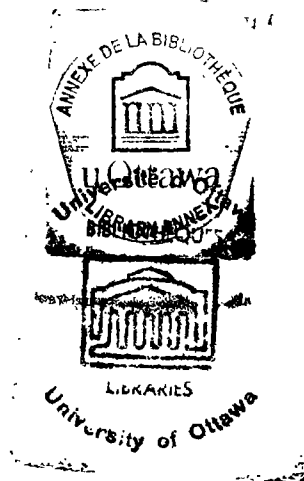


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OPERANT CONDITIONING PROCEDURES
WITH PROFOUNDLY RETARDED CHILDREN IN THE
ACQUISITION OF CONCEPTS

by James B. Pace

Thesis presented to the Faculty
of Psychology of the University
of Ottawa as partial fulfillment
of the requirements for the
degree of Doctor of Philosophy



Ottawa, Canada, 1971

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DEDICATION

This thesis is dedicated to the author's parents, Vito and Audrey Pace. Without their support and encouragement this work would not be a reality.

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CURRICULUM STUDIORUM

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INTRODUCTION

The profoundly retarded, until the last decade, have existed outside the realm of public and professional concern. Acceptance of the assumption that they were not only incurable but unmodifiable resulted in their being confined to a lifetime of custodial care, devoid of any attempt to rehabilitate or train. As they were considered to be beyond help, only their most basic, primitive needs were met.

This longstanding pessimism has been tempered by the advent of the operant approach. Operant principles have been used to accelerate the acquisition of general self-help skills including appropriate elimination habits and self-dressing and to decrease self-destructive behaviors such as head-banging.

Only a few studies, however, have attempted to modify or promote in the profoundly retarded more complex adaptive functions as concept or language development. The present study is a reaction to this state of affairs. Concept-language formation and not head-banging or toilet training is the "target behavior". Stated specifically, the purpose of this study is to investigate the applicability of the operant approach to the concept development of children with profound retardation.

The thesis is divided into four chapters. Chapter I is a literature review which begins by summarizing prominent

learning deficits characteristic of the severely-profoundly retarded and then proceeds to critically evaluate prior investigations concerned with the concept and language training of the retardate. A statement of research purpose concludes this chapter.

The second chapter presents a description of the sample population, the measuring tools, the apparatus, and the experimental procedures. This is followed by the formulation of the research hypotheses and the specification of the techniques of data analysis.

The analysis of the results is presented in the third chapter. These findings are discussed and interpreted in Chapter IV. A summary of the results and a presentation of conclusions constitute the last pages of the text.

The Appendix section contains a tabular organization of raw data, additional statistical analyses, individual learning curves, information relevant to the sample, and photographs of the operant apparatus.

CHAPTER I

REVIEW OF THE LITERATURE

1. Learning Phenomena Specific to the Mentally Retarded Child: Empirically Established Limitations.

The number of studies involving the mentally retarded population has increased dramatically since 1955. Although the results of these studies have not generated a coherent picture of the learning capacities and deficits of such children¹, they have provided the educationally-oriented clinician with a partial empirical reference from which instructional procedures can be formulated. With this in mind, the following studies were reviewed and their findings were used in the development of apparatus and procedures.

Zeaman and House^{2,3,4} have extensively studied the shape and slope of visual discrimination learning curves. These authors suggest that it is not so much in the final

1 H. Robinson and N. Robinson, The Mentally Retarded Child, New York, McGraw-Hill, 1965, p. 1-2.

2 D. Zeaman and B. House, "The Role of Attention in Retardate Discrimination Learning", Handbook of Mental Deficiency, New York, McGraw-Hill, 1963, p. 159-223.

3 -----, "A Comparison of Discrimination Learning in Normal and Mentally Defective Children", Child Development, Vol. 29, No. 2, 1958, p. 411-415.

4 -----, "Visual Discrimination Learning in Imbeciles", American Journal of Mental Deficiency, Vol. 63, No. 5, 1958, p. 447-452.

stages of learning visual discriminations as in the early stages that children of various mental ages differ from one another. The results of these studies indicate that moderately and severely retarded children tend to learn visual discriminations more slowly (i.e. require a greater number of trials-to-criterion), than do normal subjects of comparable mental ages. The reasons for this difference in performance, according to Zeaman and House, lie primarily in the initial failure to attend to the relevant cues and not in the basic incapacity to acquire the discriminative response. They further suggest that the higher the mental age, the greater the number of cues which subjects will actually observe, but that the brighter subjects will have learned to ignore cues which have a very low probability of usefulness. Accordingly, retarded subjects would be equally attracted by all observed cues. They would appear to be more distractible because they had not learned to ignore irrelevant stimulus dimensions^{5,6}. Both Zeaman and House conclude that the key to successful training with the mental retardate lies in the effective engineering of attention.

5 B. House and D. Zeaman, "Effects of Practice on the Delayed Response of Retardates", Journal of Comparative Physiological Psychology, Vol. 54, No. 1, 1961, p. 225-260.

6 Robinson and Robinson, Op. Cit., p. 329.

Conflicting results have been reported in the area of short-term memory. Some investigators (most notably Ellis⁷), have suggested that a prominent short-term memory deficit accounts for much of the retardation in the learning of the mentally handicapped. Although there are a number of studies which support this contention^{8,9,10,11,12,13,14,15}, some have

7 N.R. Ellis, "The Stimulus Trace and Behavioral Inadequacies", Handbook of Mental Deficiency, New York, McGraw-Hill, 1963, p. 134-158.

8 G.O. Johnson and K.A. Blake, "Learning Performance of Retarded and Normal Children", The Mentally Retarded Child, New York, McGraw-Hill, 1965, p. 328-329.

9 C.W. Thompson and A. Magaret, "Differential Test Responses of Normals and Mental Defectives", Journal of Abnormal Social Psychology, Vol. 42, No. 3, 1947, p. 248-293.

10 C.D. Barnet, N.R. Ellis and M.W. Pryer, "Stimulus Pretraining and the Delayed Reaction in Defectives", American Journal of Mental Deficiency, Vol. 54, No. 1, 1959, p. 104-111.

11 G.N. Cantor and J. Hottel, "Psychomotor Learning in Defectives As A Function of Verbal Pretraining", Psychological Record, Vol. 7, No. 1, 1957, p. 79-85.

12 A.R. Jensen and W.D. Rohwer, "The Effect of Verbal Mediation on the Learning and Retention of Paired Associates by Retarded Subjects", American Journal of Mental Deficiency, Vol. 68, No. 1, 1963, p. 80-84.

13 G.R. Pascal and L.M. Stolurow, "Delayed Reaction for Form and Place Contrasted", Journal of Comparative Physiological Psychology, Vol. 45, No. 2, 1952, p. 294-299.

14 G.R. Pascal, L.M. Zabarenko, and C.S. Chambers, "The Delayed Reaction in Mental Defectives", American Journal of Mental Deficiency, Vol. 56, No. 1, 1951, p. 152-160.

15 A.A. Baumeister, and C.J. Bartlett, "A Comparison of the Factor Structure of Normals and Retardates", American Journal of Mental Deficiency, Vol. 66, No. 5, 1962, p. 641-646.

not been able to demonstrate a significant difference in short-term memory between matched samples of normal and retarded subjects^{16,17,18,19}. However, varying task complexity, poor subject screening, and sample heterogeneity make it difficult to evaluate these latter studies.

Research in long-term retention in retardates generally fails to indicate a deficit^{20,21}. Contrary to the popular conjecture that retarded subjects have poor long-term memory, once a response has been acquired, they are as likely to recall it as is a normal subject provided they have an equal opportunity to utilize skills and information previously developed.

16 G.N. Cantor and T. Ryan, "Retention of Verbal Paired-Associates in Normals and Retardates", American Journal of Mental Deficiency, Vol. 66, No. 5, 1962, p. 861-865.

17 Id., Ibid..

18 W.F. Hawkins, The Effects of Stimulus Asynchrony in Compound Trial-And-Error Learning by Normals and Retardates, doctoral thesis presented to George Peabody College for Teachers, U.S.A., 1963, 97 p.

19 W. Sloan and I. Berg, "A Comparison of Two Types of Learning in Mental Defectives", American Journal of Mental Deficiency, Vol. 61, No. 4, 1957, p. 556-566.

20 G.O. Johnson and K.A. Blake, "Learning Performance of Retarded and Normal Children", The Mentally Retarded Child, New York, McGraw-Hill, 1965, p. 335.

21 B.S. Lott, "Paired Associate Learning, Generalization, and Retention As A Function of Intelligence", American Journal of Mental Deficiency, Vol. 63, No. 3, 1958, p. 481-489.

A number of studies have yielded information about the comparative discrimination-learning performance of retarded and normal subjects of equivalent Mental Age. Many of these studies have not demonstrated significant differences in discrimination learning between matched samples of retarded and normal children^{22,23,24,25,26,27,28}. However, others have found retarded subjects significantly inferior on such

22 N.R. Ellis and W. Sloan, "Oddity Learning As A Function of Mental Age", Journal of Comparative Physiological Psychology, Vol. 52, No. 1, 1959, p. 228-230.

23 N. Kass and H.W. Stevenson, "The Effect of Pre-training Reinforcement Conditions On Learning by Normal and Retarded Children", American Journal of Mental Deficiency, Vol. 66, No. 1, 1961, p. 76-80.

24 W.E. Martin and A. Blum, "Interest Generalization and Learning in Mentally Normal and Subnormal Children", Journal of Comparative Physiological Psychology, Vol. 54, No. 1, 1961, p. 28-32.

25 M. O'Connor and B. Hermelin, "Discrimination and Reversal Learning in Imbeciles", Journal of Abnormal and Social Psychology, Vol. 59, No. 3, 1959, p. 409-412.

26 M. Plenderleish, "Discrimination Learning and Discrimination Reversal Learning in Normal and Feebleminded Children", Journal of Genetic Psychology, Vol. 88, No. 1, 1956, p. 107-112.

27 H.W. Stevenson, "Learning of Complex Problems by Normal and Retarded Subjects", American Journal of Mental Deficiency, Vol. 64, No. 6, 1960, p. 1021-1026.

