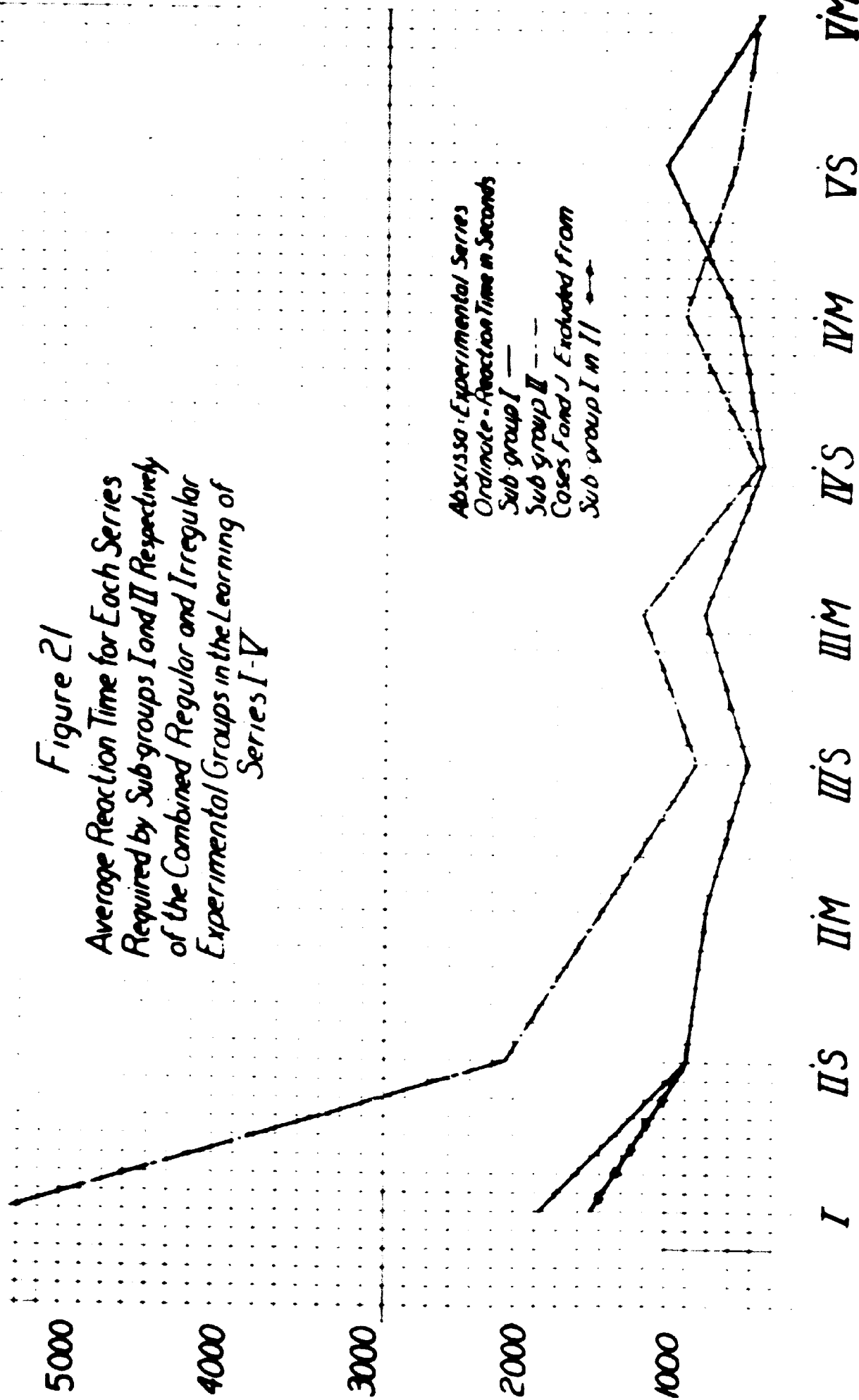


Figure 21
Average Reaction Time for Each Series
Required by Sub-groups I and II Respectively
of the Combined Regular and Irregular
Experimental Groups in the Learning of
Series I-V



Sub-group I in learning its initial series. This is true both before and after the curve for the latter group was corrected by excluding the data from Cases F and J on Series I, Form 1. However, after the initial series, this difference between the two groups decreases steadily through IIS, IIX, IIIS, IIIM, and IVS. It increases abruptly at IVV. At VS the two curves intersect, and for the first and only time during the entire Series I - V, Sub-group II spent less time than Sub-group I in the learning of an experimental series. At VX the curves again intersect, and Sub-group I spent less time than Sub-group II in learning the series. However, this last difference is relatively insignificant (374.98 sec. vs. 405.63 sec.).

2) Turning now from dissimilarities to similarities between the two curves, it is significant that they both start very high, i.e., with a very large total reaction time. This is obviously another indication of a general initial adjustment to the total experimental situation. The curves descend steadily through IIS, IIM, and IIIS, in spite of all changes in pattern, viz., the spatial orientation of the negative blocks at IIM. Both curves rise slightly and similarly at IIIM, descend at IVS, rise again in different magnitudes at IVV (See page 66; the same statistical considerations hold here), and VS, and fall significantly at VX. The different ascents at IIIM, IVV, and VS are probably due to different degrees of effectiveness of change in relative size, of increase in the number of units, and of interchange of functional relationship

(cf. pages 65-67).

Figures 22 and 23 (see pages 95 and 96), which concern average reaction time per trial, show essentially the same general characteristics as Figures 20 and 21 (see pages 91 and 92), which concern average reaction time for each series, with three exceptions:

- 1) The curve for Sub-group I starts at about 12 sec. (11.41- sec. for the Regular Experimental Group and 12.66+ sec. for the Combined Experimental Group) and remains about there throughout the rest of the experimental series. (With the scores for the review experiments -- Series IIS, IIIS and IVS -- discounted, the scores for the rest of the series range from 11.40- sec. to 13.42- sec.) This would seem to indicate that for these subjects, initial adjustment to the stimulus patterns was not reflected in reaction time per trial, even though it was clearly reflected in total reaction time (see Figures 20 and 21 on pages 91 and 92). This last fact would in turn mean that total reaction time was more positively correlated with total number of trials than with average reaction time per trial.

- 2) There is a slight rise in both curves at IIX, showing that both groups of subjects were somewhat, though very little, disturbed by change in the spatial orientation of the negative stimuli.

- 3) The curve for Sub-group II descends rather than ascends at VS. The only possible inference for this unexpected

40

30

20

10

Figure 22

Average Reaction Time Per Trial Required
by Sub-groups I and II Respectively of the
Regular Experimental Group in the Learning
of Each Series from Series I-V

Abscissa: Experimental Series
Ordinate: Reaction Time in Seconds
Sub-group I —
Sub-group II —
Cases F and J Excluded from
Sub-group I in II —

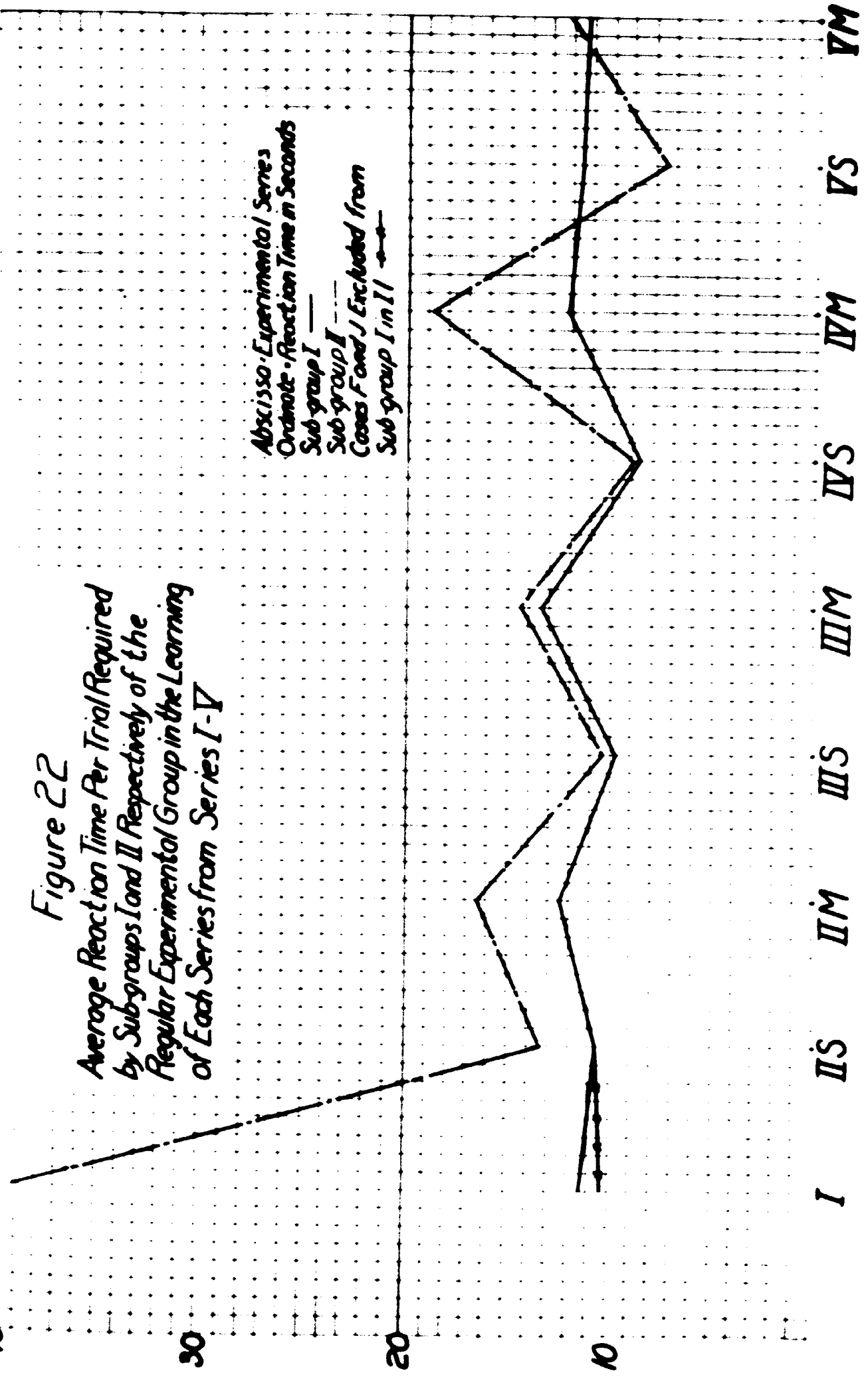
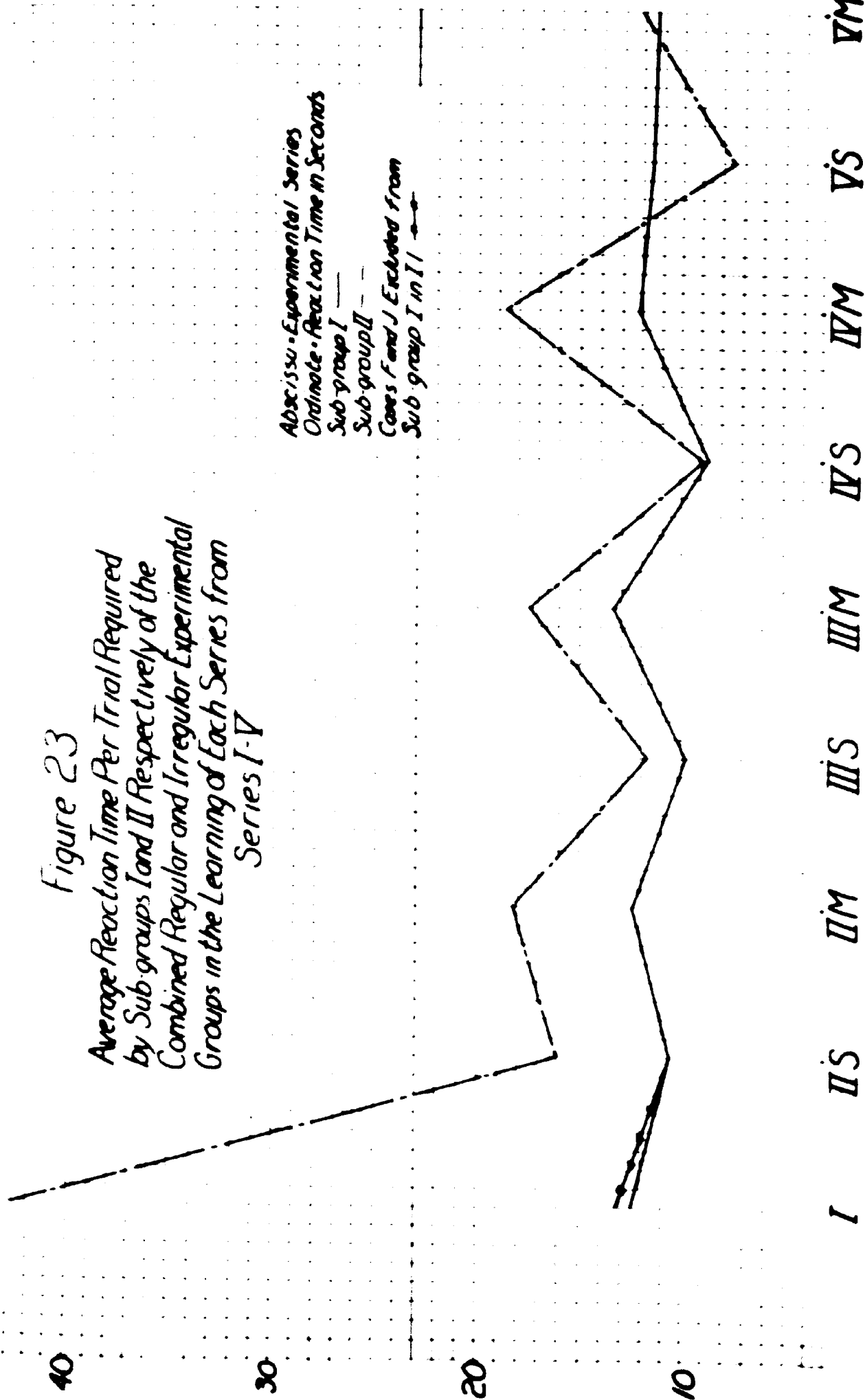


Figure 23

Average Reaction Time Per Trial Required
by Sub-groups I and II Respectively of the
Combined Regular and Irregular Experimental
Groups in the Learning of Each Series from
Series I-V



result is somehow the initial training of Sub-group II on the basis of very fine form differences (cf. pages 67-71).

Tables 24, 25 and 26 (see pages 98, 99-100, and 101) confirm the four points (see pages 67 and 71-74) shown in Tables 12, 13 and 14 (see pages 68, 69, and 70) with one notable exception: change in the relative size of the stimuli did, on the whole, raise the scores (from 2.31 to 147.55 sec.) in the average reaction time required by both sub-groups in the learning of each form combination in Series III. One possible explanation for this would be that even though such a change did not affect detrimentally the discrimination performance of either group of subjects, it increased the manipulative difficulty of the positive stimulus for the smaller infants (A number of cases were recorded in which the subjects experienced such difficulty in grasping and securing the large circle.), thereby increasing the reaction time for the learning of a given form combination.¹

¹A casual examination of Table 24 showed that the total reaction time for Sub-group II is greater for Form 3(O□) than for Form 4(O○) in Series I. This seems to conflict with the fact presented on page 67, that Sub-group II spent the largest number of trials on the circle-oval pattern, and that the number of trials for the other three combinations decreased in the direct order of presentation; also with the point made on page 94, that total reaction time seemed to be positively correlated with total number of trials. However, a more thorough check of the individual scores (see Table 11 at the back of the dissertation) which compose the data in Table 24 (see page 98) revealed that only two of the subjects in Sub-group II spent more time on Form 3 than Form 4. Apparently these two individual deviations have little functional significance as related to their other achievement scores.

AVERAGE REACTION-TIME REQUIRED BY THE REGULAR EXPERIMENTAL

GROUP IN LEARNING EACH FORM IN SERIES HY

STIMULUS STIMULUS GROUP		STIMULUS STIMULUS GROUP		STIMULUS STIMULUS GROUP		STIMULUS STIMULUS GROUP					
SITUATION PATTERN		I	II	SITUATION PATTERN		I	II				
I1	●	+	97418 49388 ^{151102 m}	●	+	14478 16149-	IVBM	●	+	▲	10132 36851*
I2	●	▲	35280 75863	●	+	26113 13176*	NCS4	●	●	●	5488 4904-
I3	●	■	21088 201941*	●	▲	5285 8379-	IVCM	●	+	▲	21644 28200
I4	●	●	33839 182608	●	▲	14189 17300	VIS	+	●	●	56089 6966*
IIS	●	+	37530 30948	●	■	17936 19790	VIM	+	●	●	13021 12371*
IIM	●	+	17665 10609	●	■	18167 26376*	Y2S	▲	●	●	13719 8288-
I2S	●	▲	14005 29699	●	●	9008 24130	Y2M	▼	●	●	8911 10403-
I2M	●	▼	14750 17074	●	●	15339 33051*	Y3S	■	●	●	22854 9876
I3S	●	■	6427 43646*	●	+	13789 16786*	Y3M	◆	●	●	10700 7806*
I3M	●	◆	15867 37368	●	▲	10960 9044*	Y4S	●	●	●	9875 31865
I4S	●	●	26946 58240	●	+	18545 23930	Y4M	●	●	●	4866 9984-
I4M	●	●	24683 48705	●	■	4385 8893-					

* The Score for Group I in I is 50000 Series
When the Results of Case I and Case I are Included

TABLE 24

* The Figure Within the Parenthesis is Obtained
By Including the 92 Doubtful Trials of Case I

Table 26

Total and Average Reaction Times Required by Sub-Groups I and II respectively
of the Combined Regular and Irregular Experimental Groups

in the Learning of Each Form in Series I - V

Experiment Number	Sub-Group I			Sub-Group II		
	Total	Avg. for Form	Avg. for Trial	Total	Avg. for Form	Avg. for Trial
I1	11087.4	852.88-	14.12+	4225.8	362.16	19.04-
	6019.9**	547.28***	13.62**			
	14455.8***	1111.98***	16.48***			
I2	5620.1	468.34+	15.70-	6545.4	503.49+	27.86+
I3	2266.7	188.06-	10.12-	21589.5	1542.11-	54.66-
I4	3594.6	299.55	8.77+	23245.3	1549.69-	39.87+
I11	3811.6	317.63-	11.96-	2753.3	250.35-	17.66+
I111	1918.7	169.89+	10.96+	913.5	83.06-	8.96-
I12	1638.5	128.17-	9.55+	2965.1	269.55+	13.64-
I121	2266.0	188.83+	13.73+	1470.3	133.66+	10.28+
I13	670.8	60.98+	5.54+	5708.7	518.97+	19.16-
I131	1724.6	156.73+	12.50-	5402.4	491.13-	27.56+
I14	3724.2	358.56+	11.94-	7068.2	642.56+	14.73-
I141	2468.3	246.53	15.24-	2846.6	440.6	19.62+
I1111	1447.8	144.76	9.63-	1413.1	128.46+	9.81+
I11111	2611.3	261.13	13.01-	1801.6	163.77+	14.30-
I1121	528.5	52.85	6.61-	862.7	78.43-	9.69+
I11211	1413.9	141.39	11.44+	2435.8	225.98+	17.76-
I113	1793.6	179.36	16.76+	1971.4	179.22-	14.71+
I1131	1816.7	181.67	12.62-	3268.9	297.17+	21.61-
I114	900.8	90.08	6.67+	2944.8	267.71-	12.17-
I1141	1633.3	163.33	11.13+	2826.3	266.66-	16.06+

*All reaction time in seconds.

**These figures are obtained by excluding the results of Cases V and J in Series I, Form 1.

***These figures are obtained by including 92 doubtful trials of Case F.

Table 25 (cont'd)

Experiment Number	Sub-Group 1			Sub-Group 2		
	Total	Avg. for Form	Avg. for Trial	Total	Avg. for Form	Avg. for Trial
IVAs1	1378.9	137.89	9.98-	1342.9	134.29	11.58-
IVAs2	1096.0	109.6	11.7+	723.5	72.35	8.13-
IVAm	1854.6	185.46	10.42-	1914.4	191.44	17.89+
IVBs3	433.5	43.35	7.07+	711.4	71.14	9.61+
IVBm	1013.2	101.32	9.74+	2940.1	294.01	18.66-
IVCs4	548.8	54.88	5.54+	332.3	33.23	5.09+
IVCm	2464.4	246.44	16.06+	2256.0	225.6	19.79-
IVIs	5604.9	560.49	17.42-	557.3	55.73	54.64-
IVIm	1302.1	130.21	14.80-	989.7	98.97	17.86+
V2s	1371.9	137.19	8.4+-	663.0	66.3	7.13-
V2m	891.1	89.11	10.24+	832.2	83.22	10.96
V3s	2205.4	220.54	9.18-	790.1	79.01	7.12-
V3m	1070.0	107.0	12.43+	624.5	62.45	10.77-
V4s	987.5	98.75	6.67+	2549.2	254.92	8.53-
V4m	486.6	48.66	1.16-	798.7	79.87	10.79+

Table 26

Average Reaction Times* for Each Form Group Required

by Sub-Groups I and II Respectively of the Regular and Combined Experimental Groups

In the Learning of Series I - V

Subjects	Circle-Cross Group	Circle-Triangle Group	Circle-Square Group	Circle-Oval Group
Regular Sub-Group I	11,111s,111m, 1111s,1111m, IVAs1 2065.93 1680.04** 2406.77***	12,112s,112m, 1112s,1112m, IVAs2 344.69	13,113s,113m, 1113s,1113m, IVBs3 339.65	14,114s,114m, 1114s,1114m, IVCs4 1152.97
Regular Sub-Group II	1370.36 (1)	1573.19 (3)	3380.14 (4)	3516.38 (2)
Combined Sub-Groups I	1874.2 1568.5c** 2132.3*** (1)	1069.68 (3)	310.70 (2)	1183.23 (1)
Combined Sub-Groups II	1112.07 (4)	1283.46 (3)	3099.74 (4)	3196.64 (2)

The figures within the parentheses indicate the ranking order (descending) of the figures directly above.

*Reaction time in seconds.

**These figures are obtained by excluding the results of Cases F and J in II.

***These figures are obtained by including 92 doubtful trials of Case F.

d) Oral Behavior

Figure 24 (see page 103) shows that:

1) Individual differences among the members of the same group in the amount of oral behavior exhibited during the learning of Series I - V are very marked.

2) Group differences, while present, are relatively small. This is shown by the small differences in the means (37.99-% for Sub-group I and 45.04-% for Sub-group II) and medians (32.38-% for Sub-group I and 43.33-% for Sub-group II) of the two groups.

3) About 71% of the subjects of the Regular Experimental Group exhibited, both "regular" oral behavior (By "regular" oral behavior is meant that form of oral behavior in which the stimulus block is actually in contact with the subject's mouth.) and "special" oral behavior. (By "special" oral behavior is meant that form of concomitant oral behavior in which the stimulus block is not in actual contact with the subject's mouth.) Close observation of the total behavior patterns of this 71% throughout the entire experimental period suggests that this latter type of oral behavior occurred particularly in those infants who were more variable, labile, plastic and versatile in their activities than their companions who exhibited little or no "special" oral behavior. However, the amount of "special" or concomitant oral behavior present in a given subject was not correlated, either positively or negatively, with the degree of success in his discrimination

Oral Behavior

Regular Oral Behavior
Special Oral Behavior
Regular plus Special



performance. The amount of "regular" or "contact" oral behavior, however, bore an appreciably high positive correlation with the degree of success in his discrimination task. While the exact coefficient of correlation has not been finally computed, it may be estimated as somewhat above .60. This seems offhand to confirm the interpretation of "mouthing" [Stern (17), Volkelt (7), Révész (36)] as a tactual experience of some importance in the development of spatial qualities (see page 36). In any event, it seems to illustrate the results of enhancing motivation through a gustatory reward.

When the individual scores in oral behavior ("regular" + "special"), (see Figure 24 on page 103) were correlated with those in total number of trials (see Figure 13 on page 58), a negative coefficient of $.64 \pm .094$ was obtained. One might attribute this rather high degree of correlation between the two apparently distantly related phenomena in question to the combined result of two important factors discussed above: (1) the maintenance or even enhancement of initial motivating factors toward the positive stimulus through additional gustatory reward, (2) the addition of a second tactual aid in perceptual discrimination of contour.

Figures 25 and 26 (see pages 105 and 106) show the distribution of oral behavior from Series I through V. One possible interpretation of these curves, based on the assumed use of oral activity as a tactual auxiliary cue in infants' form discrimination, and the ability of these infants as

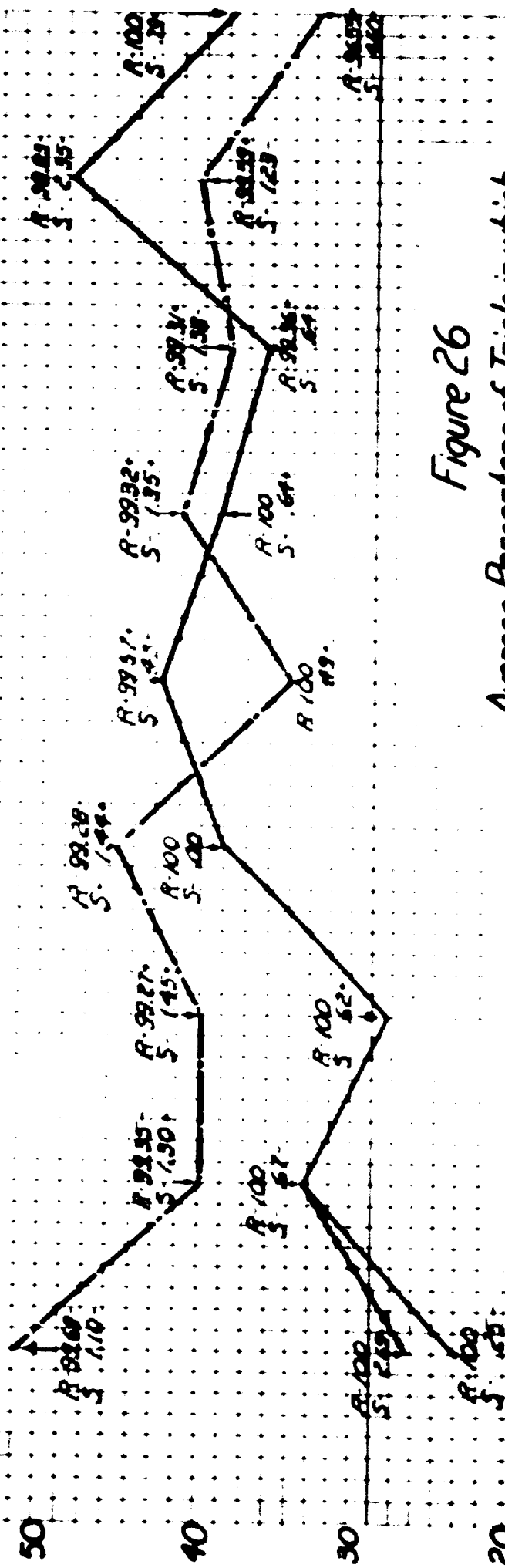


Figure 26

Average Percentage of Trials in which Oral Behavior was Exhibited by Sub-groups I and II Respectively of the Combined Regular and Irregular Experimental Groups in the Learning of Each Series from Series I-V

Abc/150 - Experimental Series
Ordinate - Percentage of Trials

Sub-group I — R: Regular

Sub-group II - - - S: Irregular

Cases Found Excluded from

Sub-group I in I/ —

I II III IV V VI VII VS VM

measured by their scores in the total number of trials, percentage of success and reaction time, is as follows:

The relatively high initial incidence of oral behavior in Sub-group II is apparently again related to the greater difficulty of the initial task; therefore, the total behavior pattern was more complex, as evidenced in oral behavior, reaction time, etc. The obvious influence or power of the gustatory reward, plus whatever assistance such oral manipulation added to the ease of discrimination, encouraged this behavior throughout all of Series I (see Table 27 on pages 108-111 and Table 28 on pages 112-115). The subjects in Sub-group I, on the other hand, began with a less difficult task and their initial responses were therefore qualitatively less complex or "diffuse," with less incidental mouthing as a motor "irradiation," and consequently less likelihood of forming a mouthing habit (see Tables 27 and 28).

From Series I on to Series IVX both groups of subjects apparently found their tasks to be of medium difficulty (see Figures 25 and 26 on pages 105 and 106). Here the complexity of the total behavior pattern, including oral activity, diminished.

In Series VS Sub-group I apparently found the change in the functional relationship between the positive and negative stimuli very upsetting, and in this series there is a striking increase in the incidence of oral behavior. Sub-group II, on the other hand, was not so greatly disturbed by the change

Table 27

Average Number and Percentage of Trials in which Oral Behavior was Exhibited
by Sub-Groups I and II Respectively of the Regular Experimental Group
in the Learning of Each Form in Series I - V

Experiment Number	Sub-Group	Total Number	Present			Absent
			Total	Regular ¹	Special ²	
I ₁	I	730	170	170	0	560
			23.00%	100 %	0 %	77.00%
		306 ^a	135 ^a	135 ^a	0 ^a	261 ^a
			34.09%	100 %	0 %	65.91%
		(831)	(174)	(174)	(0)	(657)
			(20.94%)	(100 %)	(0 %)	(79.06%)
	II	195	95	94	2	100
			48.72%	98.95%	2.11%	51.28%
I ₂	I	515	76	76	0	259
			24.13%	100 %	0 %	75.87%
	II	196	116	116	2	80
			59.18%	100 %	1.72%	40.82%
I ₃	I	203	54	54	1	149
			26.60%	100 %	1.85%	73.40%
	II	279	152	151	2	127
			54.48%	99.34%	13.2 %	45.52%
I ₄	I	308	86	86	0	302
			22.16%	100 %	0 %	77.84%
	II	374	199	199	1	175
			53.21%	100 %	.50%	46.79%
II ₁₀	I	309	86	86	0	224
			27.81%	100 %	0 %	72.49%
	II	145	60	60	1	85
			41.38%	100 %	1.67%	58.62%
II ₁₂	I	156	32	32	0	124
			20.65%	100 %	0 %	79.35%
	II	69	35	35	0	34
			50.33%	100 %	0 %	49.67%
II ₂₀	I	151	39	39	0	112
			25.83%	100 %	0 %	74.17%
	II	183	86	86	0	97
			46.45%	100 %	0 %	53.55%

The figures within the parentheses are obtained by including 92 doubtful trials of Case F.

These figures are obtained by excluding the results of Cases F and J in Series I, Run 1.

¹ "regular" oral behavior is meant that form of oral behavior in which the stimulus block is actually in contact with the subject's mouth.

² "special" oral behavior is meant that form of oral behavior in which the stimulus block is not in actual contact with the subject's mouth.

Table 27 (cont'd)

Experiment Number	Sub-Group	Total Number	Present			Absent
			Total	Regular	Special	
II _{2a}	I	139	49	49	1	90
			35.26%	100 %	2.04%	64.73%
	II	133	56	56	2	77
			42.11%	98.21%	3.57%	57.89%
II _{2b}	I	116	51	51	0	65
			43.97%	100 %	0 %	56.03%
	II	251	112	112	0	139
			44.62%	100 %	0 %	55.38%
II _{2c}	I	128	37	37	0	91
			28.91%	100 %	0 %	71.09%
	II	132	69	69	1	63
			52.27%	100 %	1.45%	47.73%
II _{4a}	I	217	79	79	2	138
			36.41%	100 %	2.53%	63.59%
	II	387	146	145	2	241
			37.73%	99.32%	1.37%	62.27%
II _{4b}	I	162	43	43	0	119
			26.54%	100 %	0 %	73.46%
	II	198	78	77	1	120
			39.39%	98.72%	1.28%	60.61%
III _{1a}	I	152	45	45	0	107
			29.61%	100 %	0 %	70.39%
	II	139	45	44	2	94
			32.37%	97.78%	4.44%	67.63%
III _{1b}	I	145	72	72	0	73
			49.66%	100 %	0 %	50.34%
	II	102	35	35	0	67
			34.31%	100 %	0 %	65.69%
III _{2a}	I	80	38	38	0	42
			47.5 %	100 %	0 %	52.5 %
	II	72	27	26	2	45
			37.5 %	96.50%	7.41%	62.5 %
III _{2b}	I	124	57	57	0	67
			45.97%	100 %	0 %	54.03%
	II	117	42	42	1	75
			35.90%	100 %	2.38%	64.10%
III _{2c}	I	107	40	40	0	67
			37.38%	100 %	0 %	62.62%
	II	106	53	53	0	53
			50 %	100 %	0 %	50 %

Table 27 (cont'd)

Experiment Number	Sub-Group	Total Number	Present			Absent
			Total	Regular	Special	
III _{3a}	I	144	54	54	0	90
			37.5 %	100 %	0 %	62.5 %
	II	113	40	40	0	73
			35.40 %	100 %	0 %	64.60 %
III _{4a}	I	135	60	60	0	75
			44.44 %	100 %	0 %	55.56 %
	II	204	110	110	0	94
			53.92 %	100 %	0 %	46.08 %
III _{4a}	I	137	52	51	1	85
			37.96 %	98.08 %	1.92 %	62.04 %
	II	166	63	63	0	103
			37.95 %	100 %	0 %	62.05 %
IV _{Aa1}	I	144	48	48	1	96
			33.33 %	100 %	2.08 %	66.67 %
	II	116	53	53	0	63
			45.69 %	100 %	0 %	54.31 %
IV _{Aa2}	I	93	24	24	0	69
			25.81 %	100 %	0 %	74.19 %
	II	89	38	38	0	51
			42.70 %	100 %	0 %	57.30 %
IV _{Am}	I	178	44	44	0	134
			24.72 %	100 %	0 %	75.28 %
	II	107	46	46	1	61
			42.99 %	100 %	2.17 %	57.01 %
IV _{Ba3}	I	62	35	35	0	27
			56.45 %	100 %	0 %	43.55 %
	II	74	25	24	1	49
			33.78 %	96 %	4 %	66.22 %
IV _{Ba}	I	104	46	46	0	58
			44.23 %	100 %	0 %	55.77 %
	II	158	55	54	1	103
			34.81 %	98.18 %	1.82 %	65.19 %
IV _{Ba4}	I	99	49	49	0	50
			49.49 %	100 %	0 %	50.51 %
	II	77	32	32	1	45
			41.56 %	100 %	3.13 %	58.44 %
IV _{Ba}	I	154	67	66	1	87
			43.51 %	98.51 %	1.49 %	56.49 %
	II	114	44	44	0	70
			38.60 %	100 %	0 %	61.40 %

Table 27 (cont'd)

Experiment Number	Sub-Group	Total Number	Present			Absent
			Total	Regular	Special	
V ₁₂	I	322	151	140	3	171
			46.82%	98.68%	1.99%	53.11%
	II	102	49	49	0	53
			48.04%	100%	0%	51.96%
V ₁₃	I	88	29	29	0	59
			32.95%	100%	0%	67.05%
	II	57	10	10	0	47
			17.54%	100%	0%	82.46%
V ₁₄	I	162	75	72	4	87
			46.30%	96%	5.35%	53.70%
	II	93	38	38	0	55
			40.86%	100%	0%	59.14%
V ₁₅	I	87	41	41	0	46
			47.13%	100%	0%	52.87%
	II	76	27	27	0	49
			35.53%	100%	0%	64.47%
V ₁₆	I	249	118	118	3	131
			47.39%	100%	2.54%	52.61%
	II	111	47	47	1	64
			42.34%	100%	2.13%	57.66%
V ₁₇	I	86	28	28	1	58
			32.56%	100%	3.57%	67.44%
	II	58	14	14	0	44
			24.14%	100%	0%	75.86%
V ₁₈	I	148	82	82	0	66
			55.41%	100%	0%	44.59%
	II	299	110	109	2	189
			36.79%	99.09%	1.82%	63.21%
V ₁₉	I	68	28	28	0	40
			41.18%	100%	0%	58.82%
	II	74	36	33	4	38
			48.65%	91.67%	11.11%	51.35%

Table 28

Average number and Percentage of Trials in which Oral Behavior was Exhibited
by Sub-Groups I and II Respectively
of the Combined Regular and Irregular Experimental Groups
in the Learning of Each Form in Series I - V

Experiment Number	Sub-Group	Total Number	Present			Absent
			Total	Regular ²⁸	Special ²⁹	
I ₁	I	786	178	178	0	607
			22.66%	100 %	0 %	77.32%
		442 ^a	143 ^a	143 ^a	0 ^a	299 ^a
	II		32.35% ^a	100 % ^a	0 % ^a	67.65% ^a
		(877)	(182)	(182)	(0)	(695)
			20.75% ^a	(100 %)	(0 %)	(79.25% ^a)
I ₂	I	222	104	103	2	118
			46.85%	99.04%	1.92%	53.15%
	II	358	84	84	0	274
			23.46%	100 %	0 %	76.54%
I ₃	I	255	125	125	2	130
			53.19%	100 %	1.60 %	46.81%
	II	223	55	55	1	168
			24.66%	100 %	1.82%	75.34%
I ₄	I	395	178	177	2	217
			45.06%	99.44%	1.12%	54.94%
	II	413	91	91	0	322
			22.03%	100 %	0 %	77.97%
II _{1a}	I	583	284	284	1	299
			48.71%	100 %	.35%	51.29%
	II	319	91	91	0	228
			28.53%	100 %	0 %	71.47%
II _{1b}	I	186	62	62	1	94
			39.74%	100 %	1.61%	60.26%
	II	175	42	42	0	133
			24 %	100 %	0 %	76 %
II _{2a}	I	102	43	43	0	59
			42.16%	100 %	0 %	57.84%
	II	161	44	44	0	117
			27.33%	100 %	0 %	72.67%
II _{2b}	I	219	91	91	0	128
			41.55%	100 %	0 %	58.45%

^a Figures within the parentheses are obtained by including 92 doubtful trials of Case F.

^b These figures are obtained by excluding the results of Cases F and J in Series I.

²⁸ "Regular" oral behavior is meant that form of oral behavior in which the stimulus block is actually in contact with the subject's mouth.

²⁹ "Special" oral behavior is meant that form of oral behavior in which the stimulus block is not in actual contact with the subject's mouth.

Table 28 (cont'd)

Experiment Number	Sub-Group	Total Number	Present			Absent
			Total	Regular	Special	
II _{2a}	I	165	63	63	1	102
			38.18%	100 %	1.59%	61.82%
	II	143	56	55	2	87
			39.16%	98.21%	3.57%	60.84%
II _{2b}	I	121	52	52	0	69
			42.98%	100 %	0 %	57.02%
	II	298	126	125	1	172
			42.28%	99.21%	.79%	57.72%
II _{2c}	I	138	38	38	0	100
			27.54%	100 %	0 %	72.46%
	II	196	80	80	1	116
			40.82%	100 %	1.25 %	59.18%
II _{3a}	I	312	120	120	2	192
			38.46%	100 %	1.67%	61.54%
	II	480	181	179	4	299
			37.71%	98.90%	2.21%	62.29%
II _{3b}	I	162	43	43	0	119
			26.54%	100 %	0 %	73.46%
	II	247	96	95	1	151
			38.87%	98.96%	1.04%	61.13%
III _{1a}	I	152	45	45	0	107
			29.61%	100 %	0 %	70.39%
	II	144	47	46	2	97
			32.64%	97.87%	4.24%	67.36%
III _{1b}	I	145	72	72	0	73
			49.66%	100 %	0 %	50.34%
	II	126	39	39	0	87
			30.95%	100 %	0 %	69.05%
III _{2a}	I	80	38	38	0	42
			47.5 %	100 %	0 %	52.5 %
	II	89	35	34	2	54
			39.33%	97.14%	5.71%	60.67%
III _{2b}	I	124	57	57	0	67
			45.97%	100 %	0 %	54.03%
	II	140	46	46	1	94
			32.86%	100 %	2.17%	67.14%
III _{2c}	I	107	40	40	0	67
			37.38%	100 %	0 %	62.62%
	II	134	66	66	0	68
			49.25%	100 %	0 %	50.75%

Table 28 (cont'd)

Experiment Number	Sub-group	Total Number	Present			Absent
			Total	Regular	Special	
III _{2m}	I	144	54	54	0	90
			37.5%	100%	0%	62.5%
		152	50	50	0	102
III _{4m}	I	135	60	60	0	75
			44.44%	100%	0%	55.56%
		242	129	129	0	113
III _{6m}	I	137	52	51	1	85
			37.96%	98.08%	1.92%	62.04%
		176	69	69	0	107
IV _{As1}	I	144	48	48	1	96
			33.33%	100%	2.08%	66.67%
		116	53	53	0	63
IV _{As2}	I	93	24	24	0	69
			25.81%	100%	0%	74.19%
		89	38	38	0	51
IV _{Am}	I	178	44	44	0	134
			24.72%	100%	0%	75.28%
		107	46	46	1	61
IV _{Ms}	I	62	35	35	0	27
			56.45%	100%	0%	43.55%
		74	25	24	1	49
IV _{Ms}	I	104	46	46	0	58
			44.23%	100%	0%	55.77%
		156	55	54	1	101
IV _{Ms}	I	99	49	49	0	50
			49.49%	100%	0%	50.51%
		77	32	32	1	45
IV _{Ms}	I	154	67	66	1	87
			43.51%	98.51%	1.49%	56.49%
		114	44	44	0	70
	II		38.60%	100%	0%	61.40%

Table 28 (cont'd)

Experiment Number	Sub-Group	Total Number	Present			Absent
			Total	Regular	Special	
V ₁₀	I	322	151	149	3	171
			46.89%	98.68%	1.99%	53.11%
	II	102	49	49	0	53
V ₁₁	I	88	48.04%	100%	0%	51.96%
			29	29	0	59
	II	57	32.95%	100%	0%	67.05%
V ₁₂	I	162	10	10	0	47
			17.54%	100%	0%	82.46%
	II	93	75	72	4	87
V ₁₃	I		46.30%	96%	5.33%	53.70%
			38	38	0	55
	II	87	40.86%	100%	0%	59.14%
V ₁₄	I	67	41	41	0	46
			47.13%	100%	0%	52.87%
	II	76	27	27	0	49
V ₁₅	I		35.53%	100%	0%	64.47%
			118	118	3	131
	II	249	47	47	1	64
V ₁₆	I	111	42.34%	100%	2.13%	57.66%
			86	28	1	58
	II	58	32.56%	100%	3.67%	67.44%
V ₁₇	I		14	14	0	44
			24.14%	100%	0%	75.86%
	II	146	82	82	0	66
V ₁₈	I		55.41%	100%	0%	44.59%
			299	110	2	189
	II		36.79%	99.09%	1.82%	63.21%
V ₁₉	I	68	28	28	0	40
			41.18%	100%	0%	58.82%
	II	74	36	33	4	38
			48.65%	91.67%	11.11%	51.35%

and its oral behavior increment was not so marked.