28 H.W. Stevenson and E.F. Zigler, "Discrimination Learning and Rigidity in Normal and Feebleminded Individuals", Journal of Personality, Vol. 25, No. 5, 1957, p. 699-711.

tasks^{29,30,31,32,33,34}.

The speed at which the discriminative response is acquired by retarded children appears to be the function of a number of training and task variables, including ability to name the essential stimuli³⁵, tutoring with a similar or equivalent discrimination problem³⁶, teaching the names of

29 F.L. Girardeau, "The Formation of Discrimination Learning Sets in Mongoloid and Normal Children", Journal of Comparative Physiological Psychology, Vol. 52, No. 4, 1959, p. 566-570.

30 B. House and D. Zeaman, "A Comparison of Discrimination Learning in Normal and Mentally Defective Children", Child Development, Vol. 29, No. 4, 1958, p. 411-415.

31 -----, "Visual Discrimination Learning in Imbeciles", American Journal of Mental Deficiency, Vol. 63, No. 2, 1958, p. 447-452.

32 R.G. Rudel, "The Absolute Response in Tests of Generalization in Normal and Retarded Children", American Journal of Psychology, Vol. 72, No. 3, 1959, p. 401-408.

33 H.W. Stevenson and I. Iscoe, "Transposition in the Feebleminded", Journal of Experimental Psychology, Vol. 49, No. 1, 1955, p. 11-15.

34 Robinson and N. Robinson, Op. Cit..

35 D. Zeaman, B. House and R. Orlando, "Use of Special Training Conditions in Visual Discrimination Learning With Imbeciles", American Journal of Mental Deficiency, Vol. 63, No. 4, 1958, p. 453-459.

36 C.D. Barnett and G.N. Cantor, "Discrimination Set in Defectives"; American Journal of Mental Deficiency, Vol. 62, No. 3, 1957, p. 334-337.

the discriminative stimuli^{37,38,39}, introducing novel stimuli into a long series of trials⁴⁰, proximity of the stimulus to the reward⁴¹ and various distinctive qualities of the stimuli themselves⁴².

Discrimination reversal in retarded and normal individuals has also received much study. Most of the research has been instigated by Kounin's⁴³ proposal that retarded individuals can more easily produce discrimination reversals than normal subjects because of the former's characteristic "response rigidity". A number of studies in this area fail

37 C.D. Barnett, N.R. Ellis and M.W. Margaret, "Stimulus Pretraining and the Delayed Reaction in Defectives", American Journal of Mental Deficiency, Vol. 64, No. 1, 1959, p. 104-111.

38 G.N. Cantor and J.V. Hottel, Op. Cit., p. 79-85.

39 D.J. Dickerson, F.L. Girardeau and J.E. Spradlin, "Verbal Pre-Training and Discrimination Learning by Retardates", American Journal of Mental Deficiency, Vol. 68, No. 3, 1964, p. 476-484.

40 D. Zeaman, B. House and R. Orlando, Op. Cit., p. 453-459.

41 -----, "The Role of Attention in Retardate Discrimination Learning", Handbook of Mental Deficiency, New York, McGraw-Hill, 1963, p. 159-223.

42 Id., Ibid..

43 J.S. Kounin, "Experimental Studies of Rigidity: II. The Explanatory Power of the Concept of Rigidity As Applied to Feeblemindedness", The Mentally Retarded Child, New York, McGraw-Hill, 1965, p. 334.

to support Kounin's hypothesis^{44,45,46}, but some substantiating evidence has been reported^{47,48}.

The experimental data in the area of paired-associate learning indicate that mental retardates are at a greater disadvantage when the learning tasks are more difficult and verbal mediators are presumably required. In rather simple, concrete paired-associate learning situations, the performance difference between normal and retarded subjects has not been significantly different^{49,50,51}. In more complex situations

44 P.L. Gardner, "The Learning of Low Grade Aments", American Journal of Mental Deficiency, Vol. 50, No. 1, 1948, p. 59-80.

45 M. Plenderleish, Op. Cit., p. 107-112.

46 H.W. Stevenson and E.F. Zigler, "Discrimination Learning and Rigidity in Normal and Feebleminded Individuals", Journal of Personality, Vol. 25, No. 5, 1957, p. 699-711.

47 M. O'Connor and B. Hermelin, Op. Cit., p. 409-412.

48 R.K. Penney, J. Croskery and G. Allen, "Effect of Training Schedules on Rigidity As Manifested by Normal and Mentally Retarded Children", Psychological Reports, Vol. 10, No. 2, 1962, p. 243-249.

49 D. Akutagwa and E.P. Benoit, "The Effect of Age and Relative Brightness on Associative Learning in Children", Child Development, Vol. 30, No. 2, 1959, p. 229-238.

50 G. Berkson and G.N. Cantor, "A Study of Mediation in Mentally Retarded and Normal School Children", Journal of Educational Psychology, Vol. 51, No. 1, 1960, p. 82-86.

51 B.S. Lott, Op. Cit., p. 481-489.

such as difficult serial learning tasks, the difference between these two groups has been clearly shown^{52,53,54}.

A number of studies have indicated that learning-set formation is slower in retarded subjects as compared to normal children of the same MA^{55,56,57}. Investigators have demonstrated that this difference between normal and retarded subjects is not only a function of neural development but also

52 N.R. Ellis, C.D. Bennett, and M.W. Pryer, "Operant Behavior in Mental Defectives: Exploratory Studies", Journal of Experimental Analysis of Behavior, Vol. 3, No. 1, 1960, p. 63-69.

53 R.S. Pryer, "Retroactive Inhibition in Normals and Defectives As A Function of Temporal Position of the Interpolated Task", American Journal of Mental Deficiency, Vol. 64, No. 7, p. 1004-1015.

54 R.S. Lipman, "Learning: Verbal, Perceptual Motor and Classical Conditioning", Handbook of Mental Deficiency, New York, McGraw-Hill, 1963, p. 391-423.

55 S.J. Wischner and J.P. O'Donnell, "Concurrent Learning Set Formation in Normal and Retarded Children", The Mentally Retarded Child, New York, McGraw-Hill, 1965, p. 336.

56 F.L. Girardeau, Op. Cit., p. 566-570.

57 N.R. Ellis, F.L. Girardeau, and M. Margaret, "Analysis of Learning Sets in Normal and Severely Defective Human Beings", The Mentally Retarded Child, New York, McGraw-Hill, 1965, p. 336.

of the latter's frequent experience of failure^{58,59}.

Retarded subjects tend to have a lower generalized expectancy for success than do normal children^{60,61,62}, and generally encounter rejection, frustration and ridicule more frequently than the latter^{63,64}. These findings are in accord with the general observation that retarded and normal children have different reinforcement histories. The nature of the difference is such as to place the retardate at a learning disadvantage under conditions such as failure, threat, stress,

58 B. House and D. Zeaman, "Transfer of A Discrimination from Objects to Patterns", Journal of Experimental Psychology, Vol. 59, No. 2, 1960, p. 298-302.

59 D. Zeaman and B. House, "Approach and Avoidance in the Discrimination Learning of Retardates", Child Development, Vol. 33, No. 3, 1962, p. 355-372.

60 H.W. Stevenson and E.F. Zigler, "Probability Learning in Children", Journal of Experimental Psychology, Vol. 56, No. 1, 1958, p. 185-192.

61 R.F. Heber, Expectancy and Expectancy Changes in Normal and Mentally Retarded Boys, doctoral thesis presented to George Peabody College for Teachers, U.S.A., 1957, 76 p.

62 W.I. Gardner, Reactions of Intellectually Normal and Retarded Boys After Experimentally Induced Failure--A Social Learning Theory Interpretation, doctoral thesis presented to George Peabody College of Teachers, U.S.A., 1958, 136 p.

63 R.C. Robinson and R. Poseward, "Behavior in Intellectual Deficit: A Critical Review of the Literature", American Journal of Mental Deficiency, Vol. 55, No. 4, 1951, p. 589-607.

64 M. Woodward, "Early Experiences and Later Social Responses of Severely Subnormal Children", British Journal of Medical Psychology, Vol. 33, No. 1, 1960, 123-132.

criticism, and others, as compared with children of normal intelligence.

A limited number of studies have considered stimulus generalization in retarded versus normal subject comparisons. The evidence gathered thus far suggests an essential equivalence between the groups on simple stimulus generalization but the retarded subjects tend to fail to utilize learned cues in generalizing their responses^{65,66}.

Although very few investigations of classical conditioning with retarded subjects have been reported, two experimentally verified contentions seem worth noting. First, mentally retarded subjects with organic damage are slower in both response acquisition and extinction⁶⁷. However, there is little if any deficit in the conditioning behavior of non-organic cultural-familial subjects when compared with normal

65 C.D. Barnett, Stimulus Generalization in Normals and Retardate On A Visual--Spatial Task Requiring A Voluntary Response, doctoral thesis presented to George Peabody College for Teachers, U.S.A., 1958, 201 p.

66 I. Bialer and R.L. Cromwell, "Task Repetition In Mental Defectives As A Function of Chronological and Mental Age", The Mentally Retarded Child, New York, McGraw-Hill, 1965, p. 323.

67 W. Fraulss and C.M. Franks, "Conditioning In Defectives and In Normals As Related to Intelligence and Mental Deficit: The Application of A Learning Theory Model To A Study of the Learning Process In The Mental Defective", The Mentally Retarded Child, New York, McGraw-Hill, 1965, p. 120-140.

subjects of equivalent CA or MA⁶⁸.

The results of operant conditioning research suggest that the general laws of learning which apply to the normal population also apply to the mentally retarded^{69,70}, but that there are some behavioral differences which are probably related to mental retardation. For instance, extinction appears to take a longer time in severely retarded subjects⁷¹, and to be less closely related to the schedule of reinforcement under which the response was acquired⁷². Furthermore, unaccounted for variability from session to session may be more extreme than in normal subjects⁷³. It may also be more

68 R.L. Cromwell, B.E. Pal, and J.G. Foshee, "Studies in Activity Level: V. The Relationships Among Eyelid Conditioning, Intelligence, Activity Level, and Age", American Journal of Mental Deficiency, Vol. 65, No. 7, 1961, p. 744-748.

69 N.R. Ellis, C.D. Barnett, and M.W. Pryer, "Operant Behavior in Mental Defectives: Exploratory Studies", Journal of Experimental Analysis of Behavior, Vol. 3, No. 1, 1960, p. 63-69.

70 R. Orlando and S.W. Bijou, "Single and Multiple Schedules of Reinforcement in Developmentally Retarded Children", Journal of Experimental Analysis of Behavior, Vol. 3, No. 4, 1960, p. 339-348.

71 N.R. Ellis, "Amount of Reward and Operant Behavior in Mental Defectives", American Journal of Mental Deficiency, Vol. 66, No. 6, 1959, p. 595-599.

72 J. Spradlin, "Effects of Reinforcement Schedules on Extinction Severely Mentally Retarded Children", American Journal of Mental Deficiency, Vol. 66, No. 7, 1962, p. 634-640.

73 B.H. Barrett and O.R. Lindsley, "Deficits in Acquisition of Operant Discrimination and Differentiation Shown by Institutionalized Retarded Children", American Journal of Mental Deficiency, Vol. 67, No. 5, 1962, p. 424-436.

difficult to establish secondary reinforcers with severely retarded subjects than it is with those with moderate retardation⁷⁴.

Studies concerned with schedules of reinforcement have found that complex multiple schedules tended to control the retardate's discriminative response more consistently than did simple schedules^{75,76,77,78}. Also, in accord with past operant research, the efficacy of intermittent reinforcement over a continuous schedule has been consistently demonstrated^{79,80}.

Research concerned with the suitability of different types of positive reinforcement has generally demonstrated the

74 F.L. Girardeau, "The Effect of Secondary Reinforcement on the Operant Behavior of Mental Defectives", American Journal of Mental Deficiency, Vol. 67, No. 5, 1962, p. 441-449.

75 R. Orlando and S.W. Bijou, Op. Cit., p. 339.

76 S. Bijou and R. Orlando, "Rapid Development of Multiple Schedule Performances With Retarded Children", Journal of Experimental Analysis of Behavior, Vol. 4, No. 1, 1961, p. 6-16.

77 N. Ellis, C. Barnett, and M. Pryer, "Operant Behavior in Mental Defectives: Exploratory Studies", Journal of Experimental Analysis of Behavior, Vol. 3, No. 1, 1960, p. 63-69.

78 M.E. Cupp, Effectiveness On Certain Reinforcement Schedules On The Discrimination Learning of Moderate and Mild Mental Retardates, doctoral thesis presented to Ohio State University, U.S.A., 1968, 96 p.

79 Robinson and N. Robinson, Op. Cit., p. 332.

80 J.E. Spradlin, F. Girardeau, and E. Corte, "Fixed Ratio and Fixed Interval Behavior of Severely and Profoundly Retarded Subjects", Journal of Experimental Child Psychology, Vol. 2, No. 3, 1965, p. 340-353.

effectiveness of both nutritive and social reinforcement for the mental retardate^{81,82,83,84,85}. Three studies, however, have reported finding no "best" reward condition^{86,87,88}.

Investigators concerned with the application of negative reinforcement have generally found primary aversive stimulation to be effective in the deceleration of a wide range

81 M.P. Andronico, The Effects of Different Reinforcing Cues Upon the Free Operant Response Rates of Mental Retardates and Normal Children of Equated CA or MA, doctoral thesis presented to Ohio State University, U.S.A., 1964, 153 p.

82 R.E. Pace, The Effects of Tangible Reinforcement on the Efficiency in Which E.M.R. Pupils Memorize Selected Multiplication Facts, doctoral thesis presented to Brigham Young University, U.S.A., 1967, 96 p.

83 B.G. Waldron, A Study of Verbal and Material Reinforcers and Their Effect On Socially Deprived and Socially Satiated Mental Defectives, doctoral thesis presented to Columbia University, U.S.A., 1966, 258 p.

84 L.M. Newman, The Effects of Reinforcement Variations On Concept Formation In Retarded Boys, doctoral thesis presented To Western Reserve University, U.S.A., 1965, 110 p.

85 R.M. Gray and J.M. Kasteler, "The Effects of Social Reinforcement and Training On Institutionalized Mentally Retarded Children", American Journal of Mental Deficiency, Vol. 74, No. 1, 1969, p. 50-56.

86 G.M. White, The Effect of Type of Reward On Learning By Educable Mentally Retarded Pupils, doctoral thesis presented to Ohio State University, U.S.A., 1968, 170 p.

87 D.D. Sage, Reinforcing Effects of Differential Contingencies On Verbal Learning in Educable Mentally Retarded Children, doctoral thesis presented to Stanford University, U.S.A., 1966, 150 p.

88 B. Sulzer, Match To Sample Performance By Normals and Institutionalized Retardates Under Different Reinforcing Conditions, doctoral thesis presented to Western Reserve University, U.S.A., 1966, 350 p.

of inappropriate behaviors^{89,90,91,92}. It tends to be most effective in rapid and total elimination of single specific behavior which occurs with little variation in frequency or type and which seldom involves direct interaction with others⁹³. Under these conditions, punishment has long-lasting effects^{94,95}, and when "applied appropriately", does not

89 R.O. Blackwood, Operant Conditioning As A Method of Training the Mentally Retarded, doctoral thesis presented to Ohio State University, U.S.A., 1962, 110 p.

90 K. Henriksen and R.D. Daughy, "Decelerating Undesirable Mealtime Behavior In A Group of Profoundly Retarded Boys", American Journal of Mental Deficiency, Vol. 72, No. 1, 1967, p. 40-44.

91 T. Risley, "The Effects and Side Effects of Punishing the Autistic Behaviors of A Deviant Child", Journal of Applied Behavior Analysis, Vol. 1, No. 1, 1968, p. 21-34.

92 L.R. Whitney and K.E. Barnard, "Implications of Operant Learning Theory for Nursing Care of the Retarded Child", Mental Retardation, Vol. 4, No. 1, 1966, p. 26-29.

93 J. Hamilton and L. Stephens, "Reinstating Speech In An Emotionally Disturbed Mentally Retarded Young Woman", in W.I. Gardner, "Use of Punishment Procedures With the Severely Retarded: A Review", American Journal of Mental Deficiency, Vol. 74, No. 1, 1969, p. 86-103.

94 J.B. Appel, "Punishment and Shock Intensity", Science, Vol. 141, No. 4, 1963, p. 528-529.

95 E.G. Karsh, "Changes In Intensity of Punishment: Effect On Runaway Behavior of Rats", Science, Vol. 140, No. 8, 1963, p. 1084-1085.

precipitate harmful side effects of social disruption^{96,97,98}.

Finally, the effectiveness of fading procedures and 'errorless learning' for the retarded has been demonstrated^{99,100,101,102,103,104}.

In summary, the following conclusions seem to apply to the mentally retarded:

96 T. Risley, Op. Cit..

97 H. Hamilton, L. Stephens and P. Allen, "Controlling Aggressive and Destructive Behavior in Severely Retarded Institutionalized Residents", American Journal of Mental Deficiency, Vol. 71, No. 4, 1967, p. 852-856.

98 L.R. Whitney and K.E. Barnard, Op. Cit..

99 M. Sidman and L. Stoddard, "The Effectiveness of Fading in Programming A Simultaneous Form Discrimination For Retarded Children", Journal of Experimental Analysis of Behavior, Vol. 10, No. 1, 1967, p. 3-5.

100 -----, "Programming Perception and Learning For Retarded Children", in N.R. Ellis, International Review of Research in Mental Retardation, Academic Press, New York, 1968, p. 141-155.

101 R. Moore and I. Goldiamond, "Errorless Establishment of A Visual Discrimination Using Fading Procedures", Journal of Experimental Analysis of Behavior, Vol. 7, No. 3, 1964, p. 269-272.

102 J.P. Kennedy, "The Effects of Graduated Stimulus Change On The Acquisition of A Simple Discrimination In Severely Retarded Boys", Journal of Experimental Analysis of Behavior, Vol. 11, No. 1, 1968, p. 39-48.

103 R.S. Terrace, "Discrimination Learning With And Without Errors", Journal of Experimental Analysis of Behavior, Vol. 6, No. 1, 1963, p. 1-27.

104 -----, "Errorless Transfer Of A Discrimination Across Two Continua", Journal of Experimental Analysis of Behavior, Vol. 6, No. 2, 1963, p. 223-232.

A) Although they are apparently handicapped in terms of short-term memory, there is no deficiency in long-term memory storage;

B) Mildly retarded children do not show a deficit in acquiring a simple discrimination but brain-damaged retarded children and those with mental ages below about five years do show the deficit;

C) There is an essential equivalence between mentally retarded and normal groups on simple stimulus generalization, but normal subjects tend increasingly to utilize learned cues in generalizing their responses;

D) As the learning task becomes more difficult in the paired-associate learning situation, retardates are increasingly at a disadvantage;

E) Mentally retarded children have a lower generalized expectancy of success when compared with normal subjects;

F) Retarded subjects generally do not differ from normals in terms of classical conditioning. Operant conditioning studies suggest that the learning behavior of the mentally retarded follows the same general laws which apply to other human and subhuman subjects;

G) Learning-set formation is slower in retarded children as compared with normal subjects of equal MA; and

H) Marked deficits in attention characterize the retarded population.

2. The Use Of Operant Conditioning Procedures In The Language Training Of Mentally Retarded Children: A Review Of The Literature.

Deficits in the development and usage of language skills characterize the retarded, with the degree and scope of language dysfunction increasing with descending mental age. This is the general finding of incidence statistics which report an inverse relationship between language handicap and intelligence¹⁰⁵. These studies indicate about 100% of the low-grade defectives IQs below 20, about 90% of the retardates in the IQ range between 21 and 50, and around 45% in the mildly retarded group are impaired in general language acquisition^{106,107,108,109,110}.

105 This is partly to be expected because tests used to assess intelligence and to define classifications of retardation tend to be dependent on language.

106 G. Gens, "Speech Retardation in the Normal and Subnormal Child", Training School Bulletin, Vol. 47, No. 1, 1950, p. 32-36.