In Series VM where both groups proved easily adjustable to the change in the spatial orientation of the positive blocks, the incidence of oral behavior markedly decreases.

Tables 27 (see pages 108-111) and 28 (see pages 112-115), showing the average number and percentage of trials in which oral behavior was exhibited by the sub-groups of the Regular and the Combined Experimental Groups respectively in the learning of each form in Series I - V, corroborate the statements made on the basis of the statistics presented in Figures 25 and 26 (see pages 105 and 106). Thus, whatever be the significance or interpretation of this form of behavior, it is a dynamic concomitant clearly related in infancy to the difficulty of a given task.

e) Vocalization

Figure 27 (see page 117) shows that:

1) Individual differences among the members of the same group in the amount of vocalization during the learning of Series I - V are marked.

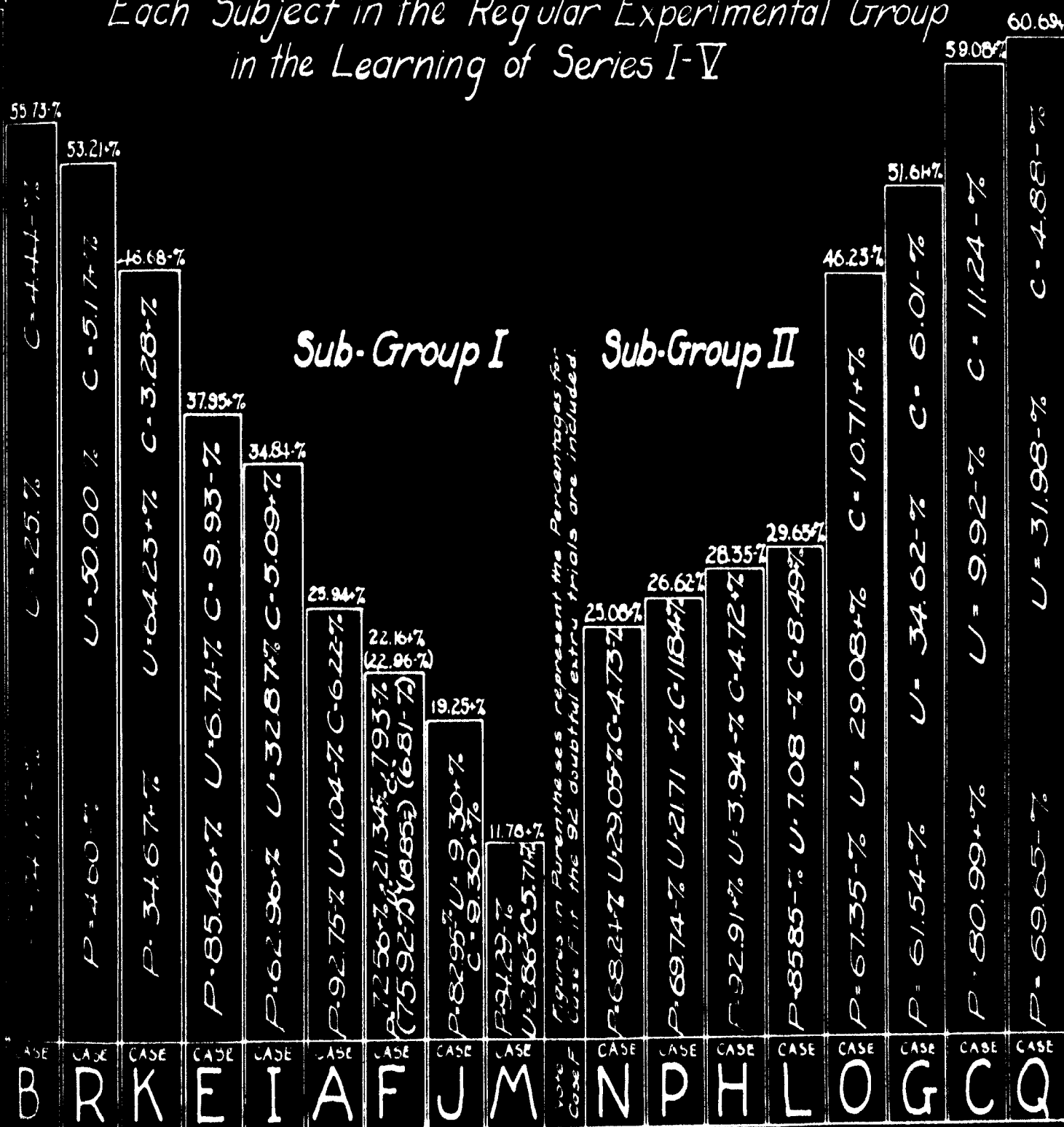
2) The group differences are relatively insignificant. This is shown by the very small difference between the (1) means (37.03+ $\%$ for Sub-group I and 40.91+ $\%$ for Sub-group II) and (2) medians (36.40- $\%$ for Sub-group I and 37.94+ $\%$ for Sub-group II) of the respective groups.

3) Among the three types of vocalization observed in each subject, expressions of pleasantness are by far the

Figure 27

Vocalization

Percentage of Trials in which it Occured with
Each Subject in the Regular Experimental Group
in the Learning of Series I-V



most predominant in all the infants except Cases K and R. Expressions of unpleasantness are second in order of frequency in 56% of the cases, third in 33% of the cases, and first in Cases K and R. Communicative vocalization (Communicative vocalization is that type which is apparently more than spontaneous vocalization, coupled with a general pleasant or unpleasant state of the subject. It conveys some spatially directed meaning: such as, an attempt to communicate with someone or something; or the sounds accompanying a search for the block after it has slipped out of the subject's grasp and disappeared from sight, etc.) is least frequent in eleven, and second in nine of the total eighteen subjects.

When the individual scores in vocalization were correlated with those in total number of trials, a positive coefficient of correlation of $.0058 \pm .16$ was obtained. This complete lack of correlation between the two types of behavior under consideration stands out even more vividly if Figures 14 and 15 (see pages 62 and 63) are compared with Figures 28 and 29 (see pages 119 and 120) respectively. This would seem to invalidate the very common use of the vocalization increment as a reliable behavior criterion indicative of the ease or difficulty of a given perceptual pattern or learning task [of. Fajans (47,48)]. However, that vocalization is intimately related to the general "dynamic" or affective phases of behavior remains unchallenged.

Tables 29 (see pages 122-125) and 30 (see pages 126-129)

Abc1330-Experimental Series
 Ordinate-Percentage of Trials
 Sub-group I ——— P: Present
 Sub-group II ——— U: Unpresent
 Cases F and J Excluded from
 Sub-group I in II ——— C: Communicative

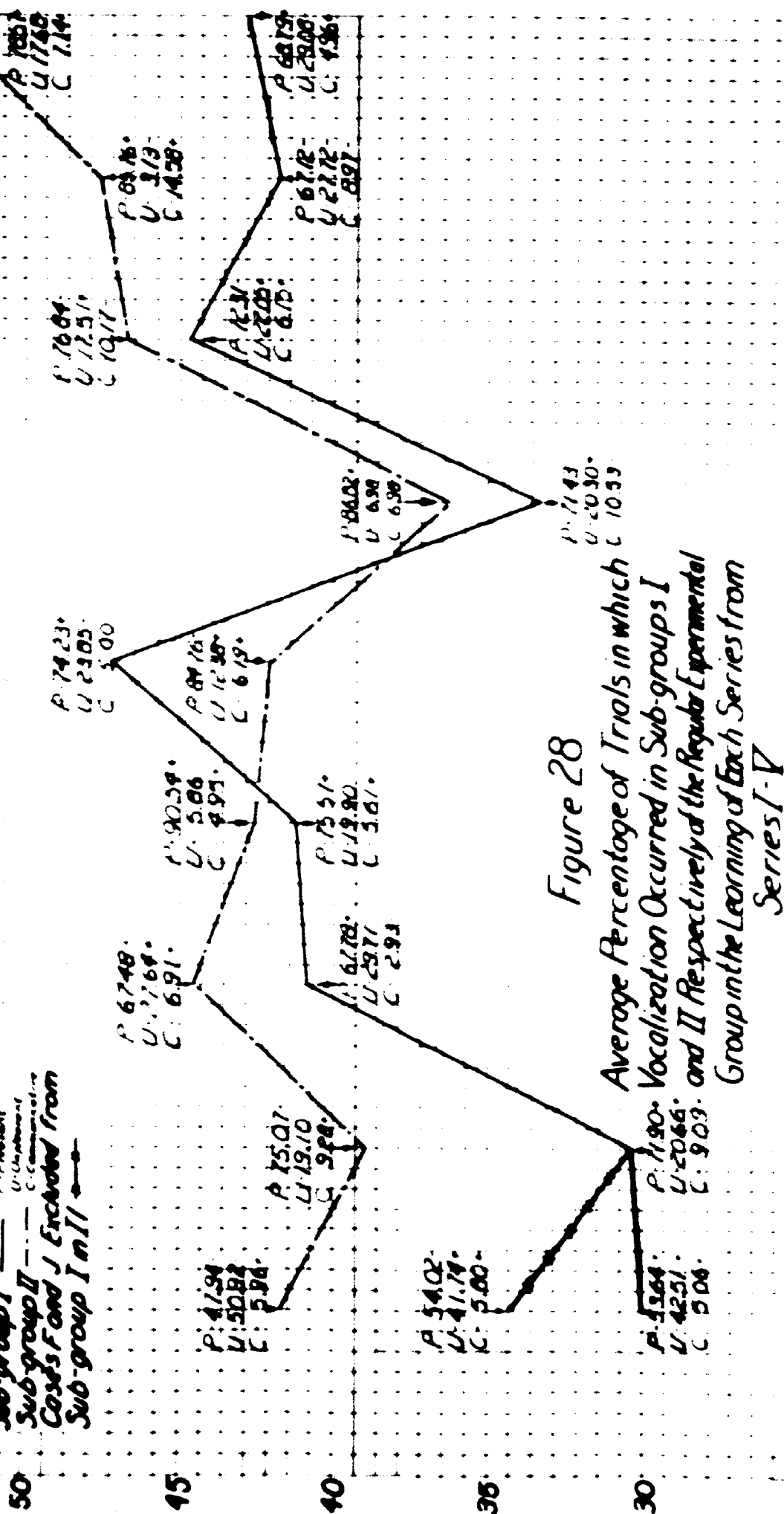
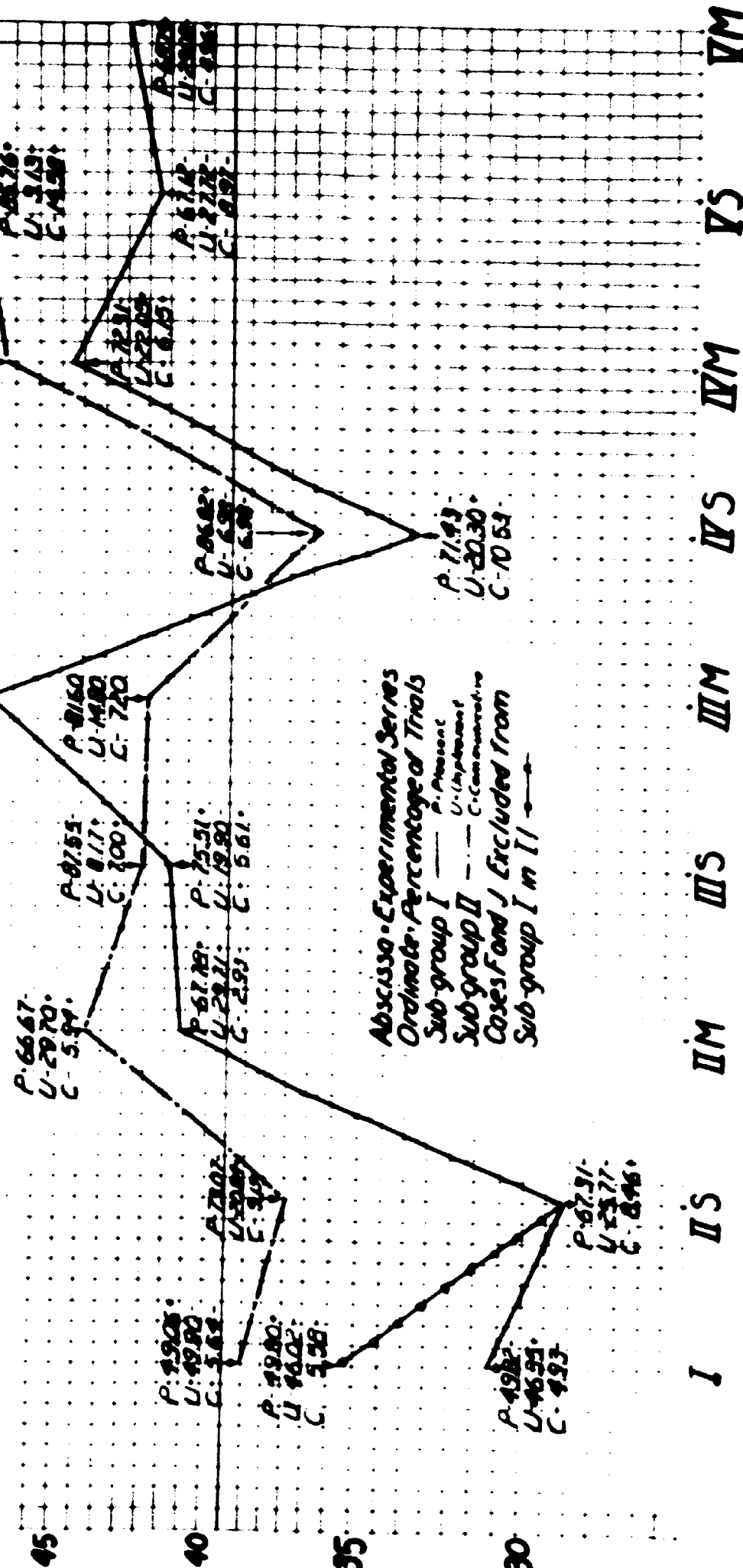


Figure 28
 Average Percentage of Trials in which
 Vocalization Occurred in Sub-groups I
 and II Respectively of the Regular Experimental
 Group in the Learning of Each Series from
 Series I-V

Figure 29

Average Percentage of Trials in which Vocalization Occurred in Subgroups I and II Respectively of the Combined Regular and Irregular Experimental Group in the Learning of Each Series from Series I-V



Abscissa - Experimental Series
Ordinate - Percentage of Trials
Sub-group I — P. Present
Sub-group II - - U. Unpresent
Cases F and J Excluded from Sub-group I in II

show that:

1) In Series I, the percentage of trials in which vocalization occurred in Sub-group I increased steadily from Form 1 to 4; expressions of pleasantness and communication increased, while those of unpleasantness decreased from Form 1 to 4. This is true with or without the exclusion of the results from Cases F and J in Form 1. These data seem to present a very clear picture of the gradual and successful adjustment of the subjects to the general experimental situation as well as to the specific stimulus patterns (cf. Tables 14 on page 70, 19 on page 84, and 26 on page 101).

The corresponding data from Sub-group II, on the other hand, do not give us such a picture of orderly adaptation or adjustment. Although there was a general tendency for the percentage of trials in which vocalization occurred to increase from the beginning to the end of Series I, no systematic increase or decrease could be detected in the relative frequency of expressions of pleasantness, unpleasantness, and communication within the total amount.

2) In Series IIM, the percentage of trials in which vocalization occurred increased consistently from form to form with Sub-group I and decreased in general with Sub-group II.¹ Vocalization of pleasantness decreased in Sub-group I

¹The terms "increase" and "decrease," used here and in the following pages, describe the changes in the size of the scores from form to form in a given series in the order in

Table 29

Average Number and Percentage of Trials in which Vocalization Occurred
in Sub-Groups I and II Respectively of the Regular Experimental Group
in the Learning of Each Form in Series I - V

Experiment Number	Sub-Group	Total Number	Present				Absent
			T.	P.	U.	C. ²²	
I ₁	I	739	179	79	103	0	580
			24.22%	44.13%	57.54%	0 %	75.78%
		396*	133*	88*	50*	0*	263*
	II		33.59-%	43.11-%	60.15-%	0 %	66.41-%
		(831)	(208)	(103)	(104)	(0)	(625)
			(24.79-%)	(50.97-%)	(50.49-%)	(0 %)	(75.21-%)
I ₂	I	195	82	37	42	6	113
			42.05%	45.12%	51.22-%	7.32-%	57.95-%
	II	315	81	39	38	5	234
			25.71%	48.15-%	46.91%	6.17%	74.29-%
I ₃	I	196	94	43	49	5	102
			47.96-%	45.74%	52.13-%	5.32-%	52.04%
	II	203	72	40	27	6	131
			35.47-%	55.56-%	37.5 %	8.33%	64.53%
I ₄	I	279	112	64	51	7	167
			40.14%	57.14%	45.54-%	6.25 %	59.86-%
	II	368	162	107	42	15	226
			41.75%	66.05-%	25.93-%	9.26-%	58.25-%
II _{1a}	I	374	148	65	80	8	226
			39.57%	43.92-%	54.05%	5.41-%	60.43-%
	II	309	91	68	14	11	218
			29.45-%	74.73-%	15.38%	12.09-%	70.55%
II _{1b}	I	145	60	44	11	7	85
			41.38-%	73.33%	16.33%	1.17-%	58.62%
	II	166	52	42	6	4	103
			38.85-%	60.77-%	11.54-%	7.69%	61.45%
II _{2a}	I	69	28	22	4	2	41
			31.46%	78.57%	14.29-%	7.14%	68.54-%
	II	151	42	34	6	2	109
			27.81%	80.93%	14.29-%	4.76%	72.19-%
II _{2b}	I	163	61	46	12	5	122
			33.33%	75.41-%	19.67%	8.20-%	66.67-%

The figures within the parentheses are obtained by including 92 doubtful trials of Case F.

*These figures are obtained by excluding the results of Cases F and J in Series I, Form 1.

T.=Total; P.=Pleasant; U.=Unpleasant; C.=Communicative

²²Communicative vocalization is that type which is apparently more than spontaneous vocalization, coupled with a general pleasant or unpleasant state of the subject. It conveys some spatially directed meaning; such as an attempt to communicate with someone or something; or the sounds accompanying a search for the block after it has slipped out of the subject's grasp and disappeared from sight.

Table 29 (cont'd)

Experiment Number	Sub-Group	Total Number	Present				Absent
			T.	P.	U.	C.**	
II _{2m}	I	139	54	40	13	1	86
			38.85-%	74.07-%	24.07-%	1.86-%	61.15-%
	II	133	61	41	17	5	72
			45.86-%	67.21-%	27.87-%	8.20-%	54.14-%
II _{3s}	I	116	42	29	9	6	74
			36.21-%	69.05-%	21.43-%	14.29-%	63.79-%
	II	251	117	80	32	12	134
			46.61-%	68.38-%	27.35-%	10.26-%	53.39-%
II _{3m}	I	128	52	34	18	1	76
			40.63-%	65.38-%	34.62-%	1.92-%	59.37-%
	II	132	66	46	19	3	66
			50 %	69.70-%	28.79-%	4.58-%	50 %
II _{4s}	I	217	67	43	21	3	150
			30.88-%	64.18-%	31.34-%	4.48-%	69.12-%
	II	387	139	113	17	11	248
			35.92-%	81.29-%	12.23-%	7.91-%	64.08-%
II _{4m}	I	162	81	46	34	1	81
			50 %	56.79-%	41.98-%	1.23-%	50 %
	II	198	91	57	28	7	107
			45.96-%	62.64-%	30.77-%	7.69-%	54.04-%
III _{1s}	I	152	65	54	5	6	87
			42.76-%	83.08-%	7.69-%	9.23-%	57.24-%
	II	139	58	55	4	0	81
			41.73-%	94.83-%	6.90-%	0 %	58.27-%
III _{1m}	I	145	73	54	20	4	72
			50.34-%	73.97-%	27.40-%	5.48-%	49.66-%
	II	102	43	39	2	3	59
			42.16-%	90.70-%	4.65-%	6.98-%	57.84-%
III _{2s}	I	80	37	35	1	2	43
			46.25 %	74.59-%	2.70-%	5.41-%	53.75 %
	II	72	37	31	3	3	35
			51.39-%	83.78-%	8.11-%	8.11-%	48.61-%
III _{2m}	I	124	54	45	9	0	70
			43.55-%	83.33-%	16.67-%	0 %	56.45-%
	II	117	50	45	1	5	67
			42.74-%	90 %	2 %	10 %	57.26-%
III _{3s}	I	107	44	24	20	1	63
			41.12-%	54.55-%	45.45-%	2.27-%	58.88-%
	II	106	43	36	2	4	63
			40.57-%	88.37-%	4.65-%	9.50-%	59.43-%

Table 29 (cont'd)

Experiment Number	Sub-Group	Total Number	Present				Absent
			T.	P.	U.	C.	
III _{3m}	I	144	71	40	29	4	73
			49.31%	56.34%	40.85%	5.63%	50.69%
	II	113	57	50	9	2	56
			50.44%	87.72%	15.79%	35.09%	49.56%
III _{4a}	I	135	50	55	13	2	63
			37.04%	70	26	4	62.96%
	II	204	84	77	4	4	120
			41.18%	91.67%	4.76%	4.76%	58.82%
III _{4m}	I	137	62	54	4	5	75
			45.26%	87.10%	6.45%	8.06%	54.74%
	II	166	60	44	14	3	106
			36.14%	73.33%	23.33%	5	63.86%
IV _{Aa1}	I	144	47	34	5	8	97
			32.64%	72.34%	10.64%	17.02%	67.36%
	II	116	43	38	4	1	73
			37.07%	88.37%	9.30%	2.53%	62.93%
IV _{Aa2}	I	93	48	30	17	4	45
			51.61%	62.5	35.42%	8.33%	48.39%
	II	89	25	21	2	2	64
			28.09%	84	8	8	71.91%
IV _{Am}	I	178	89	57	25	7	89
			50	64.04%	28.09%	7.87%	50
	II	107	50	34	14	5	57
			46.73%	68	28	10	53.27%
IV _{Ba3}	I	62	12	11	1	0	50
			19.35%	91.67%	8.33%	0	80.65%
	II	74	30	23	3	5	44
			40.54%	76.67%	10	16.67%	59.46%
IV _{Bm}	I	104	45	37	8	1	59
			43.27%	82.22%	17.78%	2.22%	56.73%
	II	158	70	59	4	9	88
			44.30%	84.29%	5.71%	12.86%	55.70%
IV _{Ca4}	I	99	26	20	4	2	73
			26.26%	76.92%	15.38%	7.69%	73.74%
	II	77	31	30	0	1	46
			40.26%	96.77%	0	3.23%	59.73%
IV _{Om}	I	154	61	47	10	4	93
			39.61%	77.05%	16.39%	6.56%	60.39%
	II	114	57	43	13	4	57
			50	75.44%	22.81%	7.02%	50

Table 29 (cont'd)

Experiment Number	Sub-group	Total Number	Present				Absent
			I.	P.	U.	C.	
V _{1s}	I	322	133	86	35	15	189
			41.30 ±	64.66 ±	26.32 ±	11.25 ±	58.70 ±
	II	102	45	42	0	4	57
			44.12 ±	93.33 ±	0	8.89 ±	55.88 ±
V _{1m}	I	88	39	27	13	2	49
			44.32 ±	69.23 ±	33.33 ±	5.13 ±	55.68 ±
	II	87	28	20	2	1	58
			38.60 ±	90.91 ±	9.09 ±	4.55 ±	61.40 ±
V _{2s}	I	162	66	43	16	11	96
			40.74 ±	68.15 ±	24.24 ±	16.67 ±	59.26 ±
	II	93	42	39	0	7	51
			45.16 ±	92.86 ±	0	16.67 ±	54.84 ±
V _{2m}	I	87	45	27	17	1	42
			51.72 ±	60	37.78 ±	2.22 ±	48.28 ±
	II	76	38	27	12	0	38
			50	71.05 ±	31.58 ±	0	50
V _{3s}	I	249	119	89	32	5	130
			47.79 ±	74.79 ±	26.89 ±	4.20 ±	52.21 ±
	II	111	55	46	5	6	56
			49.55 ±	83.64 ±	9.09 ±	10.91 ±	50.45 ±
V _{3m}	I	86	28	21	7	1	58
			32.56 ±	75	25	3.57 ±	67.44 ±
	II	58	37	26	7	8	21
			63.79 ±	70.27 ±	18.92 ±	13.51 ±	36.21 ±
V _{4s}	I	148	50	29	19	2	98
			33.78 ±	58	38	4	66.22 ±
	II	299	146	120	4	25	153
			48.83 ±	82.19 ±	2.74 ±	17.12 ±	51.17 ±
V _{4m}	I	68	29	22	4	3	39
			42.65 ±	75.86 ±	13.79 ±	10.54 ±	57.35 ±
	II	74	43	37	4	4	31
			58.11 ±	86.05 ±	9.30 ±	9.30 ±	41.89 ±

Table 30

Average Number and Percentage of Trials in which Vocalization Occurred
in Sub-Groups I and II Respectively
of the Combined Regular and Irregular Experimental Groups
in the Learning of Each Form in Series I - V

Exper. Number	Sub-Group	Total Number	Present				Absent
			F.	P.	U.	C. ^{ab}	
I ₁	I	786	198	82	118	1	587
			25.22%	41.41%	59.60%	.51%	74.78%
		442 ^a	152 ^a	59 ^a	95 ^a	1 ^a	290 ^a
	II		34.59-% ^a	38.82-% ^a	62.5-% ^a	.66-% ^a	65.61-% ^a
		(877)	(225)	(108)	(119)	(1)	(652)
			(28.66-%)	(48-%)	(52.89-%)	(.44-%)	(74.34-%)
I ₂	I	222	84	38	43	6	138
			37.84-%	45.24-%	51.19-%	7.14-%	62.16-%
	II	358	102	42	56	5	256
I ₃	I	235	109	54	54	5	126
			46.38-%	49.54-%	49.54-%	4.59-%	53.62-%
	II	223	77	40	32	6	146
I ₄	I	395	149	71	80	8	246
			37.72-%	47.65-%	53.69-%	5.37-%	62.28-%
	II	413	177	109	54	16	236
II _{1a}	I	583	202	98	101	9	381
			34.65-%	46.51-%	50-%	4.46-%	65.36-%
	II	319	96	69	18	11	223
II _{1b}	I	156	62	44	13	7	94
			39.74-%	70.97-%	20.97-%	11.29-%	60.26-%
	II	175	87	48	11	4	118
II _{2a}	I	102	30	24	4	3	72
			29.41-%	80-%	13.33-%	10-%	70.59-%
	II	161	47	34	11	2	114
II _{2b}	I	219	70	54	13	5	149
			31.96-%	77.14-%	18.57-%	7.14-%	68.04-%
	II						

The figures within the parentheses are obtained by including 92 doubtful trials of Case F.

These figures are obtained by excluding the results of Cases F and J in Series I, Form 1.

Total; F=Pleasant; U=Unpleasant; C=Communicative

Communicative vocalization is that type which is apparently more than spontaneous vocalization, coupled with a general pleasant or unpleasant state of the subject. It conveys some spatially directed meaning; such as an attempt to communicate with someone or something; or the sounds accompanying a search for a block after it has slipped out of the subject's grasp and disappeared from sight.

Table 30 (cont'd)

Experiment Number	Sub-Group	Total Number	Present				Absent
			T.	P.	U.	C.	
II _{2a}	I	165	58	41	16	1	107
			35.15%	70.69%	27.59%	1.72%	64.86%
II _{2a}	II	143	61	41	17	5	82
			42.66%	67.21%	27.87%	8.20%	57.34%
II _{3a}	I	121	42	29	9	6	79
			34.71%	69.05%	21.43%	14.29%	65.29%
II _{3a}	II	298	135	92	37	13	163
			45.30%	68.15%	27.41%	9.63%	54.70%
II _{3a}	I	136	53	34	19	1	86
			38.41%	64.15%	35.85%	1.89%	61.59%
II _{3a}	II	196	102	72	29	3	94
			52.04%	70.59%	28.43%	2.94%	47.96%
II _{4a}	I	312	84	43	38	3	228
			26.92%	51.19%	45.24%	3.57%	73.08%
II _{4a}	II	460	160	122	26	14	320
			33.33%	76.25%	16.25%	8.75%	66.68%
II _{4a}	I	162	81	46	34	1	81
			50%	56.79%	41.98%	1.23%	50%
II _{4a}	II	247	110	65	40	7	137
			44.53%	59.09%	36.36%	6.86%	55.47%
III _{1a}	I	152	66	54	5	6	87
			42.76%	83.08%	7.69%	9.23%	57.24%
III _{1a}	II	144	60	55	4	2	84
			41.67%	91.67%	6.67%	3.33%	58.33%
III _{1a}	I	145	73	54	20	4	72
			50.34%	73.97%	27.40%	5.48%	49.66%
III _{1a}	II	126	51	45	2	6	75
			40.48%	68.24%	3.92%	11.76%	59.52%
III _{2a}	I	80	37	35	1	2	45
			46.25%	94.59%	2.70%	8.63%	53.75%
III _{2a}	II	89	45	38	3	5	44
			50.56%	84.44%	6.67%	11.11%	49.44%
III _{2a}	I	124	54	45	9	0	70
			43.55%	83.33%	16.67%	0%	56.45%
III _{2a}	II	140	59	51	4	5	81
			42.14%	86.44%	6.78%	8.47%	57.86%
III _{3a}	I	107	44	24	20	1	63
			41.12%	54.55%	45.45%	2.27%	58.88%
III _{3a}	II	134	56	52	2	6	78
			43.28%	89.66%	3.45%	10.34%	56.72%

Table 30 (cont'd)

Experiment Number	Sub-Group	Total Number	Present				Absent
			T.	P.	U.	C.	
III _{3m}	I	144	71	40	29	4	73
			49.31%	56.34%	40.85%	5.63%	50.69%
	II	152	76	64	13	4	76
			50%	84.21%	17.11%	8.26%	50%
III _{4s}	I	155	50	35	13	2	85
			37.04%	70%	26%	4%	62.96%
	II	242	94	80	12	5	148
			38.84%	85.11%	12.77%	5.32%	61.16%
III _{4m}	I	157	62	54	4	5	75
			45.26%	87.10%	6.45%	8.06%	54.74%
	II	176	64	44	18	3	112
			36.36%	68.75%	28.13%	4.69%	63.64%
IV _{Aa1}	I	144	47	34	5	8	97
			32.64%	72.34%	10.64%	17.02%	67.36%
	II	116	43	38	4	1	73
			37.07%	88.37%	9.30%	2.33%	62.93%
IV _{Aa2}	I	93	48	30	17	4	45
			51.61%	62.5%	35.42%	8.33%	48.39%
	II	89	25	21	2	2	64
			28.09%	84%	8%	8%	71.91%
IV _{Am}	I	178	89	57	25	7	89
			50%	64.04%	28.09%	7.87%	50%
	II	107	50	34	14	5	57
			46.73%	68%	28%	10%	53.27%
IV _{Ba3}	I	68	12	11	1	0	50
			19.35%	91.67%	8.33%	0%	80.65%
	II	74	30	23	3	5	44
			40.54%	76.67%	10%	16.67%	59.46%
IV _{Bm}	I	104	45	37	8	1	59
			43.27%	82.82%	17.78%	2.22%	56.73%
	II	158	70	59	4	9	88
			44.30%	84.29%	5.71%	12.86%	55.70%
IV _{Ca4}	I	99	26	20	4	2	73
			26.26%	76.92%	15.38%	7.69%	73.74%
	II	77	31	30	0	1	46
			40.26%	96.77%	0%	3.23%	50.74%
IV _{Ca}	I	154	61	47	10	4	93
			39.61%	77.05%	16.39%	6.56%	60.39%
	II	114	57	43	13	4	57
			50%	75.44%	22.81%	7.02%	50%

Table 30 (cont'd)

Experiment Number	Sub-group	Total Number	Present				Absent
			T.	P.	U.	C.	
V _{1a}	I	322	133	86	35	15	189
			41.30%	64.66%	26.32%	11.28%	58.70%
	II	102	45	42	0	4	57
			44.12%	93.33%	0%	8.89%	55.88%
V _{1b}	I	88	39	27	13	2	49
			44.32%	69.23%	33.33%	5.13%	55.68%
	II	57	22	20	2	1	35
			38.60%	90.91%	9.09%	4.55%	61.40%
V _{2a}	I	162	66	43	16	11	96
			40.74%	65.15%	24.24%	16.67%	59.26%
	II	93	42	39	0	7	51
			45.16%	92.86%	0%	16.67%	54.84%
V _{2b}	I	87	45	27	17	1	42
			51.72%	60%	37.78%	2.22%	48.28%
	II	76	38	27	12	0	38
			50%	71.05%	31.58%	0%	50%
V _{3a}	I	249	119	89	32	5	130
			47.79%	74.79%	26.89%	4.20%	52.21%
	II	111	55	46	5	6	56
			49.55%	83.64%	9.09%	10.91%	50.45%
V _{3b}	I	86	28	21	7	1	58
			32.56%	75%	25%	3.57%	67.44%
	II	58	37	26	7	5	21
			63.79%	70.27%	18.92%	13.51%	36.21%
V _{4a}	I	148	50	29	19	2	98
			33.78%	58%	38%	4%	66.22%
	II	299	146	120	4	25	153
			48.83%	82.19%	2.74%	17.12%	51.17%
V _{4b}	I	68	29	22	4	5	39
			42.65%	75.86%	13.79%	10.34%	57.35%
	II	74	43	37	4	4	31
			58.11%	86.05%	9.30%	9.30%	41.89%

and increased in Sub-group II. The relative percentage of expressions of unpleasantness, on the other hand, increased consistently in Sub-group I and decreased in Sub-group II. Communicative vocalization fell abruptly (from 7.69 ± 4 to 1.85 ± 4) from Form 1 to 2 with Sub-group I, and remained relatively constant from then on; it fluctuated with Sub-group II. This part of the data presents a perfect picture of two sets of diametrically opposite results from the two sub-groups of the Regular and the Combined Experimental Groups. On the surface, this seems to indicate, again, some specific relation of vocal concomitant to the nature and sequence of the experimental task, especially evident at the beginning of learning.

3) However, in the rest of the Series (IIS, IISB, IIIM, IVS, IVM, VS and VM) the statistics show little or no systematic and meaningful change in the relative frequency of these three types of vocalization and no appreciable and consistent correlation between vocalization and total number of trials, percentage of success, reaction time or even oral behavior. These data would therefore seem to signify that incidence and type of vocalization were more indicative of the amount of interest in and the state of adjustment to the different aspects of the general experimental situation than

(footnote continued from page 121)
which these forms are presented. Thus, for Sub-group I an increase would mean the increase in the size of a score from Form 1 to 4; whereas for Sub-group II, it would mean the increase in the size of a score from Form 4 to 1.

of the degree of success which the subjects attained, or the amount of difficulty which they encountered, in any specific discrimination "Aufgabe" beyond parts of the first two series.

4) Nevertheless, special reference must be made here to the first form combination of Series V (cross-circle for Sub-group I and oval-circle for Sub-group II). In this, during the first one or two experimental sittings, there was always an increase in the total amount of vocalization present, as well as a proportionate increase in expressions of unpleasant and particularly of communicative types; and a corresponding decrease in those of the pleasant type. This would seem to suggest once more some specific relation of vocalization to the nature of the experimental task.

f) Affective Concomitant

Figure 30 (see page 132) and Table 31 (see page 133) show that:

1) Among the five different aspects of affective concomitant observed in the Regular Experimental Group throughout Series I - V, pleasantness is by far the most predominant (mean, 39.56-%). Neutral concomitant is second in order of frequency (mean, 10.79+%). Unpleasantness comes third with a mean of 10.10-%. Very pleasant concomitant is fourth with a mean of 9.65-%, while very unpleasant concomitant is the least frequent of all (mean, 1.02-%).

2) Considering these five aspects of affective

Effective Communication

Effective Communication

Effective Communication

Effective Communication

Effective Communication

Effective Communication

CASE

K

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C

Affective Concomitant

and the manner in which Different Aspects of it were Observed in Each
Subject in the Learning of Series I-V



Table 31

Percentage of Trials in which different Aspects of
Affective Concomitant Were Observed in Each Sub-Group of the
Regular Experimental Group in the Learning of Series I - V

Aspects	Scores	Sub-Group I	Sub-Group II	Combined
Very Pleasant	Total	85.68 %	88.02 %	173.68 %
	Mean	8.57 %	11.00 %	9.65 %
	Rank Order	(4)	(3)	(4)
Pleasant	Total	889.58 %	722.40 %	1611.98 %
	Mean	88.96 %	90.30 %	89.56 %
	Rank Order	(1)	(1)	(1)
Neutral	Total	96.21 %	98.07 %	194.28 %
	Mean	9.62 %	12.26 %	10.79 %
	Rank Order	(3)	(2)	(2)
Unpleasant	Total	108.36 %	73.40 %	181.76 %
	Mean	10.84 %	9.18 %	10.15 %
	Rank Order	(2)	(4)	(3)
Very Unpleasant	Total	9.99 %	8.83 %	18.82 %
	Mean	1.00 %	1.04 %	1.02 %
	Rank Order	(5)	(5)	(5)

concomitant from the point of view of individual differences, pleasantness again heads the list with a range of 97.43+ $\frac{1}{2}$ to 70.03+ $\frac{1}{2}$. The others, listed in order of diminishing range, are unpleasantness (27.94- $\frac{1}{2}$ to .57+ $\frac{1}{2}$), neutral concomitant (24.03+ $\frac{1}{2}$ to 2.34+ $\frac{1}{2}$), very pleasant concomitant (20.72+ $\frac{1}{2}$ to 2.16+ $\frac{1}{2}$), and very unpleasant concomitant (3.47+ $\frac{1}{2}$ to 0 $\frac{1}{2}$).

3) Viewing the same aspects of affective concomitant from the standpoint of group differences, it is significant that pleasantness is the most frequent, and that very unpleasant is the least frequent for both of the sub-groups. Unpleasantness comes second in order of decreasing frequency for Sub-group I and fourth for Sub-group II. Neutral concomitant is third for Sub-group I and second for Sub-group II, while very pleasant concomitant is fourth for Sub-group I and third for Sub-group II.

From the above results the following generalizations have been reached:

1) In spite of a strictly experimental situation and the rigid isolation of the subject during all trials, pleasantness was the most predominant affective concomitant for every subject in the Regular Experimental Group.

2) Both of the extreme aspects of affective concomitant, very pleasant and very unpleasant, were infrequent in all the Regular Experimental Cases and showed the least amount of individual variation.

3) On the whole, Sub-group II seemed to enjoy the experiment more than Sub-group I (see Table 31 on page 133).

The first and third points stand out particularly clearly in Figures 31 (see page 136) and 32 (see page 137), which means that these points apply not only to the Regular Cases in the Experimental Group, but to the Irregular ones as well. Hence, the total number of experimental weeks, which one might expect to correlate with boredom, or incomplete adaptation, etc., apparently have little relation to affective response.

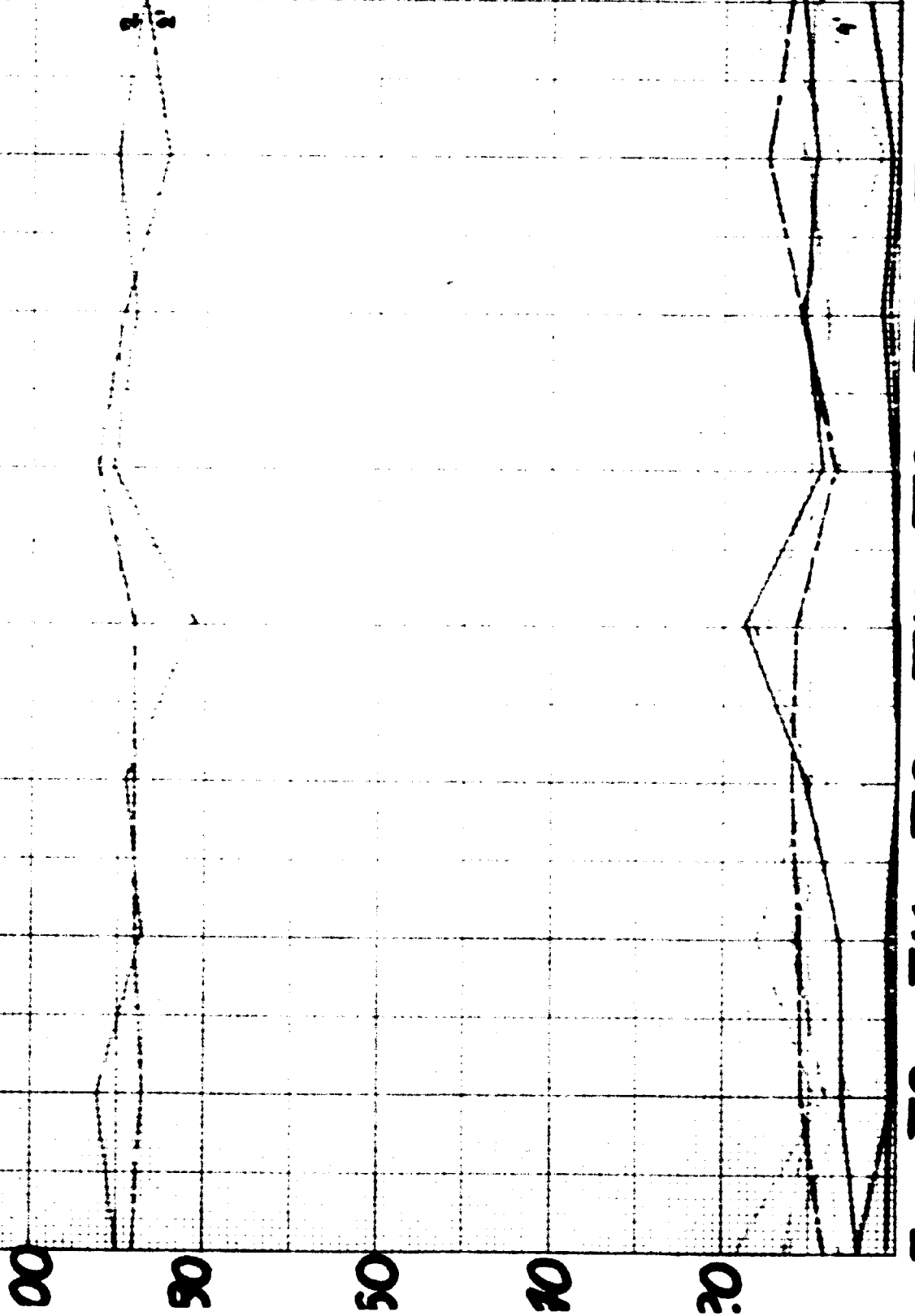
Tables 32 (see pages 138-141) and 33 (see pages 142-145) show that:

1) In Series I there was a consistent increase in the pleasant aspects of affective concomitant and a proportionate decrease in the unpleasant aspects from Form 1 to 4 for Sub-group I. This is true with or without the exclusion of the results from cases 5 and 6 in Form 1. The entire data present a very clear picture of the gradual and successful adjustment of Sub-group I to the experimental situation in general and the stimulus patterns in particular (cf. e) 1) on page 121).

The corresponding data from Sub-group II, on the other hand, do not present such a picture of orderly adaptation. The pleasant aspects of affective concomitant tended to decrease, slightly but consistently, from Form 4 to 1, while the unpleasant aspects fluctuated from form to form with no

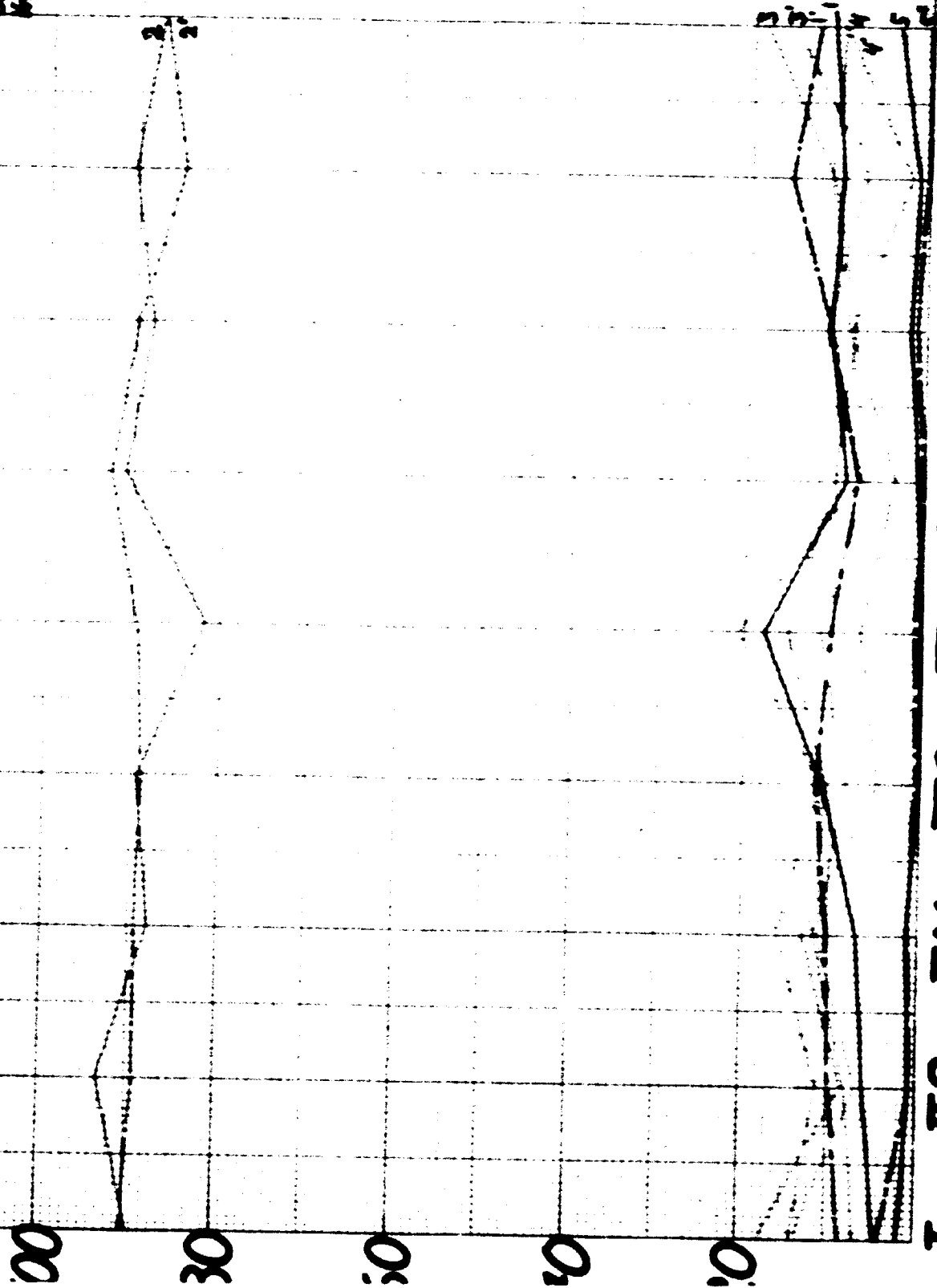
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Table 32

Average Number and percentage of Trials in which
Different Aspects of Affective Concomitant were Observed
in Sub-Groups I and II Respectively of the Regular Experimental Group
in the Learning of Each Form in Series I - V

Experiment Number	Sub-Group	Total Number	V. P.	P.	N.	U.	v. U.
I ₁	I	739	23	665	46	101	8
			3.11%	89.99%	6.22%	13.67%	1.08%
		396*	22*	324*	14*	79*	4*
	II		5.56%	81.82%	3.54%	19.95%	1.01%
		(831)	(25)	(755)	(68)	(101)	(9)
			(3.01%)	(90.85%)	(8.18%)	(12.15%)	(1.08%)
I ₂	I	195	16	171	28	35	10
			8.21%	87.69%	14.36%	17.95%	5.13%
	II	315	11	288	20	41	3
			3.49%	91.43%	6.35%	13.02%	.95%
I ₃	I	196	15	174	12	36	15
			7.65%	88.78%	6.12%	18.37%	7.65%
	II	203	11	180	23	27	1
			5.42%	88.67%	11.33%	13.30%	.49%
I ₄	I	279	23	251	41	52	8
			8.24%	89.96%	14.70%	18.64%	2.87%
	II	388	27	353	21	38	6
			6.96%	90.98%	5.41%	9.79%	1.55%
II _{1a}	I	374	37	327	56	74	13
			9.89%	87.43%	14.97%	19.79%	3.48%
	II	309	20	286	27	12	3
			6.47%	92.56%	8.74%	5.86%	.97%
II _{1b}	I	145	18	127	15	15	0
			12.41%	87.59%	10.34%	10.34%	0
	II	155	11	144	20	6	0
			7.10%	92.90%	12.90%	3.87%	0
II _{2a}	I	89	13	76	8	4	0
			14.61%	85.39%	8.99%	4.49%	0
	II	151	6	146	15	6	0
			3.97%	96.69%	9.93%	3.97%	0
II _{2b}	I	183	9	172	19	12	0
			4.92%	93.99%	10.38%	6.56%	0
	II	139	11	128	11	13	0
			7.91%	92.09%	7.91%	9.35%	0
II _{2c}	I	133	9	126	26	17	0
			6.77%	94.74%	19.55%	12.78%	0

The figures within the parentheses are obtained by including 92 doubtful trials of Case F.

*These figures are obtained by excluding the results of Cases F and J in Series I, Form 1.

Table 32 (cont'd)

Experiment Number	Sub-Group	Total Number	V. P.	P.	M.	U.	V. U.
II _{3a}	I	116	11	103	7	2	0
			9.48%	88.79%	6.03%	7.76%	0
	II	251	36	207	33	35	3
			14.34%	82.47%	13.15%	13.94%	1.20%
II _{3m}	I	128	7	109	14	17	2
			5.47%	85.16%	10.94%	13.28%	1.56%
	II	132	16	114	24	19	2
			12.12%	86.36%	18.18%	14.39%	1.52%
II _{4a}	I	217	16	198	18	18	3
			7.37%	91.24%	8.29%	8.29%	1.38%
	II	387	44	340	29	17	3
			11.37%	87.86%	74.94%	4.39%	.78%
II _{4m}	I	162	11	132	24	31	5
			6.79%	81.48%	14.81%	19.14%	9.09%
	II	198	25	170	32	28	2
			12.63%	85.86%	16.16%	14.14%	1.01%
III _{1a}	I	152	17	134	10	5	0
			11.18%	88.16%	6.58%	3.29%	0
	II	139	13	126	6	9	0
			9.35%	90.65%	4.17%	64.78%	0
III _{1m}	I	145	26	118	24	20	0
			17.93%	81.38%	16.55%	13.79%	0
	II	102	6	96	17	3	0
			5.88%	94.12%	16.67%	2.94%	0
III _{2a}	I	80	12	68	5	1	0
			15%	85%	6.25%	1.25%	0
	II	72	12	60	6	3	0
			16.67%	83.33%	8.33%	4.17%	0
III _{2m}	I	124	23	101	14	10	0
			18.55%	81.45%	11.29%	8.06%	0
	II	117	17	100	15	1	0
			14.53%	85.47%	12.82%	.86%	0
III _{3a}	I	107	11	96	24	20	0
			10.28%	89.72%	22.43%	18.69%	0
	II	106	12	95	24	2	0
			11.32%	89.68%	22.64%	18.87%	0
III _{3m}	I	144	22	121	21	29	0
			15.28%	84.03%	14.58%	20.14%	0
	II	113	16	96	17	10	1
			14.16%	84.96%	15.04%	8.85%	.88%

Table 32 (cont'd)

Experiment Number	Sub-Group	Total Number	V. P.	P.	N.	U.	v. U.
III _{4a}	I	135	11	123	10	13	0
			8.15- 2	92.59 2	7.41- 2	9.63- 2	0
	II	204	27	178	18	5	0
			13.24- 2	87.25 2	7.84 2	2.45 2	0
III _{4m}	I	137	26	109	24	4	0
			18.98- 2	79.56 2	17.52- 2	2.92- 2	0
	II	166	19	147	33	17	0
			11.45- 2	88.55 2	19.88- 2	10.24 2	0
IV _{Aa1}	I	144	7	137	16	5	0
			4.86 2	95.14- 2	11.11 2	3.47 2	0
	II	116	11	105	9	6	0
			9.48 2	90.52- 2	7.76- 2	5.17 2	0
IV _{Aa2}	I	93	14	78	18	17	0
			15.05 2	83.87 2	19.35 2	18.28- 2	0
	II	89	4	85	7	2	0
			4.49 2	95.51- 2	7.87- 2	2.25- 2	0
IV _{Am}	I	178	16	159	14	21	5
			8.99- 2	89.33- 2	7.87- 2	11.80- 2	2.81- 2
	II	107	9	99	17	14	1
			8.41 2	92.52 2	15.89- 2	13.08 2	.93 2
IV _{Ba3}	I	62	5	57	2	1	0
			8.06 2	91.94- 2	3.23- 2	1.61 2	0
	II	74	5	69	7	3	0
			6.76- 2	93.24 2	9.46- 2	4.05 2	0
IV _{Bm}	I	104	15	88	7	7	2
			14.42 2	84.62- 2	6.73 2	6.73 2	1.92 2
	II	158	14	145	15	4	0
			8.86 2	91.77 2	9.49 2	2.53 2	0
IV _{Ca4}	I	99	8	90	4	2	2
			8.08 2	90.91- 2	4.04 2	2.02 2	2.02 2
	II	77	6	71	2	0	0
			7.79 2	92.21- 2	2.60- 2	0	0
IV _{Cm}	I	154	16	137	14	9	1
			10.39- 2	88.96 2	9.09 2	5.84 2	.65 2
	II	114	18	96	10	13	2
			15.79- 2	84.21 2	8.77 2	11.40 2	1.75 2
V _{1a}	I	322	24	294	20	32	6
			8.07 2	91.30 2	15.63- 2	9.94- 2	1.86 2
	II	102	22	80	3	0	0
			21.57- 2	78.43 2	2.94 2	0	0

Table 32 (cont'd)

Experiment Number	Sub-Group	Total Number	V. P.	P.	N.	U.	V. U.
V _{1m}	I	88	12	74	27	10	4
			13.64-%	84.09+%	30.68+%	11.36+%	4.55-%
	II	57	5	51	12	2	0
			8.77+%	89.47+%	21.05+%	3.51-%	0 %
V _{2s}	I	162	11	153	13	16	0
			6.79+%	94.44+%	8.02+%	9.88-%	0 %
	II	93	11	82	3	0	0
			11.83-%	88.17+%	3.23-%	0 %	0 %
V _{2m}	I	87	8	77	17	11	6
			9.20-%	88.51-%	19.54+%	12.64+%	6.90-%
	II	76	6	70	16	12	0
			7.89+%	92.11-%	21.05+%	15.79-%	0 %
V _{3s}	I	249	37	213	26	30	2
			14.86-%	85.54+%	10.44+%	12.06-%	.80+%
	II	111	15	96	8	5	0
			13.51+%	86.49-%	7.21-%	4.50+%	0 %
V _{3m}	I	86	5	79	13	6	1
			5.81+%	91.86+%	15.12-%	6.98-%	1.16+%
	II	58	6	52	5	7	0
			10.34+%	89.66-%	8.62+%	12.07-%	0 %
V _{4s}	I	148	10	138	6	19	0
			6.76-%	93.24+%	4.05+%	12.84-%	0 %
	II	299	44	253	28	6	0
			14.72-%	84.62-%	9.36+%	2.01-%	0 %
V _{4m}	I	68	11	57	4	4	0
			16.18-%	83.82+%	5.88+%	5.88+%	0 %
	II	74	16	58	7	4	0
			21.62+%	78.38-%	9.46-%	5.41-%	0 %

Table 33

Average Number and Percentage of Trials in which
Different Aspects of Affective Concomitant were Observed
in Sub-Groups I and II Respectively
of the Combined Regular and Irregular Experimental Groups
in the Learning of Each Form in Series I - V

Experiment Number	Sub-Group	Total Number	V. P.	P.	N.	U.	V. U.
I ₁	I	786	23	709	46	113	12
			2.93%	90.32%	5.86%	14.39%	1.53%
		442 ^a	22 ^a	368 ^a	14 ^a	91 ^a	8 ^a
	II		4.98%	85.26%	3.17%	20.59%	1.81%
		(877)	(25)	(799)	(68)	(113)	(15)
			(2.85%)	(91.11%)	(7.75%)	(12.88%)	(1.48%)
I ₂	I	222	16	198	28	36	10
			7.21%	89.19%	12.61%	16.22%	4.50%
	II	358	13	320	26	57	9
			3.63%	89.39%	7.26%	15.92%	2.51%
I ₃	I	235	15	213	12	41	15
			6.38%	90.64%	5.11%	17.45%	6.38%
	II	223	11	198	23	31	4
			4.93%	88.79%	10.31%	13.90%	1.79%
I ₄	I	395	23	345	57	65	25
			5.82%	87.34%	14.43%	16.46%	6.33%
	II	413	27	369	21	48	9
			6.54%	89.35%	5.08%	11.62%	2.18%
II _{1a}	I	583	32	528	79	94	19
			5.49%	89.88%	13.55%	16.12%	3.26%
	II	319	20	296	27	14	5
			6.27%	92.79%	8.46%	4.39%	1.57%
II _{1b}	I	156	18	137	16	18	0
			11.54%	87.82%	10.26%	11.54%	0%
	II	175	12	160	20	6	5
			6.86%	91.43%	11.43%	3.43%	2.86%
II _{2a}	I	102	13	89	8	4	0
			12.75%	87.25%	7.84%	3.92%	0%
	II	161	6	155	15	9	2
			3.73%	96.27%	9.32%	5.59%	1.24%
II _{2b}	I	219	10	207	23	13	0
			4.57%	94.52%	10.50%	5.94%	0%
	II	165	11	154	18	13	3
			6.67%	93.33%	9.09%	7.88%	1.82%
II _{2c}	I	143	9	136	27	17	0
			6.29%	95.10%	18.88%	11.89%	0%

V.P.=Very Pleasant; P.=Pleasant; N.=Neutral; U.=Unpleasant; V.U.=Very Unpleasant
 figures within the parentheses are obtained by including 92 doubtful trials of
 in V.

These figures are obtained by excluding the results of Cases F and J in Series
 Run 1.

Table 33 (cont'd)

Experiment Number	Sub-Group	Total Number	V. P.	P.	N.	U.	V. U.
II _{3a}	I	121	11	108	7	9	0
			9.09%	89.26%	5.79%	7.44%	0%
II _{3a}	II	298	40	250	38	39	4
			13.42%	83.89%	12.75%	13.09%	13.42%
II _{3m}	I	138	7	119	16	18	2
			5.07%	86.23%	11.59%	13.04%	1.45%
II _{3m}	II	196	21	172	36	28	4
			10.71%	87.76%	18.37%	14.29%	2.04%
II _{4a}	I	312	16	293	21	55	5
			5.13%	93.91%	6.73%	11.22%	.96%
II _{4a}	II	480	45	432	49	26	5
			9.38%	90%	10.21%	5.42%	.63%
II _{4m}	I	162	11	132	24	31	5
			6.79%	81.48%	14.81%	19.14%	3.09%
II _{4m}	II	247	28	216	37	40	2
			11.34%	87.45%	14.98%	16.19%	.81%
III _{1a}	I	152	17	134	10	5	0
			11.18%	88.16%	6.58%	3.29%	0%
III _{1a}	II	144	13	131	7	9	0
			9.03%	90.97%	4.86%	6.25%	0%
III _{1m}	I	145	26	118	24	20	0
			17.93%	81.38%	16.55%	13.79%	0%
III _{1m}	II	126	6	120	28	5	0
			4.76%	95.24%	22.22%	2.36%	0%
III _{2a}	I	80	12	68	5	1	0
			15%	85%	6.25%	1.25%	0%
III _{2a}	II	89	12	77	7	5	0
			13.48%	86.52%	7.87%	3.37%	0%
III _{2m}	I	124	23	101	14	10	0
			18.55%	81.45%	11.29%	8.06%	0%
III _{2m}	II	140	18	123	25	4	0
			12.86%	87.86%	17.86%	2.86%	0%
III _{3a}	I	107	11	96	24	20	0
			10.28%	89.72%	22.43%	18.69%	0%
III _{3a}	II	134	18	117	28	2	0
			13.43%	87.31%	20.90%	1.49%	0%
III _{3m}	I	144	22	121	21	29	0
			15.28%	84.03%	14.58%	20.14%	0%
III _{3m}	II	152	18	132	34	14	1
			11.84%	86.84%	22.37%	9.21%	.66%

Table 33 (cont'd)

Experiment Number	Sub-Group	Total Number	V. P.	r.	N.	U.	V. U.
III _{4a}	I	135	11	125	10	13	0
			8.15 ±	92.59 ±	7.41 ±	9.63 ±	0 ±
	II	242	29	215	25	13	1
			11.98 ±	88.84 ±	10.33 ±	5.37 ±	.41 ±
III _{4b}	I	137	26	109	24	4	0
			18.98 ±	79.56 ±	17.52 ±	2.92 ±	0 ±
	II	176	19	156	35	20	1
			10.80 ±	88.64 ±	19.89 ±	11.36 ±	.57 ±
IV _{Aa1}	I	144	7	137	16	5	0
			4.86 ±	95.14 ±	11.11 ±	3.47 ±	0 ±
	II	116	11	105	9	6	0
			9.48 ±	90.52 ±	7.76 ±	5.17 ±	0 ±
IV _{Aa2}	I	93	14	78	18	17	0
			15.05 ±	83.87 ±	19.35 ±	18.28 ±	0 ±
	II	89	4	85	7	2	0
			4.4 ±	95.51 ±	7.97 ±	2.25 ±	0 ±
IV _{Aa}	I	178	16	159	14	21	5
			8.99 ±	99.33 ±	7.87 ±	11.80 ±	2.81 ±
	II	107	9	99	17	14	1
			8.41 ±	92.52 ±	15.8 ±	13.08 ±	.93 ±
IV _{Ba3}	I	62	5	57	2	1	0
			8.06 ±	91.54 ±	8.28 ±	1.61 ±	0 ±
	II	74	5	69	7	3	0
			6.76 ±	93.24 ±	9.46 ±	4.05 ±	0 ±
IV _{Ba}	I	104	15	88	7	7	2
			14.42 ±	84.62 ±	6.73 ±	6.73 ±	1.92 ±
	II	156	14	145	15	4	0
			8.86 ±	91.77 ±	9.49 ±	2.53 ±	0 ±
IV _{Ca4}	I	99	8	90	4	2	2
			8.06 ±	90.91 ±	4.04 ±	2.02 ±	2.02 ±
	II	77	6	71	2	0	0
			7.79 ±	92.21 ±	2.60 ±	0 ±	0 ±
IV _{Ca}	I	154	16	137	14	9	1
			10.39 ±	88.96 ±	9.09 ±	5.84 ±	.65 ±
	II	114	18	96	10	13	2
			15.79 ±	84.21 ±	8.77 ±	11.40 ±	1.75 ±
V _{1a}	I	322	26	294	50	32	6
			8.07 ±	91.30 ±	15.53 ±	9.94 ±	1.86 ±
	II	102	22	80	3	0	0
			21.57 ±	78.43 ±	2.24 ±	0 ±	0 ±

Table 33 (cont'd)

Experiment Number	Sub-Group	Total Number	V. P.	P.	N.	U.	V. U.
V_{1n}	I	88	12	74	27	10	4
			13.64%	84.09%	30.68%	11.36%	4.55%
	II	57	5	51	12	2	0
			8.77%	89.47%	21.05%	3.51%	0
V_{2s}	I	162	11	153	13	16	0
			6.79%	94.44%	8.02%	9.88%	0
	II	93	11	82	3	0	0
			11.83%	88.17%	3.23%	0	0
V_{2n}	I	87	8	77	17	11	6
			9.20%	88.51%	19.54%	12.64%	6.90%
	II	76	6	70	16	12	0
			7.89%	92.11%	21.05%	15.79%	0
V_{3s}	I	249	37	213	26	30	2
			14.86%	85.54%	10.44%	12.05%	.80%
	II	111	15	96	8	5	0
			13.51%	86.49%	7.21%	4.50%	0
V_{3n}	I	86	5	79	13	6	1
			5.81%	91.86%	15.12%	6.98%	1.16%
	II	58	6	52	5	7	0
			10.34%	89.66%	8.62%	12.07%	0
V_{4s}	I	148	10	138	6	19	0
			6.76%	93.24%	4.05%	12.84%	0
	II	299	44	255	28	6	0
			14.72%	84.62%	9.36%	2.01%	0
V_{4n}	I	68	11	57	4	4	0
			16.18%	83.82%	5.88%	5.88%	0
	II	74	16	58	7	4	0
			21.62%	78.38%	9.46%	5.41%	0

system or congruity (cf. e) 1) on page 121).

2) In Series IIM the relative proportion of the pleasant aspects of affective concomitant tended to increase from Form 1 to 2 in Sub-group I, and to decrease steadily from then on. In Sub-group II it tended to decrease steadily from Form 4 to 2 and to increase from then on. The relative proportion of unpleasant aspects of affective concomitant increased consistently with Sub-group I and decreased¹ in like manner with Sub-group II. As in the case of vocalization this part of the data (Series IIM) gives a picture of two sets of opposite results from the two sub-groups of the Regular and Irregular Experimental Groups (cf. e) 2) on pages 121 and 130) which appears to be somehow correlated with the order of tasks.

3) The rest of the series (IIS, IIIS, IIIM, IVS, IVM, VS and VM) shows little or no systematic and meaningful distribution of the five aspects of affective concomitant and no significant and consistent correlation between affective concomitant and total number of trials, percentage of success, reaction time or oral behavior. However, affective concomitant is obviously related to vocalization. This is to be expected since vocalization is one of the primary indices of the affective state of the subject. Because of this high correlation between the two sets of

¹See footnote on pages 121 and 130.

results in question, the same generalization reached in the case of vocalization is applicable here; namely, it would seem that the percentages of trials in which the five different aspects of affective concomitant were present were more indicative of the amount of interest in and the state of adjustment to the different aspects of the general experimental situation than of the degree of success which the subjects attained or the amount of difficulty which they encountered in any specific discrimination "Aufgabe" beyond parts of the first two series (cf. e) 3) on pages 130-131).

4) Nevertheless, the same exceptional instance, found in vocalization, occurs here in the first form combination of Series V, when for the first time the positive was abruptly made negative. There was a decided increase in unpleasant and very unpleasant affective concomitants and a proportionate decrease in pleasant and very pleasant affective concomitants. However, this state of disturbance lasted only through the first few trials.

Leaving aside these few exceptions and considering the entire data on affective concomitant--including vocalization--it would seem that both affective concomitant and vocalization, although so widely used, [viz., Gottschaldt (44), Rajans (47,48), etc.] are really somewhat unreliable objective criteria for the apparent difficulty of a given task and the subject's success in it. The other obvious interpretation is that all the numerous discrimination problems in the present

experiment, with the above exceptions, were easily within the adaptive capacity of the primitive age levels studied.

2. Analysis on the Basis of Development¹

Analysis of the results of Series I - V on the basis of development reveals certain interesting facts not brought out by analysis on the basis of achievement. These facts will be discussed under their respective headings.

- a) Total Number of Form Combinations (See Table 34 on page 149 and Figures 33 and 34 on pages 150 and 151.)

In spite of obvious individual differences in the total number of form combinations learned per experimental period during any given age level, there are certain general trends common to the subjects of the Regular and Irregular Experimental Groups. These trends are as follows:

- 1) A general tendency in all groups for the number of form combinations learned per experimental period to increase steadily from the seventh to the eleventh or twelfth month. After this there was a definite plateau or even

¹This part of the analysis covers seven age levels--from the seventh to the thirteenth month of life. All the subjects in both the Regular and the Combined Experimental Groups completed the entire Series I - V experiment during or before the thirteenth month except Case A of Sub-group I who completed the experiment at the fifteenth month. Since she was the only one who did this, the analysis does not go beyond the thirteenth month. In the presentation of the data, however, for the sake of completeness, Case A's data are included in full.

Table 34

Average Number of Form Combinations Learned per Experimental Period
at Each Age Level by Three Typical Cases from Each of the Sub-Groups
of the Regular Experimental Group in the Learning of Series I - V

Month	Sub-Group I		Sub-Group II	
	Case Number	Av. No. of Form Comb.	Case Number	Av. No. of Form Comb.
7	J	----	C	----
	K	.40	L	----
	R	----	P	0
8	J	.40	C	----
	K	.91-	L	.44+
	R	.89-	P	1.00
9	J	1.00	C	0
	K	1.08+	L	1.09+
	R	2.00	P	1.33+
10	J	1.07+	C	.33+
	K	1.11+	L	1.10
	R	1.80	P	.50
11	J	2.00	C	1.82-
	K	----	L	2.00
	R	3.00	P	2.67-
12	J	----	C	1.55-
	K	----	L	----
	R	----	P	----
13	J	----	C	1.00
	K	----	L	----
	R	----	P	----

Figure 33
 Average Number of Form Combinations
 Learned Per Experimental Period by
 Subgroups I and II Respectively of the
 Regular Experimental Group of Each
 Age Level in the Learning of Series I-V

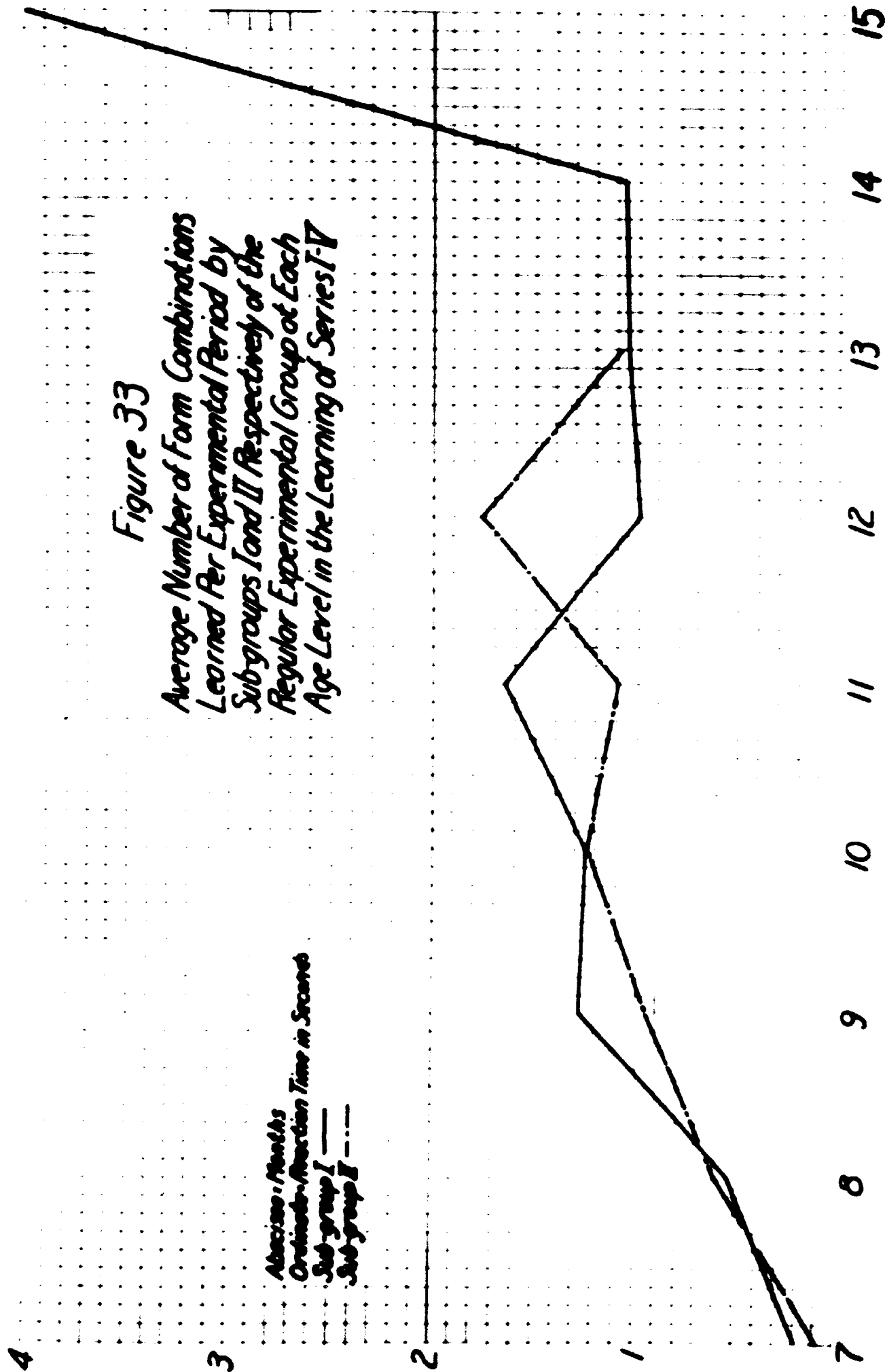
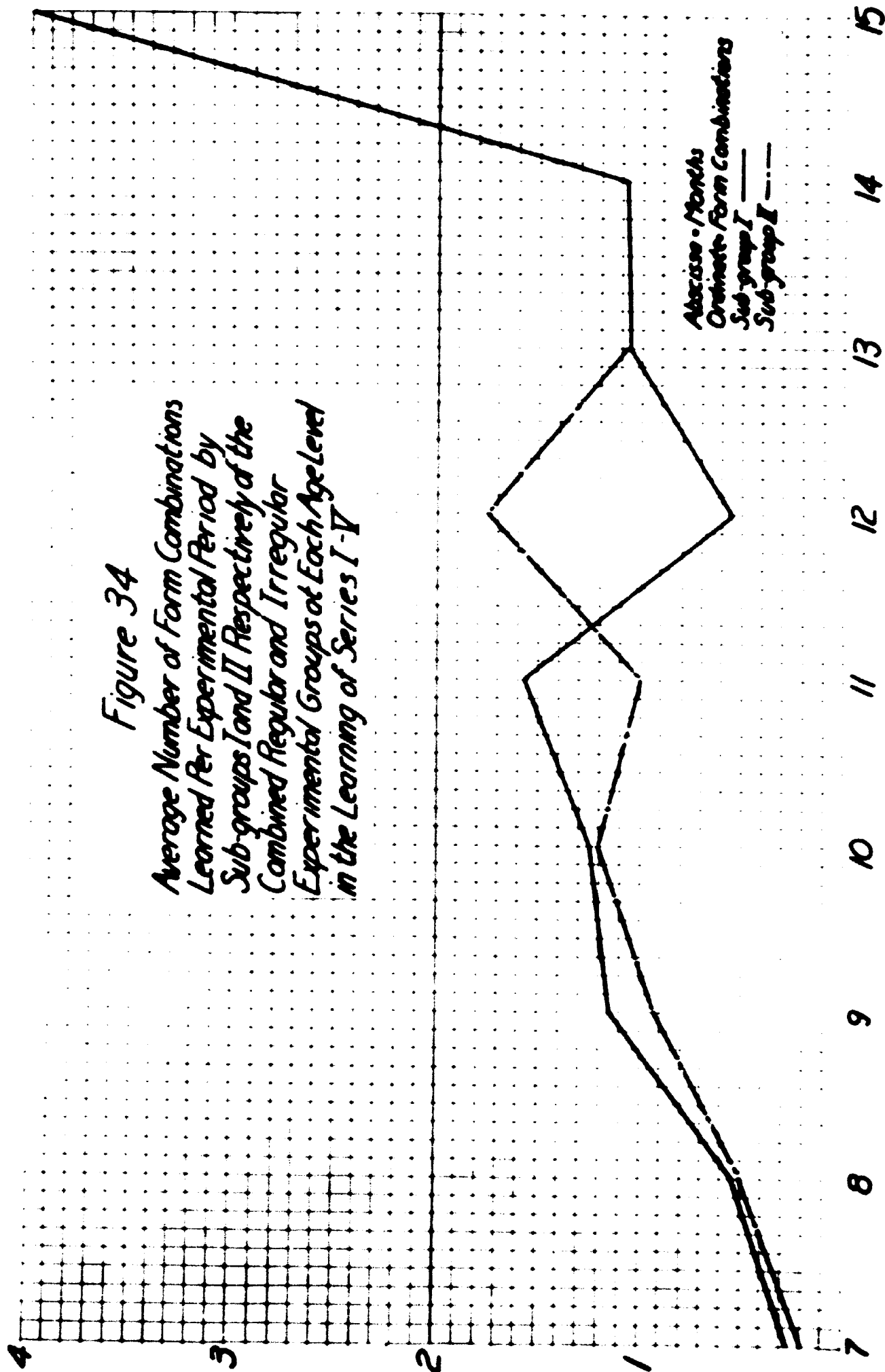


Figure 34
Average Number of Form Combinations
Learned Per Experimental Period by
Sub-groups I and II Respectively of the
Combined Regular and Irregular
Experimental Groups at Each Age Level
in the Learning of Series I-V



decrease. The improvement was probably due to the combined effect of maturation and learning, and the decline, to the loss of interest in the task which had now become too simple or too stereotyped.

2) From the seventh to the eleventh month Sub-group I surpassed Sub-group II in form combinations learned per experimental period, except for one insignificant exception (.07 form) at the eighth month level. At the eleventh month level, performance is reversed, Sub-group II now excelling Sub-group I. This, again, seems clearly related to order of presentation, i.e., relative difficulty of discrimination task.

b) Total Number of Trials (See Table 35 on page 153 and Figures 35 and 36 on pages 154 and 155.)

The same tendencies--(1) marked individual differences, within (2) a steady group increase in trials per experimental period from the seventh to the eleventh or twelfth month, followed by a definite plateau or even decrease from then on--are found here, and probably have the same causes. The reversed relationship between Sub-groups I and II, however, is not duplicated here.

c) Percentage of Success (See Table 36 on page 156 and Figures 37 and 38 on pages 157 and 158.)