107 J.E. Spradlin, "Language and Communication of Mental Defectives", N.R. Ellis, International Handbook of Mental Retardation, New York, McGraw-Hill, 1963, p. 241-257.

108 S.M. Goertzen, "Speech and the Mentally Retarded Child", American Journal of Mental Deficiency, Vol. 62, No. 3, 1957, p. 244-253.

109 B.B. Schlanger and R.H. Gottsleben, "Analysis of Speech Defects Among the Institutionalized Mentally Retarded", Journal of Speech and Hearing Diseases, Vol. 22, No. 1, 1957, p. 98-103.

110 M. Strazzulla, "A Language Guide for Parents of Retarded Children", American Journal of Mental Deficiency, Vol. 59, No. 1, 1954, p. 48-58.

Although impaired language development is prominent among the retarded population, only a few researchers have implemented language or concept training programs¹¹¹. Early pilot studies utilizing "traditional", group-applied teaching procedures failed to demonstrate the educability of the severely-profoundly retarded^{112,113,114,115,116,117,118}.

111 W.H. Blount, "Language and the More Severely Retarded: A Review", American Journal of Mental Deficiency, Vol. 73, No. 1, 1968, p. 21-29.

112 M.C. Reynolds and J.R. Kiland, A Study of Public School Children With Severe Mental Retardation, Saint Paul: State Department of Education, Research Project No. 8, U.S.A., 1953, p. 1-25.

113 H. Goldstein, "Report Number Two On Study Projects For Trainable Mentally Handicapped Children", H. Stevens and R. Heber, Mental Retardation--A Review of Research, Chicago: University of Chicago Press, 1964, p. 220-225.

114 R.J. Guenther, Final Report of the Michigan Demonstration Research Project For The Severely Retarded, Lansing, Michigan, U.S.A., Department of Public Instruction, 1960, p. 1-43.

115 G.D. Johnson and R.J. Capobianco, Research Project On Severely Retarded Children, Albany, New York: Interdepartmental Health Resources Board, U.S.A., 1957, p. 1-17.

116 J.R. Peck, A Comparative Investigation of the Learning and Social Adjustment of Trainable Children in Public School Facilities, Segregated Community Centers, and State Residential Centers, 1960, U.S. Office of Education Cooperative Research Program, Projects No. SAE 6430, p. 1-50.

117 L.F. Cain and S. Levine, Effects of Community and Institution School Programs On Trainable Mentally Retarded Children, EC Research Monographs, Series B, No. B-1, Washington, D.C., U.S.A., 1963, p. 56.

118 J. Hottel, An Evaluation of Tennessee's Day Class Program For Severely Mentally Retarded Trainable Children, Nashville, Tennessee: State Department of Education, U.S.A., 1958, p. 1-16.

The general conclusion reached by these and other studies^{119,120}, has been that retardates with Mental Ages below two and IQs below 25, apparently do not profit from special language instruction.

Relatively recently, however, a series of studies using operant principles demonstrated that low-functioning psychotic (and supposedly 'non-retarded') children can benefit from language training^{121,122,123}.

The first attempt to use a learning theory approach with retarded children in the acquisition of language was reported by Kolstoe¹²⁴. From an institutional population of 260 mongoloids, he selected a sample of 30 children ranging in

119 O.P. Kolstoe, "Language Training of Low-Grade Mongoloid Children", American Journal of Mental Deficiency, Vol. 63, No. 1, 1959, p. 17-30.

120 H. Goldstein, "Lower Limits of Eligibility For Classes For Trainable Children", Exceptional Children, Vol. 22, No. 6, 1956, p. 226-227.

121 N. Kerr, L. Meyerson, and J. Michael, "A Procedure For Shaping Vocalizations In A Mute Child", Case Studies In Behavior Modification, New York, Holt, Rinehart and Winston, 1965, p. 310-313.

122 T. Risley and M. Wolf, "Establishing Functional Speech in Echolalic Children", Operant Procedures In Remedial Speech and Language Training, Boston, Houghton Mifflin, 1968, p. 157-184.

123 O.I. Lovaas, J.P. Bererich, B.F. Perloff, and B. Schaeffer, "Acquisition of Imitative Speech by Schizophrenic Children", Science, Vol. 151, No. 7, 1966, p. 705-707.

124 O.P. Kolstoe, Op. Cit..

age from five-and-one-half to 14 years, and in IQs from 18 to 36. No details concerning stage of speech development (or degree of retardation) were presented. The 30 children were separated into Experimental and Control groups, with subjects from both groups being matched only in terms of MA (disregarding CA as well as the pre-experimental results on the various language measures). Although the specific instructional procedures were not explicitly defined (and in fact, varied to "suit the needs of the individual"), the general experimental sequence involved the securing of attention, introduction of a symbol, repetition and use of the symbol on the part of the child and, finally, praise contingent with correct responding. Approximately 90 hours of instruction were accorded to the Experimental group. The Control group received no training. Generally, the results of the Kolstoe study were positive. Although post-experimental Kulman IQ rating dropped for both groups, the Experimental group demonstrated significant gains over its counterpart in general language skills.

The validity of the above findings is questionable in view of a number of defects in the experimental design. These include the generality of pre- and posttest measures, insufficient matching of the Experimental and Control groups, and non-equivalent pre- and posttest administrations.

Denny¹²⁵, in a theoretical discussion, outlined the operant procedures thought to be basic to an effective concept training program with the retardate. These include the use of "crutch cues" (i.e. prompting, fading, match-to-sample), differential feedback via positive and negative reinforcement, stimulus generalization, stimulus randomization, distributed repetition and, sequential building by successive approximations. Although no actual data were provided, Denny reported using these principles (in conjunction with the Multiple Differential Response and Feedback Apparatus) to teach moderately retarded subjects such concepts as "up", "down", "push"; "pull", "right-left", "color", "behind", and "through".

Sloane, et al.¹²⁶, developed the verbal behavior of five retarded children with IQs ranging from 30 to 60. A ten stage imitative sequence which proceeded from simple non-verbal motor imitation to the development of specific speech sounds, object tacting, and, finally, word chains, was coupled with fading techniques and contingent positive and negative reinforcement. Although the authors cited positive results,

125 M.R. Denny, "A Theoretical Analysis", International Review of Mental Retardation, New York, Academic Press, Vol. 2, 1966, p. 3-25.

126 H.N. Sloane, M.K. Johnson, and F.R. Harris, "Remedial Procedures for Teaching Verbal Behavior to Speech Deficient or Defective Young Children", Operant Procedures in Remedial Speech and Language Training, Boston, Houghton Mifflin Company, 1960, p. 115-132.

insufficient pre-post experimental testing and the absence of control measures, make it difficult to determine the extent to which these subjects actually benefited from language training.

In a pilot study utilizing explicit reinforcement contingencies, programming, and color-coding, MacAulay¹²⁷ taught speech to eleven non-verbal, mentally retarded children, ranging in IQs from 26 to 89. The program consisted of teaching individual sounds, blending sounds into words, teaching a naming vocabulary and, in some cases, teaching word phrases. Black alphabet letters were used as visual cues for specific consonant sounds, while vowel sounds were color-coded. A token economy plus social reward was used for reinforcement purposes. Although there were no formal baseline data or control procedures, the findings were positive and MacAulay concluded that the "rate of sound acquisition seemed to be rapid using operant conditioning principles".

Using a match-to-sample apparatus, Bijou¹²⁸ attempted to develop right-left discrimination (concepts) in both normal primary school children and in mildly retarded subjects.

127 B.D. MacAulay, "A Program for Teaching Speech and Beginning Reading To Non-Verbal Retardates", Operant Procedures In Remedial Speech and Language Training, Boston, Houghton Mifflin Company, 1968, p. 102-124.

128 S. Bijou, "Studies in the Experimental Development of Left-Right Concepts in Retarded Children Using Fading Techniques", International Review of Research in Mental Retardation, New York, Academic Press, Vol. 3, 1968, p. 65-99.

The experiment consisted of training in form discrimination, mirror-image discrimination, and rotated mirror-image discrimination presented as five-choice, match-to-sample problems. Fading, positive and negative reinforcement, and correctional techniques were used in the instructional program. Analysis of error frequencies and differences between pre- and posttest performance suggested that the program was reasonably effective for both the normal and retarded child, although the latter was more prone to make repetitive errors. A positive relationship between progress in the program and Mental Age was demonstrated for the retarded subjects with those with MAs above eight showing the greatest gains.

Combining modeling and reinforcement procedures, Brown, et al.¹²⁹, taught rudimentary sight vocabulary to trainable level mental retardates. The specific instructional materials consisted of the 57 words from the Sullivan Programmed Reading Book, printed on 4" by 6" colored index cards. The results indicated that all subjects learned to orally identify the 57 stimulus words. Comprehension of word meanings and transfer of learning to novel situations were likewise observed but objective tests of these two functions were not employed.

129 L. Brown, H. Hermanson, P. Haubrich, and J.P. Ora, "Using Behavior Modification Principles To Teach Sight Vocabulary", Teaching Exceptional Children, Vol. 2, No. 3, 1970, p. 120-128.

The Matrix Language Program (MLP) was used by Talkington and Hall¹³⁰ with 40 adult, moderately retarded, mongoloids. With an Experimental-Control group design matched in terms of CA and MA, the authors demonstrated a general difference in language and concept usage between those subjects who received MLP training (Experimental group) versus the non-trained (Control group). Yet, in light of their failure to match the two groups on significant variables such as pretest results, language-specific psychometric data, and years of institutionalization these results should be viewed with caution. Also, the failure to administer tests of retention, generalization, and transfer limits the generality of their findings.

Ross¹³¹ reported a nine-month game program for 20 educable children (Experimental group), in which general game skills and basic number concepts were taught. The experimental treatment consisted of small group games requiring the manipulation of numbers in conjunction with the systematic use of excitement techniques, modeling procedures, and a token reward economy. A Control group, matched in terms of CA, MA, IQ, and

130 L.W. Talkington and S.M. Hall, "Matrix Language Program With Mongoloids", American Journal of Mental Deficiency, Vol. 75, No. 1, 1970, p. 88-91.