1) Individual differences are again present; however, they are not so marked as in (1) total number of form combinations learned, or (2) total number of trials

Table 35

Average Number of Trials Carried Out per Experimental Period at Each Age Level
by Three Typical Cases from Each of the Sub-Groups
of the Regular Experimental Group in the Learning of Series I - V

Month	Sub-Group I		Sub-Group II	
	Case Number	Average Number of Trials	Case Number	Average Number of Trials
7	J	----	C	----
	K	7.40	L	----
	R	----	P	4.00
8	J	18.70	C	----
	K	15.27+	L	19.67-
	R	10.75-	P	18.58+
9	J	19.45+	C	13.33+
	K	18.67-	L	23.09+
	R	16.17-	P	18.56-
10	J	17.27+	C	19.83+
	K	17.56-	L	20.40
	R	16.40	P	16.53+
11	J	19.75	C	17.55-
	K	----	L	20.00
	R	25.50	P	25.00
12	J	----	C	25.56+
	K	----	L	----
	R	----	P	----
13	J	----	C	22.83+
	K	----	L	----
	R	----	P	----

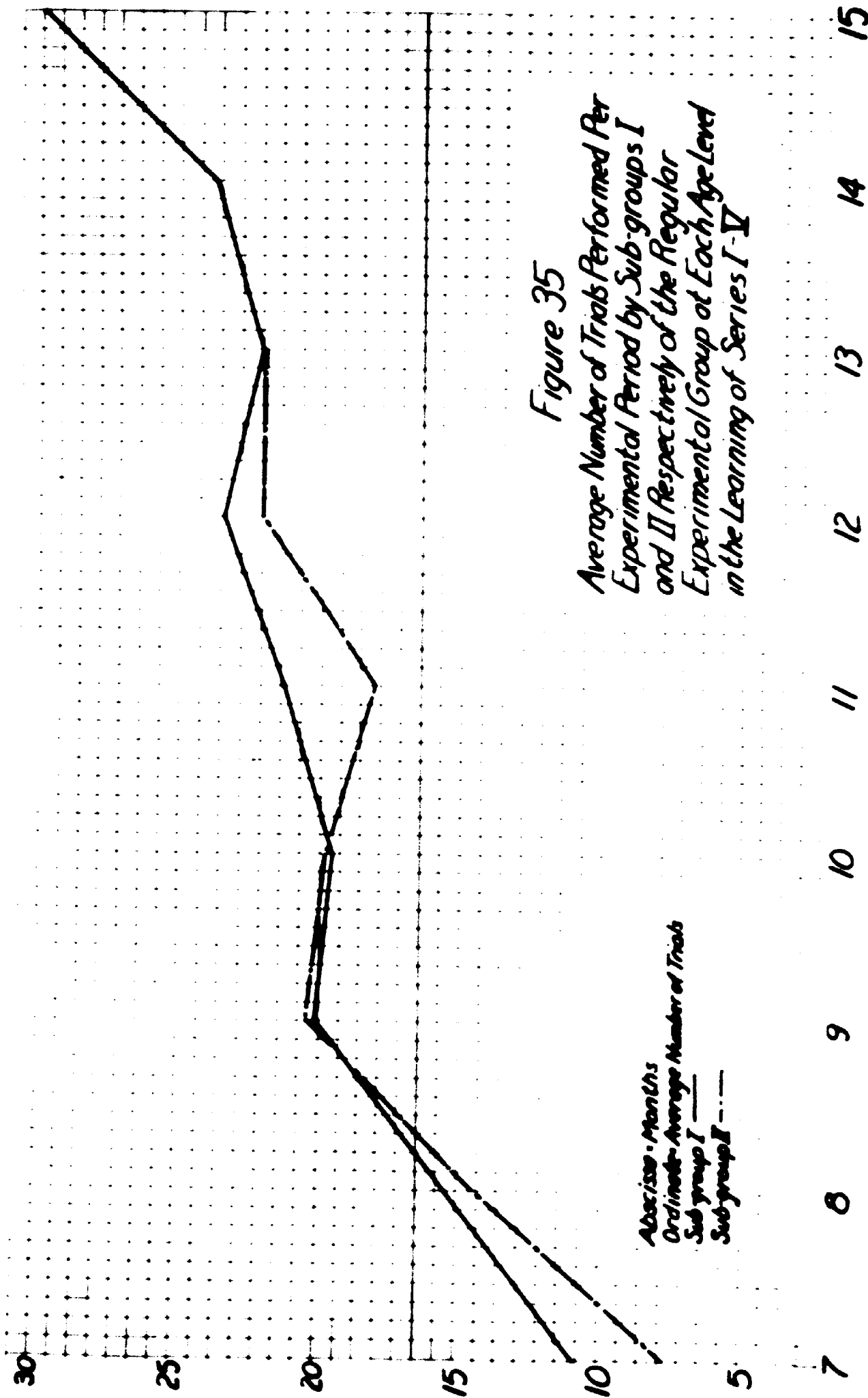


Figure 35
*Average Number of Trials Performed Per
 Experimental Period by Sub-groups I
 and II Respectively of the Regular
 Experimental Group of Each Age Level
 in the Learning of Series I-V*

Abscissa - Months
Ordinate - Average Number of Trials
Sub-group I —
Sub-group II - - -

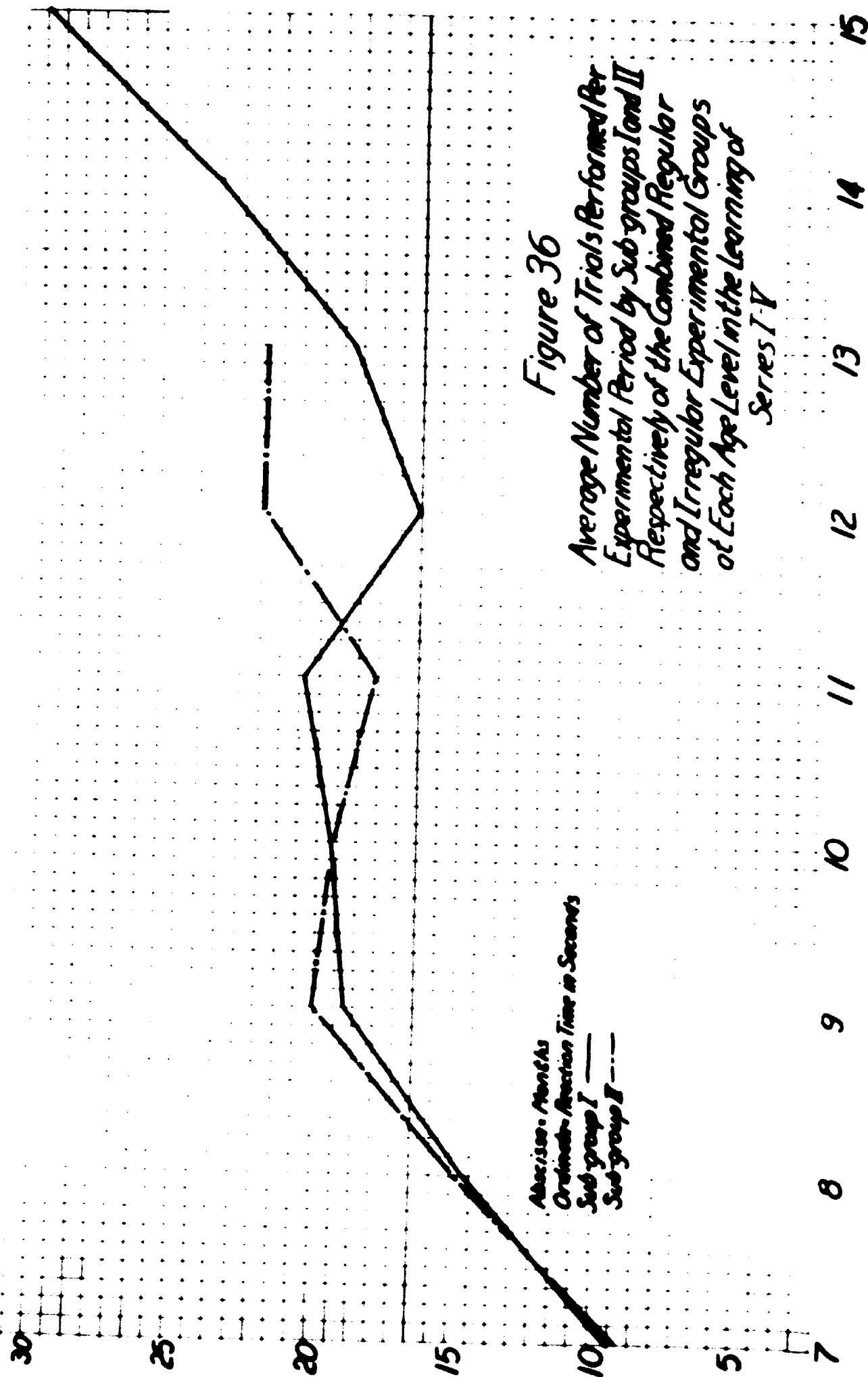


Table 36

Percentage of Success Obtained at Each Age Level by Three Typical Cases
from Each of the Sub-Groups of the Regular Experimental Group
in the Learning of Series I - V

Month	Sub-Group I		Sub-Group II	
	Case Number	Percentage of Success	Case Number	Percentage of Success
7	J	----	C	----
	K	66.49%	L	----
	H	----	P	62.5 %
8	J	48.66%	C	----
	K	68.45%	L	55.37%
	R	79.38%	P	63.68%
9	J	64.49%	C	40 %
	K	64.29%	L	57.32%
	R	87.63%	P	61.68%
10	J	62.11%	C	49.58%
	K	63.29%	L	68.63%
	H	71.95%	P	46.94%
11	J	74.66%	C	47.67%
	K	----	L	77.5 %
	H	78.43%	P	80 %
12	J	----	C	62.89%
	K	----	L	----
	R	----	P	----
13	J	----	C	59.49%
	K	----	L	----
	H	----	P	----

Figure 37
Average Percentage of Success Obtained
by Subgroups I and II Respectively of the
Regular Experimental Group at Each Age
Level in the Learning of Series I-V

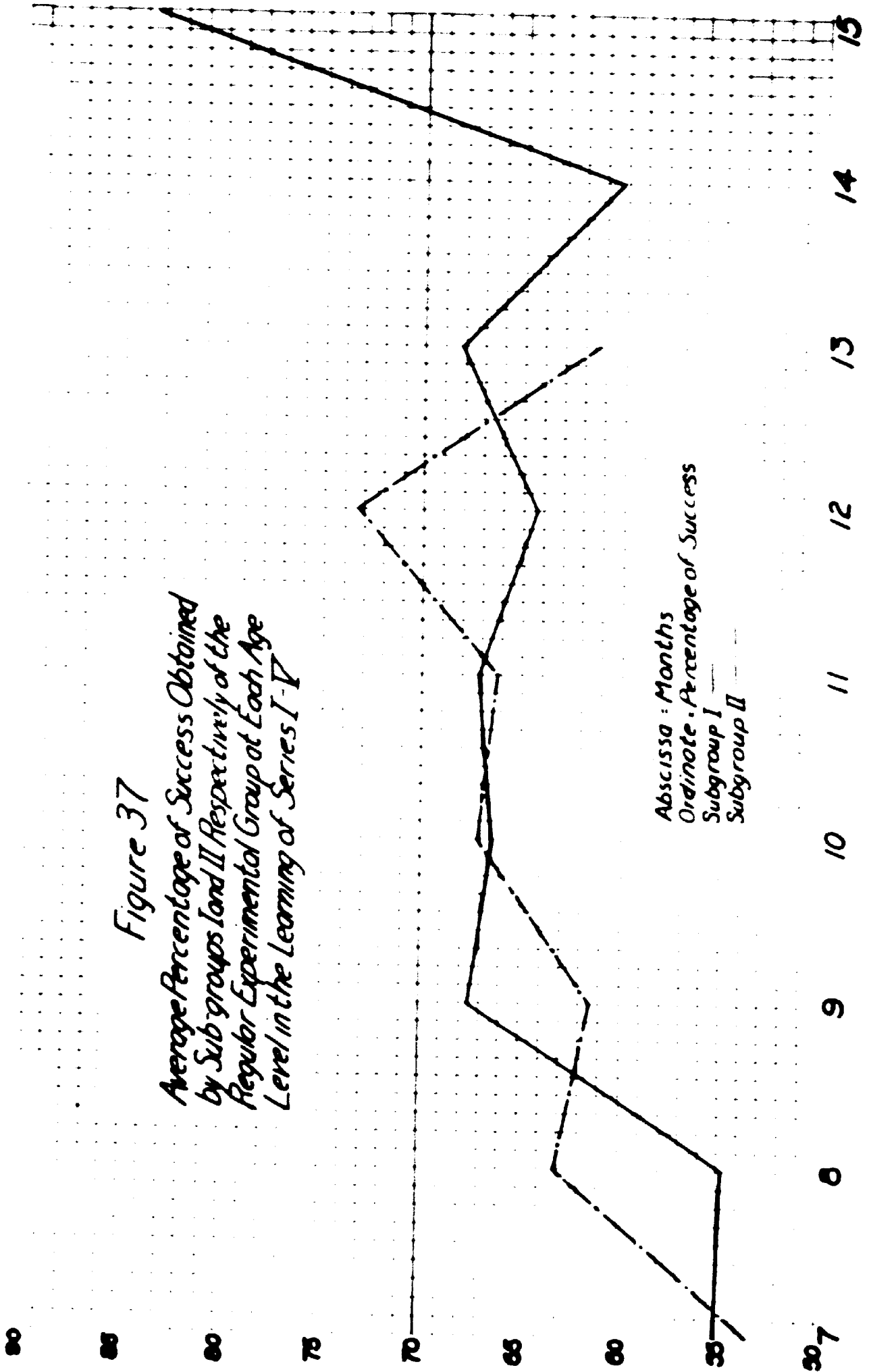
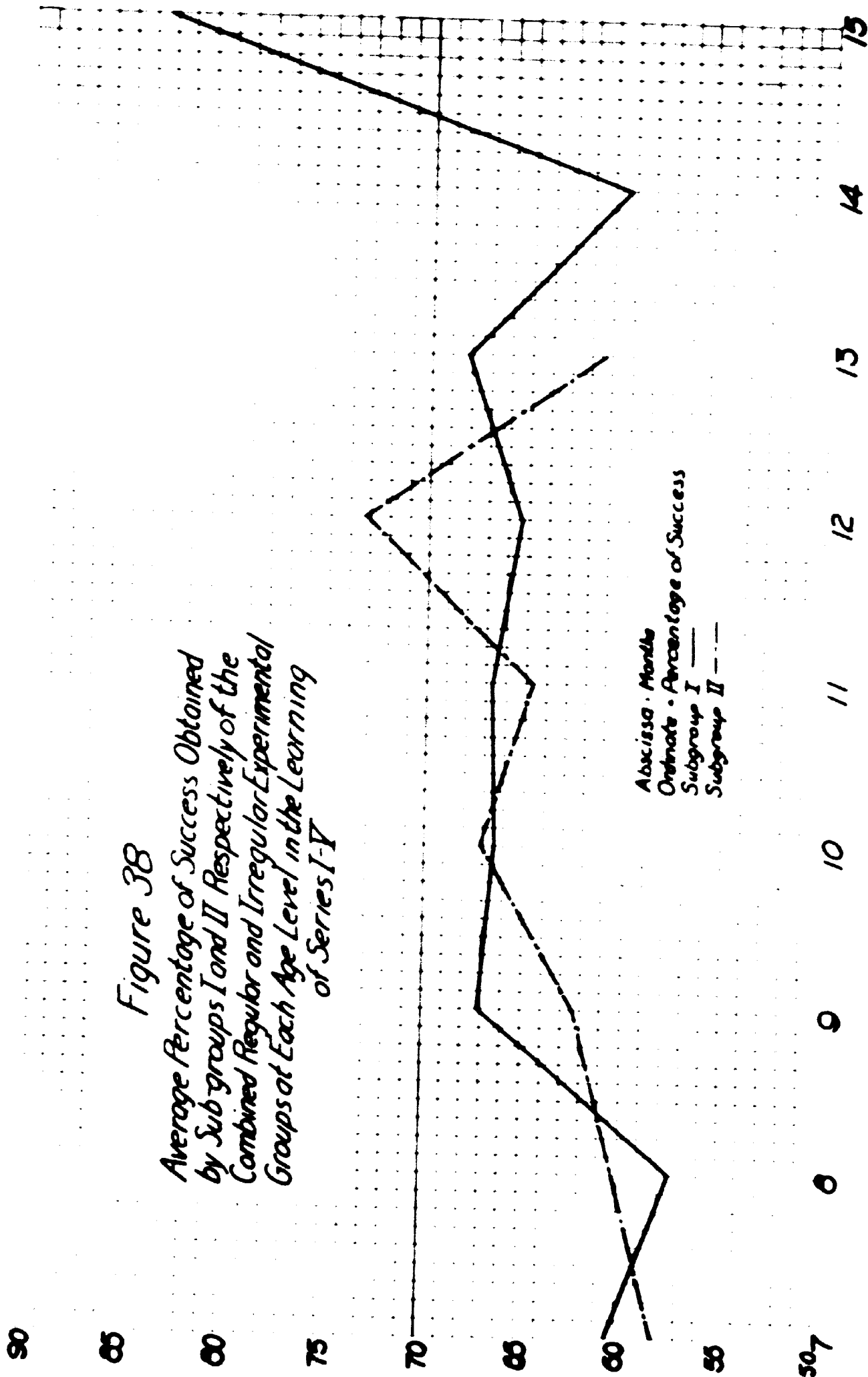


Figure 38
*Average Percentage of Success Obtained
 by Sub groups I and II Respectively of the
 Combined Regular and Irregular Experimental
 Groups at Each Age Level in the Learning
 of Series I-V*



carried out.

2) There was again a general tendency in both sub-groups of the Regular and Combined Experimental Groups for the scores to increase from the seventh month on. However, the increase was slight and irregular. The irregularity was probably due to the sequence of the experimental series whereby the standard series (review experiments) were interspersed with the modified series (new experiments), while the meagre increase may be attributed to increasing difficulty in the type of task presented to the subjects as they became more and more advanced in their discrimination performance. In consequence, what improvement they had gained in percentage of success through the processes of maturation and training was partially offset at least through the twelfth month, by the increasing difficulty in the task.

3) There is no consistent or stable difference between the two sub-groups in percentage of success through these age levels, but rather, an irregular alternation with small statistical range (2% to 9% variation).

d) Reaction Time

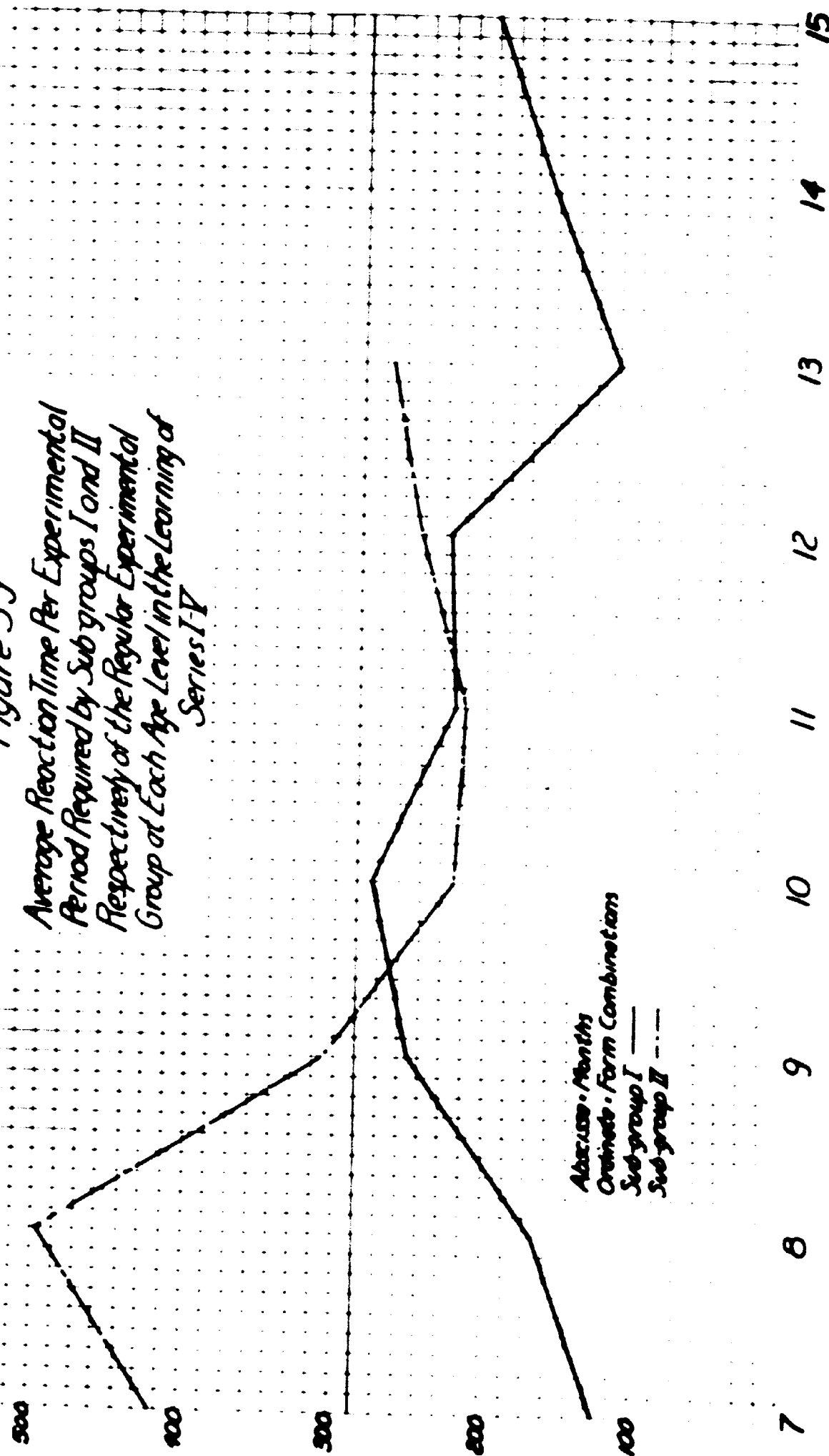
1) Group Differences

(a) Total Reaction Time Per Experimental Period

(See Figures 39 and 40 on pages 160 and 161.)

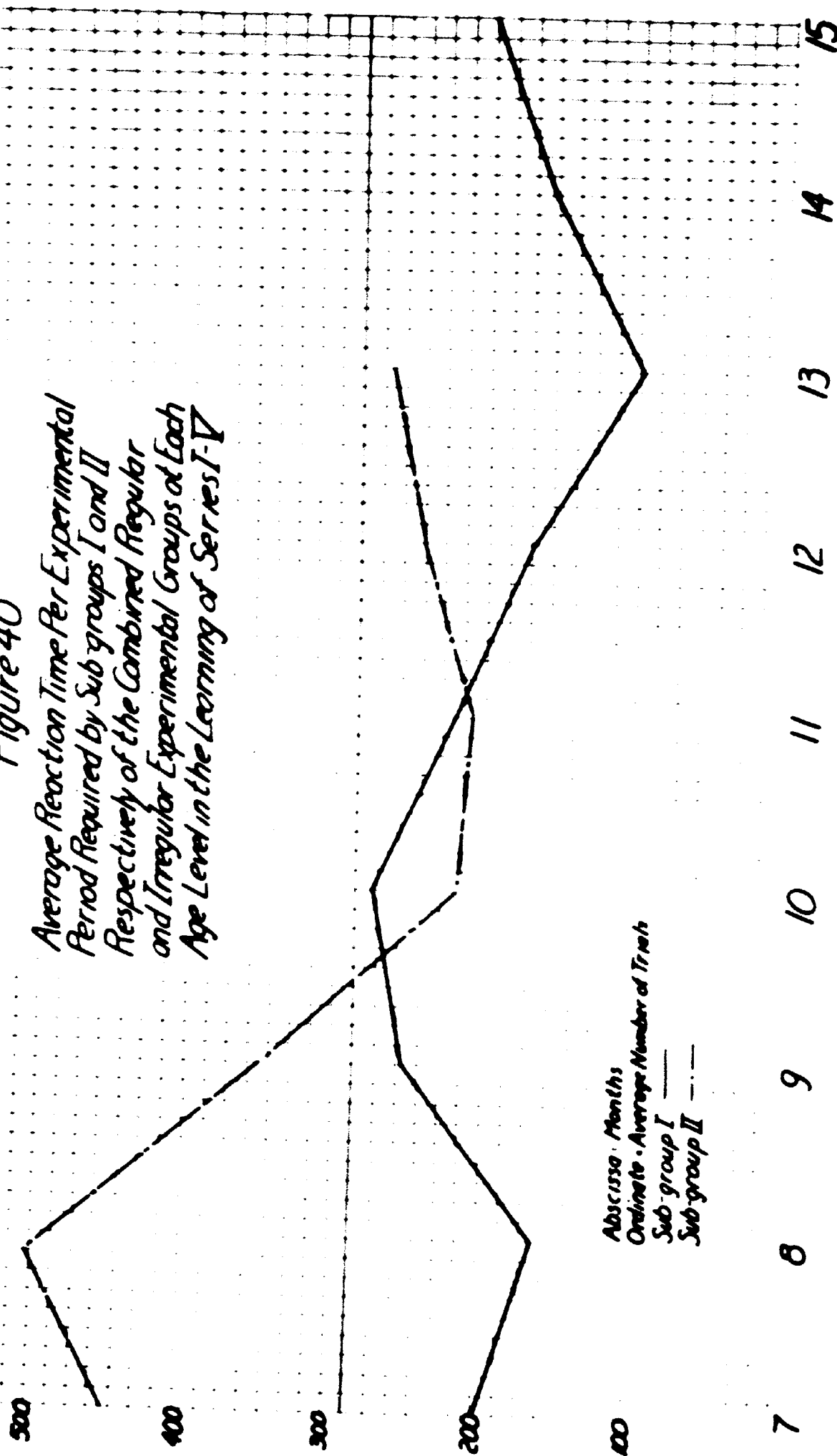
In total reaction time per experimental period at each age level from the seventh to the thirteenth month, Sub-group

Figure 39
Average Reaction Time Per Experimental
Period Required by Subgroups I and II
Respectively of the Regular Experimental
Group at Each Age Level in the Learning of
Series I-V



Abc: 1500 - Months
Ordinate - Form Combinations
Sub-group I —
Sub-group II ---

Figure 40
*Average Reaction Time Per Experimental
 Period Required by Sub groups I and II
 Respectively of the Combined Regular
 and Irregular Experimental Groups of Each
 Age Level in the Learning of Series I-V*



I differed significantly from Sub-group II in two ways:

(1) The curve for Sub-group I shows a short total reaction time per experimental period at first (126.10- sec. - 200.08- sec.),¹ an increase to the tenth month (277.52+ sec.) and a fall to its minimum (116.28+ sec. - 99.67+ sec.) at the thirteenth month.

One possible interpretation of this curve is that during the first days of the experiment the subjects of Sub-group I were too young to maintain their interest in the task very long. As they grew older, they were able generally to prolong their experimental period, thus learning to discriminate more and more forms (see a) 1) on pages 148 and 152). After the tenth month they had reached a stage in development in which they were able to perform so fast that there was no longer any need for them to remain in the experimental crib for any great length of time. Furthermore, as the range of attention expanded, they became increasingly impatient with the task which had apparently become too simple.

The curve for Sub-group II, on the other hand, shows a long initial total reaction time per experimental period (between 419.46+ and 503.51+ sec.) maintained through the first two months, a descent to the minimum (214.01 sec. -

¹Here, as well as on the following pages, when two figures are hyphenated, the first number is a score for the Regular Experimental Group and the second, a score for the Combined Regular and Irregular Experimental Groups. Thus, 126.10- sec. belongs to the Regular and 200.08- sec. to the Combined Groups.

210.16+ sec.) at the eleventh month, and a rise back to 246.21- sec. and 268.63- sec. at the twelfth and thirteenth months. This is practically the opposite of Sub-group I's reaction time.

Since the two sub-groups were carefully equated in both chronological and developmental ages, the longer reaction time for Sub-group II during the first two months could not be interpreted as an indication of a higher degree of maturity on the part of the group. Therefore, initial sequence of difficulty seems, once more, the only explanation.

The combined data on total number of form combinations learned, total number of trials carried out and total reaction time required per experimental period at different age levels have shown that the subjects of both groups attained their maximum degree of interest and efficiency when their scores in reaction time were somewhere between 210 to 280 seconds. Beyond this limit in either direction the scores perhaps indicate either immaturity on the part of the subject, or loss of interest in the task, or excessive difficulty of the stimulus pattern.

(2) This explanation leads directly to a difference between Sub-groups I and II: With the exception of the tenth month, the reaction time per experimental period for Sub-group II was consistently higher than that for Sub-group I. Aside from a possible difference in personality between the groups, the cause, again, seems to be the different

order of pattern presentation.

(b) Average Reaction Time Per Trial (See

Figures 41 and 42 on pages 165 and 166.)

Group differences are likewise indicated here:

(1) Sub-group I shows low reaction time per trial at first (11.56- sec. for the Regular Experimental Group), 252.01- sec. - 255.55+ sec. at the ninth month, and 277.52+ sec. at the tenth month, and minimum (5.25- sec.) at the thirteenth month.

Sub-group II begins at 54.20 sec. - 49.54 sec., falls rapidly to about 11 sec. at the tenth month, and remains approximately there through the thirteenth month.

(2) With the exception of the tenth month, reaction time per trial for Sub-group II was consistently higher than that for Sub-group I.

2) Individual Differences (See Tables 37 and 38 on pages 167 and 168.)

So far our discussion of reaction time has been confined to group differences. Individual differences both in total reaction time per experimental period and in average reaction time per trial are, however, very marked (see Tables 37 and 38 on pages 167 and 168).

c) Oral Behavior

1) Individual Differences (See Tables 39 and 40 on pages 169 and 170.)

The wide range of individual differences, apparently

Figure 41
*Average Reaction Time Per Trial Required
 by Subgroups I and II Respectively of the
 Regular Experimental Group of Each Age
 Level in the Learning of Series I-V*

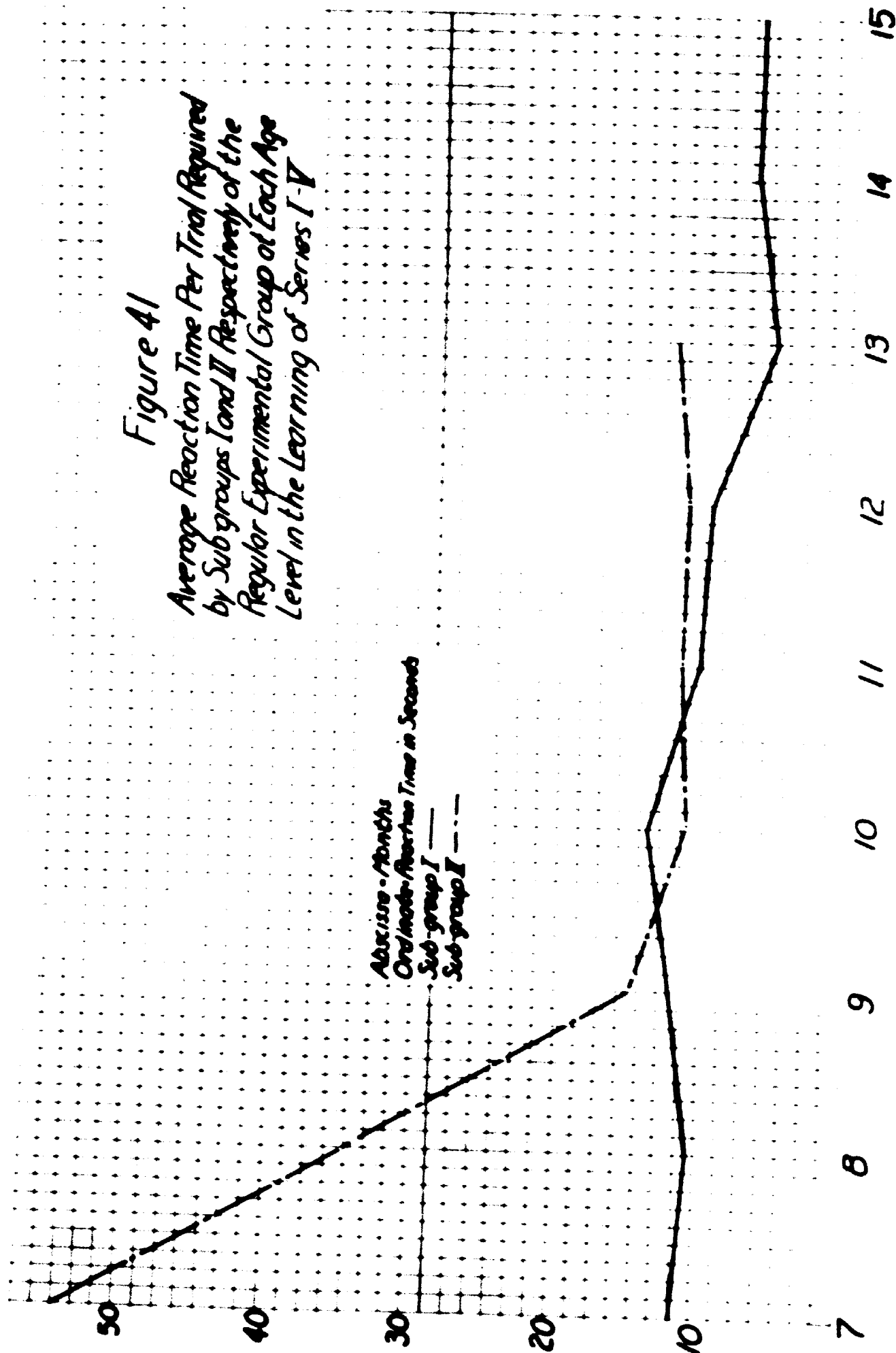


Figure 42
Average Reaction Time Per Trial Required
by Sub-groups I and II Respectively of the
Combined Regular and Irregular Experimental
Groups of Each Age Level in the Learning
of Series I-V

Abscissa - Months
Ordinate - Reaction Time in Seconds
Sub group I —
Sub group II - - -

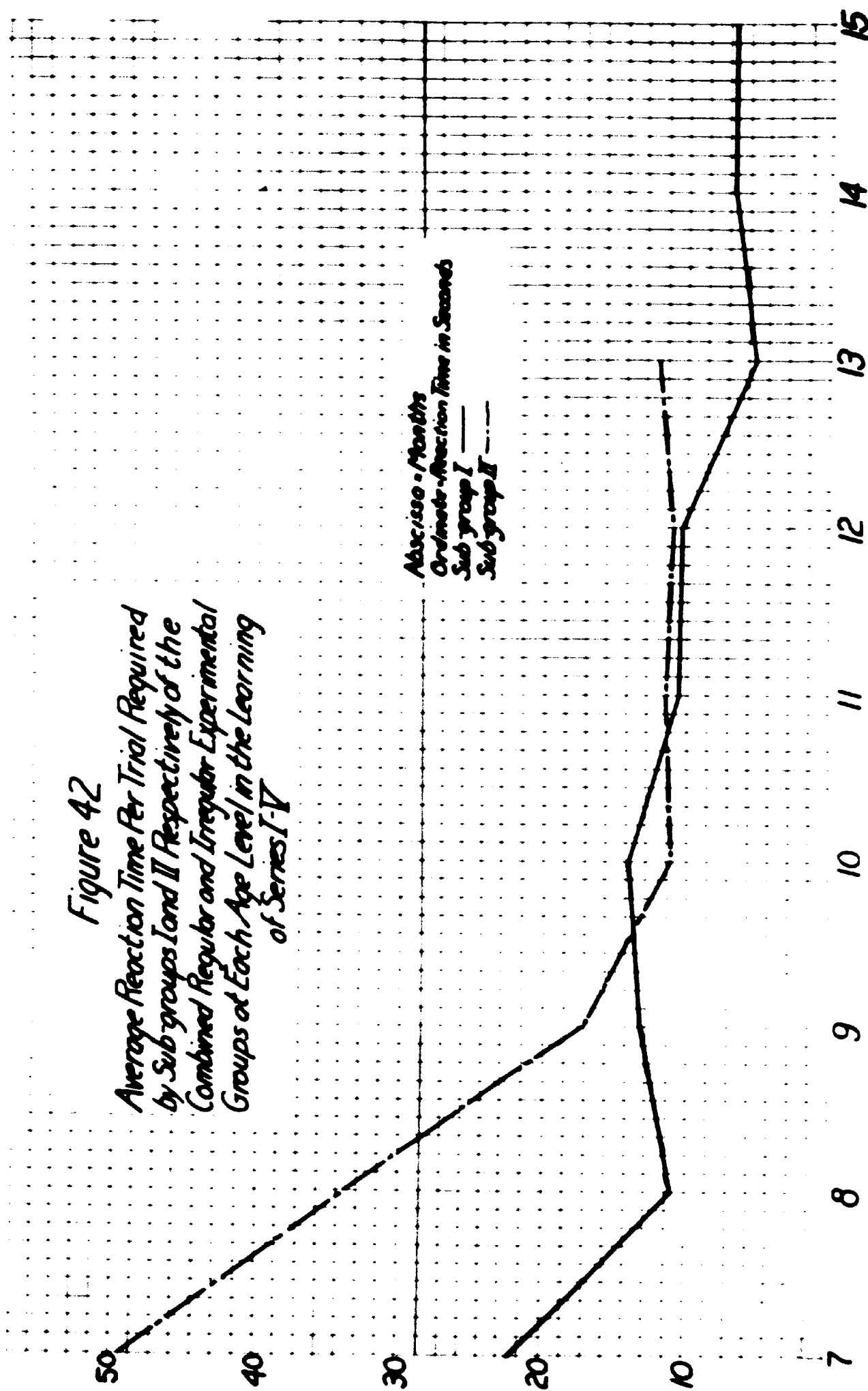


Table 37

Average Reaction Time* Required per Experimental Period at Each Age Level
by Three Typical Cases from Each of the Sub-Groups
of the Regular Experimental Group in the Learning of Series I - V

Age	Sub-Group I		Sub-Group II	
	Case Number	Av. React. Time per Exp. Period	Case Number	Av. React. Time per Exp. Period
7	I	----	C	----
	K	105.20	H	----
	R	----	P	521.00
8	I	99.70	C	----
	K	261.47♦	H	----
	R	178.20	P	469.92-
9	I	197.35-	C	147.63♦
	K	276.88-	H	----
	R	165.75	P	284.13♦
10	I	289.20	C	243.49♦
	K	301.80	H	----
	R	146.88	P	254.47-
11	I	261.78-	C	266.29♦
	K	----	H	194.17
	R	251.4	P	281.50
12	I	----	C	286.90
	K	----	H	237.89♦
	R	----	P	----
13	I	----	C	253.13-
	K	----	H	573.80
	R	----	P	----

*All reaction time in seconds

Table 38

Average Reaction Time* Required per Trial at Each Age Level
by Three Typical Cases from Each of the Sub-Groups
of the Regular Experimental Group in the Learning of Series I - V

Month	Sub-Group I		Sub-Group II	
	Case Number	Average Reaction Time	Case Number	Average Reaction Time
7	I	----	C	----
	K	14.22-	H	----
	R	----	P	130.25
8	I	7.48-	C	----
	K	17.12+	H	----
	R	16.53+	P	25.29-
9	I	9.44-	C	11.07+
	K	14.83+	H	----
	R	10.25+	P	15.41+
10	I	14.56+	C	12.28-
	K	17.19+	H	----
	R	9.38-	P	14.36-
11	I	13.78-	C	15.18-
	K	----	H	10.22-
	R	9.86-	P	11.26
12	I	----	C	11.31+
	K	----	H	12.15-
	R	----	P	----
13	I	----	C	11.09-
	K	----	H	24.95-
	R	----	P	----

*All reaction time in seconds

Table 39

Average Number and Percentage of Trials in which Oral Behavior
was Exhibited at Each Age Level by Three Typical Cases
in Sub-Group I of the Regular Experimental Group
in the Learning of Series I - V

Age	Case	Present			Absent	
		Total	Regular ^a	Special ^b	Number	Percentage
7	B	-	-	-	-	-
		----	----	----	-	----
	E	13	13	0	12	48 %
		52 %	100 %	0 %		
8	B	-	-	-	-	-
		----	----	----	-	----
	E	5	5	0	55	91.67 %
		8.33 %	100 %	0 %		
9	B	39	39	0	133	77.33 %
		22.67 %	100 %	0 %		
	E	2	2	0	114	98.28 %
		1.72 %	100 %	0 %		
10	B	54	54	1	168	75.68 %
		24.32 %	100 %	1.85 %		
	E	30	30	0	36	54.55 %
		45.45 %	100 %	0 %		
11	B	4	4	0	108	96.43 %
		3.57 %	100 %	0 %		
	E	50	50	0	182	78.45 %
		21.55 %	100 %	0 %		
12	B	93	93	0	171	64.77 %
		35.25 %	100 %	0 %		
	E	2	2	0	134	98.53 %
		1.47 %	100 %	0 %		
13	B	135	133	4	119	46.85 %
		53.15 %	98.52 %	2.96 %		
	E	59	59	1	157	72.69 %
		27.31 %	100 %	1.69 %		
14	B	8	8	0	224	96.55 %
		3.45 %	100 %	0 %		
	E	-	-	-	-	-
		----	----	----	-	----
15	B	-	-	-	-	-
		----	----	----	-	----
	E	60	60	0	84	58.33 %
		41.67 %	100 %	0 %		

^a "regular" oral behavior is meant that form of oral behavior in which the stimulus block is actually in contact with the subject's mouth.
^b "special" oral behavior is meant that form of oral behavior in which the stimulus block is not in actual contact with the subject's mouth.

Table 40

Average Number and Percentage of Trials in which Oral Behavior
was Exhibited at Each Age Level by Three Typical Cases
in Sub-Group II of the Regular Experimental Group
in the Learning of Series I - v

Month	Case	Present			Absent	
		Total	Regular*	Special**	Number	Percentage
7	G	22	22	0	14	36.89%
		61.11%	100%	0%		
	N	35	35	0	40	53.33%
		46.67%	100%	0%		
	O	14	14	0	11	44%
		56%	100%	0%		
8	G	55	55	0	69	61.81%
		38.19%	100%	0%		
	N	107	107	0	80	42.78%
		57.22%	100%	0%		
	O	72	71	4	18	20%
		80%	98.61%	5.56%		
9	G	112	112	0	169	60.14%
		39.86%	100%	0%		
	N	125	124	1	78	38.42%
		61.58%	99.2%	.8%		
	O	40	40	0	16	28.57%
		71.43%	100%	0%		
10	G	101	101	0	201	66.66%
		33.44%	100%	0%		
	N	65	62	3	60	48%
		52%	95.38%	4.62%		
	O	111	111	1	69	38.35%
		61.67%	100%	.99%		
11	G	3	3	0	40	93.02%
		6.98%	100%	0%		
	N	--	--	--	--	----
		----	----	----		
	O	53	53	0	20	27.45%
		72.60%	100%	0%		

* By "regular" oral behavior is meant that form of oral behavior in which the stimulus block is actually in contact with the subject's mouth.

** By "special" oral behavior is meant that form of oral behavior in which the stimulus block is not in actual contact with the subject's mouth.

unrelated to age, is illustrated in these tables.

2) Group Trends (See Figures 43 and 44 on pages 172 and 173.)

(a) Distribution of Oral Behavior

The relatively high initial incidence of oral behavior in the curves for both sub-groups, as shown in Figures 43 and 44, is probably due to the interplay of two important factors: (1) a characteristically high incidence at the seventh month maturation level, and (2) power of the gustatory motivation factor. As stated earlier, most authorities regard oral behavior as a form of manipulation characteristic of this age level (see page 104).

The steady descent of both curves after the ninth month is probably explainable by the combined effect of: (1) a natural waning of oral activity due both to maturation and to social inhibition; (2) the gradual dominance of complex manual activity over primitive gustatory lures as motivating factors; and (3) increasingly rapid eye-hand domination of behavior [cf. Stern (17), Gesell (45), Bühler (12), etc.].

The contrast between the curves for Sub-groups I and II is probably attributable to the different order of pattern presentation as discussed above. In other words, oral behavior is apparently a qualitative concomitant of behavior as related to a specific task as well as to maturation.

(b) Frequency of Oral Behavior

In every month except the thirteenth, Sub-group II

Figure 43

Average Percentage of Trials in which Oral Behavior was Exhibited by Subgroups I and II Respectively of the Regular Experimental Group at Each Age Level in the Learning of Series I-V

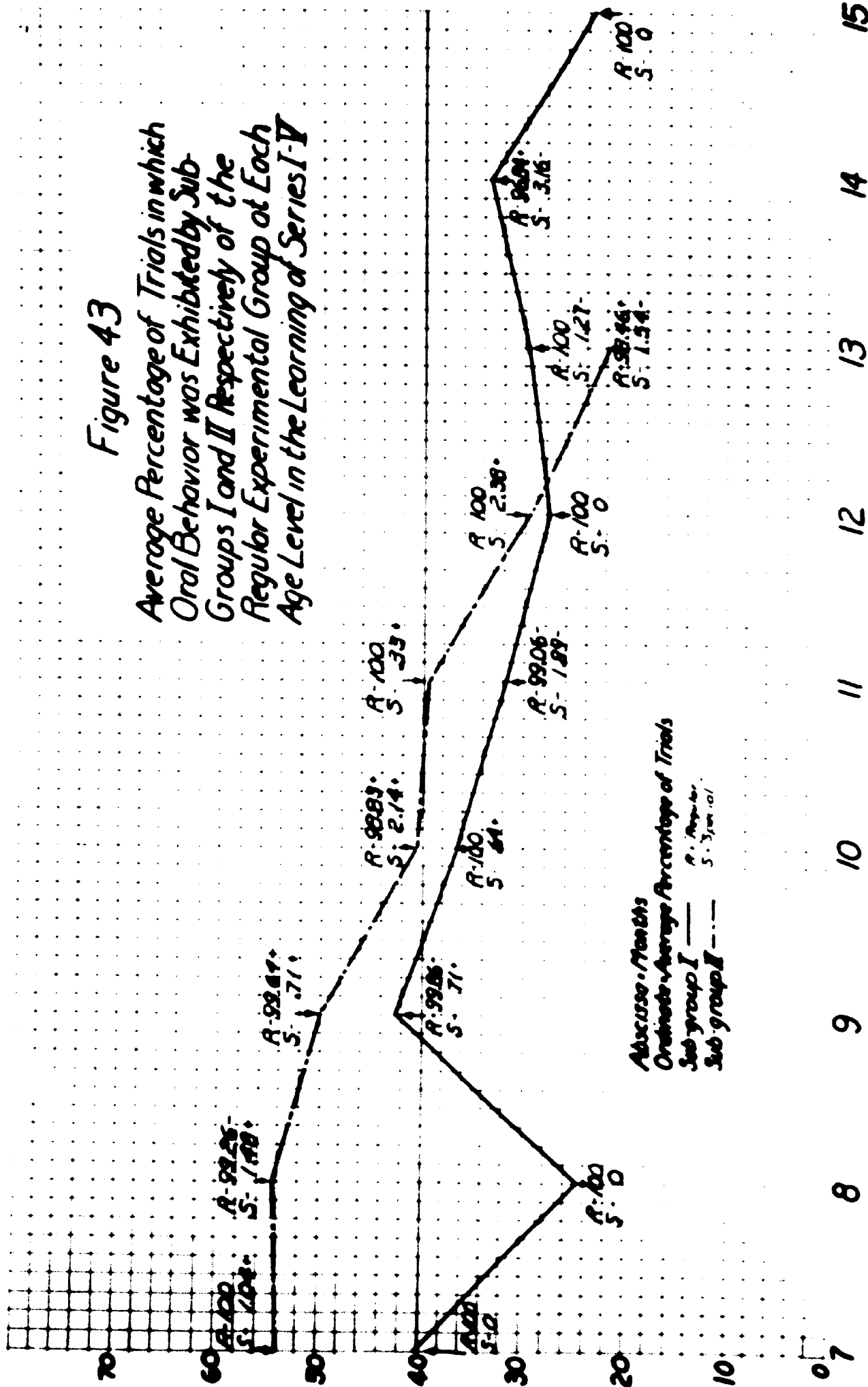
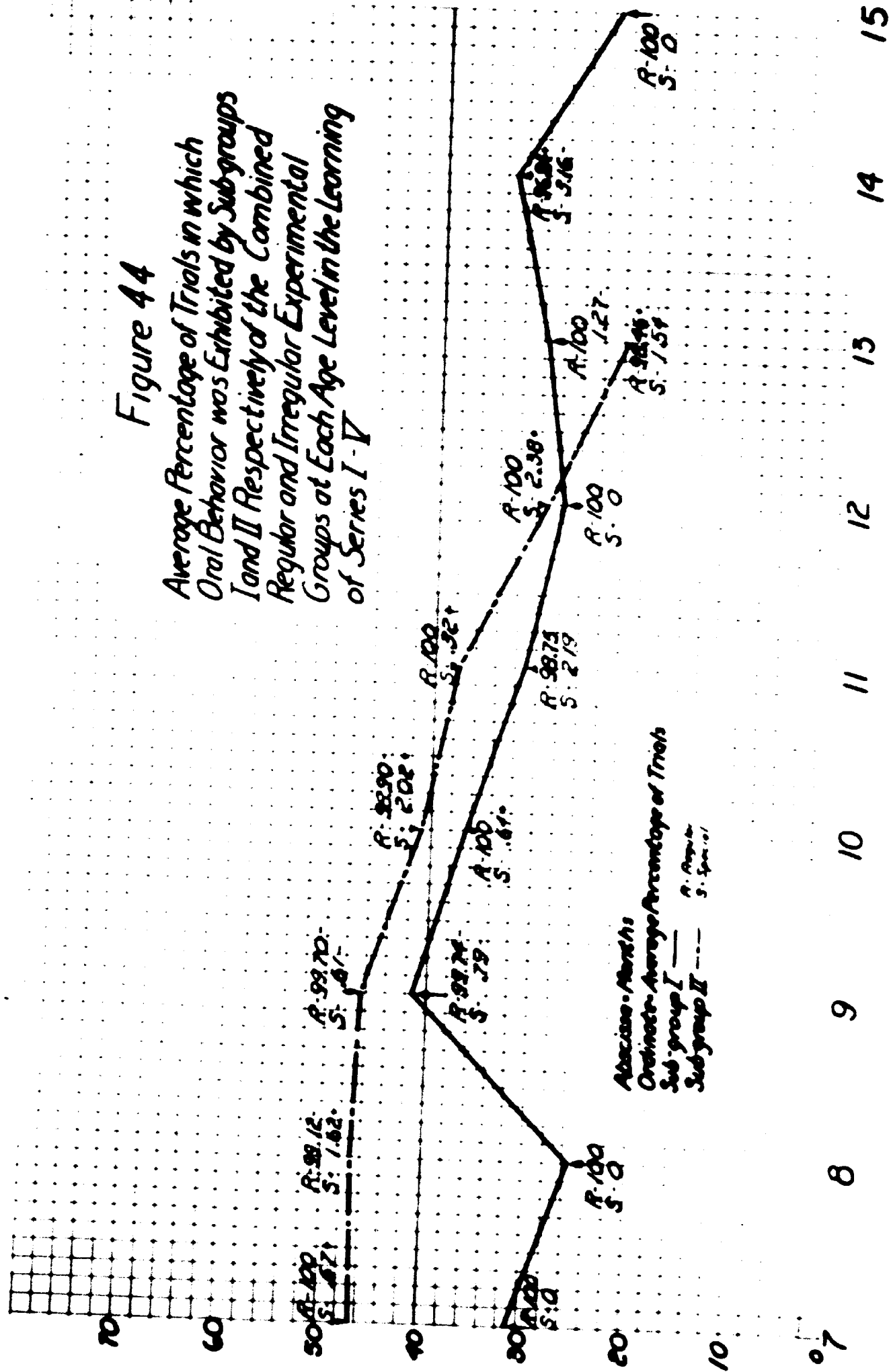


Figure 44
Average Percentage of Trials in which
Oral Behavior was Exhibited by Subgroups
I and II Respectively of the Combined
Regular and Irregular Experimental
Groups at Each Age Level in the Learning
of Series I-V



exhibited oral behavior more frequently than Sub-group I. This difference was more marked during the seventh, eighth and ninth months than in the following three months. Of the total number of trials in which oral behavior was present, between 98% to 99% of them contained "regular" oral behavior; about 1% to 2%, "special" oral behavior; and about $\frac{1}{2}\%$, both kinds. This last statement applies to both sub-groups.

Since the use of oral behavior apparently did aid discrimination performance (see page 104), and also in view of the initial difficulty in task for Sub-group II, it seems possible to infer that Sub-group II, either through involuntary "motor irradiation" or deliberately, made greater use of oral activity as an auxiliary learning cue than did Sub-group I. Common maturational and social factors in both groups, however, seem indicated in the common decline of oral behavior after the ninth month.

2) Vocalization

1) Individual Differences (See Tables 41 and 42 on pages 175-176 and 177.)

The wide range of individual differences with relation to age is illustrated in these tables.

2) Group Trends (See figures 45 and 46 on pages 178 and 179.)

(a) Distribution of Vocalization

(1) Total Amount of Vocalization

There is no reliable difference between the two sub-groups

Table 41

Average Number and Percentage of Trials in which Vocalization Occurred
at Each Age Level in Three Typical Cases in Sub-Group I
of the Regular Experimental Group in the Learning of Series I - V

Path	Case	Present				Absent
		Total	Pleasant	Unpleasant	Communicative*	
7	A	-	-	-	-	-
		----	----	----	----	----
	D	30	0	30	0	17
		63.83%	0 %	100 %	0 %	36.17%
	J	-	-	-	-	-
		----	----	----	----	----
8	A	-	-	-	-	-
		----	----	----	----	----
	D	183	78	106	10	87
		67.78%	42.62%	52.46%	5.46%	32.22%
	J	25	13	12	1	162
		13.37%	52 %	48 %	4 %	86.63%
9	A	-	-	-	-	-
		----	----	----	----	----
	D	160	134	9	19	117
		57.76%	83.75 %	5.63%	11.66%	42.24%
	J	50	47	0	4	164
		23.36%	94 %	0 %	8 %	76.64%
10	A	-	-	-	-	-
		----	----	----	----	----
	D	-	-	-	-	-
		----	----	----	----	----
	J	44	40	0	5	146
		23.16%	90.91%	0 %	11.36%	76.84%
11	A	-	-	-	-	-
		----	----	----	----	----
	D	-	-	-	-	-
		----	----	----	----	----
	J	10	7	0	3	69
		12.66%	70 %	0 %	30 %	87.34%
12	A	17	13	2	2	145
		10.49%	76.47%	11.76%	11.76%	89.51%
	D	-	-	-	-	-
		----	----	----	----	----
	J	-	-	-	-	-
		----	----	----	----	----

*Communicative vocalization is that type which is apparently more than spontaneous vocalization, coupled with a general pleasant or unpleasant state of the subject. It conveys some spatially directed meaning; such as an attempt to communicate with someone or something; or the sounds accompanying a search for the block after it has slipped out of the subject's grasp and disappeared from sight.

Table 41 (cont'd)

Path	Case	Present			Communicative ^a	Absent
		Total	Pleasant	Unpleasant		
13	A	63	58	0	5	203
		23.68%	92.06%	0 %	7.94%	76.32%
	D	-	-	-	-	-
		----	-----	-----	-----	-----
	J	-	-	-	-	-
		----	-----	-----	-----	-----
14	A	99	94	0	5	187
		34.62%	94.95%	0 %	5.05%	65.38%
	D	-	-	-	-	-
		----	-----	-----	-----	-----
	J	-	-	-	-	-
		----	-----	-----	-----	-----
15	A	14	14	0	0	16
		46.67%	100 %	0 %	0 %	53.33%
	D	-	-	-	-	-
		----	-----	-----	-----	-----
	J	-	-	-	-	-
		----	-----	-----	-----	-----

Table 42

Average Number and Percentage of Trials in which Vocalization Occurred
at Each Age Level in Three Typical Cases in Sub-Group II
of the Regular Experimental Group in the Learning of Series I - V

Month	Case	Present				Absent
		Total	Pleasant	Unpleasant	Communicative	
7	G	24	18	9	0	18
		66.67%	66.67%	37.5 %	0 %	33.33%
	H	-	-	-	-	-
		----	----	----	----	----
	Q	11	1	10	0	23
		32.36%	9.09%	90.91%	0 %	67.65%
8	G	93	17	76	8	81
		64.58%	18.28%	81.72%	3.23%	36.42%
	H	-	-	-	-	-
		----	----	----	----	----
	Q	104	73	33	3	63
		62.28%	70.19%	31.73%	2.86%	37.72%
9	G	126	66	50	13	185
		44.84%	52.38%	39.68%	10.32%	55.16%
	H	-	-	-	-	-
		----	----	----	----	----
	Q	63	40	28	0	56
		52.07%	63.49%	44.44%	0 %	47.93%
10	G	150	148	7	9	143
		52.65%	91.19%	4.40%	5.66%	47.35%
	H	-	-	-	-	-
		----	----	----	----	----
	Q	81	63	22	3	39
		68.64%	77.78%	27.16%	3.70%	31.36%
11	G	14	12	2	0	29
		32.56%	65.71%	14.29%	0 %	67.44%
	H	28	27	1	0	162
		14.74%	26.43%	3.57%	0 %	85.26%
	Q	72	49	18	9	34
		67.92%	68.06%	25 %	12.5 %	32.08%
12	G	-	-	-	-	-
		----	----	----	----	----
	H	84	76	4	6	151
		35.74%	90.46%	4.76%	7.14%	64.26%
	Q	36	31	7	3	24
		61.29%	81.56%	18.42%	7.89%	38.71%
13	G	-	-	-	-	-
		----	----	----	----	----
	H	15	15	0	0	9
		65.22%	100 %	0 %	0 %	34.78%
	Q	-	-	-	-	-
		----	----	----	----	----

Communicative vocalization is that type which is apparently more than spontaneous vocalization coupled with a general pleasant or unpleasant state of the subject. It conveys some spatially directed meaning; such as an attempt to communicate with someone or something; or the sounds accompanying a search for the block after it has slipped out of the subject's grasp and disappeared from sight.

Figure 45

Average Percentage of Trials in which
Vocalization Occurred with Sub groups
I and II Respectively of the Regular
Experimental Group at Each Age Level
in the Learning of Series I-V

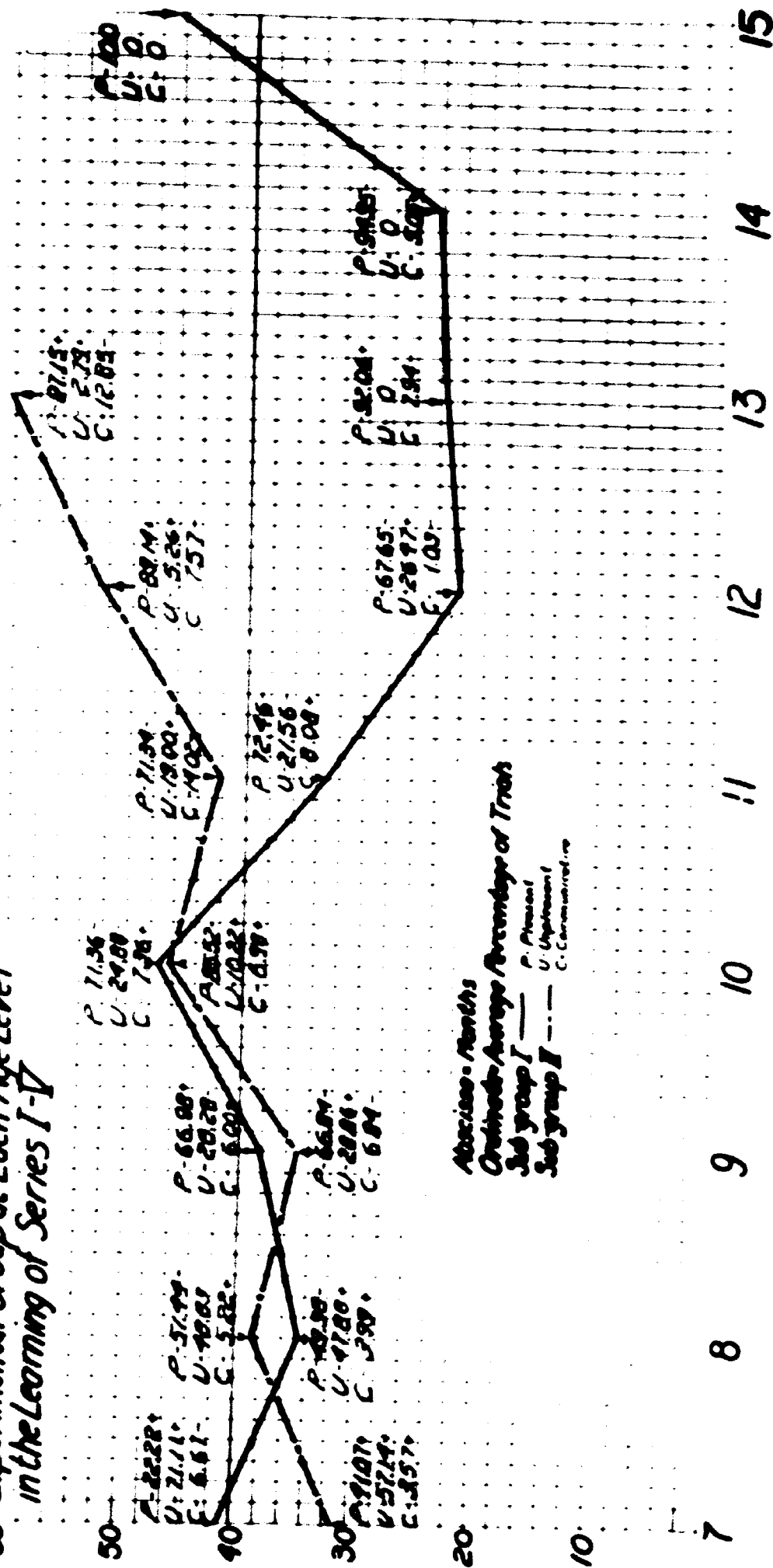
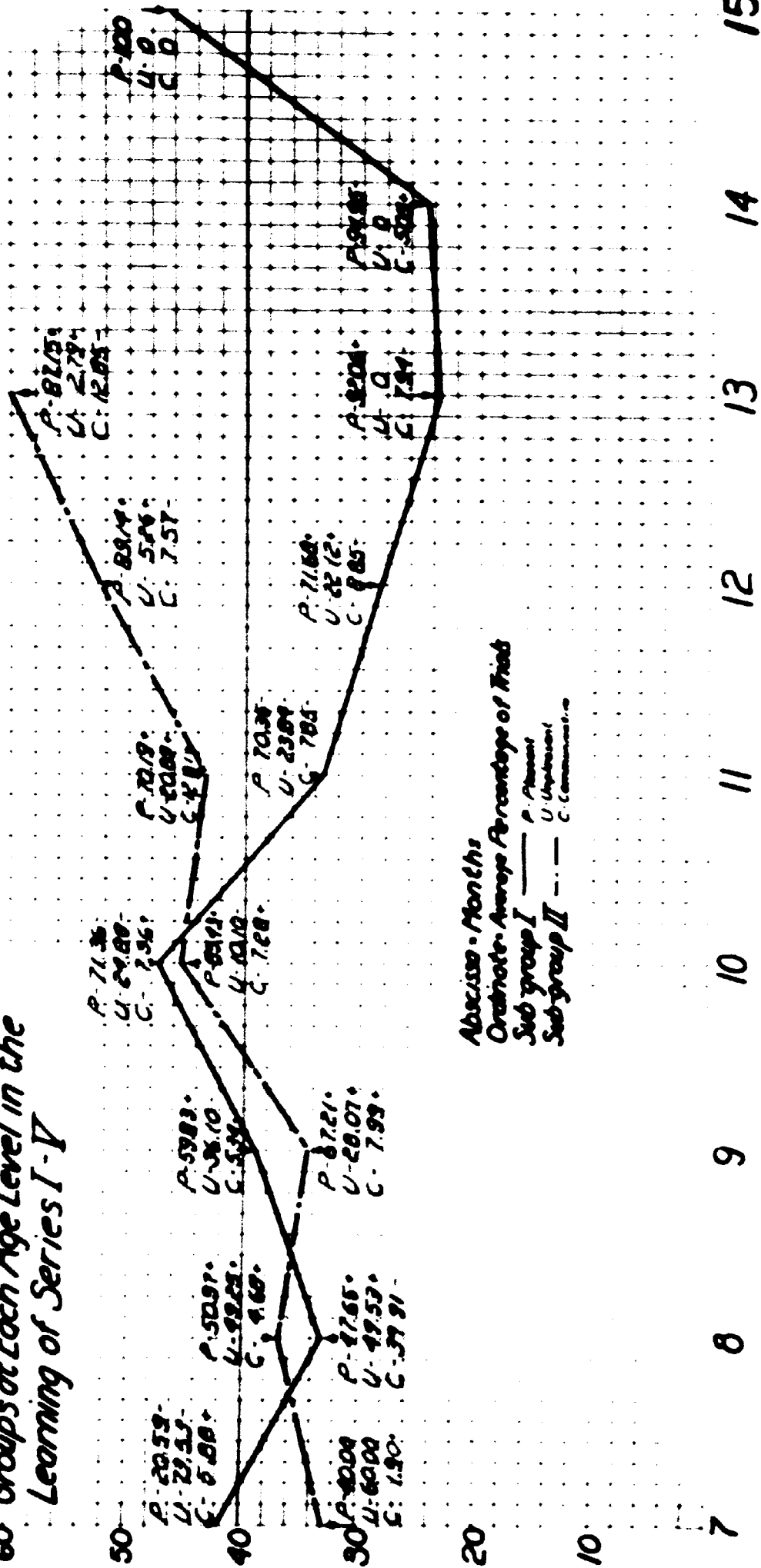


Figure 46

Average Percentage of Trials in which
Vocalization Occurred in Sub-groups
I and II Respectively of the Combined
Regular and Irregular Experimental
Groups at Each Age Level in the
Learning of Series I-V



except at the very beginning when Sub-group I excels and after the eleventh month, in which Sub-group II steadily exceeds in vocalization increment. By the thirteenth month, this difference (36.59%) appears to be significant.

(2) Types of Vocalization

a Pleasant

This curve for Sub-group I starts very low ($22.22 \pm 20.59\%$); then it ascends steadily and consistently until it reaches its peak ($92.06 \pm 4\%$) at the thirteenth month. The curve for Sub-group II starts relatively higher ($41.07 \pm 40.00\%$); then it ascends steadily, even though not so markedly until it reaches its peak ($89.14 \pm 4\%$) at the twelfth month. It descends very slightly (2%) at the thirteenth month.

b Unpleasant

This curve, for obvious reasons, is practically the reverse of the preceding one.

c Communicative

This type of vocal expression fluctuates in both groups, though, on the whole, Sub-group II tends to increase it somewhat at older age levels.

As a whole, the combined data of all the curves in Figures 45 (see page 178) and 46 (see page 179) show:

(1) A process of gradual and permanent adjustment to the experimental situation in general and the stimulus patterns in particular can be traced through these seven successive age levels (from the seventh to the thirteenth

months).

(2) There are no consistent group differences except at the very beginning and after the eleventh month.

(3) Neither the total amount of vocalization, nor the distribution of the three types, correlate with the degree of success obtained by either sub-group throughout the seven consecutive age levels, as measured by the form combination, trial, and reaction time curves (cf. figures 33-42 on pages 150, 151, 154, 155, 157, 158, 160, 161, 165, and 166).

(b) Amount of Vocalization

On the whole, Sub-group II was both more voluble and more variable in type than Sub-group I.

g) Affective Concomitant

1) Individual Differences (See Tables 43 and 44 on pages 182-183 and 184.)

Individual differences are present in all the five aspects of affective concomitant, but in different degrees. These differences tend to persist through maturational levels.

2) Group Trends (See Figures 47 and 48 on pages 185 and 186.)

Significant group trends are:

(a) A very low initial incidence followed by a small but consistent increase in very pleasant concomitant

Table 45

Average Number and Percentage of Trials in which Different Aspects
of Affective Concomitant were Observed at Each Age Level

Three Typical Cases in Sub-Group I of the Regular Experimental Group
in the Learning of Series I - V

Case	Very Pleasant	Pleasant	Neutral	Unpleasant	Very Unpleasant
7	A	-	-	-	-
		-----	-----	-----	-----
	K	3	33	3	0
		8.11%	89.19%	8.11%	0%
8	F	-	-	-	-
		-----	-----	-----	-----
	A	-	-	-	-
		-----	-----	-----	-----
9	K	6	161	32	22
		3.57%	95.83%	19.05%	13.10%
	F	0	115	15	9
		0%	99.14%	12.93%	7.76%
10	A	-	-	-	-
		-----	-----	-----	-----
	K	11	209	54	70
		4.91%	93.30%	24.11%	31.25%
11	F	0	112	12	2
		0%	100%	10.71%	1.79%
	A	-	-	-	-
		-----	-----	-----	-----
12	K	8	147	42	70
		5.06%	93.04%	20.58%	44.30%
	F	2	134	19	4
		1.47%	98.53%	13.97%	2.94%
13	A	-	-	-	-
		-----	-----	-----	-----
	K	-	-	-	-
		-----	-----	-----	-----
14	F	7	225	34	2
		3.02%	96.98%	14.66%	.86%
	A	4	158	9	7
		2.47%	97.53%	5.56%	4.32%
15	K	-	-	-	-
		-----	-----	-----	-----
	F	7	135	13	16
		4.86%	93.75%	9.03%	11.11%

Table 4B (cont'd)

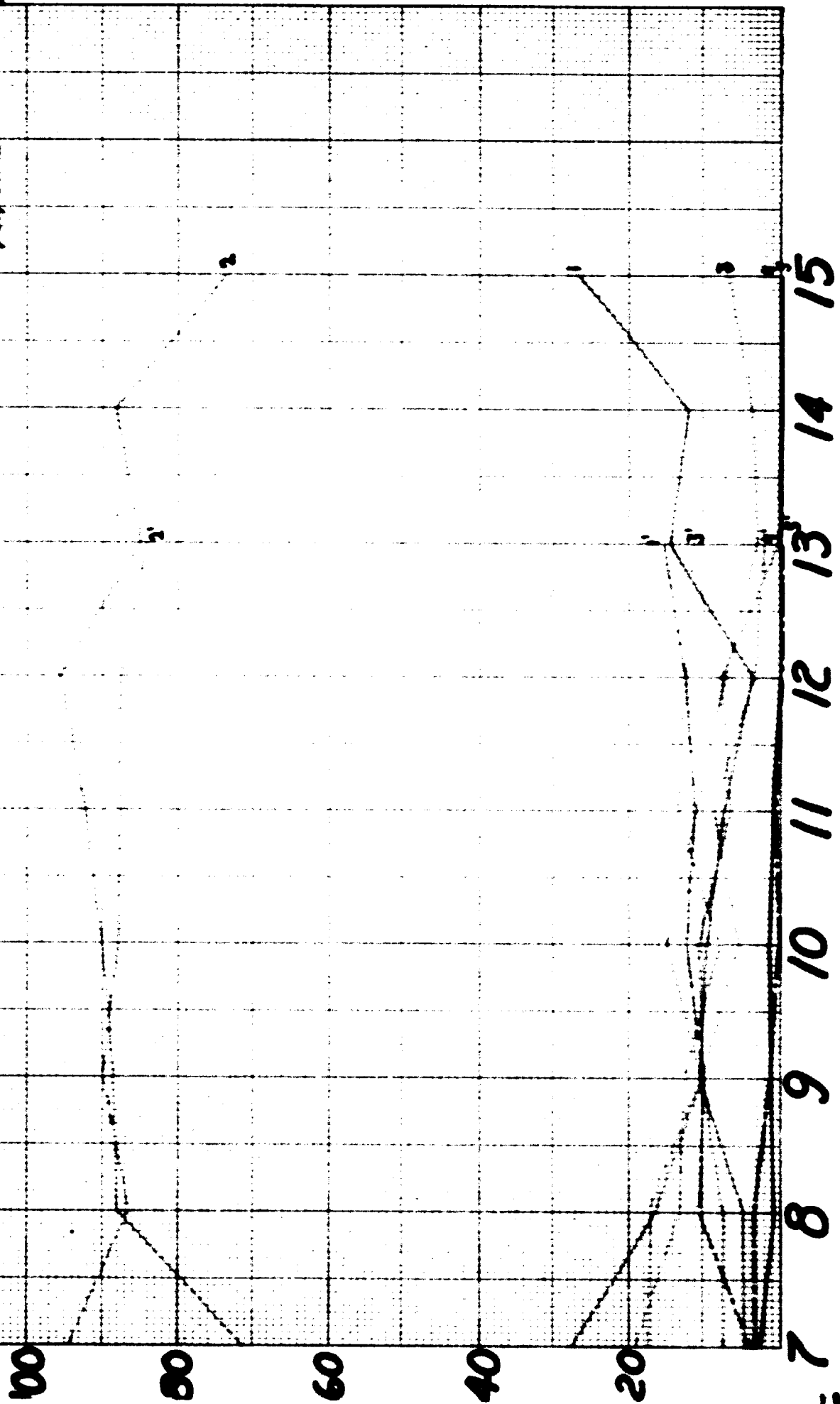
Month	Case	Very Pleasant	Pleasant	Neutral	Unpleasant	Very Unpleasant
13	A	38	226	8	1	0
		14.29%	84.96%	3.01%	.38%	0
	K	-	-	-	-	-
		----	----	----	----	----
	F	-	-	-	-	-
		----	----	----	----	----
14	A	34	252	11	0	0
		11.89%	88.11%	3.85%	0	0
	K	-	-	-	-	-
		----	----	----	----	----
	F	-	-	-	-	-
		----	----	----	----	----
15	A	8	22	2	0	0
		26.67%	73.33%	6.67%	0	0
	K	-	-	-	-	-
		----	----	----	----	----
	F	-	-	-	-	-
		----	----	----	----	----

Table 44

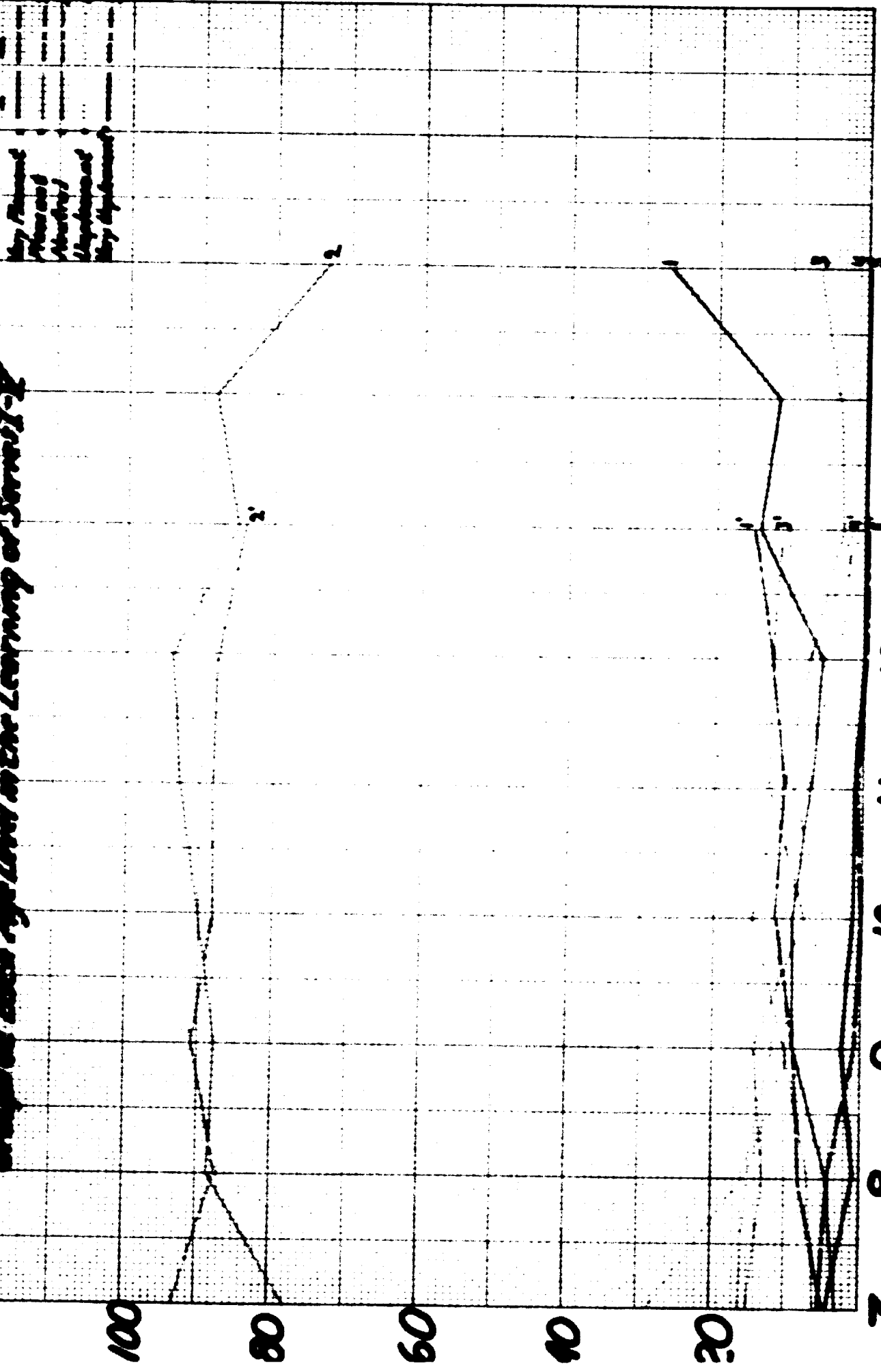
Average Number and Percentage of Trials in which Different Aspects
of Affective Concomitant were Observed at Each Age Level
in Three Typical Cases in Sub-Group II of the Regular Experimental Group
in the Learning of Series I - V

Month	Case	Very Pleasant	Pleasant	Neutral	Unpleasant	Very Unpleasant
7	C	-	-	-	-	-
		----	----	----	----	----
	N	1	74	12	7	0
		1.33%	98.67%	16 %	9.33%	0 %
	P	0	8	3	3	2
		0 %	100 %	37.5 %	37.5 %	25 %
8	C	-	-	-	-	-
		----	----	----	----	----
	N	9	177	19	23	5
		4.81%	94.65%	10.16%	12.30%	2.67%
	P	21	202	34	18	0
		9.42%	90.58%	15.25%	8.07%	0 %
9	C	10	28	4	12	6
		25 %	70 %	10 %	30 %	15 %
	N	10	193	40	6	1
		4.93%	95.07%	19.70%	2.96%	.43%
	P	13	156	18	13	0
		7.78%	92.81%	10.78%	7.78%	0 %
10	C	24	214	14	9	2
		10.08%	89.92%	5.88%	3.78%	.84%
	N	22	103	10	5	0
		17.60 %	82.40 %	8. %	4 %	0 %
	P	3	93	12	4	0
		3.10%	94.90%	12.24%	4.08%	0 %
11	C	24	162	31	29	3
		12.44%	83.94%	16.06%	15.03%	1.55%
	N	-	-	-	-	-
		----	----	----	----	----
	P	4	71	10	12	0
		5.33%	94.67%	13.33%	16 %	0 %
12	C	47	232	27	8	0
		16.85%	83.15%	9.68%	2.87%	0 %
	N	-	-	-	-	-
		----	----	----	----	----
	P	-	-	-	-	-
		----	----	----	----	----
13	C	43	229	27	6	0
		15.69%	83.58%	9.86%	2.19%	0 %
	N	-	-	-	-	-
		----	----	----	----	----
	P	-	-	-	-	-
		----	----	----	----	----

Subject	Score
Very Advanced	100
Advanced	90
Intermediate	80
Very Elementary	70
Elementary	60
Very Elementary	50
Elementary	40
Very Elementary	30
Elementary	20
Very Elementary	10
Elementary	0



Development of Logical Thinking in the Different Stages of the Learning Process
When the Conditions were Observed in Sub-Groups
1 and 2, Respectively, of the Combined Regular and Irregular
Grouped Most Age Level in the Learning of Series I-V



Sub-group 1
Sub-group 2

Sub-group 1
Sub-group 2

Sub-group 1
Sub-group 2

Sub-group 1
Sub-group 2

Sub-group 1
Sub-group 2

with increased age in both sub-groups.

(b) A comparatively low percentage of pleasant concomitant at the start in Sub-group I, succeeded by a steady increase to the thirteenth month with an abrupt decline at that age level; a very high initial percentage and a slight subsequent decrease in Sub-group II.

(c) A low initial incidence of neutral concomitant in Sub-group I followed by a slight but steady increase to the tenth month and a definite decline from then on; a relatively high initial incidence in Sub-group II, followed by a general decrease to the tenth month and a marked increase after that age level. The results of the two groups show an interesting contrast.

(d) A high initial incidence followed by a consistent and steady decrease in both unpleasant and very unpleasant affective concomitants with increased age in both sub-groups.

In general, none of the five aspects of affective concomitant seemed to correlate with achievement in either group, throughout the seven consecutive age levels, as measured by the form combination, trial, and reaction time curves (cf. Figures 33-42 on pages 150, 151, 154, 155, 157, 158, 160, 161, 165, and 166), or with specific maturation level. Pleasantness was by far the most predominant affective concomitant at all the seven consecutive age levels covered by this part of the study. The extreme

aspects of pleasantness and unpleasantness were very infrequent.

h) Visual Regard

When the six months infants were first presented with the stimulus blocks, they usually looked at them at once. However, this visual regard was, as a rule, momentary and intermittent; and was directed to one block at a time, very often completely ignoring the presence of the other until it was discovered that the first stimulus (if it happened to be the negative form) was fixed to the board. As they grew older, attention increased both in span and duration. By the ninth and tenth months, visual regard was much more sustained and coördinated. Attention was rarely limited to one block. On the contrary, they surveyed the entire visual field at one glance; or if the stimulus pattern was unusually complex, such as the five-block situation in Series IV, Section C, Modified, they examined each block singly and systematically by turning their heads slowly from one end of the visual field to another in a semicircular fashion, fixation apparently determined by spatial sequence (proximity) more than by geometric contour. After having secured the positive block, instead of immediately putting it into their mouths as younger infants did, they usually examined it very closely with varied manipulation.

By the twelfth and thirteenth months attention had

increased so greatly both in range and duration, and a relative motor maturity had made them so active, that they refused to sit still in the crib and the once highly motivated individual task had now only a temporary interest. Frequently, therefore, their visual regard was rarely confined to the stimulus pattern, but shifted rapidly from object to object within the experimental cubicle. However, during these moments of "coöperation," they showed coöordinated, controlled, alert and sustained visual regard, of the type not to be found in infants of earlier age levels.

1) Manipulation

In general, the manual behavior patterns in this experimental situation follow the developmental sequence established by Castner (53), Halverson (54,55,56), True (57), etc., namely, (1) failure to contact, (2) contact only, (3) primitive squeeze, (4) squeeze grasp, (5) hand grasp, (6) palm grasp, (7) superior palm grasp, (8) inferior-forefinger grasp, (9) forefinger grasp, (10) superior-finger grasp and (11) double grasp.¹

A familiar picture of the manipulative behavior of the six months infants, when first placed in the stimulus situation, consisted of the random patting of the experimental board (see page 22). The length of the time devoted to this

¹For description of these different types of grasping reactions, see True, A. Prehension in the Colored Infant, (Doctor's Thesis), pp. 59-63.

form of activity varied greatly with individual subjects, but sooner or later it would be terminated by the sudden discovery, often accidental, of the presence of the two bright yellow form blocks against the grey background. Visual fixation of these blocks, however, was momentary and intermittent (see page 188), and frequently the infants soon lost their interest in the blocks and engaged once more in the random manipulation of the board. In so doing they eventually came into contact with one or the other block. The positive stimulus was first dislodged by accident. The dislodged block was seldom picked up or further noticed, unless attention was deliberately refocused by a second presentation. Even if picked up, however, the block was never retained beyond a very brief period of time.

With increasing maturity manipulative activity became less random and more coördinated. Mere board manipulation disappeared by degrees, and approach to the block became more direct and deliberate. By the ninth and tenth months both eye-hand coördination and finger-thumb opposition had developed to such a stage that the positive block was secured with ease and apparent determination. Having secured the block the infants manipulated it in every conceivable way. Frequently a positive transfer of some incidental activity developed outside the laboratory could be detected among these various reactions. For example, Case P would invariably hold the block by its end and tip it

from side to side in a manner clearly simulating the use of one of his toys at home.

By the twelfth and thirteenth months the prehensile reactions were further improved by a marked decline in the palmer types of grasp, which were still prevalent in the ninth and tenth months, and a corresponding increase in the digital types. The securing movement became direct, swift and well-coördinated. Instead of subsequent prolonged manual or oral manipulation, the typical reaction pattern now was to turn in the crib, throw the block to the floor, and then actively search for it visually. The subjects had obviously reached a maturational level in which the experimental task was too simple, and the whole response became actively negative unless increased complexity was introduced. It seems likely that much of the prevalent opinion, that geometric form discrimination is very difficult for these age levels, is based not on perceptual discrimination as such, but on use of motivating factors ineffective at a given age level. This is substantiated by the comparison of the Guernsey (58) and the Watson (59) imitation experiments in which Watson's negative results are clearly based on a situation totally inadequate for the age level he used (18 months).

To obviate this difficulty a cup or box had frequently to be introduced as an additional motive for securing the block. Under such a condition the block was repeatedly

dropped into the cup or box, spilled out, and put back again; or it was left in the container to be violently shaken about. If the container happened to be a cup, they would simulate the motions of drinking something, almost invariably smacking their lips and vocalizing contentedly after each sip.¹ The whole picture of the manipulative behavior of the infants during the twelfth and thirteenth months was one of variety, dexterity and speed, unparalleled by the corresponding qualities at any earlier age level.

¹These incidental responses are perhaps qualitatively significant as suggesting a very early spontaneous origin of what we call "fantasy," or responses induced by "centrally aroused sensations." Most investigators regard this phenomenon as a much later development, barely beginning by the second or third year [Piaget (60, 61), Decroly (62)] and reaching a reliable quantitative frequency only by the fifth or sixth year [Hetzler (63)].

II. Series VI

a. Introduction

This part of the investigation was designed to study the following questions:

1. Do "trace" or transfer effects occur in a situation in which the familiar geometric forms are now conceivably "masked" through various combinations of figures, i.e.,

a) Will young infants show any evidence of discrimination selection based on experience within these hypothetically fused contours, or

b) Will the composite figure prove a new perceptual experience, i.e. perceived as a total homogeneous unit?

2. If "trace" effects do occur, how are these related to various mechanical laws of learning, i.e., primacy, recency, frequency, sequence, etc. of the various preceding series?

3. If perceived as a new configuration, how, if at all, do such external factors as "goodness" of external or internal contours, or both, simplicity (homogeneity), complexity (number and arrangement of angles), combination of circularity and angularity, position, etc. appear to influence the subjects' reactions? Genetically regarded, these factors would certainly seem related to such general theoretical concepts as "Prägnanz," "Law of Least Action," etc. as involved in perceptual responses.

b. Apparatus

The experimental set-up is the same as in the previous series except in form blocks used (see pages 20-24, 49-51). These blocks were so constructed that each single form was now superimposed upon another single form, thus introducing a second figure-ground relationship optically and the above-mentioned behavior possibilities functionally (see page 193). Since the blocks were of uniform color, the principal visual cues to the superimposed contour were restricted to optic depth (perspective factors). To the adult eye these contours at this standard distance are sharp and clear so that the familiar geometric forms are neither "geographically" nor "behaviorally" fused. [The experimental distance is well within the "body-radius" of the infant. Compare Stern (17), Bühler (12), Fajans (47,48), etc.] There is very little known, however, about the visual perception of figural depth per se in infancy.