131 D. Ross, "Incidental Learning of Number Concepts in Small Group Games", American Journal of Mental Deficiency, Vol. 75, No. 6, 1970, p. 718-725.

the results of the General Games Skills and Number Knowledge Tests, spent equal time in a "traditional" special-class program covering the same number concepts. The findings demonstrated that the Experimental group improved more than the Control group in knowledge of basic number concepts and in general game skills.

The Wisconsin General Test Apparatus was used by Bricker and Bricker¹³² in the development of word control over object choice with institutionalized, severely retarded children. A two-choice discrimination paradigm was used in which object name indicated the reinforced response. The experimental design consisted of four groups: a "random" training group in which the stimulus object was not presented as the named choice on two consecutive trials, a "sequential" training group in which the same stimulus object was presented consecutively until a criterion of five successive correct responses, a "Hawthorne effect" Control group, and a "do nothing" Control group. Candy, praise, and tokens were used as reinforcing conditions.

The results of the Brickers' study revealed training effects in favor of the operant approach for those subjects identified on the pretest as "learners", but none of the

132 W.A. Bricker and D.D. Bricker, "Development of Receptive Vocabulary in Severely Retarded Children", American Journal of Mental Deficiency, Vol. 75, No. 6, 1970, p. 599-607.

approaches was able to improve the performance of those identified as "nonlearners"¹³³.

Guess, et al.¹³⁴, used operant conditioning procedures to establish a generative use of the plural morpheme in the speech of a severely retarded girl. During training trials, reinforcement was presented contingent with correct imitation of singular and plural vocalizations by the experimenter, in response to objects presented to the subject singly and in pairs. A generative productive plural usage resulted as the subject correctly labeled new objects in the singular or plural without further direct training relevant to those objects.

In a related study, Wheeler and Sulzer¹³⁵ used a combination of chaining, imitative prompting, and differential reinforcement to develop syntax (including the correct use of articles, appropriate verb endings, and word order), in an eight-year-old boy described as "brain damaged", "autistic", and "retarded". Prior to operant training, the subject

133 The Brickers' study can be criticized on several counts, including extreme sample heterogeneity and disregard for Experimental-Control group matching.

134 D. Guess, et al., "An Experimental Analysis of Linguistic Development: The Productive Use of the Plural Morpheme", Journal of Applied Behavior Analysis, Vol. 1, No. 4, 1968, p. 297-306.

135 A.J. Wheeler and B. Sulzer, "Operant Training and Generalization of A Verbal Response Form In A Speech Deficient Child", Journal of Applied Behavior Analysis, Vol. 3, No. 2, 1970, p. 139-147.

spoke in "telegraphic" English - leaving out most of the necessary articles and auxiliary verbs. During the experimental sessions he was trained to use a particular sentence form that included the articles and verbs to describe a set of standardized pictures. The authors reported that the subject quickly acquired the desired sentence form and that he used it effectively in his response to the training stimuli as well as to sets of novel stimuli.

Although the above two studies could be criticized in terms of a sample N of one and the absence of appropriate subject data (e.g., IQ, MA, and/or SQ ratings), they suggest that complex verbal behaviors can be produced in speech-deficient, retarded children.

Buddenhagen¹³⁶, in an unpublished doctoral thesis, attempted to produce "vocal verbal responses" in four profoundly retarded, non-talking mongoloid adults. Although the specific instructional procedure varied from subject to subject, the general training sequence was similar to the one reported by Lovaas¹³⁷. This training consisted of the reinforcement of random vocalizations followed by the shaping

136 R.G. Buddenhagen, Operant Conditioning As a Technique For Establishing Vocal Verbal Behavior In Non-Talking, Institutionalized Mongoloid Children, doctoral thesis presented to the University of Rochester, U.S.A., 1967, 94 p.

137 O.I. Lovaas, J.P. Berberich, B.F. Perloff, and B. Schaeffer, "Acquisition of Imitative Speech by Schizophrenic Children", Science, Vol. 151, No. 7, 1959, p. 705-707.

of eye contact and the establishment of basic motor imitation. Finally, the imitation of the instructor's acoustico-visual models was developed using contingent rewards (praise and candy). Negative reinforcement via "time out" periods served as an aversive consequence for inappropriate behaviors (i.e. temper tantrums, "acting silly", and others). Total training time required per subject averaged 27 hours.

Although two of the four Subjects in the Buddenhagen study learned such mands as "I wanna coke" and "I wanna book", as well as several tacts including "a mamma" and "a daddy", the results are difficult to interpret because of the absence of pre-post treatment testing. Consequently, there were no baseline data and no tests of learning, generalization, and transfer. The only measure of subject improvement was the experimenter's subjective appraisal. Also, the small number of Subjects, the absence of control measures, and individualized training programs restricted the extent to which the results could be generalized.

3. Research Purpose.

Most of the above studies were characterized by prominent defects in design including insufficient pre- and posttests, extremely small sample size, and the absence of control measures. Moreover, with the exception of the Buddenhagen study, language training programs for the

profoundly retarded have not been implemented. The low-grade retardate has been considered to be beyond help -- suitable only for constant custodial care.

The present research was a reaction to this state of affairs. As such, it was a controlled investigation designed to study the applicability of a learning theory approach to the concept training of children with profound retardation. More specifically, this research attempted to determine if profoundly mentally retarded children (Binet IQ, below 20; MA, three years and below), could acquire concepts (e.g. CAR, SPOON, SQUARE, CIRCLE), through the use of a specific operant apparatus and procedure¹³⁸.

138 This research was predicated on the assumption that one cannot infer that an organism is incapable of a given behavior merely because it has failed to emit that response. The necessary environmental-instructional conditions for modifying the behavior may as yet lie undiscovered.

CHAPTER II

METHODOLOGY

This chapter will present procedures employed to determine the efficacy of the operant approach for the concept training of children with profound retardation. It will begin by operationally defining terms germane to this study. This will be followed by a description of the sample, the measuring tools, and the apparatus. The final segments will include an outline of the experimental procedures, formulation of the research hypotheses, and specification of the techniques of data analysis.

1. Operational Definitions.

A:- Concept Acquisition:- an increase in the Subject's appropriate oral or pointing response to a given stimulus class. (N.B.: An appropriate response is here defined as that employed by the Experimenter for imitation during the first instructional set. Refer to p. 46).

In this study, the terms concept acquisition, concept formation, and learning are used interchangeably.

B:- Retention:- the score a Subject receives on post-test II. (N.B.: It is assumed here that the second posttest measures the degree to which the trained behaviors are being maintained over time).

C:- Profoundly Mentally Retarded:- Subject whose S-B IQ rating is 20 or below.

2. Materials and Instruments.

The test condition assessed the Subject's ability to identify the concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE. Both the Subject's 'expressive' and 'receptive' functioning were measured (Refer to p. 40).

Test materials consisted of 10 different pictures for each concept (i.e. 10 man items, 10 spoons, 10 squares, and others). These pictures consisted of drawings and magazine cutouts presented on 3" x 5" white, unlined index cards. Geometric figures differed from each other in terms of size, color, and method of presentation (i.e. whether drawn or pasted). The remaining concepts varied in accord with these dimensions and in terms of general figure complexity and 'closeness to reality'.

3. Apparatus.

A semi-automatic conditioning apparatus was used in this study. It consisted of a rectangular shaped wooden desk equipped with the following features:-

- A) Reinforcement dispenser;
- B) Two-toned set of chimes;
- C) Electric shock device;

- D) Remote control projector and opaque 8" x 10" glass screen;
- E) Control box;and.
- F) Various instructional stimulus materials.

The reinforcement dispenser was constructed out of $\frac{1}{4}$ " clear plexiglass, and powered by a solenoid (intermittent type) and recoil spring. Candy was released from the mechanism by the instructor via the control box button designated 'Reinforcement'. It was then fed to a cylindrical connecting tube which transported the candy to a readily accessible container located against the inside left wall of the conditioning desk. Total time required for this process was $\frac{1}{4}$ second.

Chimes (auditory reinforcer), attached to the underside of the manipulanda, were rung by the 'Reinforcement' button controlled by the Experimenter. (The chimes and nutritive reinforcer occurred simultaneously).

The control box was attached to the undercarriage of the apparatus. It consisted of a power (off-on) switch, individual buttons which delivered an established amount of positive reinforcement (chimes and candy) and/or aversive stimulation (shock), and a dial calibrated in milliamps used to regulate shock intensity. A $4\frac{1}{2}$ ' electrode-tipped cord extended from the control center and was used to deliver the

aversive stimulation¹ (Refer to p. 47).