Three series of form blocks were required for this part of the study. They are:

1. Double-circles, double-ovals, double-squares, double-triangles and double-crosses. Each of these forms was composed of two large-sized blocks used in Series III superimposed one on top of the other.
2. Circle-on-crosses, circle-on-triangles, circle-on-squares and circle-on-ovals. Each of these forms was composed of a standard-sized circle placed on top of a large-

sized cross, triangle, square or oval.

3. Cross-on-circles, triangle-on-circles, square-on-circles and oval-on-circles. Each of these forms was composed of a standard-sized cross, triangle, square or oval placed on top of a large-sized circle.

c. Method of Procedure

This varied in three ways from the previous series.

1. The problem here is not one of learning, but of spontaneous preference or selection; therefore,

2. Neither of the paired compound forms was fastened to the board.

3. The scheme of presentation was altered as follows:

Section A

Circle-Cross Combinations

Part 1	Double-Circle	Cross-on-Circle ¹
Part 2	Double-Cross	Circle-on-Cross
Part 3	Circle-on-Cross	Cross-on-Circle
Part 4	Double-Circle	Circle-on-Cross
Part 5	Double-Cross	Cross-on-Circle
Part 6	Double-Cross	Double-Circle

Section B

Circle-Triangle Combinations

Part 1	Double-Circle	Triangle-on-Circle
Part 2	Double-Triangle	Circle-on-Triangle
Part 3	Circle-on-Triangle	Triangle-on-Circle
Part 4	Double-Circle	Circle-on-Triangle
Part 5	Double-Triangle	Triangle-on-Circle
Part 6	Double-Triangle	Double-Circle

¹Each part consisted of four trials. In the first and fourth trials the first block (e.g., Double-Circle) was placed to the right of the subject and the second block (Cross-on-Circle) to the left. In the second and third trials the relative positions of the two stimuli were reversed.

Section C

Circle-Square Combinations

Part 1	Double-Circle	Square-on-Circle
Part 2	Double-Square	Circle-on-Square
Part 3	Circle-on-Square	Square-on-Circle
Part 4	Double-Circle	Circle-on-Square
Part 5	Double-Square	Square-on-Circle
Part 6	Double-Square	Double-Circle

Section D

Circle-Oval Combinations

Part 1	Double-Circle	Oval-on-Circle
Part 2	Double-Oval	Circle-on-Oval
Part 3	Circle-on-Oval	Oval-on-Circle
Part 4	Double-Circle	Circle-on-Oval
Part 5	Double-Oval	Oval-on-Circle
Part 6	Double-Oval	Double-Circle

d. Subjects

The subjects, ranging in age from 35 weeks 4 days to 59 weeks 1 day, included (1) 12 subjects of the Regular Experimental Group who had had intensive training through Series I - V, and (2) an equal number of subjects of the Control Group carefully matched in age and developmental scores. Both groups were further divided into two sub-groups. Sub-groups I performed in the forward order, i.e., from Section A to D; Sub-groups II performed in the backward order, viz., from Section D to A.

e. Results

Altogether 2304 trials were carried out by the 24 subjects. These data were analyzed, both qualitatively and quantitatively, under form preference, reaction time, manipulation and the various dynamic attributes previously discussed.

1. Form Preference

Tables 45,¹ 46 and 47 (see pages 198-199, 200-201, and 202-203) show the actual number and percentage of times in which each member of the total 24 pairs of stimuli was secured either in preference to or simultaneously with the other member of the pair by Sub-groups I, Sub-groups II and Combined Sub-groups respectively of the Experimental and Control Groups. As they stand, the data are too scattered to throw much positive light on the problems for which this part of the investigation was designed. This fact in itself, however, seems to emphasize the danger of assuming a priori any one of the manifold hypotheses listed above, as is so frequently done in the theoretical literature on contour perception.

Since Tables 45, 46 and 47 provide few clues as to how the infants actually perceived these compound patterns, further analyses of these tables on the basis of three different assumptions, all representing comparative (adult) approaches, were attempted. (In "rating" these forms in order of visual potency, it is perhaps significant that no staff members or graduate students agreed in their selections.) Accordingly the first analysis is based on the assumption that in a given compound block the top form is visually

¹In this table, as well as in all the tables for Series VI, the form mentioned first is the top form and the one mentioned last is the bottom form. Thus, circle cross means circle on top of the cross.

Table 45

Comparison of Sub-Group I of the Regular Experimental Group
with Sub-Group I of the Control Group in regard to Form Preference

S E T	P T	Stimulus Pattern	Regular Experimental		Control	
			Sub-Group I		Sub-Group I	
			No. of Times	Per Cent	No. of Times	Per Cent
A	1	Double Circle	13	46.43-%	14	50 %
		Cross Circle	17	60.71+%	18	64.29-%
	2	Double Cross	16	57.14+%	17	60.71+%
		Circle Cross	13	46.43-%	12	42.86-%
	3	Circle Cross	11	39.29-%	16	57.14+%
		Cross Circle	17	60.71+%	14	50 %
	4	Double Circle	14	50 %	17	60.71+%
		Circle Cross	14	50 %	12	42.86-%
	5	Double Cross	13	46.43-%	14	50 %
		Cross Circle	16	57.14+%	18	64.29-%
	6	Double Cross	19	67.86-%	16	57.14+%
		Double Circle	9	32.14+%	16	57.14+%
B	1	Double Circle	17	60.71+%	17	60.71+%
		Triangle Circle	12	42.86-%	14	50 %
	2	Double Triangle	18	64.29-%	16	64.29-%
		Circle Triangle	13	46.43-%	15	53.57+%
	3	Circle Triangle	13	46.43-%	17	60.71+%
		Triangle Circle	18	64.29-%	16	57.14+%
	4	Double Circle	14	50 %	17	60.71+%
		Circle Triangle	15	53.57+%	14	50 %
	5	Double Triangle	17	60.71+%	12	42.86-%
		Triangle Circle	12	42.86-%	19	67.86-%
	6	Double Triangle	15	53.57+%	17	60.71+%
		Double Circle	13	46.43-%	15	53.57+%
C	1	Double Circle	17	60.71+%	21	75 %
		Square Circle	13	46.43-%	11	39.29-%
	2	Double Square	15	53.57+%	19	67.86-%
		Circle Square	15	53.57+%	10	35.71+%
	3	Circle Square	15	53.57+%	19	67.86-%
		Square Circle	15	53.57+%	14	50 %
	4	Double Circle	18	64.29-%	20	71.43-%
		Circle Square	14	50 %	12	42.86-%
	5	Double Square	14	50 %	17	60.71+%
		Square Circle	15	53.57+%	11	39.29-%
	6	Double Square	14	50 %	16	57.14+%
		Double Circle	16	57.14+%	16	57.14+%

Table 45 (cont'd)

S E C.	P T. C.	Stimulus Pattern	Regular Experimental		Control	
			Sub-Group I		Sub-Group I	
			No. of Times	Per Cent	No. of Times	Per Cent
1		Double Circle	13	46.43-%	14	50 %
		Oval Circle	16	57.14-%	15	53.57-%
2		Double Oval	22	78.57-%	17	60.71-%
		Circle Oval	8	28.57-%	11	39.29-%
3		Circle Oval	15	53.57-%	12	42.86-%
		Oval Circle	14	50 %	18	64.29-%
4		Double Circle	14	50 %	13	46.43-%
		Circle Oval	14	50 %	16	57.14-%
5		Double Oval	18	64.29-%	16	57.14-%
		Oval Circle	10	35.71-%	12	42.86-%
6		Double Oval	13	46.43-%	19	67.86-%
		Double Circle	17	60.71-%	9	32.14-%

Table 46

Comparison of Sub-Group II of the Regular Experimental Group
with Sub-Group II of the Control Group in regard to Form Preference

S. T. C.	Stimulus Pattern	Regular Experimental Sub-Group II		Control Sub-Group II	
		No. of Times	Per Cent	No. of Times	Per Cent
1	Double Circle	15	75 %	7	35 %
	Cross Circle	11	55 %	16	80 %
2	Double Cross	13	65 %	14	70 %
	Circle Cross	13	65 %	10	50 %
3	Circle Cross	15	75 %	13	65 %
	Cross Circle	13	65 %	12	60 %
4	Double Circle	13	65 %	10	50 %
	Circle Cross	14	70 %	15	75 %
5	Double Cross	12	60 %	13	65 %
	Cross Circle	10	50 %	11	55 %
6	Double Cross	15	75 %	14	70 %
	Double Circle	6	30 %	9	45 %
1	Double Circle	14	70 %	7	35 %
	Triangle Circle	9	45 %	14	70 %
2	Double Triangle	12	60 %	9	45 %
	Circle Triangle	12	60 %	12	60 %
3	Circle Triangle	10	50 %	14	70 %
	Triangle Circle	13	65 %	10	50 %
4	Double Circle	10	50 %	13	65 %
	Circle Triangle	12	60 %	10	50 %
5	Double Triangle	7	35 %	13	65 %
	Triangle Circle	13	65 %	11	55 %
6	Double Triangle	10	50 %	11	55 %
	Double Circle	12	60 %	13	65 %
1	Double Circle	11	55 %	9	45 %
	Square Circle	12	60 %	14	70 %
2	Double Square	11	55 %	10	50 %
	Circle Square	13	65 %	10	50 %
3	Circle Square	14	70 %	11	55 %
	Square Circle	12	60 %	10	50 %
4	Double Circle	14	70 %	13	65 %
	Circle Square	6	30 %	8	40 %
5	Double Square	12	60 %	5	25 %
	Square Circle	10	50 %	16	80 %
6	Double Square	15	75 %	9	45 %
	Double Circle	11	55 %	14	70 %

Table 46 (cont'd)

S E C.	P T.	Stimulus Pattern	Regular Experimental		Control	
			Sub-Group II		Sub-Group II	
			No. of Times	Per Cent	No. of Times	Per Cent
1		Double Circle	10	50	5	40
		Oval Circle	14	70	12	60
2		Double Oval	12	60	7	35
		Circle Oval	12	60	17	85
3		Circle Oval	9	45	12	60
		Oval Circle	14	70	9	45
4		Double Circle	12	60	15	75
		Circle Oval	9	45	5	25
5		Double Oval	13	65	12	60
		Oval Circle	9	45	9	45
6		Double Oval	9	45	10	50
		Double Circle	11	55	10	50

Table 47

Comparison of Experimental and Control GroupsRegarding Form Preference

(Combined Results of Sub-Groups I and II)

S E C.	P T.	Stimulus Pattern	Regular Experimental		Control	
			No. of Times	Per Cent	No. of Times	Per Cent
A	1	Double Circle	28	58.33%	21	43.75 %
		Cross Circle	28	58.33%	34	70.83%
	2	Double Cross	29	60.42%	31	64.58%
		Circle Cross	26	54.17%	22	45.83%
	3	Circle Cross	26	54.17%	29	60.42%
		Cross Circle	30	62.5 %	26	54.17%
	4	Double Circle	27	56.25 %	27	56.25 %
		Circle Cross	28	58.33%	27	56.25 %
	5	Double Cross	25	52.08%	27	56.25 %
		Cross Circle	26	54.17%	29	60.42%
	6	Double Cross	34	70.83%	30	62.5 %
		Double Circle	15	31.25 %	25	52.08%
B	1	Double Circle	31	64.58%	24	50 %
		Triangle Circle	21	43.75 %	28	58.33%
	2	Double Triangle	30	62.5 %	27	56.25 %
		Circle Triangle	25	52.08%	27	56.25 %
	3	Circle Triangle	23	47.92%	31	64.58%
		Triangle Circle	31	64.58%	26	54.17%
	4	Double Circle	24	50 %	30	62.5 %
		Circle Triangle	27	56.25 %	24	50 %
	5	Double Triangle	24	50 %	25	52.08%
		Triangle Circle	25	52.08%	30	62.5 %
	6	Double Triangle	25	52.08%	28	58.33%
		Double Circle	25	52.08%	28	58.33%
C	1	Double Circle	28	58.33%	30	62.5 %
		Square Circle	25	52.08%	25	52.08%
	2	Double Square	26	54.17%	29	60.42%
		Circle Square	28	58.33%	20	41.67%
	3	Circle Square	29	60.42%	30	62.5 %
		Square Circle	27	56.25 %	24	50 %
	4	Double Circle	32	66.67%	33	68.75 %
		Circle Square	20	41.67%	20	41.67%
	5	Double Square	26	54.17%	22	45.83%
		Square Circle	25	52.08%	27	56.25 %
	6	Double Square	29	60.42%	25	52.08%
		Double Circle	27	56.25 %	30	62.5 %

Table 47 (cont'd)

S T. C.	Stimulus Pattern	Regular Experimental		Control	
		No. of Times	Per Cent	No. of Times	Per Cent
1	Double Circle	23	47.92-%	22	45.83+%
	Oval Circle	30	62.5 %	27	56.25 %
2	Double Oval	34	70.83+%	24	50 %
	Circle Oval	20	41.67-%	28	58.33+%
3	Circle Oval	24	50 %	24	50 %
	Oval Circle	23	58.33+%	27	56.25 %
4	Double Circle	26	54.17-%	23	58.33+%
	Circle Oval	23	47.92-%	21	43.75 %
5	Double Oval	31	64.58+%	28	58.33+%
	Oval Circle	19	39.58+%	21	43.75 %
6	Double Oval	22	45.83+%	29	60.42-%
	Double Circle	28	58.33+%	19	39.58+%

more potent than the bottom form, because the former (1) retains in full its continuity in shape, and (2) is higher in relief from the general background, whereas the latter (1) is partially covered by the former, thereby losing much of its homogeneity, and (2) is lower in relief. Consequently, taking Section A as an example, the order of potency from the circle to the cross would be (1) double-circle, (2) circle-on-cross, (3) cross-on-circle, and (4) double-cross. Accordingly, when Part 3 was exposed, the circle-on-cross looked more like a circle than the cross-on-circle, but less so than the double-circle. Table 48 (see page 205) is the result of the analysis based on this first assumption. Several significant points may be noted in this table:

a) Both Sub-groups I and II of the Experimental Group showed a slight preference for non-circle forms (by non-circle forms is meant those compound blocks which have cross, triangle, square or oval--but not circle--as the top form.) to circle forms. (by circle forms is meant those compound blocks which have circle as the top form.) (The degrees of preference are 5.96% and .18% respectively.) This preference was somewhat stronger in Sub-group I than in Sub-group II (a difference of 5.78%).

b) Sub-group I of the Control Group showed a slight preference for non-circle to circle forms (1.50%), while Sub-group II of the Control Group showed a slight preference for circle to non-circle forms (2.24%).

Table 48

Comparison of Experimental and Control Groups
Regarding the Number of Times Each Form Type was Preferred
 (Analysis I)

Section	Group	Regular	Experimental	Control	
		Circle Forms	Non-Circle Forms	Circle Forms	Non-Circle Forms
A Circle vs. Cross	Sub-Group I	76	98	83	91
	Sub-Group II	72	78	60	84
	Combined	148	174	133	175
B Circle vs. Triangle	Sub-Group I	82	95	100	91
	Sub-Group II	71	63	70	67
	Combined	153	158	170	158
C Circle vs. Square	Sub-Group I	86	85	97	89
	Sub-Group II	73	68	72	66
	Combined	159	153	169	145
D Circle vs. Oval	Sub-Group I	77	87	71	101
	Sub-Group II	63	71	61	55
	Combined	140	158	132	156
Circle vs. Others	Sub-Group I	331	375	381	372
		47.02%	52.98%	49.25%	50.75%
	Sub-Group II	279	280	274	262
		49.91%	50.09%	51.12%	48.88%
	Combined	610	653	655	634
		48.30%	51.70%	50.04%	49.96%

c) Both Sub-group I of the Experimental Group and Sub-group I of the Control Group preferred non-circle to circle forms. This preference was somewhat stronger in the trained than in the untrained group (a difference of 4.46%).

d) Sub-group II of the Experimental Group preferred non-circle to circle forms, while the reverse was the case with Sub-group II of the Control Group. However, in both cases the degree of preference was very insignificant (0.18% and 2.24% respectively).

e) The Combined Sub-groups of the Experimental Group showed a slight preference for non-circle to circle forms (3.40%); the Combined Sub-groups of the Control Group showed little or no preference for either kind of forms (0.08% in favor of circle forms).

Several divergent interpretations of the above data are possible:

a) The Experimental Group showed a consistent though marginal preference for non-circle forms, whereas the Control Group showed no such consistency. This would seem to indicate that the circle-avoidance reaction, formed in Series V, was carried over to influence immediately the results of Series VI (factor of recency). The margin of choice, however, is certainly very small; hence, this inference depends only on internal consistency of the groups' responses.

b) From the point of view of statistical difference, it would seem that the trained subjects, in spite of several months of concentrated experience with the geometric form blocks, behaved in this compound block situation very much like the totally untrained subjects. Certainly whatever "trace" effects may have remained during Series VI did not play any conspicuous rôle in their spontaneous selection of forms. This result could logically imply that the trained subjects regarded these compound blocks as essentially new Gestalten, instead of perceiving in them familiar elements which had been highly functional as powerful habit cues.

c) Viewing the situation from a totally different angle, it is also possible to interpret these data as meaning that the "trace" effects from the first four series of experiments (primacy and frequency) were so diametrically opposite to those from the fifth series (recency) that these two sets of "trace" effects neutralized each other in Series VI. Even though the trained subjects might, therefore, recognize in these compound blocks very familiar elements, they had no definite preference for any of them. Consequently, their selection of forms was much like that of the untrained subjects. In this case, one might, however, expect reaction time and other qualitative differences between the trained and untrained subjects. Such qualitative differences, as will be seen later, were very pronounced.

d) A fourth possible interpretation of Series VI data is that the trained subjects quickly "understood" the new situation (evidence of "insight," as in Series V) and accepted it "pragmatically" on the basis of their previous experiences with changed patterns.

The second analysis of the data is based on the assumption that in a given compound block the bottom form is more potent than the top form, because the former, by virtue of being slightly larger, serves as a sort of framework for the latter and consequently may partially absorb the latter by weakening its contour. Likewise, it retains the strong advantage of a color difference against the gray background. Accordingly, taking Section A as an example, the order of potency from the circle to the cross would be (1) double-circle, (2) cross-on-circle, (3) circle-on-cross, and (4) double-cross. On this hypothesis, when Part 3 was exposed, the cross-on-circle looked more like a circle than the circle-on-cross, even though due to the presence of the cross at its top, it appeared less circular than the double-circle. Table 49 (see page 209) is the result of the analysis based on this second assumption. Several important points may be noted in this table.

a) In the trained subjects Sub-group I showed a slight preference for non-circle forms (3.12%). (By non-circle forms is meant those compound blocks which have cross, triangle, square or oval--but not circle--as the

Table 49

Comparison of Experimental and Control GroupsRegarding the Number of Times Each Form Type was Preferred

(Analysis 2)

Section	Group	Regular Experimental		Control	
		Circle Forms	Non-Circle Forms	Circle Forms	Non-Circle Forms
A Circle vs. Cross	Sub-Group I	82	90	91	93
	Sub-Group II	70	80	59	85
	Combined	152	170	150	178
B Circle vs. Triangle	Sub-Group I	87	90	99	92
	Sub-Group II	74	60	66	71
	Combined	161	150	165	163
C Circle vs. Square	Sub-Group I	96	85	92	94
	Sub-Group II	71	70	72	57
	Combined	167	155	164	151
D Circle vs. Oval	Sub-Group I	76	98	77	95
	Sub-Group II	68	66	68	56
	Combined	144	164	145	153
Circle vs. Others	Sub-Group I	341	363	359	374
		48.44-%	51.56-%	48.98-%	51.02-%
	Sub-Group II	283	276	265	271
		50.63-%	49.37-%	49.44-%	50.56-%
	Combined	624	639	624	645
		49.41-%	50.59-%	49.17-%	50.83-%

bottom form.) Sub-group II, on the other hand, showed a slight preference for circle forms (1.26%). (By circle forms is meant those compound blocks which have circle as the bottom form.)

b) Both sub-groups of the Control Group showed a slight preference for non-circle forms. (The degrees of preference are 2.04% for Sub-group I and 1.12% for Sub-group II.) This preference was slightly stronger in Sub-group I than in Sub-group II (a difference of .92%).

c) Both Sub-groups I of the Experimental and Control Groups preferred non-circle to circle forms. However, this preference was very slight (3.12% for the Experimental and 2.04% for the Control Groups), and was practically the same for both sub-groups (a difference of 1.08%).

d) Sub-group II of the Experimental Group preferred circle to non-circle forms (1.26%), while the reverse was the case with Sub-group II of the Control group (1.12%). However, in both cases the degree of preference was very insignificant.

e) Both the Combined Sub-groups of the Experimental Group and those of the Control Group showed a slight preference for non-circle to circle forms. However, this preference was very slight, and was practically the same for both groups. (The scores are 1.16% and 1.66% respectively.)

Taken as a whole, the above data would seem to discredit the first interpretation (trace effect of circle-

avoidance in Series V) derived from Analysis One. Instead of the Experimental Group the Control group now showed a consistent though very marginal preference for non-circle forms, whereas Sub-group II of the trained subjects was now the "exception." This difference between the two sub-groups of the Experimental Group might possibly be linked with the difference in the order of presentation which was so clearly a factor in Series I - V. Against such inference are:

(1) the small statistical margins, (2) the purely dogmatic and hypothetical nature of the assumption of the particular figure-ground relationship underlying this analysis, and (3) contradiction by the interpretations derived from Analyses One and Three. On the other hand, this second analysis supports the last three interpretations derived from Analysis One (see pages 207-208).

The third analysis is based on the assumption that if the top form in a given compound block is a cross, triangle, square or oval and the bottom one a circle, the resultant block will assume the shape of the former, because a non-circle is a more complex contour than a circle and, therefore, possibly as a matter of attention or "intent," will effectively resist absorption by the simpler figure. If, on the other hand, the two constituent forms reverse their relative positions so that now the circle is on top, this, in turn, will be partially absorbed by its more complex background or framework. As a result a new Gestalt--neither

of the two components as such but a combination of them-- will be originated. Taking the circle-on-cross and cross-on-circle combination (Section A, Part III) as an example, the cross-on-circle remains cross-like in appearance while the circle-on-cross, owing to the partial absorption of the circle by the cross, assumes a totally new shape which is intermediate between the two component forms. Table 50 (see page 213), the result of analysis based on this third assumption, has accordingly three columns: (1) circle forms (i.e., combinations of circles), (2) non-circle forms (i.e., combinations of crosses, triangles, squares or ovals; also combinations which have any of the non-circles as the top form and circle as the bottom form), and (3) combined forms (combinations which have circle as the top form and any of the non-circles as the bottom form). Several interesting points may be noted in this table:

a) Both Sub-groups I and II of the Experimental Group showed a slight preference for non-circle forms. This was somewhat stronger in the former than in the latter (1.82% and 0.36% respectively). Sub-group II, on the other hand, selected the combined forms somewhat more frequently than Sub-group I (difference, 2.41%).

b) In the Control Group Sub-group I showed no preference whatever for either circle or non-circle forms, while Sub-group II showed a slight preference

Table 50

Comparison of Experimental and Control GroupsRegarding the Number of Lines Each Form Type was Preferred

(Analysis C)*

Section	Sub- Form	Experimental			Control		
		Circle	Non-Circle	Combined	Circle	Non-Circle	Combined
Circle A vs. Cross	I	85	7	92	87	20	107
	II	84	74	158	87	20	107
	III	7	174	181	87	20	107
Circle B vs. Triangle	I	84	74	158	87	20	107
	II	87	74	161	87	20	107
	III	7	174	181	87	20	107
Circle C vs. Square	I	81	74	155	87	20	107
	II	84	74	158	87	20	107
	III	87	174	181	87	20	107
Circle D vs. oval	I	87	74	161	87	20	107
	II	84	74	158	87	20	107
	III	87	174	181	87	20	107
Circle vs. Others	I	108	174	282	108	20	128
		355	174	529	108	20	128
		33.81-	37.82+	35.81-	34.84+	34.84+	34.81+
	II	108	174	282	108	20	128
		372	174	546	108	20	128
		33.81+	33.82+	33.81+	34.84+	34.84+	34.81-
Others	III	314	174	488	108	20	128
		339	174	513	108	20	128
		33.48-	34.86-	34.17-	34.84+	34.84-	34.84+

*Since the circle and combined forms were not included in the circle forms in the stimulus pattern, in the analysis of calculated percentages, the totals of the circle and combined forms were first added in order to offset the discrepancy.

**d. Combined.

for non-circle forms (1.87%). Furthermore, the latter selected the combined forms a little oftener than the former (difference 3.70%).

c) Sub-group I of the Experimental Group showed a slight preference for non-circle to circle forms (1.82%); Sub-group I of the Control Group showed no preference whatever for either kind of forms. The two sub-groups were practically equal in the frequency of their responses to the combined forms (30.80-% for Sub-group I of the Experimental Group and 30.51+-% for Sub-group I of the Control Group).

d) Both Sub-group II of the Experimental Group and Sub-group II of the Control Group showed a slight preference for non-circle to circle forms (0.36% and 1.87% respectively). The two sub-groups were nearly equal in the frequency of their responses to the combined forms (33.21+-% for Sub-group II of the Experimental Group and 34.21+-% for Sub-group II of the Control Group).

e) Both the Combined Sub-groups of the Experimental Group and those of the Control Group showed a slight preference for non-circle to circle forms. However, this preference was very insignificant and was practically the same for both groups (1.17% and .80% respectively). Furthermore, their scores in the frequency of responses to the combined forms are practically equal (31.88-% for the Experimental and 32.08+-% for the Control Groups).

Taken as a whole, the data would seem to confirm all the four points of Analysis One and the last three points of Analysis Two (see pages 206-208 and 211); they disagree with the first interpretation of Analysis Two (see pages 210-211).

The first interpretation of Analysis One is rejected by the results of Analysis Two and supported by those of Analysis Three, but opposed to all the other three interpretations which have the unanimous support of all the three analyses. Since its margin of support is statistically insignificant [the degree of preference for non-circle forms in Sub-group II of the Experimental Group being 0.18% in Analysis One (see pages 204 and 206) and 0.36% in Analysis Three (see pages 212 and 214)], it seems necessary to discard this interpretation in favor of the other three discussed above. That is, "trace effects" as such do not reliably exist in the form preference of highly trained subjects as measured by Series VI.

In conclusion it may be said that from the three above analyses based on three very different hypotheses of figure-ground relationship, the trained subjects behaved astonishingly like the untrained subjects in their spontaneous selection of patterns. Whether such seemingly "traceless" reactions were due to inhibition of memory effects by new Gestalten, or whether they were

the result of the neutralization of previously reversed positive and negative effects, or whether they represent the "understanding" of and therefore immediately successful adjustment to a new situation ("insight") on the part of the trained subjects, cannot be determined by this manner of analysis. Equally obscure, therefore, is the problem of how these compound blocks were visually perceived by either group. On the other hand, it would be incorrect to imply that the total reactions of the two groups were similar. On the contrary, they are, as will be seen presently, extremely dissimilar.

Another significant point derived from the above analyses is the apparently spontaneous though marginal preference, exhibited by the trained and untrained subjects alike, for non-circle forms (see Tables 48, 49 and 50 on pages 205, 209 and 213). This seems on the surface, at least, inconsistent with the prevailing concept that "primitive" minds will respond most directly to the simplest, i.e., most homogeneous, configurations in cases of free choice as the easiest course of action .

(2) Reaction Time

In both total reaction time and average reaction time per trial, the subjects of the Experimental Group were consistently and markedly faster than the subjects of the Control Group (see Tables 51, 52, 53 and 54 on

pages 218-219, 220-221, 222-223, and 224),--quite obviously a transfer or "trace" of previous training.

(3) Manipulation

On the whole, the Control Cases, somewhat more frequently than the Experimental Cases, employed bimanual approach to the stimulus patterns. (The scores are 10.16-% and 9.64-% respectively.) Since all preceding series required that the subjects use unimanual approach only, this may be regarded as evidence of the positive transfer of learning. The Experimental Group, on the other hand, tended to resort to positional cue in their manipulative reactions to the blocks slightly more persistently than the Control Group. (The scores are 14.24-% and 13.19+-% respectively.) This difference is explainable by the fact that the more frequent use of bimanual approach by the untrained subjects reduced the number of times in which the positional cue might be used by those subjects. However, the fact that the Experimental Cases did employ the positional cue in this series, despite the rigorous control of this primitive tendency in all the previous series, seems to suggest that those highly trained subjects accepted ("understood") Series VI as an entirely new situation, both in visual pattern and motivation, thus supporting the conclusion reached on Form Preference (see pages 215-216). In any event, the trained subjects exhibited

Table 51
Comparison of
Sub-Groups I and II of the Regular Experimental Group and
Sub-Groups I and II of the Control Group
in Regard to Total Reaction Time*

Stimulus Pattern	Regular Experimental		Control	
	I	II	I	II
Double Circle	115.00	40.50	486.50	137.60
Cross Circle				
Double Cross	128.00	56.60	262.00	93.80
Circle Cross				
Circle Cross	144.30	72.80	382.90	133.70
Cross Circle				
Double Circle	114.50	98.20	257.80	47.20
Circle Cross				
Double Cross	152.50	88.70	226.80	161.50
Double Circle				
Double Cross	133.90	115.40	150.10	99.80
Double Circle				
Double Circle	149.50	57.70	562.60	406.80
Triangle Circle				
Double Triangle	170.40	46.50	98.30	342.70
Circle Triangle				
Circle Triangle	243.10	93.60	85.10	273.00
Triangle Circle				
Double Circle	211.80	144.70	290.30	168.40
Circle Triangle				
Double Triangle	338.00	135.10	224.90	97.00
Triangle Circle				
Double Triangle	203.80	153.50	540.70	161.40
Double Circle				

*Reaction time in seconds

Table 51 (cont'd)

S E C.	P T.	Stimulus Pattern	Regular Experimental		Control	
			I	II	I	II
B	1	Double Circle	129.60	66.20	323.80	635.70
		Square Circle				
	2	Double Square	278.70	38.60	122.90	449.20
		Circle Square				
	3	Circle Square	294.10	66.60	226.80	257.00
		Square Circle				
	4	Double Circle	261.90	63.60	169.90	372.10
		Circle Square				
	5	Double Square	296.30	100.40	397.60	180.50
		Square Circle				
	6	Double Square	273.80	67.80	285.80	393.00
		Double Circle				
D	1	Double Circle	163.20	47.60	237.40	640.30
		Oval Circle				
	2	Double Oval	186.10	47.20	206.20	192.00
		Circle Oval				
	3	Circle Oval	191.10	93.60	780.60	248.90
		Oval Circle				
	4	Double Circle	190.80	163.50	1091.20	469.50
		Circle Oval				
	5	Double Oval	260.20	362.60	429.20	349.00
		Oval Circle				
	6	Double Oval	152.20	170.10	738.90	868.80
		Double Circle				

Table 52
Comparison of
Sub-Groups I and II of the Regular Experimental Group and
Sub-Groups I and II of the Control Group
In Regard to Average Reaction Time*

S P T. E.	Stimulus Pattern	Regular Experimental		Control	
		I	II	I	II
1	Double Circle	4.11-	2.03-	17.38-	6.56
	Cross Circle				
2	Double Cross	4.57+	2.83	9.38-	4.69
	Circle Cross				
3	Circle Cross				
	Cross Circle	5.15+	3.64	13.68-	6.69-
4	Double Circle				
	Circle Cross	4.09-	4.91	9.21-	2.36
	Double Cross				
5	Cross Circle	5.45-	4.44-	8.17+	6.08-
	Double Cross				
6	Double Circle	4.73+	5.77	5.38+	4.99
1	Double Circle	5.34-	2.89-	20.09+	20.34
	Triangle Circle				
2	Double Triangle	6.09-	2.43-	3.51+	17.14-
	Circle Triangle				
3	Circle Triangle				
	Triangle Circle	8.65+	4.65	3.94-	13.65
4	Double Circle				
	Circle Triangle	7.56+	7.24-	10.37-	6.42
	Double Triangle				
5	Triangle Circle	12.07+	6.76-	8.03+	4.85
	Double Triangle				
6	Double Circle	7.28-	7.68-	19.31+	8.07

*Reaction time in seconds.

Table 52 (cont'd)

P T. C.	Stimulus Pattern	Regular Experimental		Control	
		I	II	I	II
1	Double Circle	4.63-	3.31	11.56+	31.79-
2	Square Circle				
	Double Square	9.95+	1.93	4.39-	22.46
3	Circle Square				
	Circle Square	10.50+	3.33	9.17+	12.85
4	Square Circle				
	Double Circle	9.35+	3.13	6.07-	13.61-
	Circle Square				
	Double Square				
5	Square Circle	10.53+	5.27	14.20	9.03-
6	Double Square				
	Double Square	9.78-	3.39	10.21-	19.65
	Double Circle				
1	Double Circle	6.01-	2.39	10.26+	32.04
	Oval Circle				
2	Double Oval	6.65-	2.35	7.44-	9.60
	Circle Oval				
	Circle Oval				
3	Oval Circle	6.83-	4.68	27.58-	12.45-
4	Double Circle	6.81+	8.18-	38.97+	23.48-
	Circle Oval				
	Double Oval				
5	Oval Circle	9.29+	13.13	15.33-	17.45
6	Double Oval				
	Double Circle	5.44-	8.51-	26.39-	43.44

Table 53
Comparison of
Regular Experimental Group and Control Group
Regarding Total and Average Reaction Times*
 (Combined Results of Sub-Groups I and II)

S E C.	P T. C.	Stimulus Pattern	Regular Experimental		Control	
			Total	Average	Total	Average
	1	Double Circle	155.50	3.24-	624.10	13.00+
		Cross Circle				
	2	Double Cross	184.60	3.35-	355.60	7.41+
		Circle Cross				
	3	Circle Cross	217.10	4.52+	515.60	10.76+
		Cross Circle				
	4	Double Circle	212.70	4.43+	305.00	6.35+
		Circle Cross				
		Double Cross				
	5	Double Cross	241.20	5.03-	350.30	8.13+
		Cross Circle				
	6	Double Cross	249.30	5.19+	249.90	5.21-
		Double Circle				
	1	Double Circle	207.20	4.32-	969.40	20.20-
		Triangle Circle				
	2	Double Triangle	219.90	4.56+	441.00	9.19-
		Circle Triangle				
	3	Circle Triangle	336.70	7.01+	358.10	7.45+
		Triangle Circle				
	4	Double Circle	356.50	7.43-	458.70	9.56-
		Circle Triangle				
		Double Triangle				
	5	Double Triangle	473.10	9.86-	321.90	6.71-
		Triangle Circle				
	6	Double Triangle	357.30	7.44+	702.10	14.63-
		Double Circle				

*Reaction time in seconds.

Table 53 (cont'd)

S E C	P T. C	Stimulus Pattern	Regular Experimental		Control	
			Total	Average	Total	Average
C	1	Double Circle	195.80	4.08-	959.50	19.99-
		Square Circle				
	2	Double Square	317.30	6.61+	572.10	11.92-
		Circle Square				
	3	Circle Square	360.70	7.51+	485.80	10.12+
		Square Circle				
C	4	Double Circle	325.50	6.73+	542.00	11.29+
		Circle Square				
		Double Square				
	5	Square Circle	401.70	8.37-	573.10	12.04+
		Double Square				
	6	Double Square	341.60	7.12-	515.80	14.14+
C		Double Circle				
	1	Double Circle	216.00	4.50	528.20	19.34-
		Oval Circle				
	2	Double Oval	233.30	4.86+	400.20	9.34-
		Circle Oval				
	3	Circle Oval	284.70	5.93+	1023.50	21.45-
C		Oval Circle				
	4	Double Circle	354.30	7.38+	1560.70	32.51+
		Circle Oval				
	5	Double Oval	622.80	12.98-	776.20	16.21+
		Oval Circle				
	6	Double Oval	322.30	6.71+	1607.70	33.49+
C		Double Circle				
		Double Circle				

Table 54

Comparison of Experimental and Control GroupsRegarding Total Reaction Time* and Average Reaction Time per Trial*Required for Performing Series VI

Section	Group	Regular Experimental		Control	
		Total React. Time	Average React. Time	Total React. Time	Average React. Time
A Circle vs. Cross	Sub-Group I	788.20	4.63+	1758.10	10.52+
	Sub-Group II	472.20	3.94-	673.60	5.61+
	Combined	1260.40	4.38-	2441.70	8.48-
B Circle vs. Triangle	Sub-Group I	1316.60	7.84-	1801.90	10.73-
	Sub-Group II	633.10	5.28-	1449.30	12.08-
	Combined	1949.70	6.77-	3251.20	11.29-
C Circle vs. Square	Sub-Group I	1554.40	9.13+	1528.80	9.10
	Sub-Group II	408.20	3.40+	2287.50	19.06+
	Combined	1941.60	6.75-	3816.30	13.25+
D Circle vs. Oval	Sub-Group I	1148.60	6.84-	3535.50	21.04+
	Sub-Group II	864.80	7.37+	2769.00	23.08-
	Combined	2033.40	7.06+	6304.50	21.89+
Circle vs. Others	Sub-Group I	4787.80	7.12+	8634.30	12.85-
	Sub-Group II	2398.30	5.00-	7177.40	14.96+
	Combined	7186.10	6.24-	15811.70	13.73-

*All reaction time in seconds.

a type of behavior which obviously required the least amount of action under the circumstances; whereas the Control subjects reacted in a typically untrained, diffuse, indirect, "chance" manner. The difficulty of general adaptation in this group increased markedly with chronological age.

(4) Oral Behavior

The scores in oral behavior for the Experimental and Control subjects (see Tables 55, 56 and 57 on pages 226-227, 228-229 and 230-231) are very similar, even though the former group exhibited a slightly larger amount than the latter (difference 1.56%; see Table 58 on page 232). The Control subjects, on the other hand, showed a higher incidence of "special" oral behavior (oral behavior without block contact). This difference is apparently due to a difference in the training and experience of the two groups of subjects, since the gustatory reward was an auxiliary motive for the trained group.

(5) Vocalization

On the whole, the Control subjects were more vocal than the Experimental subjects with the vocalization type reflecting their general lack of adjustment to the situation. Of the total amount of vocalization exhibited, the trained group had accordingly a much higher percentage of vocalization of pleasantness. (The scores are 70.57+ $\frac{1}{2}$ and 53.63-% respectively.) The untrained subjects, on the

Table 55

Comparison of
Sub-Group I of the Regular Experimental Group
with Sub-Group I of the Control Group in regard to Oral Behavior

Section	Part	Stimulus Pattern	Regular Experimental				Control			
			Present			Absent	Present			Absent
			Total	Regular*	Special**		Total	Regular	Special	
A	1	Double Circle	18	15	0	15	10	10	0	18
		Cross Circle	53.57%	100 %	0 %	46.43%	35.71%	100 %	0 %	64.29%
	2	Double Cross	13	13	0	15	11	11	0	17
		Circle Cross	46.43%	100 %	0 %	53.57%	39.29%	100 %	0 %	60.71%
	3	Circle Cross	8	8	0	20	10	10	0	18
		Cross Circle	28.57%	100 %	0 %	71.43%	35.71%	100 %	0 %	64.29%
	4	Double Circle	7	7	0	21	10	10	0	18
		Circle Cross	25 %	100 %	0 %	75 %	35.71%	100 %	0 %	64.29%
	5	Double Cross	11	11	0	17	5	5	0	23
		Cross Circle	39.29%	100 %	0 %	60.71%	17.86%	100 %	0 %	82.14%
	6	Double Cross	5	5	0	23	6	6	0	23
		Double Circle	17.86%	100 %	0 %	82.14%	21.43%	100 %	0 %	78.57%
B	1	Double Circle	7	7	0	21	17	17	0	11
		Triangle Circle	25 %	100 %	0 %	75 %	60.71%	100 %	0 %	39.29%
	2	Double Triangle	9	9	0	19	17	17	0	11
		Circle Triangle	32.14%	100 %	0 %	67.86%	60.71%	100 %	0 %	39.29%
	3	Circle Triangle	6	6	0	22	9	9	0	19
		Triangle Circle	21.43%	100 %	0 %	78.57%	32.14%	100 %	0 %	67.86%
	4	Double Circle	5	5	0	23	5	5	0	23
		Circle Triangle	17.86%	100 %	0 %	82.14%	17.86%	100 %	0 %	82.14%
	5	Double Triangle	8	8	0	20	5	5	0	23
		Triangle Circle	28.57%	100 %	0 %	71.43%	10.71%	100 %	0 %	89.29%
	6	Double Triangle	5	5	0	22	6	6	0	23
		Double Circle	17.86%	100 %	0 %	82.14%	21.43%	100 %	0 %	78.57%
C	1	Double Circle	14	14	0	14	9	9	0	19
		Square Circle	50 %	100 %	0 %	50 %	32.14%	100 %	0 %	67.86%
	2	Double Square	13	13	0	15	13	13	0	18
		Circle Square	46.43%	100 %	0 %	53.57%	46.43%	100 %	0 %	53.57%
	3	Circle Square	4	4	0	24	8	8	0	20
		Square Circle	14.29%	100 %	0 %	85.71%	28.57%	100 %	0 %	71.43%
	4	Double Circle	5	5	0	23	8	8	0	20
		Circle Square	17.86%	100 %	0 %	82.14%	28.57%	100 %	0 %	71.43%
	5	Double Square	8	8	0	20	5	5	0	23
		Square Circle	28.57%	100 %	0 %	71.43%	17.86%	100 %	0 %	82.14%
	6	Double Square	13	13	0	15	9	9	0	19
		Double Circle	46.43%	100 %	0 %	53.57%	32.14%	100 %	0 %	67.86%

*By "regular" oral behavior is meant that form of oral behavior in which the stimulus block is actually in contact with the subject's mouth.
 **By "special" oral behavior is meant that form of oral behavior in which the stimulus block is not in actual contact with the subject's mouth.

Table 35 (cont'd)

Section	Part	Stimulus Pattern	Regular Experimental				Control			
			Present			Absent	Present			Absent
			Total	Regular	Special		Total	Regular	Special	
D	1	Double Circle	19	19	0	9	12	12	0	16
		Oval Circle	67.86%	100	0	32.14%	42.86%	100	0	57.14%
	2	Double Oval	20	19	1	8	10	10	0	18
		Circle Oval	71.43%	95	5	28.57%	35.71%	100	0	64.29%
	3	Circle Oval	11	11	0	17	6	6	0	22
		Oval Circle	39.29%	100	0	60.71%	21.43%	100	0	78.57%
	4	Double Circle	12	12	0	16	5	5	0	23
		Circle Oval	42.86%	100	0	57.14%	17.86%	100	0	82.14%
	5	Double Oval	1	1	0	27	3	3	0	25
		Oval Circle	3.57%	100	0	96.43%	10.71%	100	0	89.29%
	6	Double Oval	3	3	0	25	2	2	0	26
		Double Circle	10.71%	100	0	89.29%	7.14%	100	0	92.86%

Table 56
Comparison of
Sub-Group II of the Regular Experimental Group
with Sub-Group II of the Control Group in regard to Oral Behavior

Section	Part	Stimulus Pattern	Regular Experimental				Control			
			Present			Absent	Present			Absent
			Total	Regular*	Special**		Total	Regular*	Special**	
A	1	Double Circle	8	8	0	12	9	8	1	11
		Cross Circle	40	100	0	60	45	98.89	11.11	55
	2	Double Cross	6	6	0	14	5	3	2	15
		Circle Cross	30	100	0	70	25	60	40	75
	3	Circle Cross	5	5	0	15	3	3	0	17
		Cross Circle	25	100	0	75	15	100	0	85
	4	Double Circle	5	5	0	15	4	4	0	16
		Circle Cross	25	100	0	75	20	100	0	80
	5	Double Cross	2	2	0	18	7	7	0	13
		Cross Circle	10	100	0	90	35	100	0	65
	6	Double Cross	5	5	0	15	6	6	0	14
		Double Circle	25	100	0	75	30	100	0	70
B	1	Double Circle	7	7	0	13	5	2	3	15
		Triangle Circle	35	100	0	65	25	40	60	75
	2	Double Triangle	6	6	0	14	5	4	1	15
		Circle Triangle	30	100	0	70	25	80	20	75
	3	Circle Triangle	7	7	0	13	1	1	0	19
		Triangle Circle	35	100	0	65	5	100	0	95
	4	Double Circle	4	4	0	16	8	8	1	12
		Circle Triangle	20	100	0	80	40	100	12.5	60
	5	Double Triangle	4	4	0	16	8	8	0	12
		Triangle Circle	20	100	0	80	40	100	0	60
	6	Double Triangle	4	4	0	16	6	6	0	14
		Double Circle	20	100	0	80	30	100	0	70
C	1	Double Circle	4	4	0	16	4	4	0	16
		Square Circle	20	100	0	80	20	100	0	80
	2	Double Square	6	6	0	14	4	4	0	16
		Circle Square	30	100	0	70	20	100	0	80
	3	Circle Square	2	2	0	18	5	5	0	13
		Square Circle	10	100	0	90	25	100	0	75
	4	Double Circle	7	7	0	13	3	3	0	17
		Circle Square	35	100	0	65	15	100	0	85
	5	Double Square	3	3	0	17	9	9	1	11
		Square Circle	18	100	0	85	45	100	11.11	55
	6	Double Square	2	2	0	18	8	5	4	12
		Double Circle	10	100	0	90	40	62.5	50	60

*By "regular" oral behavior is meant that form of oral behavior in which the stimulus block is actually in contact with the subject's mouth.

**By "special" oral behavior is meant that form of oral behavior in which the stimulus block is not in actual contact with the subject's mouth.

Table 56 (cont'd)

Section	Part	Stimulus Pattern	Regular Experimental				Control			
			Present			Absent	Present			Absent
			Total	Regular	Special		Total	Regular	Special	
D	1	Double Circle	3	3	0	17	0	0	0	20
		Oval Circle	15	100	0	85	0	0	0	100
	2	Double Oval	6	6	0	14	0	0	0	20
		Circle Oval	30	100	0	70	0	0	0	100
	3	Circle Oval	8	8	0	12	4	4	0	16
		Oval Circle	40	100	0	60	20	100	0	80
	4	Double Circle	6	6	0	14	4	4	0	16
		Circle Oval	30	100	0	70	20	100	0	80
	5	Double Oval	3	3	0	17	7	7	0	13
		Oval Circle	15	100	0	85	35	100	0	65
	6	Double Oval	5	5	0	15	8	8	0	12
		Double Circle	25	100	0	75	40	100	0	60

Table 57

Comparison of
the Combined Sub-Groups of
the Regular Experimental Group
with the Combined Sub-Groups of the Control Group in regard to oral behavior

Section	Part	Stimulus Pattern	Regular Experimental				Control			
			Present			Absent	Present			Absent
			Total	Regular	Special		Total	Regular	Special	
A	1	Double Circle	23	23	0	25	19	18	1	27
		Cross Circle	47.92%	100%	0	52.08%	39.58%	94.74%	5.26%	60.42%
	2	Double Cross	15	19	0	29	16	14	2	32
		Circle Cross	39.58%	100%	0	60.42%	33.33%	87.5%	12.5%	66.67%
	3	Circle Cross	13	15	0	35	13	13	0	38
		Cross Circle	27.38%	100%	0	72.92%	27.08%	100%	0	72.92%
	4	Double Circle	12	12	0	36	14	14	0	34
		Circle Cross	25	100%	0	75%	29.17%	100%	0	70.83%
	5	Double Cross	13	13	0	35	12	12	0	36
		Cross Circle	27.38%	100%	0	72.92%	25%	100%	0	75%
	6	Double Cross	10	10	0	38	12	12	0	36
		Double Circle	20.83%	100%	0	79.17%	25%	100%	0	75%
B	1	Double Circle	14	14	0	34	22	19	3	26
		Triangle Circle	29.17%	100%	0	70.83%	45.83%	86.36%	13.64%	54.17%
	2	Double Triangle	15	15	0	33	22	21	1	26
		Circle Triangle	31.25%	100%	0	68.75%	45.83%	95.45%	4.55%	54.17%
	3	Circle Triangle	13	13	0	35	10	10	0	38
		Triangle Circle	27.38%	100%	0	72.92%	20.53%	100%	0	79.17%
	4	Double Circle	9	9	0	39	13	13	1	36
		Circle Triangle	18.75%	100%	0	81.25%	27.08%	100%	7.69%	72.92%
	5	Double Triangle	12	12	0	36	11	11	0	37
		Triangle Circle	25	100%	0	75%	22.92%	100%	0	77.08%
	6	Double Triangle	9	9	0	39	12	12	0	36
		Double Circle	18.75%	100%	0	81.25%	25%	100%	0	75%
C	1	Double Circle	18	18	0	30	13	13	0	35
		Square Circle	37.5%	100%	0	62.5%	27.08%	100%	0	72.92%
	2	Double Square	19	19	0	27	17	17	0	31
		Circle Square	39.58%	100%	0	60.42%	35.42%	100%	0	64.58%
	3	Circle Square	6	6	0	42	13	13	0	35
		Square Circle	12.5%	100%	0	87.5%	27.08%	100%	0	72.92%
	4	Double Circle	12	12	0	36	11	11	0	37
		Circle Square	25	100%	0	75%	22.92%	100%	0	77.08%
	5	Double Square	11	11	0	37	14	14	1	34
		Square Circle	22.92%	100%	0	77.08%	29.17%	100%	7.14%	70.83%
	6	Double Square	15	15	0	33	17	14	4	31
		Double Circle	31.25%	100%	0	68.75%	35.42%	82.35%	23.53%	64.58%

*By "regular" oral behavior is meant that form of oral behavior in which the stimulus block is actually in contact with the subject's mouth.
 **By "special" oral behavior is meant that form of oral behavior in which the stimulus block is not in actual contact with the subject's mouth.

Table 57 (cont'd.)

Section	Part	Stimulus pattern	Regular Experimental				Control			
			Present			Absent	Present			Absent
			Total	Regular	Special		total	regular	special	
1	Double Circle		22	22	0	26	12	12	0	36
	Oval Circle		45.83	100	0	54.17	25	100	0	75
2	Double Oval		26	25	1	22	10	10	0	38
	Circle Oval		54.17	86.15	3.85	45.83	20.83	100	0	79.17
3	Circle Oval		19	19	0	29	10	10	0	38
	Oval Circle		37.56	100	0	60.42	20.83	100	0	79.17
4	Double Circle		18	18	0	30	9	9	0	39
	Circle Oval		37.5	100	0	62.5	18.75	100	0	81.25
5	Double Oval		4	4	0	44	10	10	0	38
	Oval Circle		8.33	100	0	91.67	20.83	100	0	79.17
6	Double Oval		8	8	0	40	10	10	0	38
	Double Circle		16.67	100	0	83.33	20.83	100	0	79.17

Table 58

Comparison of Experimental and Control GroupsRegarding Oral BehaviorObserved in Series VI

Section	Group	Regular Experimental			Control		
		Total	Regular*	Special**	Total	Regular*	Special**
Circle A vs. Cross	Sub-Group I	59	59	0	52	52	0
	Sub-Group II	31	31	0	34	31	3
	Combined	90	90	0	86	83	3
Circle B vs. Triangle	Sub-Group I	40	40	0	57	57	0
	Sub-Group II	32	32	0	33	29	5
	Combined	72	72	0	90	86	5
Circle C vs. Square	Sub-Group I	57	57	0	52	52	0
	Sub-Group II	24	24	0	33	30	5
	Combined	81	81	0	85	82	5
Circle D vs. oval	Sub-Group I	66	65	1	38	38	0
	Sub-Group II	31	31	0	23	23	0
	Combined	97	96	1	61	61	0
Circle vs. Others	Sub-Group I	222	221	1	199	199	0
		33.04%	99.55%	.45%	29.61%	100.	0
	Sub-Group II	118	118	0	123	113	15
		24.58%	100	0	25.63%	91.87%	10.57%
	Combined	340	339	1	322	312	15
		29.51%	99.71%	.29%	27.95%	96.89%	4.04%

*By "regular" oral behavior is meant that form of oral behavior in which the stimulus block is actually in contact with the subject's mouth.

**By "special" oral behavior is meant that form of oral behavior in which the stimulus block is not in actual contact with the subject's mouth.

other hand, exceeded the trained ones in the percentages of vocalization of unpleasantness and of communication. (The scores are: for the Control Group, vocalization of unpleasantness = 41.33+%; communicative vocalization = 7.26-%; for the Experimental Group, vocalization of unpleasantness = 25.29-%, communicative vocalization = 4.37-%.) (See Tables 59, 60, 61 and 62 on pages 234-235, 236-237, 238-239, and 240.)

(6) Affective Concomitant

In affective concomitant, as in vocalization, the Experimental subjects exceeded the Control subjects in the relative proportions of pleasant and very pleasant affective concomitant. (The scores are: for the Experimental Group, very pleasant = 9.20+%, pleasant = 80.92-%; for the Control Group, very pleasant = 6.16+%, pleasant = 88.98-%.) They were exceeded by the Control subjects in neutral, unpleasant, and very unpleasant affective concomitant. (The scores are: for the Experimental Group, neutral = 11.89+%, unpleasant = 8.85+%, and very unpleasant = .69+%; for the Control Group, neutral = 14.76-%, unpleasant = 16.84+%, very unpleasant = 1.56+%.) (See Tables 63, 64, 65, and 66 on pages 241-242, 243-244, 245-246, and 247.)

Taking into consideration all the data on reaction time, manipulation, vocalization and affective concomitant, it is evident that the trained subjects, except in the one critical matter of form-choice, gave conclusive evidence

Table 59

Comparison of

Sub-Group I of the Regular Experimental Group

with Sub-Group I of the Control Group in Regard to Vocalization

Section	Part	Stimulus Pattern	Regular Experimental					Control				
			Present				Absent	Present				Absent
			Total	P.	U.	C.		Total	P.	U.	C.	
A	1	Double Circle	11	9	2	0	17	9	3	5	1	19
		Cross Circle	39.29%	81.82%	18.18%	0	60.71%	32.14%	33.33%	55.56%	11.11%	67.86%
	2	Double Cross	14	11	3	0	14	10	8	5	0	18
		Circle Cross	50	78.57%	21.43%	0	50	35.71%	60	50	0	64.29%
	3	Circle Cross	13	9	3	1	15	8	3	3	2	20
		Cross Circle	46.43%	69.23%	23.08%	7.69%	53.57%	28.57%	37.5	37.5	25	71.43%
	4	Double Circle	11	5	4	2	17	11	5	6	1	17
		Circle Cross	39.29%	45.45%	36.36%	18.18%	60.71%	39.29%	45.45%	54.55%	9.09%	60.71%
	5	Double Cross	12	11	1	1	16	10	7	1	2	18
		Cross Circle	42.86%	91.67%	8.33%	8.33%	57.14%	35.71%	70	10	20	64.29%
	6	Double Cross	11	7	3	1	17	11	1	10	1	17
		Double Circle	39.29%	63.64%	27.27%	9.09%	60.71%	39.29%	9.09%	90.91%	9.09%	60.71%
B	1	Double Circle	10	8	1	1	16	9	6	3	0	19
		Triangle Circle	35.71%	80	10	10	64.29%	32.14%	66.67%	33.33%	0	67.86%
	2	Double Triangle	8	6	1	1	20	7	6	0	1	21
		Circle Triangle	28.57%	75	12.5	12.5	71.43%	25	85.71%	0	14.29%	75
	3	Circle Triangle	13	7	6	0	15	15	14	1	0	15
		Triangle Circle	46.43%	53.85%	46.15%	0	53.57%	53.57%	93.33%	6.67%	0	46.43%
	4	Double Circle	13	8	4	1	15	14	8	8	0	14
		Circle Triangle	46.43%	61.54%	30.77%	7.69%	53.57%	50	42.86%	57.14%	0	50
	5	Double Triangle	14	8	5	1	14	14	7	8	0	14
		Triangle Circle	50	57.14%	35.71%	7.14%	50	50	50	57.14%	0	50
	6	Double Triangle	20	13	7	0	8	12	4	7	1	16
		Double Circle	71.43%	65	35	0	28.57%	42.86%	33.33%	58.33%	8.33%	57.14%
C	1	Double Circle	12	7	4	1	16	9	5	4	2	19
		Square Circle	42.86%	58.33%	33.33%	8.33%	57.14%	32.14%	55.56%	44.44%	22.22%	67.86%
	2	Double Square	13	8	4	1	15	6	6	0	0	22
		Circle Square	46.43%	61.54%	30.77%	7.69%	53.57%	21.43%	100	0	0	78.57%
	3	Circle Square	10	5	5	0	18	14	7	5	2	14
		Square Circle	35.71%	50	50	0	64.29%	50	50	35.71%	14.29%	80
	4	Double Circle	10	6	4	0	18	9	8	1	0	19
		Circle Square	35.71%	60	40	0	64.29%	32.14%	88.89%	11.11%	0	67.86%
	5	Double Square	15	7	8	0	13	21	13	7	1	7
		Square Circle	53.57%	46.67%	53.33%	0	46.43%	76	61.90%	33.33%	4.76%	25
	6	Double Square	11	4	7	0	17	10	7	3	0	18
		Double Circle	39.29%	36.36%	63.64%	0	60.71%	35.71%	70	30	0	64.29%

P.: Pleasant; U.: Unpleasant; C.: Communicative

Communicative vocalization is that type which is apparently more than spontaneous state of the subject. It conveys some spatially directed meaning; such as an accompanying a search for the block after it has slipped out of the subject's

vocalization, coupled with a general pleasant or unpleasant attempt to communicate with someone or something; or the sounds grasp and disappeared from sight.

Table 59

(cont'd)

Section	Part	Stimulus Pattern	Regular Experimental					Control				
			Present				Absent	Present				Absent
			Total	P.	U.	C.		Total	P.	U.	C.	
D	1	Double Circle	9	8	0	1	19	9	8	0	1	19
		Oval Circle	32.14 ±	88.89 ±	0	11.11 ±	67.86 ±	32.14 ±	88.89 ±	0	11.11 ±	67.86 ±
	2	Double Oval	7	5	1	1	21	10	7	2	1	18
		Circle Oval	25	71.43 ±	14.29 ±	14.29 ±	75	35.71 ±	70	20	20	64.29 ±
	3	Circle Oval	9	9	0	0	18	5	4	0	1	23
		Oval Circle	32.14 ±	100	0	0	67.86 ±	17.86 ±	80	0	20	82.14 ±
	4	Double Circle	11	11	0	0	19	13	4	10	0	15
		Circle Oval	39.29 ±	100	0	0	60.71 ±	45.43 ±	30.77 ±	76.92 ±	0	63.07 ±
	5	Double Oval	12	2	10	0	18	21	14	5	2	6
		Oval Circle	42.86 ±	16.67 ±	83.33 ±	0	57.14 ±	71.43 ±	20	25	5	65.57 ±
	6	Double Oval	10	4	6	0	18	19	7	12	0	9
		Double Circle	35.71 ±	40	60	0	64.29 ±	67.86 ±	47.37 ±	52.63 ±	0	82.14 ±

Table 60

Comparison of

Sub-Group II of the Regular Experimental Group
and Sub-Group II of the Control Group in Regard to Vocalization

Section	Part	Stimulus Pattern	Regular Experimental					Control				
			Present				Absent	Present				Absent
			Total	P.	U.	C.		Total	P.	U.	C.	
A	1	Double Circle	5	4	0	1	15	7	5	1	1	15
		Cross Circle	25	80	0	20	75	35	71.43	14.29	14.29	65
	2	Double Cross	6	5	1	0	14	6	6	0	0	14
		Circle Cross	30	83.33	16.67	0	70	30	100	0	0	70
	3	Circle Cross	12	10	1	1	8	2	2	0	0	18
		Cross Circle	60	83.33	8.33	8.33	40	10	100	0	0	90
	4	Double Circle	9	5	4	0	11	7	5	1	1	13
		Circle Cross	45	55.56	44.44	0	55	35	7.43	14.29	14.29	65
	5	Double Cross	5	5	0	0	15	7	3	3	1	13
		Cross Circle	25	100	0	0	75	35	42.86	42.86	14.29	65
	6	Double Cross	8	8	0	0	12	11	6	4	1	9
		Double Circle	40	100	0	0	60	55	54.55	36.36	9.09	45
B	1	Double Circle	7	6	0	1	13	12	6	6	1	8
		Triangle Circle	35	85.71	0	14.29	65	60	50	50	8.33	40
	2	Double Triangle	6	5	0	1	14	13	7	4	2	7
		Circle Triangle	30	83.33	0	16.67	70	65	53.85	30.77	15.38	35
	3	Circle Triangle	8	8	0	0	12	12	8	4	0	8
		Triangle Circle	40	100	0	0	60	60	66.67	33.33	0	40
	4	Double Circle	7	5	2	0	13	9	5	4	0	11
		Circle Triangle	35	71.43	28.57	0	65	45	85.56	44.44	0	55
	5	Double Triangle	10	8	2	0	10	8	4	4	0	12
		Triangle Circle	50	80	20	0	50	40	50	50	0	60
	6	Double Triangle	12	10	2	0	8	6	2	4	0	14
		Double Circle	60	83.33	16.67	0	40	30	33.33	66.67	0	70
C	1	Double Circle	9	9	0	0	11	13	3	7	3	7
		Square Circle	45	100	0	0	55	65	23.08	53.85	23.08	35
	2	Double Square	8	8	0	0	12	16	7	7	0	4
		Circle Square	40	100	0	0	60	80	56.25	43.75	0	20
	3	Circle Square	7	7	0	0	13	13	5	8	0	7
		Square Circle	35	100	0	0	65	65	36.46	61.54	0	35
	4	Double Circle	7	7	0	0	13	13	6	6	2	7
		Circle Square	35	100	0	0	65	65	46.15	46.15	15.38	35
	5	Double Square	5	5	0	0	15	7	4	2	1	13
		Square Circle	25	100	0	0	75	35	57.14	28.57	14.29	65
	6	Double Square	7	4	3	0	13	13	4	8	1	7
		Double Circle	35	57.14	42.86	0	65	65	30.77	61.54	7.69	35

P.: Pleasant; U.: Unpleasant; C.: Communicative

Communicative vocalization is that type which is apparently more than spontaneous vocalization of the subject. It conveys some spatially directed meaning, such as an attempt accompanying a search for the block after it has slipped out of the subject's grasp

ization, coupled with a general pleasant or unpleasant to communicate with someone or something; or the sounds and disappeared from sight.

Table 60 (cont'd)

Section	Part	Stimulus Pattern	Regular Experimental					Control				
			Present				Absent	Present				Absent
			Total	P.	U.	C.		Total	P.	U.	C.	
D	1	Double Circle	5	4	0	1	15	6	0	3	3	14
		Oval Circle	25 %	80 %	0 %	20 %	75 %	30 %	0 %	50 %	50 %	70 %
	2	Double Oval	2	2	0	0	18	7	3	4	0	13
		Circle Oval	10 %	100 %	0 %	0 %	90 %	35 %	42.86 %	57.14 %	0 %	65 %
	3	Circle Oval	2	2	0	0	18	6	2	4	1	14
		Oval Circle	10 %	100 %	0 %	0 %	90 %	30 %	33.33 %	66.67 %	16.67 %	70 %
	4	Double Circle	3	0	2	1	17	7	2	5	0	13
		Circle Oval	15 %	0 %	66.67 %	33.33 %	85 %	35 %	28.57 %	71.43 %	0 %	65 %
	5	Double Oval	4	1	3	0	18	8	3	5	0	12
		Oval Circle	20 %	25 %	75 %	0 %	80 %	40 %	37.5 %	62.5 %	0 %	60 %
	6	Double Oval	2	1	1	0	18	12	8	4	0	8
		Double Circle	10 %	50 %	50 %	0 %	90 %	60 %	66.67 %	33.33 %	0 %	40 %

Table 61
Comparison of
the Combined Sub-Groups of the regular Experimental Group
and the Combined Sub-Groups of the Control Group in regard to Vocalization

Section	Part	Stimulus pattern	Regular Experimental				
			Present				Absent
			Total	P.	U.	C.	
A	1	Double Circle	16	10	2	1	32
		Cross Circle	33.33%	61.25%	11.5%	6.25%	66.67%
	2	Double Cross	20	16	4	0	26
		Circle Cross	41.67%	80%	20%	0%	66.67%
	3	Circle Cross	25	17	4	2	23
		Cross Circle	50.00%	78%	16%	8%	47.92%
B	4	Double Circle	20	12	8	0	28
		Circle Cross	40.00%	60%	40%	0%	60.00%
	5	Double Cross	17	10	1	1	11
		Cross Circle	33.33%	58.82%	5.88%	5.88%	64.58%
	6	Double Cross	17	10	1	1	11
		Circle Cross	33.33%	58.82%	5.88%	5.88%	64.58%
C	1	Double Circle	16	14	1	1	31
		Triangle Circle	31.43%	62.85%	1.92%	11.76%	64.58%
	2	Double Triangle	14	11	1	2	24
		Circle Triangle	35.71%	78.57%	7.14%	4.29%	70.00%
	3	Triangle Circle	17	11	1	1	14
		Circle Triangle	33.33%	64.71%	5.88%	5.88%	64.58%
D	4	Double Circle	20	10	2	1	26
		Circle Triangle	40.00%	50%	10%	5%	58.33%
	5	Double Triangle	24	17	7	0	34
		Triangle Circle	60.00%	70.83%	29.17%	0%	70.83%
	6	Double Triangle	21	13	2	0	16
		Circle Triangle	42.86%	61.90%	9.52%	0%	61.90%
E	1	Double Circle	21	16	4	0	27
		Square Circle	42.86%	76.19%	19.05%	0%	54.29%
	2	Double Square	21	16	4	1	27
		Circle Square	42.86%	76.19%	19.05%	3.70%	54.29%
	3	Circle Square	17	12	5	0	31
		Square Circle	35.41%	70.59%	29.41%	0%	64.71%
F	4	Double Circle	17	10	4	0	31
		Circle Square	35.41%	70.59%	29.41%	0%	64.71%
	5	Double Square	20	12	8	0	28
		Square Circle	40.00%	60%	40%	0%	58.33%
	6	Double Square	18	8	10	0	30
		Circle Square	37.5%	44.44%	55.56%	0%	62.5%

Control				
Present				Absent
Total	P.	U.	C.	
16	8	6	2	32
33.33%	50 %	37.5 %	12.5 %	66.67%
16	12	5	0	32
33.33%	75 %	31.25 %	0 %	66.67%
10	5	3	2	30
20.00%	50 %	30 %	20 %	79.17%
18	10	7	2	30
37.5 %	55.56%	38.89%	11.11%	62.5 %
17	10	4	3	31
35.42%	58.82%	23.53%	17.65%	64.58%
22	7	14	2	26
45.45%	31.82%	63.64%	9.09%	54.17%
21	12	9	1	27
43.75 %	57.14%	42.86%	4.76%	56.25 %
20	13	4	3	26
41.67%	65 %	20 %	15 %	58.33%
27	22	5	0	21
56.25 %	81.48%	16.52%	0 %	43.75 %
23	11	12	0	25
47.92%	47.83%	52.17%	0 %	52.08%
22	11	12	0	26
45.45%	50 %	54.55%	0 %	54.17%
18	6	11	1	30
37.5 %	33.33%	61.11%	8.56%	62.5 %
22	8	11	5	26
45.45%	36.36%	50 %	22.73%	54.17%
22	15	7	0	26
45.45%	68.18%	31.82%	0 %	54.17%
27	12	13	2	21
56.25 %	44.44%	48.15%	7.41%	43.75 %
22	14	7	2	26
45.45%	63.64%	31.82%	9.09%	54.17%
23	17	9	2	20
58.33%	60.00%	38.14%	7.14%	41.67%
23	11	11	1	25
47.92%	47.83%	47.83%	4.35%	52.08%

P.= Pleasant; U.= Unpleasant; C.= Communicative
Communicative vocalization is that type which is apparently more than spontaneous state of the subject. It conveys some spatially directed meaning; such as an accompanying a search for the block after it has slipped out of the subject's

vocalization, coupled with a general pleasant or unpleasant attempt to communicate with someone or something; or the sounds grasp and disappeared from sight.

Table 61 (cont'd)

Section	Part	Stimulus Pattern	regular Experimental				Control					
			Present				Absent	Present				Absent
			Total	P.	U.	C.		Total	P.	U.	C.	
D	1	Double Circle	14	12	0	2	34	15	6	6	3	SS
		Oval Circle	29.17%	75.71%	0%	14.29%	70.83%	31.25%	40%	40%	20%	68.75%
	2	Double Oval	8	7	1	1	39	17	10	6	2	31
		Circle Oval	18.75%	77.78%	11.11%	11.11%	81.25%	35.42%	58.82%	35.29%	11.76%	64.56%
	3	Circle Oval	11	11	0	0	37	11	6	4	2	37
		Oval Circle	22.92%	100%	0%	0%	77.06%	22.92%	54.55%	36.36%	18.18%	77.08%
	4	Double Circle	14	11	2	1	34	20	6	15	0	28
		Circle Oval	29.17%	78.57%	14.29%	2.86%	70.83%	41.67%	30%	75%	0%	58.33%
	5	Double Oval	16	3	13	0	32	28	17	10	1	20
		Oval Circle	33.33%	18.75%	81.25%	0%	87.5%	56.33%	66.71%	35.71%	3.57%	41.67%
	6	Double oval	12	6	7	1	36	31	17	14	0	17
		Double Circle	25%	41.67%	58.33%	2.78%	75%	64.56%	54.04%	45.16%	0%	55.42%

Table 62

Comparison of Experimental and Control GroupsRegarding VocalizationObserved in Series VI

Section	Sub-Group	Regular Experimental				Control			
		Total	Pleasant	Un-pleasant	Communi-cative	Total	Pleasant	Un-pleasant	Communi-cative*
A Circle vs. Cross	I	72	52	16	5	59	25	30	7
	II	45	37	6	2	40	27	9	4
	C**	117	89	22	7	99	52	39	11
B Circle vs. Triangle	I	78	50	24	4	71	43	27	2
	II	50	42	6	2	60	32	26	3
	C**	128	92	30	6	131	75	53	5
C Circle vs. Square	I	71	37	32	2	69	46	20	5
	II	43	40	3	0	75	31	38	7
	C**	114	77	35	2	144	77	58	12
D Circle vs. Oval	I	58	39	17	2	76	44	30	4
	II	18	10	6	2	46	18	25	4
	C**	76	49	23	4	122	62	55	8
Circle vs. Others	I	279	178	89	15	275	158	107	18
		41.52%	63.80%	31.90%	4.66%	40.92%	57.45%	38.91%	6.55%
	II	156	129	21	6	221	108	98	18
		32.50%	82.69%	13.46%	3.85%	46.04%	48.87%	44.34%	8.14%
Others	C**	435	307	110	19	496	266	205	36
		37.76%	70.57%	25.29%	4.37%	43.06%	53.63%	41.33%	7.26%

*Communicative vocalization is that type which is apparently more than spontaneous vocalization, coupled with a general pleasant or unpleasant state of the subject. It conveys some spatially directed meaning; such as an attempt to communicate with someone or something; or the sounds accompanying a search for the block after it has slipped out of the subject's grasp and disappeared from sight.

**C= Combined

table 65

Comparison of

Sub-Group I of the Regular Experimental Group

and Sub-Group I of the Control Group in regard to Affective Concomitant

Section	Part	Stimulus Pattern	Regular Experimental					Control				
			V. P.	P.	N.	U.	V. U.	V. P.	P.	N.	U.	V. U.
A	1	Double Circle	4	24	1	2	0	1	27	2	5	0
		Cross Circle	14.29%	85.71%	3.57%	7.14%	0	3.57%	96.43%	7.14%	17.86%	0
	2	Double Cross	3	25	1	3	0	2	25	6	4	1
		Circle Cross	10.71%	89.29%	3.57%	10.71%	0	7.14%	89.29%	21.43%	14.29%	3.57%
	3	Circle Cross	5	23	1	5	0	0	28	4	5	0
		Cross Circle	17.86%	82.14%	3.57%	10.71%	0	0	92.86%	14.29%	10.71%	0
	4	Double Circle	4	24	3	5	1	2	25	3	6	0
		Circle Cross	14.29%	85.71%	10.71%	10.71%	3.57%	7.14%	89.29%	10.71%	21.43%	0
	5	Double Cross	4	24	3	1	0	0	28	6	1	0
		Cross Circle	14.29%	85.71%	10.71%	3.57%	0	0	100	21.43%	3.57%	0
	6	Double Cross	5	25	2	5	0	0	28	2	10	0
		Double Circle	10.71%	89.29%	7.14%	10.71%	0	0	100	7.14%	35.71%	0
B	1	Double Circle	4	24	2	1	0	3	25	0	3	2
		Triangle Circle	14.29%	85.71%	7.14%	3.57%	0	10.71%	89.29%	0	10.71%	7.14%
	2	Double Triangle	5	23	3	1	0	8	20	1	0	0
		Circle Triangle	17.86%	82.14%	10.71%	3.57%	0	28.57%	71.43%	3.57%	0	0
	3	Circle Triangle	1	27	3	6	0	5	23	2	1	0
		Triangle Circle	3.57%	96.43%	10.71%	21.43%	0	17.86%	82.14%	7.14%	3.57%	0
	4	Double Circle	3	24	4	4	0	1	25	6	2	1
		Circle Triangle	10.71%	85.71%	14.29%	14.29%	0	3.57%	89.29%	21.43%	28.57%	3.57%
	5	Double Triangle	3	23	6	5	0	1	26	10	8	0
		Triangle Circle	10.71%	82.14%	28.57%	17.86%	0	3.57%	92.86%	35.71%	28.57%	0
	6	Double Triangle	3	24	5	7	0	2	25	11	7	0
		Double Circle	10.71%	85.71%	10.71%	25	0	7.14%	89.29%	39.29%	25	0
C	1	Double Circle	4	24	1	4	0	1	26	3	3	1
		Square Circle	14.29%	85.71%	3.57%	14.29%	0	3.57%	92.86%	10.71%	10.71%	3.57%
	2	Double Square	5	25	6	4	0	3	26	1	0	0
		Circle Square	10.71%	89.29%	21.43%	14.29%	0	10.71%	89.29%	3.57%	0	0
	3	Circle Square	2	26	7	5	0	2	26	3	5	0
		Square Circle	7.14%	92.86%	25	17.86%	0	7.14%	92.86%	10.71%	17.86%	0
	4	Double Circle	2	24	4	4	0	1	27	2	1	0
		Circle Square	7.14%	85.71%	14.29%	14.29%	0	3.57%	96.43%	7.14%	3.57%	0
	5	Double Square	3	24	4	6	2	1	27	7	7	0
		Square Circle	10.71%	85.71%	14.29%	21.43%	7.14%	3.57%	96.43%	25	25	0
	6	Double Square	1	27	4	5	2	3	24	7	2	1
		Double Circle	3.57%	96.43%	14.29%	17.86%	7.14%	10.71%	85.71%	25	7.14%	3.57%

V. P. = Very Pleasant; P. = Pleasant; N. = Neutral; U. = Unpleasant; V. U. = Very Unpleasant

Table 63

(cont. d)

Section	Part	Stimulus Pattern	Regular Experimental					Control				
			V. P.	P.	H.	U.	V. U.	V. P.	P.	H.	U.	V. U.
D	1	Double Circle	3	25	2	0	0	3	25	2	3	0
		Oval Circle	10.71 4	89.29 3	7.14 4	0	0	10.71 4	89.29 3	7.14 4	10.71 4	0
	2	Double Oval	1	27	3	0	1	4	21	3	2	0
		Circle Oval	3.57 4	96.43 3	10.71 4	0	3.57 4	14.29 3	75	10.71 4	7.14 4	0
	3	Circle oval	3	25	2	0	0	1	25	7	0	0
		Oval Circle	10.71 4	89.29 3	7.14 4	0	0	3.57 4	89.29 3	25	0	0
	4	Double Circle	8	20	6	0	0	1	21	9	9	0
		Circle Oval	28.57 3	71.43 3	21.43 3	0	0	3.57 4	75	32.14 3	32.14 3	0
	5	Double Oval	0	27	7	8	8	3	24	4	5	0
		Oval Circle	0	96.43 3	25	28.57 3	7.14 4	10.71 4	85.71 3	14.29 3	17.86 3	0
	6	Double Oval	1	27	6	6	0	1	24	6	9	1
		Double Circle	3.57 4	96.43 3	21.43 3	21.43 3	0	3.57 4	85.71 3	21.43 3	32.14 3	3.57 4

Table 64

Comparison of

Sub-Group II of the Reg

ular Experimental Group

and Sub-Group II of the Control Group in

Regard to Affective Concomitant

Section	Part	Stimulus Pattern	Regular Experimental					Control				
			V. P.	P.	N.	U.	V. U.	V. P.	P.	N.	U.	V. U.
A	1	Double Circle	2	18	0	0	0	0	20	0	1	0
		Cross Circle	10	90	0	0	0	0	100	0	5	0
	2	Double Cross	2	18	0	1	0	1	19	0	0	0
		Circle Cross	10	90	0	5	0	5	95	0	0	0
	3	Circle Cross	3	17	4	1	0	1	19	2	0	0
		Cross Circle	15	85	20	5	0	5	95	10	0	0
	4	Double Circle	0	20	2	4	0	0	20	1	1	0
		Circle Cross	0	100	10	20	0	0	100	5	5	0
	5	Double Cross	0	20	4	0	0	0	20	2	3	0
		Cross Circle	0	100	20	0	0	0	100	10	15	0
	6	Double Cross	4	18	5	0	0	1	19	3	4	0
		Double Circle	20	80	25	0	0	5	95	15	20	0
B	1	Double Circle	0	20	1	0	0	1	19	0	6	1
		Triangle Circle	0	100	5	0	0	5	95	0	30	5
	2	Double Triangle	3	17	0	0	0	2	18	3	4	0
		Circle Triangle	15	85	0	0	0	10	80	15	20	0
	3	Circle Triangle	2	18	2	0	0	0	20	1	4	0
		Triangle Circle	10	90	10	0	0	0	100	5	20	0
	4	Double Circle	1	19	2	2	0	2	16	3	4	0
		Circle Triangle	5	95	10	10	0	10	80	15	20	0
	5	Double Triangle	1	18	2	2	0	2	18	0	4	0
		Triangle Circle	5	90	10	10	0	10	90	0	20	0
	6	Double Triangle	2	18	3	2	0	0	20	4	4	0
		Double Circle	10	90	15	10	0	0	100	20	20	0
C	1	Double Circle	3	17	2	0	0	0	18	2	9	2
		Square Circle	15	85	10	0	0	0	80	10	35	10
	2	Double Square	2	18	0	0	0	1	14	3	5	2
		Circle Square	10	90	0	0	0	5	70	15	25	10
	3	Circle Square	0	20	2	0	0	0	16	2	9	2
		Square Circle	0	100	10	0	0	0	80	10	35	10
	4	Double Circle	1	19	1	0	0	2	14	5	6	0
		Circle Square	5	95	5	0	0	10	70	25	20	0
	5	Double Square	1	19	4	0	0	2	15	5	2	0
		Square Circle	5	95	20	0	0	10	75	25	10	0
	6	Double Square	0	20	0	3	0	1	17	5	6	2
		Double Circle	0	100	0	15	0	5	85	25	30	10

V. P.= Very Pleasant; P.= Pleasant; N.= Neutral; U.= Unpleasant; V. U.= Very Unpleasant

Table 64, cont'd)

Section	Part	Stimulus Pattern	Regular Experimental					Control				
			V. P.	P.	N.	U.	V. U.	V. P.	P.	N.	U.	V. U.
D	1	Double Circle	2	18	0	0	0	0	20	2	4	0
		Oval Circle	10 %	90 %	0 %	0 %	0 %	0 %	100 %	10 %	20 %	0 %
	2	Double Oval	2	18	0	0	0	0	19	3	4	0
		Circle Oval	10 %	90 %	0 %	0 %	0 %	0 %	95 %	15 %	20 %	0 %
	3	Circle Oval	1	19	2	0	0	1	19	2	4	0
		Oval Circle	5 %	95 %	10 %	0 %	0 %	5 %	95 %	10 %	20 %	0 %
	4	Double Circle	0	20	3	2	0	1	17	7	5	0
		Circle Oval	0 %	100 %	15 %	10 %	0 %	5 %	85 %	35 %	25 %	0 %
	5	Double Oval	0	20	5	3	0	0	20	2	5	0
		Oval Circle	0 %	100 %	25 %	15 %	0 %	0 %	100 %	10 %	25 %	0 %
	6	Double oval	1	19	7	1	0	4	12	6	2	2
		Double Circle	5 %	95 %	35 %	5 %	0 %	20 %	60 %	30 %	10 %	10 %

Table 35

Comparison of
the Combined Regular Experimental Groups
and the Combined Control Groups in Regard to Affective Concomitant

Section	Part	Stimulus Pattern	Regular Experimental					Control				
			V. P.	P.	N.	U.	V. U.	V. P.	P.	N.	U.	V. U.
A	1	Double Circle	6	42	1	2	0	1	47	2	6	0
		Cross Circle	12.5 %	87.5 %	2.08 %	4.17 %	0 %	2.08 %	97.92 %	4.17 %	12.5 %	0 %
	2	Double Cross	5	43	1	4	0	5	44	6	4	1
		Circle Cross	10.42 %	89.58 %	2.08 %	8.33 %	0 %	6.25 %	91.67 %	12.5 %	8.33 %	2.08 %
	3	Circle Cross	8	40	5	4	0	1	45	6	5	0
		Cross Circle	16.67 %	83.33 %	10.42 %	8.33 %	0 %	2.08 %	93.75 %	12.5 %	6.25 %	0 %
	4	Double Circle	4	44	5	7	1	2	45	4	7	0
		Circle Cross	8.33 %	91.67 %	10.42 %	14.58 %	2.08 %	4.17 %	93.75 %	8.33 %	14.58 %	0 %
	5	Double Cross	4	44	7	1	0	0	48	8	4	0
		Cross Circle	8.33 %	91.67 %	14.58 %	2.08 %	0 %	0 %	100 %	16.67 %	8.33 %	0 %
	6	Double Cross	7	41	7	3	0	1	47	5	14	0
		Double Circle	14.58 %	85.42 %	14.58 %	6.25 %	0 %	2.08 %	97.92 %	10.42 %	29.17 %	0 %
B	1	Double Circle	4	44	8	1	0	4	44	0	9	5
		Triangle Circle	8.33 %	91.67 %	6.25 %	2.08 %	0 %	8.33 %	91.67 %	0 %	18.75 %	6.25 %
	2	Double Triangle	8	40	5	1	0	10	36	4	4	0
		Circle Triangle	16.67 %	83.33 %	6.25 %	2.08 %	0 %	20.83 %	75 %	8.33 %	6.33 %	0 %
	3	Circle Triangle	5	45	5	6	0	5	43	3	5	0
		Triangle Circle	6.25 %	93.75 %	10.42 %	12.5 %	0 %	10.42 %	89.58 %	6.25 %	10.42 %	0 %
	4	Double Circle	4	45	6	6	0	5	41	9	12	1
		Circle Triangle	8.33 %	89.58 %	12.5 %	12.5 %	0 %	6.25 %	85.42 %	18.75 %	25 %	2.08 %
	5	Double Triangle	4	41	10	7	0	5	44	10	12	0
		Triangle Circle	8.33 %	85.42 %	20.83 %	14.58 %	0 %	6.25 %	91.67 %	20.83 %	25 %	0 %
	6	Double Triangle	5	42	6	9	0	2	45	15	11	0
		Double Circle	10.42 %	87.5 %	12.5 %	18.75 %	0 %	4.17 %	93.75 %	31.25 %	22.92 %	0 %
C	1	Double Circle	7	41	5	4	0	1	44	5	10	5
		Square Circle	14.58 %	85.42 %	6.25 %	8.33 %	0 %	2.08 %	91.67 %	10.42 %	20.83 %	6.25 %
	2	Double Square	5	43	6	4	0	4	39	4	5	2
		Circle Square	10.42 %	89.58 %	12.5 %	8.33 %	0 %	8.33 %	81.25 %	8.33 %	10.42 %	4.17 %
	3	Circle Square	2	46	9	5	0	2	42	5	12	2
		Square Circle	4.17 %	95.83 %	18.75 %	10.42 %	0 %	4.17 %	87.5 %	10.42 %	25 %	4.17 %
	4	Double Circle	3	43	5	4	0	3	41	7	9	0
		Circle Square	6.25 %	89.58 %	10.42 %	8.33 %	0 %	6.25 %	85.42 %	14.58 %	14.58 %	0 %
	5	Double Square	4	43	8	6	2	5	42	18	9	0
		Square Circle	8.33 %	89.58 %	16.67 %	12.5 %	4.17 %	6.25 %	87.5 %	25 %	18.75 %	0 %
	6	Double Square	1	47	4	8	2	4	41	12	8	3
		Double Circle	2.08 %	97.92 %	8.33 %	16.67 %	4.17 %	8.33 %	85.42 %	25 %	16.67 %	6.25 %

V. P.=Very Pleasant; P.=Pleasant; N.=Neutral; U.=Unpleasant; V. U.=Very unpleasant

Table 66

Comparison of Experimental and Control Groups
regarding different aspects of Affective Reactivity
Observed in Series VI

Section	Sub-group	Number Experimental					Number Control				
		very Pleasant	Pleasant	Neutral	Unpleasant	Very Unpleasant	Very Pleasant	Pleasant	Neutral	Unpleasant	Very Unpleasant
A vs. Cross	Sub-group I	23	14	1	10	1	5	14	1	1	1
	Sub-group II	11	102	25	5	1	5	117	1	1	1
	Combined	34	254	26	15	2	10	131	2	2	2
B vs. Triangle	Sub-group I	19	14	1	1	1	21	14	1	1	1
	Sub-group II	8	11	1	1	1	27	117	41	1	4
	Combined	27	25	2	2	2	48	128	42	2	5
C vs. Square	Sub-group I	15	15	1	1	1	11	11	1	1	2
	Sub-group II	7	11	1	1	1	6	14	1	1	6
	Combined	22	26	2	2	2	17	25	2	2	8
D vs. Oval	Sub-group I	16	11	2	1	1	10	11	1	1	1
	Sub-group II	7	114	17	1	1	6	107	21	24	2
	Combined	23	125	19	2	2	16	117	22	25	3
Circle vs. Others	Sub-group I	73	101	11	11	1	48	107	11	11	1
	Sub-group II	33	44	1	1	1	20	117	11	11	1
	Combined	106	145	12	12	2	68	124	22	22	2

of positive transfer of previous training. This was objectively evident in superior regard and sustained attention, direct approach, short reaction time, and affective adjustment to the stimulus patterns in particular and the total experimental situation in general.