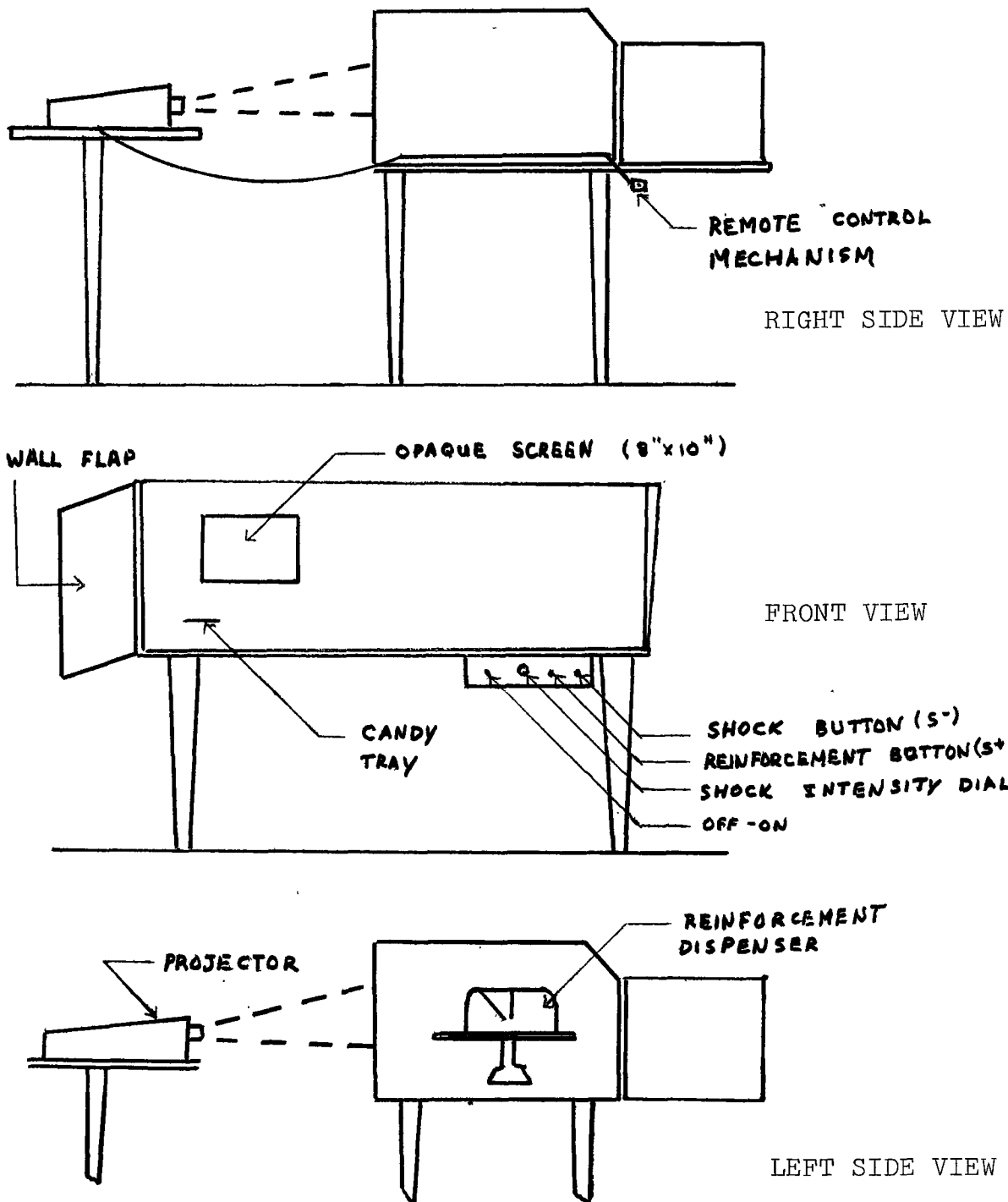
Located on the left-front wall of the conditioning desk was an opaque glass screen. Three feet behind the screen was a remote control Kodak Carousel 800 Projector. The remote control mechanism was located to the right of the control box where it was conveniently accessible to the instructor.

In order to minimize the effects of extraneous stimuli, two flaps were constructed to extend 16" out from the side walls of the apparatus. Two horizontal extensions from the base of the desk served to restrict the Subject's general maneuverability², to prevent the removal of the shock-delivering electrodes, and to reduce observation of the Experimenter's use of the control box.

(A diagram of the conditioning desk is found on the following page and photographs are contained in Appendix 5).

1 Redux electrode paste and standard electrical tape were used to reduce contact impedance and to prevent burning. The use of rubber placement mats and grounded wall plugs were additional precautionary measures.

2 Although the Subject's body movements were largely restricted, his hands and arms were free to manipulate the different stimulus materials as well as to retrieve the tangible reinforcements.



Front and Side Views of the Operant Apparatus

Figure 1

The stimulus objects for the concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE, varied in terms of five dimensions: size, color, material, general complexity, and the extent to which the stimulus properties of the presented objects represented the actual objects in the environment. The stimulus items totaled 60 in number (i.e. 10 car items, 10 spoons, and others), and were administered in accord with the fading principle. (The fading schema, the sequence and medium of presentation for the individual stimulus objects are summarized in Table I). The different concrete stimulus materials were manually presented to the Subject by the Experimenter.


















































4. Sample.

Thirty male profoundly retarded Subjects³ were selected to serve as the sample population. Three from the Experimental group and one Control Subject were hospitalized during part of the 15 day training period and were consequently eliminated from the study. The transfer of one Control Subject to a new institution and the complete inability of another to respond to the training task, resulted in equal groups of 12 Subjects.

Subject selection was based on the following criteria:

³ All Subjects were from the Rideau Regional Hospital School, located within Smith Fall's, Ontario.

Table I.- Fading Schema For Instructional Stimuli:
Sequence, Medium of Presentation, and Number of Objects in
Each Category.

Concept	Sequence(→) : Medium of Presentation						
	Three Dimensional Objects			Two Dimensional Objects			
	Wood	Steel	Rubber	Plastic & Cloth	Picture Pasted	Picture Drawn	Projected on Screen
CAR							
SPOON		 			 	  	  
MAN							
TRIANGLE	 			 	 	  	
SQUARE	 			 	  	  	
CIRCLE	 			 	  	  	

- A) Chronological Age between 7 and 12 years;
- B) Mental Age between one month and 3 years as measured by the Stanford-Binet Intelligence Scale (S-BIS)⁴;
- C) I.Q. ratings below 20 on the S-B;

(N.B.: Table II presents the Chronological Ages, Mental Ages, Intelligence Quotients, and months of institutionalization for the Experimental and Control groups).

- D) A speaking vocabulary of at least four words, as indicated by the observations of two ward attendants;
- E) Absence of impaired upper limb coordination and inability to respond appropriately to the training situation; and
- F) Ability to cooperate with the instructor and perform the primary responses required for this study. This was determined by the Experimenter's judgment after a preliminary five minute contact with each Subject.

The Experimental and Control groups were matched in terms of C.A., I.Q., M.A., period of institutionalization, and performance on the Stanford-Binet 'Picture Vocabulary Test'.

⁴ The S-B was administered to the Subjects by two psychologists, one of whom was the author. The consequent M.A. and I.Q. ratings were of recent date.

Table II.- Months of Institutionalization, Chronological Ages, Mental Ages, and IQ Ratings for Experimental and Control Groups.

Experimental Group					Control Group				
Subject	Months of Instit.	CA	MA	IQ	Subject	Months of Instit.	CA	MA	IQ
Henry	105	12	2mos. below 20		Jack	100	12	4mos. below 20	
Louis	110	12	5mos. below 20		Joe	100	12	2yrs. below 8mos. 20	
Larry	70	12	2mos. below 20		Roy	80	12	2mos. below 20	
Dave	95	11	10mos. below 20		John	95	11	3mos. below 20	
Art	95	11	3mos. below 20		Jim	100	11	1mon. below 20	
Bill	74	11	2yrs. below 9mos. 20		Tony	70	11	1mon. below 20	
Sam	85	10	8mos. below 20		Jerry	85	10	8mos. below 20	
Brian	80	10	1mon. below 20		Russ	65	10	3mos. below 20	
Paul	95	10	11mos. below 20		Dan	105	10	3mos. below 20	
Bob	90	9	6mos. below 20		Fred	95	9	3mos. below 20	
Ken	80	8	2yrs. below 2mos. 20		Doug	75	8	2yrs. below 6mos. 20	
Tony	60	7	2mos. below 20		George	70	8	4mos. below 20	

The extent to which the two groups are equivalent on the latter three variables is summarized in Tables III, IV, and V.

Both groups were further matched in accord with their 'expressive' and 'receptive' pretest performances (Refer to Tables VI, VII).

The etiological classifications for the 24 Subjects, obtained from medical records, consisted of four categories: (1) Down's Syndrome, (2) Encephalopathy, (3) Phenylketonuria, and (4) "Congenital Cerebral Defect" (Cf. Table VIII). All but six of the Subjects had a history of epileptic seizures and most (18Ss) were on seizure depressing and/or tranquilizing drugs (Refer to Appendix 1, Tables XIX and XX). No medication was given immediately before or during a concept training session.

5. Procedure.

The experimental design employed an Experimental and a Control group, each undergoing a 15 day training period, preceded by a pretest condition and followed by two post training testings. The procedural outline is discussed in detail below.

The pretest consisted of two parts. The first, the 'expressive' phase, measured the Subject's ability to orally identify the six concepts used in the study. In the second phase of the pretest, the 'receptive', the Subject was asked to non-verbally associate the stimulus name (vocalized by the Experimenter) with a corresponding stimulus picture.

Table III.- Stanford-Binet Mental Age Ratings for Experimental and Control Groups.

df	\bar{X} (mos.) E: Group	\bar{X} (mos.) C: Group	SD : E: Group	SD : C: Group	t-Test Value
22	9.08	7.83	10.19	10.97	0.27

Table IV.- Stanford-Binet Picture Vocabulary Test Results for Experimental and Control Groups.

df	\bar{X} (mos.) E: Group	\bar{X} (mos.) C: Group	SD : E: Group	SD : C: Group	t-Test Value
22	2.83	3.41	3.24	4.07	-0.36

Table V.- Period of Institutionalization for Experimental and Control Groups.

df	\bar{X} (mos.) E: Group	\bar{X} (mos.) C: Group	SD : E: Group	SD : C: Group	t-Test Value
22	86.58	86.66	14.58	14.19	-0.01

Table VI.- 'Expressive' Pretest Result Summary for Experimental and Control Groups.

Concept	df	\bar{X} : E: Group	\bar{X} : C: Group	SD : E: Group	SD : C: Group	t-Test Value
CAR	22	2.00	2.12	2.98	1.77	-0.11
SPOON	22	2.66	2.58	2.67	2.28	0.07
MAN	22	2.75	2.79	3.13	2.75	-0.03
TRIANGLE	22	0	0	0	0	0.00
SQUARE	22	0	0	0	0	0.00
CIRCLE	22	0	0	0	0	0.00
Total Pretest	71	1.23	1.24	2.35	1.99	-0.04

Table VII.- 'Receptive' Pretest Result Summary for Experimental and Control Groups.

Concept	df	\bar{X} : E: Group	\bar{X} : C: Group	SD : E: Group	SD : C: Group	t-Test Value
CAR	22	3.25	3.12	2.26	2.39	0.13
SPOON	22	3.33	3.20	2.87	2.21	0.11
MAN	22	3.41	3.37	2.53	3.26	0.03
TRIANGLE	22	0	0	0	0	0.00
SQUARE	22	0	0	0	0	0.00
CIRCLE	22	0	0	0	0	0.00
Total Pretest	71	1.66	1.61	2.40	2.42	0.16

Table VIII.- Etiological Classifications For Experimental and Control Groups.