GENERAL DISCUSSION

A. Space Perception

The perception of visual form is obviously related to the basic problems of space perception in general. Since all general space perception theories directly or indirectly assume certain genetic hypotheses, it may be of final interest to touch briefly upon such correlations as our data afford. Thus, the older nativistic school [Descartes (1596-1650), Kant (1724-1804), Fichte (1762-1814), Johannes Müller (1801-1858), Hering (1834-1918), Stumpf (1848-), etc.] assert that the capacity to appreciate space is innate and may be used without preliminary practice. For them space offers no empirical problems: it is appreciated at once. Their major discussions and experiments deal with depth or distance, but since they do not state otherwise, we may assume that this hypothesis holds also for form.

Genetic data from this experiment which seem to accord with the nativistic concept are: (1) persistent and consistent individual differences in form discrimination within a given series despite identical training; (2) the ability to discriminate, even at the six month level when the optical apparatus is probably still somewhat

immature (64, pp. 584-608), such fine differences as circle-oval; (3) the apparent "absolute" nature of form as evident in the small percentage of difficulties produced through changing size, contour, orientation, position, and total pattern complexity; and (4) the close resemblance between the Experimental and Control Groups in their spontaneous selection of compound form blocks which, on the whole, seems to support "immediate" perception of these figures as "new" configurations.

The empiricists [Berkeley (1685-1753), Lotze (1817-1881), Helmholtz (1821-1894), Wundt (1832-1920), etc.] assert that the notion of space is developed through experience, and that therefore it is essential to discover the components of the idea of space and also to determine its origin. They are of the opinion that the nativistic theory is unnecessary and gratuitous, and that the development of space perception in experience is to a certain extent demonstrable.

Opposed to the strictly nativistic hypothesis and supporting the empirical concept are the evidences of practice and learning in form discrimination: (1) Superior discrimination performance was clearly present at the end of the experiment as compared with large number of trials and long reaction time in the early learning series. This could, of course, be attributed to general maturation except for the obvious differences between older trained

subjects and beginning subjects of identical age (see Table 11 on back of dissertation). Furthermore, as these differences decreased rapidly with training, they can hardly represent innate maturational perception differences alone. (2) Since Sub-groups I and II of the Experimental Group were equated in both physical and mental development, the various differences in results on form discrimination between the two sub-groups were undoubtedly due to the difference in training, i.e., in the order of presentation of the stimuli.

Since Munn and Stiening (5) used only one subject, it is impossible to prove here what nevertheless is an obvious inference through comparing their data with ours; that is, requiring as many as 350 trials to learn to discriminate a cross from a square at the age of fifteen months might have been due to (1) poor form discrimination (an individual difference), (2) poor learning capacity, and (3) deprivation of the normally present manipulatory cues. Assuming the last possibility listed above on the basis of Munn's and Stiening's own description, one would then have additional data supporting the empiricists' belief that visual space percept, form or distance, is the product of many contributing senses, especially tactual manipulation. On the other hand, Révész (36) and other experimenters regard the development of tactual and visual form

discrimination as parallel processes, i.e., independently maturing capacities.

On the whole, data from Series VI may be here interpreted as rather against the empiricists, since they fail to show any of the specific "trace" effects which could be logically anticipated from the long training in Series I - V.

Finally, it is quite conceivable that the effects of training in Series I - V represent trained attention to form differences, rather than improved form discrimination capacity per se, although "behaviorally" it would be quite impossible to separate these two functions in an adult, as in these infants.

On the basis of the present investigation, it seems probable that space perception, as we find it even in the young infant, is the combined result of both inborn maturational capacities and individual experiences. Like all genetic studies, the results of this one point backward to still younger age levels, as far as the question of innate or acquired perceptual patterns are concerned. In this study the lower limit of six months was arbitrarily selected because of three reasons: (1) a mass of standardized data regarding normal eye-hand behavior patterns at this age, providing basis for legitimate technique; (2) the known maturation level of the physiological optical

processes;¹ and (3) the almost universal implications in genetic literature that such perceptual discrimination of geometric form as we have measured would be quite impossible at six months (see Introduction, pp. 11-12). Having provided the first exact quantitative and qualitative data for geometric form discrimination at this age, it is now clear that some technique must be devised to study the same phenomenon in much younger infants. Similarly, a subsequent study must isolate all possible parallel or auxiliary cues, both manipulatory and gustatory.

In "configuration" theories form perception as such is of special significance, as its name so clearly implies. Likewise the genetic aspects are of fundamental importance. Compare such conflicting statements as those of Koffka (10) and Stern (17) on the nature and level of "primitive figure-ground" relationship:

1It is a well known physiological fact that the distal portion of the optic nerve is completely myelinated at six months, even though myelination of the entire nerve does not take place until the end of the first year. Also at the sixth month, binocular coördination becomes increasingly efficient; refraction is improved because of the increased curvature of the cornea; the size of the pupil increases noticeably; and the lens gains both in thickness and degree of curvature. About the same age level, the optical axis increases greatly in length, the surface of the retina in size, and the cones in number. Foveal fixation, too, seems definitely established; therefore, beginning from the sixth month, the infant is optically ready for this type of experimental task whereas children of younger age levels are conceivably not (64, pp. 584-608).

Koffka (10) writes:

Very early the child turns toward bright objects, and begins to react differently to light and darkness. In this connection it should be noted that light and dark are not really color-designations, such as black and white, but instead indicate differences in the "level" of the surroundings. All we can properly say is that a bright object may stand out readily from its "background" at a very early age (10, pp. 265-6).

Stern (17) states:

We must think of the earliest condition as one of entirely diffuse general sensibility We must first ask how the child in any way manages to distinguish and isolate a single phenomenon out of the confusion of this general condition Motor movements and concentrated attention are the two means by which the young creature selects and retains separate elements from the original confused chaos of outer sensations, and immediately separates them from that general condition and reserve them as a special experience. Gradually they assume thus a character opposed to merely subjective experiences, they point outward to things--in short, they become perceptions. Only this process is a very gradual one If we consider more closely the result of this process we see it is not now the sum, so to speak, of its component simple sensations. The image standing out from the background of consciousness (mother, rattle, etc.) is rather, from the beginning, a whole, within which single tones, lines, colors, etc., only have significance as mutually dependent, necessary component parts of that whole. Such a defined whole new psychology calls a psychic "form," and the formation, and the organization of the parts its "structure." (17, pp. 102 and 106).

Apropos of this theoretical confusion our data show that the finer capacities in form discrimination, i.e., specific geometric detail within a "mass-pattern" as opposed to mere "brightness discrimination," are present at very early age levels, much earlier than is admitted anywhere in the literature with the possible exception

of the work reported by Volkelt (7). They are not, as so frequently labelled by others, an "advanced" form of mental activity which emerges "relatively late" from a more primitive "diffuse" state, though the term "relatively late" is certainly indefinite enough. Furthermore, these objective differences (sensory cues) within a given pattern may be quite minute without being easily obscured or "absorbed" by the "gesamtheit Charakter" of a "primitive" level of perception, "vague, fluid, inaccurate, and liable to modification in accordance with subjective tendencies" (11, p. 178). Finally, the nature of the young infant's discrimination of geometric forms is not sufficiently "vague, diffuse and homogeneous" to be very easily affected by changes of the whole through modification of such vital collateral (i.e., "topological," "geographical") parts as spatial orientation, size, number, grouping, sequence, etc.

The present study seems not only to confirm the general opinion of Koffka (10), Vernon (11), Gellermann (3,4), Bühler (12), etc. that to a young child a form is much more independent of its absolute spatial position than it is to adults (cf. pp. 5-6), but also to show that this is marked in early infancy. On the other hand, this "independence," while preponderant, is still relative and not absolute, as a literal inference of this genetic theory might imply (see Figures 14, 15, 17, 18,

20, 21, 22 and 23 on pages 62, 63, 79, 80, 91, 92, 95, 96).

The present findings do not confirm Jersild's widely accepted doctrine that "a young child is likely to make errors by judging objects in terms of their size rather than their form" (13, p. 237). They confirm Koffka's (10) and Stern's (17) statements that size plays a very insignificant rôle in the recognition of things in early perceptual stages (10, p. 288; 17, p. 121), (cf. p. 8).

The results here show that within a multiple, i.e., "synthetic" [Kresnogorski (50)] pattern of not more than five units, an increase in the number of blocks presented simultaneously rendered the task of form discrimination more difficult but not impossible for the infants. Data from Series IV ("Increase in Number") show that the task of "abstracting" the circle (positive stimulus) from a new "synthetic" pattern was more difficult when the form in question was placed next to the oval (similarity plus proximity) than away from it (similarity only), or when it was in or near the center of the pattern than on the ends. The task was hardest if the circle was placed at the center next to the oval. These results seem to confirm Schroff's (19) and Rush's (21) finding that similarity and proximity are among the factors which exert a powerful influence in visual grouping (see pp. 9-10).

Except in the multiple series the present study shows, however, that position played a very insignificant rôle

in the form discrimination of the infants. In Series I, II, III and V they learned very rapidly to dispense with it. It is, however, interesting that a few subjects, when confronted with abrupt changes in the experimental set-ups in the first parts of Series V ("Backward Learning"), tended to resort, during their temporary confusion, to an obvious positional cue, a primitive tendency familiar to all who work in animal psychology.

Listing these "geographical" details in approximate order of decreasing effect on performance, but keeping in mind the relatively small effect of all of them, one finds that they are: (1) number, (2) similarity, (3) sequence, (4) proximity, (5) size, (6) spatial orientation and (7) position (see Figures 14, 15, 17, 18, 20, 21, 22 and 23 on pages 62, 63, 79, 80, 81, 92, 95 and 96; also see Tables 11, 12, 13, 14, 19, 24 and 26 at back of dissertation, on pages 65, 69, 70, 84, 98 and 101).

As directly or indirectly related to such factors in perception as "goodness of contour," "potency" of contour, interest, or even the physiology of vision, the spontaneous response to or selection of the different geometric contours under different pattern conditions seems of interest here. From this experiment it appears that angularity was one of the primary cues in the form discrimination of the infants. An abrupt withdrawal of

this cue rendered the task much more difficult; however, the infants were able to dispense with it when it was not available. From an arbitrary point of view it might be assumed that the primitive "goodness" of the circle, being the simplest of the forms to be perceived by a "primitive" six-month intelligence, might be translated into a simple, "primitive" motor preference. From another point of view, possibly correlated with physiological determinants--roundness of fovea, macula, pupil, etc.--as projected undifferentiated "mass" patterns, the circle is perhaps too primitive a contour to be perceptually interesting, and any change might therefore focus the infant's visual attention. This is in accordance with the general principle that we react primarily rather to change from or within a familiar or habitual stimulus than merely to the stimulus itself [Jenkins (65), Crudden (23), etc.]. On this hypothesis, spontaneous preferences would select the non-circle forms. The actual data show that in the first part of Series I when the circle was the positive stimulus and the cross (for Sub-group I) or the oval (for Sub-group II) the negative, not a single subject in either the Preliminary or the Experimental Groups learned to select the circle as against either of the other two forms in the first ten trials (the minimal number of trials required by the experiment). In fact, a few of the subjects spent as many as 100

trials or more before they stopped attempting to acquire the cross or the oval (see Tables 1 on page 31, and 11 on back of dissertation). Again in Series VI when spontaneous selection was allowed, in an overwhelming majority of the cases both the trained and untrained subjects showed slight but consistent preference for the non-circle to circle forms (see Tables 48, 49 and 50 on pages 205, 209 and 213). These results would seem to indicate that instead of preferring the form which is the simplest both "geographically" and "behaviorally," the young human infant tends to select more complex geometric forms: such as the cross, triangle, square and oval, as opposed to the circle.

From the preceding discussion it is clear that these genetic data at least partly agree with certain aspects of all the three theories of space perception in question. With the general concepts of Koffka (49) and Vernon (11) as expressed in the following paragraphs there seems to be a general agreement.

Thus Koffka (49) writes:

It will not be necessary to point out that an anti-empiristic attitude does not mean the denial of the enormous value of experience. Not that it makes use of experience causes our objection to empiricism, but how it makes use of it (49, p. 639).

Again Vernon (11) states:

But we must remember that our apprehension of space is not dependent only upon the pattern of visual stimulation. A configurational structure such

as we have described is essentially bound up with a mass of kinaesthetic and proprioceptive sensory data, with postural schemes of the kind described by Head, and with visual and kinaesthetic ideational data derived from individual experience. To the latter we have frequently alluded. The former are not exactly within the scope of this book; but we shall consider their relationship to the visual spatial configuration in Chap. X, in connection with the 'spatial framework.' We may, however, suggest that there is a definite schematic relationship between all these factors, the development of which is a purely spontaneous perceptual process, although its form is influenced by the factors of experience which we have mentioned. The ability to create structures of this kind, and to utilize more or less adequately the data which they afford, is an innate property of the organism. But the completeness and detail of a structure and its modifications under different conditions, objective and subjective, must be affected and to some extent determined by individual experience; and so also the particular accuracy and efficiency with which the individual can deal with any particular aspect of the structure and deduce from it any particular relationship of depth or distance (ll. pp. 87-88).

Notwithstanding, with the temporal aspect of the genetic development of these phenomena there is fundamental disagreement.

B. Learning

As the experimental situation in the present study obviously involves some general questions of trial-and-error learning, viz., association, both in the classical sense of contiguous pattern, and in the sense of Conditioned Reflex; "insight" or sudden learning in the Köhler-Gottschaldt sense; positive transfer of training; various phenomena of inhibition; as well as such mechanical aspects as number and order of repetitions, forward and backward learning, facilitation, extinction, etc.; some genetic aspects of these factors in learning may be briefly outlined here.

At least within this controlled experimental situation the following general statements hold true:

1. With the exception of the circle-oval combination, the number of repetitions required for the successful discrimination of the cross, the triangle, or the square from the circle seemed to depend more upon the general order of presentation of the stimuli than upon the degree of similarity which each of these forms bore to the circle. In the case of the circle-oval combination, however, the close similarity between the two forms rendered the task of discrimination markedly harder than in the case of any other form combination used in the present study (see Tables 11, 12, 13 and 14 at back of dissertation and on pages 68, 69 and 70).

It seems probable, therefore, that angularity versus non-angularity (or circularity versus non-circularity) was the "critical" or basic discriminatory clue, regardless of how small or how large this difference was. Since there is very little difference in the curves for the square, triangle and cross (contrary to expectations), it seems obvious that the range of geometric forms used in this experiment does not actually test the maximum capacity of these infants in fine discrimination. Superimposed upon our quantitative data, this general result in itself is a significant corroboration of our hypothesis that the finer processes of perceptual discrimination, as opposed to the "diffuse" or "mass", unindividuated nature of primitive perception, are certainly present in the six-months human infant. A subsequent study will try to determine the "absolute" limits of fine discrimination within a basic circular, and a basic angular, geometric figure.

2. On the whole, an increase in the number of form units composing the stimulus pattern from two blocks on made the task of discrimination more difficult. However, increase in number did not bear a straight-line relationship to the difficulty of the task, as measured by the combined scores in total number of trials, percentage of success, and total and average reaction time (see Tables 11, 12, 13, 17, 18, 24 and 25 at back of dissertation and on pages 63, 69, 82, 83, 98 and 99-100). Rather it produced very different

effects on different individuals.

3. Individual differences in the learning of the various form combinations were both consistent and marked as shown by the scores in total number of trials (range: 297-1024 trials; average: 609 trials for Sub-group I and 648.25 trials for Sub-group II), percentage of success (range: 86.20-% - 57.03+%; average: 64.24-% for Sub-group I and 64.83-% for Sub-group II), and total reaction time (range: 2123.5 sec. - 20009.0 sec.; average: 6922.80 sec. for Sub-group I and 11706.03- sec. for Sub-group II). (For more detailed statistics, see Figures 4, 5, 6, 13, 16 and 19 on pages 30, 33, 37, 58, 75 and 85; and Tables 1, 2, 3, 4, 5, 6, 7, 8 and 11 on pages 31, 32, 34, 35, 38, 39, 40, 41 and at back of dissertation.)

Among the most conspicuous of individual differences were "types" of learners. Thus, in the Regular Experimental Group of eighteen subjects (see Figures 13 and 19 on pages 58 and 85), three were fast and efficient learners, two fast but inefficient, three slow but efficient, three slow and inefficient. The remaining seven were "average" in their learning efficiency, and high, medium or low in speed. The coefficient of correlation between quality and rapidity in learning for the group was .25±15 (cf. page 36). These "type" differences were generally apparent very early in the experiment and remained consistent throughout.

On the whole, the fast and efficient learners made

the most rapid adjustment in the first form combination of Series V. The fast and inefficient subjects might give, superficially, a false impression of rapid initial adjustment, but they were never stable in the adaptation. The slow and efficient infants, on the other hand, might take a relatively long time to scrutinize the changed situation; but once the change was "cognized," the motor task was completed. The slow and inefficient learners had a great deal of trouble both in recognizing the reversal in the functional relationship of the two units of the stimulus pattern, and in adapting themselves to the new experimental condition. They spent as many as 70 to 130 trials in learning the form combination. It seems apparent, therefore, that the difficulty among those infants was primarily a perceptual one, with little reference to motor capacity. The medium cases, as one would expect, lay intermediate between these four extreme types both in their ability to detect the change and in the permanency of the new habit. Detection of such highly consistent "types" at these very early age levels would seem to emphasize the constitutional, as opposed to the purely environmental factors, in the genesis of the learning process.

4. Trial and error was of necessity used by all the subjects in the learning of the initial form combination. After a number of futile attempts [range: 6-218 trials (see Table 11 at back of dissertation)] to secure the negative

block, these unsuccessful movements were "stamped out"; only those responses leading directly to the acquisition of the positive form were retained (Thorndike's Laws of Effect and Exercise; Professor Shepard's explanation that the learning was effected by the organism's accidental attention to the proper stimulus).

5. Positional cues were used by a few subjects at the beginning of the experiment. However, these subjects soon learned to dispense with these cues and resorted to using them again only when temporarily confused, such as in the first form combination of Series V. This is a primitive or "regressive" tendency pointed out in many of the animal experiments.

6. Definite signs of one total pattern inhibiting another were shown by the subjects on such occasions as: (a) in the first form combination of Series V when there was an abrupt reversal of functional relationship between the positive and negative stimulus; and (b) in the first part of Series VI in which compound blocks, made of a negative form superimposed on a positive form, or vice versa, were exposed. Under such circumstances some of the trained subjects seemed to be at a loss as to what to do about the blocks.

7. Evidence of a positive general transfer of training can be found throughout the experiment after the first form pattern, in that the subjects spent less time and had

less trouble in learning any subsequent forms (see Table 11 at back of dissertation). This type of general transfer was most obvious in Series VI when the behavior of the Experimental Cases was compared with that of the Control Group. Such a comparison showed, first of all, a far superior general adaptation on the part of the trained subjects to an environment which was at once strange and highly artificial. These infants were more amiable, interested and quiet, and were willing to work for a much longer period of time than untrained subjects. Second, they paid more immediate and selective attention to the stimulus pattern, both to the whole and to the parts. There was definite inhibition of extraneous bodily movements. Visual regard was of an anticipatory, "critical" and sustained type, and was directed to details often unnoticed by untrained subjects. Third, they showed a more direct and accurate motor approach to the units of the stimulus pattern. Having secured the block, their manipulative activities were more varied, and their visual-tactual examinations more minute. Finally, it has been repeatedly pointed out by their parents that these trained subjects developed a smoother adaptation to various "lay" situations within the home, implying a very general type of transfer.

8. The results of the present study show that, contrary to much modern emphasis, especially in educational psychology, on learning performance as a product of the

"whole" personality, form perception as such, and this type of learning performance as such, seem relatively independent of specific constitutional temperamental differences and their affective concomitants. Nor is there any evidence in our data that learning performance at the infant level is necessarily more of a primitive emotional activity than at the higher age levels (apropos of the hypothesis that the younger, i.e., more primitive, the organism, the more its behavior is dependent on the diffuse or unspecific "mass activities" of the "whole" organism, and the more preponderant the "vegetative" levels of emotional motivation). These seem, even at this very early age level, to be subsidiary concomitants and not the major determinants of learning achievement of this form-discrimination type. This implies no under-estimation of the "dynamics" of behavior, but does seem to stress that even in very young infants, they are controllable variables of a given process, rather than the process itself.

9. A comparison between the results from the Preliminary Cases and those from the Experimental Cases shows that two-day intervals are decidedly more advantageous than three- or four-day intervals for the types of learning and the age levels involved in this study (cf. for example, Tables 1 and 2 on pages 31 and 32 with Table 11 at back of dissertation). Thus the general distribution of forgetting (or, conversely, perseveration) characteristic of human adults

seems genetically confirmed.

10. Results on achievement, plotted on the basis of each day, show that plateaus are present in a number of learning curves. These plateaus may be explained on any or all of the following bases:

a. When the subject was baffled by a difficult discrimination pattern. A few noticeable examples of such patterns were the circle-oval combinations, particularly when the oval was turned ninety degrees to the right, the multiple patterns, and the first form combinations of Series V.

b. When there was a temporary loss of interest due to lowered motivation (see 11 on pages 268 and 269).

c. When perseveration or integration of what had been learned was going on (classical interpretation).

11. Compared with the various studies of form discrimination reviewed in the Introduction (see pages 1-7), it seems that the more positive findings of the present investigation were, in a large measure, due to the selection of proper motivating factors. The brightly colored blocks of appropriate manipulatory sizes, their saccharine coating, and the simplicity of bodily action correlated specifically with the sensorimotor development and involuntary action tendencies (viz., grasping, manipulation and oral behavior) of infants between six and twelve months of age. After the twelve month level, however, the motivating factors had to

be made slightly more complex in further accordance with genetic development (cf. pages 191-192).

12. "Insight" or sudden learning in the Köhler-Gottschaldt sense seemed clearly demonstrated in the learning of the first form combination of Series V by at least four of the total eighteen subjects of the Regular Experimental Group. After one or two preliminary attempts to dislodge the circle, the subject, accidentally or deliberately, turned to the previously negative form, and much to his apparent surprise, it was easily removed. This situation produced temporarily a careful examining behavior. Then suddenly he seemed to perceive that the component units of the stimulus pattern had been functionally reversed. From that moment on his facial expression relaxed; the fretful, bewildered vocalization was promptly replaced by a cheerful and contented one; and he seldom or never returned to the once highly motivated circle. This absence of stereotypy seems rather striking evidence of a far more plastic adaptive behavior in infants than the mechanistic concepts of the Conditioned Reflex School, as extinction or backward learning, permit. It is true, of course, that this behavior may be explained in more mechanistic terms. Its qualitative aspects, however, lead us to place it rather in the same category as other "Substitution" tests [Volkel (7)], the obvious substitution being, here, a reversed functional relationship. It seems likewise very significant that in the same situation,

severe rachitic and congenitally retarded infants of the same age levels never perceive this reversed function, and must go through a tedious process of backward learning, or experimental "extinction"--often longer in duration than the initial learning [Colby (66)].

13. The controversial term "abstraction" is used here in its own original or genetic sense of the separation and "lifting" of a common factor or factors from the total configuration. According to such interpretation by Werner, it is a process "quite close to primary sensory organization" (41, p. 357), in which a limited aspect or aspects of the situation are responded to at the exclusion of all others, and in which "things having equal qualities tend to come to the fore, organizing themselves into a unit" (41, p. 357). "Abstraction" is therefore used here in Munn's (5), Field's (67), and Gellermann's (3,4) sense and is what Werner calls "primitive abstraction" (41, p. 357), as opposed to the interpretation of Smith (68,69), Klüver (70), and many others.

Throughout the first three series of experiments the infants gave unequivocal evidence of their ability to respond positively to form per se, regardless of relative position, size, or the spatial orientation of the various forms. In Series IV they demonstrated conclusively that they were capable of "lifting" a single contour from a multiple pattern of three, four and even five different

geometric forms. In Series V some subjects (better learners) succeeded almost instantaneously in "abstracting" the changed functional relationship within a pattern of highly conditioned stimuli while the poorer learners tended toward the stereotypy characteristic of unconditioning, or backward learning.

SUMMARY AND CONCLUSIONS

This experiment studies geometric form discrimination as a learning cue in infants of six to fifteen months of age. It is fourfold in its purpose:

1. To determine the nature and extent of geometric form discrimination in infants;
2. To study the efficacy of such discrimination as a cue in the various phases of the learning process;
3. To analyze quantitatively, for the first time, all the dynamic, qualitative concomitants involved;
4. To trace, by continuous longitudinal experimentation, as opposed to the sampling method, the finer phases of chronological maturation as related to the foregoing processes.

The main study consisted of six series of experiments as follows:

Series I	"Forward Learning"
Series II	"Change in Spatial Orientation"
Series III	"Change in Size"
Series IV	"Change in Number"
Series V	"Backward Learning"
Series VI	"Compound block Situation"

Throughout the first five series, a simple conditioning technique was used. In the last series, since it studied

the possible effects of combining or masking the geometric forms learned in Series I - V, spontaneous selection was the method used, and the subjects included a control group of untrained infants.

The results of the experiment, which consisted of both mechanically recorded and protocol data, were analyzed on the basis of both achievement and development. From these results the following general conclusions have been drawn:

A. Perceptual Processes

1. The normal human infant is able to discriminate between simple geometric forms as early as six months of age.
2. At this age level the normal human infant is also able to use fine geometric form discrimination per se as a learning cue, establishing definite selection and avoidance habits.
3. Individual differences in discrimination processes (including "abstraction"), learning ability, and effective concomitants, are very marked and consistent at every age level and in every series.
4. Change in the relative position, spatial orientation, or size of either or both positive and negative stimuli has a very slight effect on the discrimination performance of the infant.

5. Increase in the number of blocks presented simultaneously (increase in the complexity of the total pattern) from two on to five renders the discrimination more difficult. However, this increase in number does not bear a straight-line relationship to the difficulty of the task.

6. Within a multiple pattern of three to five blocks the task of "abstracting" the positive stimulus from the total configuration is more difficult when the stimulus is adjacent to a closely similar form (similarity plus proximity) than when away from it (similarity only); also when it is in or near the center of the pattern than when it is on the ends. The task is hardest if it is placed at the center of the pattern next to a closely similar form.

7. Sudden reversal of functional relationship between positive and negative stimuli causes temporary confusion both in selecting behavior and in affective concomitant. However, such disturbance subsides very soon and, in the case of at least twenty-two per cent of the subjects, with apparent "insight."

8. The sequence or order of presentation of the geometric form patterns has a marked influence over the learning performance of the infant. Presentation in a descending order of difficulty, i.e., from most similar to most dissimilar form combinations, makes the initial learning relatively harder, but apparently prepares the subject more adequately for more difficult tasks at a later time by

training him to notice fine differences from the start. Presentation of stimuli in an ascending order of difficulty, i. e., from most dissimilar to most similar form combinations, has an opposite effect.

9. Positional cues are apparently sought by some subjects at the beginning of the experiment. However, these infants soon learn not to rely on these cues and resort to using them again only when temporarily confused, such as in the first form combination of Series V.

10. Definite signs of one total stimulus pattern inhibiting another are shown by all the subjects in the first form combination of Series V when there is an abrupt reversal of functional relationship between the two units of the stimulus pattern, and by some trained infants in the first part of Series VI when compound black, white or a negative form superimposed on a positive form, or vice versa, are exposed for the first time.

11. In the approximate order of decreasing tendency the "geographical" factors which affect the discrimination performance in the present study are: (1) number, (2) similarity, (3) sequence, (4) proximity, (5) size, (6) spatial orientation and (7) position. None of these factors, however, has a critical effect on performance.

12. Data from Series I and VI show that the young human infant tends spontaneously to select (i. e., to "prefer") the more complex angular forms as opposed to the "primitive"

circle form.

B. Learning Processes

1. Trial-and-error method is imposed by the experimental procedure in learning the first form combination in Series I, and again in the first form combination in Series V. With these exceptions, selection without trial and error is theoretically possible in all other trials. However, with one possible exception, no infant in the present study showed such complete positive transfer. The amount of trial and error in subsequent trials varied enormously with the individual infant and was inversely correlated with the presence or absence of "insight."

2. These individual differences classify the infants rather specifically into the same five general "types" of learners as occur among adults. These fluctuate little from day to day over a long experimental period of several months.

3. Plateaus occur in about one fourth of the learning curves and seem to correlate with the difficulty of the individual task and temporary fluctuations in interest and attention. The post-plateau rise of most of these curves would imply some kind of perseverative gain rather than loss in learning during the plateau period.

4. The combined results on achievement and development show that the success of an experiment of this type depends,

in a large measure, upon the careful selection of appropriate motivating factors which must appeal powerfully to the predominant drives and lie within the sensorimotor capacities of a given age level.

5. Analysis of data on the basis of development seems to show that, with the type of task provided in this study, the infant's interest and efficiency in learning increase steadily from the seventh to the eleventh or twelfth month of age. After that there is a plateau or even a definite decrease due mainly to the extremely rapid maturational rate between eleven and fifteen months. This acceleration in development causes the older infant to disdain the very simple form patterns which, in turn, necessitates some slight increase in the complexity of the stimulus situation in order to maintain the same degree of appeal to the subject throughout the entire experiment.

6. Two-day intervals are decidedly more advantageous than three- or four-day intervals for the types of learning and the age levels involved in the present study.

7. Comparison of data on Series VI between the Experimental and Control Groups shows that when presented with blocks compounded of both positive and negative forms, the trained subject behaves very much like the untrained in spontaneous selection. This may possibly indicate that the trained infant perceives this compound block situation as a totally new Gestalt. On the other hand, it may simply

mean a more complex, and therefore a more "interesting," stimulus without regard to past "conditioning." Evidence for final interpretation of this series is not yet complete.

8. The results of Series VI do, however, give clear evidence of positive transfer of training in other specific experimental "habits," viz., superior visual "regard," sustained attention, direct manual approach, short reaction time, and affective adjustment both to the stimulus patterns in particular and the total experimental situation in general.

9. Both affective concomitant and vocalization, although so widely used as objective criteria for the apparent difficulty of a given task and the subject's success in it, appear from this study to have no correlation with achievement scores.

10. Data on oral behavior seem to confirm the interpretation of "mouthing" by Stern (17) and others as a relatively universal and stereotyped tactile experience in the development of spatial qualities. Whatever be the interpretation of this form of behavior, it is a dynamic motor concomitant clearly related in early infancy to the difficulty of a given task. Enhancing this spontaneous tendency with a gustatory reward serves merely to intensify a natural motivation factor.

11. If by abstraction is meant the capacity to respond to: (a) form per se, regardless of size, orientation, position, sequence, or pattern complexity; and (b) abruptly changed functional relationship between the two highly

conditioned units of a stimulus pattern; then this experiment may be said to have demonstrated the presence of abstraction, or at least a "primitive" form of it, in human infants within the age levels studied.

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TOTAL NUMBER OF TRIALS, PERCENTAGE OF SUCCESS AND

Series	Form	CASE I					CASE I					CASE II					CASE I					CASE II					CASE I					CASE II				
		Age	Trials	Successes	Percentage	Range	Age	Trials	Successes	Percentage	Range	Age	Trials	Successes	Percentage	Range	Age	Trials	Successes	Percentage	Range	Age	Trials	Successes	Percentage	Range	Age	Trials	Successes	Percentage	Range					
I	1	45-46	35	7497	100.0	100.0	31	30	4790	100.0	100.0	27	22	5404	100.0	100.0	23	22	5404	100.0	100.0	23	22	5404	100.0	100.0	23	22	5404	100.0	100.0					
	2	46-47	80	5790	100.0	100.0	31	40	6500	100.0	100.0	27	19	7100	100.0	100.0	23	39	5640	100.0	100.0	23	39	5640	100.0	100.0	23	39	5640	100.0	100.0					
	3	47-48	25	6522	100.0	100.0	31	37	7400	100.0	100.0	27	36	5670	100.0	100.0	23	36	5670	100.0	100.0	23	36	5670	100.0	100.0	23	36	5670	100.0	100.0					
	4	48-49	46	7400	100.0	100.0	31	37	7400	100.0	100.0	27	36	5670	100.0	100.0	23	36	5670	100.0	100.0	23	36	5670	100.0	100.0	23	36	5670	100.0	100.0					
II	15	49-50	20	6500	100.0	100.0	31	30	6500	100.0	100.0	27	32	6600	100.0	100.0	23	32	6600	100.0	100.0	23	32	6600	100.0	100.0	23	32	6600	100.0	100.0					
	1M	49-50	10	100.0	100.0	100.0	31	10	100.0	100.0	100.0	27	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0					
	25	49-50	25	7400	100.0	100.0	31	11	7270	100.0	100.0	27	5	8000	100.0	100.0	23	5	8000	100.0	100.0	23	5	8000	100.0	100.0	23	5	8000	100.0	100.0					
	2M	49-50	40	4790	100.0	100.0	31	10	8000	100.0	100.0	27	13	7400	100.0	100.0	23	13	7400	100.0	100.0	23	13	7400	100.0	100.0	23	13	7400	100.0	100.0					
	35	49-50	24	6500	100.0	100.0	31	5	8000	100.0	100.0	27	12	4790	100.0	100.0	23	12	4790	100.0	100.0	23	12	4790	100.0	100.0	23	12	4790	100.0	100.0					
	3M	49-50	10	100.0	100.0	100.0	31	10	100.0	100.0	100.0	27	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0					
	45	49-50	26	7400	100.0	100.0	31	8	100.0	100.0	100.0	27	194	4400	100.0	100.0	23	194	4400	100.0	100.0	23	194	4400	100.0	100.0	23	194	4400	100.0	100.0					
	4M	49-50	22	5790	100.0	100.0	31	26	5790	100.0	100.0	27	24	7200	100.0	100.0	23	24	7200	100.0	100.0	23	24	7200	100.0	100.0	23	24	7200	100.0	100.0					
III	15	51-52	25	6600	100.0	100.0	31	30	6600	100.0	100.0	27	5	100.0	100.0	100.0	23	5	100.0	100.0	100.0	23	5	100.0	100.0	100.0	23	5	100.0	100.0	100.0					
	1M	51-52	11	7270	100.0	100.0	31	22	6600	100.0	100.0	27	10	8000	100.0	100.0	23	10	8000	100.0	100.0	23	10	8000	100.0	100.0	23	10	8000	100.0	100.0					
	25	51-52	5	8000	100.0	100.0	31	24	7400	100.0	100.0	27	15	4790	100.0	100.0	23	15	4790	100.0	100.0	23	15	4790	100.0	100.0	23	15	4790	100.0	100.0					
	2M	51-52	11	7400	100.0	100.0	31	17	7400	100.0	100.0	27	14	6600	100.0	100.0	23	14	6600	100.0	100.0	23	14	6600	100.0	100.0	23	14	6600	100.0	100.0					
	35	51-52	5	100.0	100.0	100.0	31	17	7400	100.0	100.0	27	21	7400	100.0	100.0	23	21	7400	100.0	100.0	23	21	7400	100.0	100.0	23	21	7400	100.0	100.0					
	3M	51-52	10	100.0	100.0	100.0	31	11	7270	100.0	100.0	27	10	6600	100.0	100.0	23	10	6600	100.0	100.0	23	10	6600	100.0	100.0	23	10	6600	100.0	100.0					
	45	51-52	58	6600	100.0	100.0	31	5	8000	100.0	100.0	27	56	5790	100.0	100.0	23	56	5790	100.0	100.0	23	56	5790	100.0	100.0	23	56	5790	100.0	100.0					
	4M	51-52	10	100.0	100.0	100.0	31	10	100.0	100.0	100.0	27	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0					
IV	15	53-54	5	100.0	100.0	100.0	31	17	7400	100.0	100.0	27	24	6600	100.0	100.0	23	24	6600	100.0	100.0	23	24	6600	100.0	100.0	23	24	6600	100.0	100.0					
	1M	53-54	8	100.0	100.0	100.0	31	10	100.0	100.0	100.0	27	20	8000	100.0	100.0	23	20	8000	100.0	100.0	23	20	8000	100.0	100.0	23	20	8000	100.0	100.0					
	25	53-54	5	100.0	100.0	100.0	31	10	100.0	100.0	100.0	27	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0					
	2M	53-54	5	100.0	100.0	100.0	31	10	100.0	100.0	100.0	27	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0					
	35	53-54	5	100.0	100.0	100.0	31	10	100.0	100.0	100.0	27	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0					
	3M	53-54	10	100.0	100.0	100.0	31	10	100.0	100.0	100.0	27	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0					
	45	53-54	58	6600	100.0	100.0	31	5	8000	100.0	100.0	27	56	5790	100.0	100.0	23	56	5790	100.0	100.0	23	56	5790	100.0	100.0	23	56	5790	100.0	100.0					
	4M	53-54	10	100.0	100.0	100.0	31	10	100.0	100.0	100.0	27	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0					
V	15	55-56	50	7400	100.0	100.0	31	60	4790	100.0	100.0	27	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0	23	10	100.0	100.0	100.0					
	1M	55-56	5	100.0	100.0	100.0	31	5	100.0	100.0	100.0	27	15	6600	100.0	100.0	23	15	6600	100.0	100.0	23	15	6600	100.0	100.0	23	15	6600	100.0	100.0					
	25	55-56	45	6600	100.0	100.0	31	10	100.0	100.0	100.0	27	19	5790	100.0	100.0	23	19	5790	100.0	100.0	23	19	5790	100.0	100.0	23	19	5790	100.0	100.0					
	2M	55-56	5	100.0	100.0	100.0	31	11	7270	100.0	100.0	27	5	100.0	100.0	100.0	23	5	100.0	100.0	100.0	23	5	100.0	100.0	100.0	23	5	100.0	100.0	100.0					
	35	55-56	17	7400	100.0	100.0	31	16	6600	100.0	100.0	27	14	6600	100.0	100.0	23	14	6600	100.0	100.0	23	14	6600	100.0	100.0	23	14	6600	100.0	100.0					
	3M	55-56	5	100.0	100.0	100.0	31	14	7400	100.0	100.0	27	14	7400	100.0	100.0	23	14	7400	100.0	100.0	23	14	7400	100.0	100.0	23	14	7400	100.0	100.0					
	45	55-56	10	100.0	100.0	100.0	31	27	7400	100.0	100.0	27	120	4790	100.0	100.0	23	120	4790	100.0	100.0	23	120	4790	100.0	100.0	23	120	4790	100.0	100.0					
	4M	55-56	5	100.0	100.0	100.0	31	5	100.0	100.0	100.0	27	5	100.0	100.0	100.0	23	5	100.0	100.0	100.0	23	5	100.												

EACH CASE IN REGULAR AND IRREGULAR EXPERIMENTAL

CASE RI			CASE RII			CASE RIII			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI			CASE CCI		
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