Experimental Group		Control Group	
Subject	Etiological Classification	Subject	Etiological Classification
Bob	Mongoloid	Joe	Congenital Cerebral Defect
Tom	Congenital Cerebral Defect	Roy	Encephalopathy
Henry	Encephalopathy	Tony	Congenital Cerebral Defect
Brian	Mental Retardation of Unknown Cause	John	Mongoloid
Bill	Congenital Cerebral Defect	Jack	Encephalopathy
Art	Congenital Cerebral Defect	Jim	Congenital Cerebral Defect
Paul	Congenital Cerebral Defect	Fred	Phenylketonuria
Ken	Congenital Cerebral Defect	Doug	Encephalopathy
Larry	Congenital Cerebral Defect	George	Congenital Cerebral Defect
Sam	Mongoloid	Jerry	Congenital Cerebral Defect
Dave	Mongoloid	Russ	Congenital Cerebral Defect
Louis	Mongoloid	Dan	Mongoloid

More specifically, in the former the Subject was required to verbally name the different stimulus objects. In the latter (i.e. 'receptive' phase), the Experimenter presented the Subject with 10 sets of pretest items (i.e. six different stimulus pictures per set, each representing one of the six concepts) and asked the Subject to point to (or express in some other non-verbally appropriate manner) the stimulus picture which corresponded to the verbal label. (For example, if the Experimenter vocalized "Spoon", the Subject must have intentionally pointed to the correct picture out of the six presented before him).

The order in which the pretest items were administered (i.e. for both the 'expressive' and 'receptive' phases), was in one random sequence for all Subjects. Both pretest phases were given twice in a single day, once in the morning and once in the afternoon, for a test-retest reliability check (Table IX). While there was no difference in the 'receptive' phase during these two administrations, the 'expressive' pretest differed in that "prompting" was employed during the afternoon period. If the Subject answered incorrectly, the Experimenter aided him by verbalizing the first syllable of the concept label.

The pretesting was followed by 15 consecutive days of concept training, with each Subject receiving approximately 16 minutes of training per day.

Table IX.- Test-Retest Coefficients For Pretest Administrations.

Expressive Pretest: .93***

Receptive Pretest : .92***

*** p. < .001

Each training period was composed of three instructional sets⁵.

SET I:- (Imitative phase): The Experimenter presented the stimulus object to the Subject, orally labeled it, and asked him to imitate;

SET II:- (Expressive phase): The Experimenter manually introduced the stimulus item, and asked the Subject to state its name;

SET III:- (Receptive phase): Six stimulus objects each representing one of the six concepts, were placed in a random order before the Subject. The Experimenter then verbalized the concept and asked the Subject to point to the corresponding stimulus item.

Subject error during the three instructional sets was immediately corrected by the Experimenter. The method of correction consisted of re-presenting the stimulus object, modeling the correct response, and asking the Subject to imitate. Imitation was rewarded by verbal praise. Failure was followed by the next item.

The general sequence of concept training proceeded from CAR, SPOON, MAN, to the geometric concepts, TRIANGLE, SQUARE, CIRCLE. This sequence was the same for Experimental

⁵ The Subject received 60 stimulus presentations for each of the three instructional sets, for a total of 180 presentations per training session.

and Control groups.

The Experimental group was trained on the conditioning apparatus (see p. 32), and for each correct response on all three sets of instructional stimuli, received a standard chain of positive reinforcement (i.e. auditory reinforcement (chimes) + nutritive reward (candy), followed by verbal praise (in the form: "That's right; Good!") + tactile feedback (a pat on the back). This "reinforcement chain" was presented on a continuous schedule for the first 10 days of the training period. "Reinforcement thinning" via a shift to an intermittent schedule was initiated on day 11 and was in effect until the final day 15. During this time, a simple 3:1 ratio schedule (i.e. three correct responses per "reinforcement chain"), was established.

No reward followed incorrect responses and/or complete failure to respond to the presentation of the stimulus object. Aversive stimulation in the form of a mild electric shock (i.e. approximately seven milliamps.), was further used to control perseverative behavior⁶. Two shock-delivering electrodes were attached (1" apart) to the base of the Subject's ankle. The aversive stimulus was controlled by the Experimenter.

⁶ Perseverative behavior was here defined as an 'abnormally' persistent repetition or continuance in expression of a non-task related motor movement and/or idea.

The stimulus series was administered in accord with fading principles (Refer to Table I). The sequence of instructional stimuli proceeded from concrete, three-dimensional objects susceptible to Subject manipulation, to two-dimensional magazine cutouts and line drawings, and to images projected on a video screen. In this manner stimulus support was gradually reduced.

Subjects in the Control Condition were exposed to the same stimulus materials during the 15 days of concept training, but were trained without the conditioning desk as well as without the "reinforcement chain". Continuous verbal praise ("That's right; Good!"), coupled with varying amounts of non-contingent (candy) reinforcement, were the only rewarding conditions. Also, fading procedures were not used. The 10 stimulus items for each concept (for all three sets of instructional stimuli), were randomized and were not in accord with the above fading principles. Finally, there was no attempt at aversive control of perseverative behavior.

Posttests I and II were administered one and 21 days, respectively, following the last day of concept instruction. The individual stimulus pictures, the manner in which they were administered, and the specific (expressive-receptive) functions measured, were identical to that of the pretest condition. (NOTE:- Test-retest reliability for Posttests I and II is reported in Table X).

Table X.- Test-Retest Coefficients For Posttests
I and II.

POSTTEST I:-		
'Expressive' :		.94***
'Receptive' :		.93***
POSTTEST II:-		
'Expressive' :		.95***
'Receptive' :		.94***

*** p. < .001 .

6. Hypotheses.

A) There is no difference in 'expressive' concept acquisition between and within the Experimental and Control groups as indicated by Posttest I and II scores and by Set II performance.

B) There is no difference in 'receptive' concept acquisition between and within the Experimental and Control groups as indicated by Posttest I and II scores and by Set III performance.

C) There is no difference between the Experimental and Control groups in required total concept instruction time.

7. Statistical Tools.

The statistical procedures employed to test the research hypotheses are listed below. Both inferential and descriptive statistics were used.

A:- Between Group Analysis:-

An independent groups 't-Test' analysis was used to assess Experimental-Control group variance in:-

- a) posttest I and II performance;
- b) final (day 15) Set II and III performance; and
- c) required concept instruction time.

The corresponding Formula for this 't-Test' analysis is:-

$$t = \frac{(\bar{X}_1 - \bar{X}_2) - (M_{H_1} - M_{H_2})}{S_{\bar{X}_1 - \bar{X}_2}}$$

where,

- $(\bar{X}_1 - \bar{X}_2)$ - obtained sample mean variance.
 $(M_{H_1} - M_{H_2})$ - hypothesized population mean variance.
 $(S_{\bar{X}_1} - \bar{X}_2)$ - estimated standard error of differences.

B:- Within Group Analysis:-

To assess the variance in pre-vs-posttest performance within the Experimental and Control groups, a 't-Test' for paired observations was used. The Formula:-

$$t = \frac{\bar{D} - M_{D_H}}{S_{\bar{D}}}$$

where,

- \bar{D} - mean of sample difference scores.
 M_{D_H} - hypothesized population mean difference.
 $S_{\bar{D}}$ - estimated standard error of the mean of paired difference scores.

C:- Descriptive Analysis:-

Group and individual learning curves were employed to descriptively assess the rate and extent of concept acquisition during the 15 day training period.

CHAPTER III

PRESENTATION OF RESULTS

The analysis of the results is divided into four parts:- 1. expressive concept acquisition; 2. receptive concept acquisition; 3. time required for concept instruction; and, 4. a correlation matrix containing interrelationships among critical variables. The first three phases of this analysis tested the research hypotheses and the last one attempted to identify behavioral variables related to the concept learning ability of the profoundly-retarded. A summary statement of results concludes this section.

1. Expressive Concept Acquisition.

A significant difference was obtained on posttest I of expressive concept acquisition between Experimental ($\bar{X} = 5.37$) and Control ($\bar{X} = 1.57$) groups ($t = 6.00$, $p. < .001$), indicating treatment gains for the first group¹. This finding did not correspond to any initial pretest differences. Total pretest results for the Experimental ($\bar{X} = 1.23$) and Control

¹ Across group differences were also evident on the second posttest in which the Experimental group ($\bar{X} = 4.90$) had significantly higher scores than did its counterpart ($\bar{X} = 1.51$), ($t = 5.06$, $p. < .001$). Yet, the validity of this comparison is questionable due to the substantial difference between groups at the posttest I level. Consequently, the obtained variance here cannot be interpreted in terms of a retention difference between Experimental and Control groups.

($\bar{X} = 1.24$) groups were not significantly different ($t = -0.04$, $p. > 0.8$). These results are summarized in Table XI and illustrated in Figure 2.

The difference in final (day 15), Set II performance between Experimental ($\bar{X} = 4.20$) and Control ($\bar{X} = 1.52$) groups was significant ($t = 5.14$, $p. < .001$). Furthermore, group learning curves revealed progressive gains in concept acquisition for the Experimental group. Comparable results were not indicated by the Control group during the same period of time. The latter developed early scalloping². (Refer to Table XII, and to Figure 3).

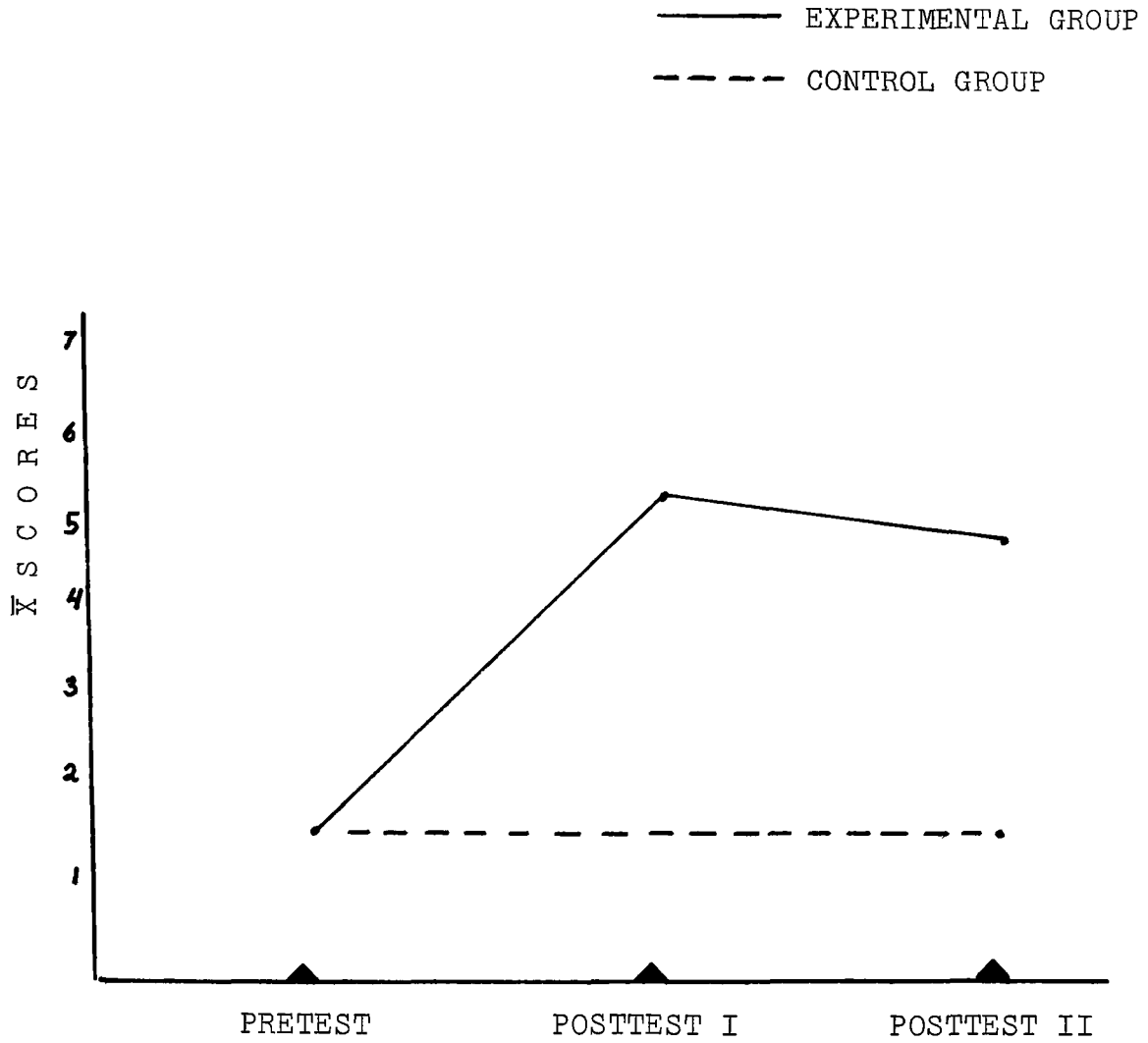
Analysis of within-group variance revealed a significant change from pretest ($\bar{X} = 1.23$) to posttests I ($\bar{X} = 5.37$) and II ($\bar{X} = 4.90$) for the Experimental group (t 's = 4.40 and 3.90, respectively, both $p. < .01$). Moreover, the difference between the first and second posttest did not reach significance ($t = 1.10$, $p. > 0.2$), indicating not only acquisition but retention effects for this group. The Control group did not demonstrate significant differences in pretest ($\bar{X} = 1.24$) vs posttests I ($\bar{X} = 1.57$) and II ($\bar{X} = 1.51$) scores (t 's = 1.11 and 0.86, respectively, both $p. > 0.2$). These results are

² The difference between day 1 ($\bar{X} = 1.36$) and day 15 ($\bar{X} = 6.08$) Set II performance was significant for the Experimental group ($t = 2.95$, $p. < .01$). The Control group, to the contrary, did not indicate an equivalent performance difference from day 1 ($\bar{X} = 0.41$) to final day 15 ($\bar{X} = 2.00$), ($t = 1.41$, $p. > 0.2$).

Table XI.- Analysis of Variance Between Experimental and Control Groups on Pre-and-Posttest I of Expressive Concept Acquisition.

Group	df	\bar{X} pre- test	\bar{X} post- test I	SD pre- test	SD post- test I	t-Test ^a Value (pretest)	t-Test ^b Value (posttest)
Experimental:	22	1.23	5.37	2.87	4.46	-0.04	6.00****
Control:	22	1.24	1.57	2.25	2.96		

a and b two-tailed test of significance
 **** p. < .001.



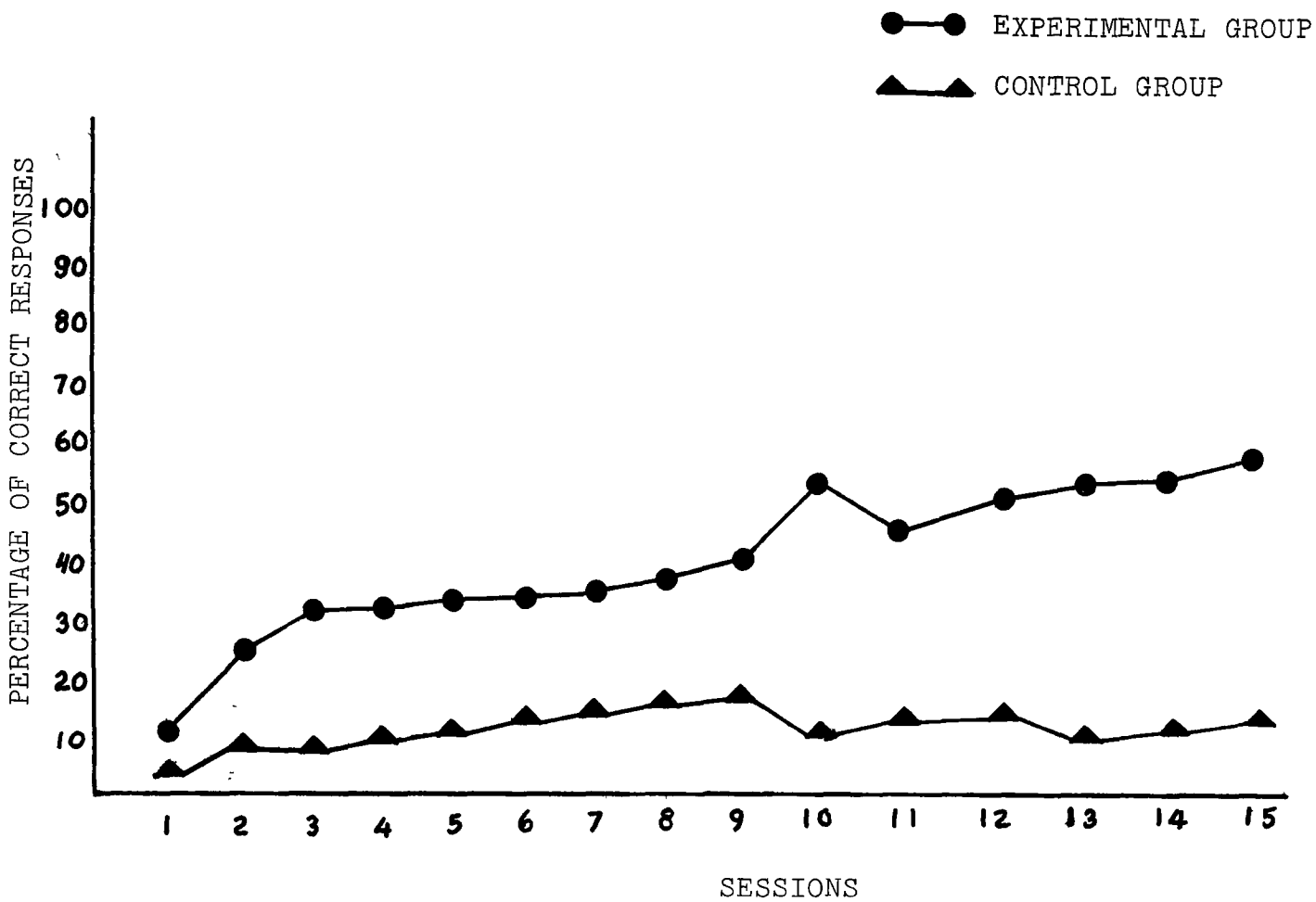
Comparison of Experimental-Control Group Performance On Pre-and Posttests of Expressive Concept Acquisition.

Figure 2

Table XIII.- Difference in Mean Set II Performance
Between Experimental and Control Groups.

df	\bar{X} E: Group	\bar{X} C: Group	SD E: Group	SD C: Group	(t-Test) ^a Value
22	4.20	1.52	3.64	2.45	5.14****

a Two-tailed test of significance
**** p. < .001.



Daily Mean Set II Performance For Experimental and Control Groups.

Figure 3

reported in Table XIII.

In view of the foregoing evidence the first null hypothesis (Refer to p. 50) was rejected.

2. Receptive Concept Acquisition.

Experimental-Control group variance was significant on posttest I of 'receptive' concept acquisition ($t = 7.03$, $p. < .001$), with the Experimental group ($\bar{X} = 6.21$) demonstrating gains over the Control group ($\bar{X} = 2.00$)³. These findings were not predicted by differences at the pretest level. Total pretest scores for the Experimental ($\bar{X} = 3.33$) and Control ($\bar{X} = 3.23$) groups were not significantly different ($t = 0.16$, $p. > 0.8$). These findings are summarized in Table XIV. Figure 4 illustrates the difference between groups in pre- and posttest I and II performance.

Day 15, Set III performance varied significantly between groups ($t = 7.75$, $p. < .001$), with the consequent difference favoring the Experimental group ($\bar{X} = 4.51$) over the Control

³ A significant difference in posttest II scores was obtained between Experimental ($\bar{X} = 5.52$) and Control ($\bar{X} = 2.47$) groups ($t = 4.87$, $p. < .01$). Yet, because of the significant across group variance at the posttest I stage these findings cannot be interpreted as a difference in retention between the two groups.

Table XIII.- Summary Analysis of Within Group Variance For Experimental and Control Groups: Expressive Concept Acquisition.

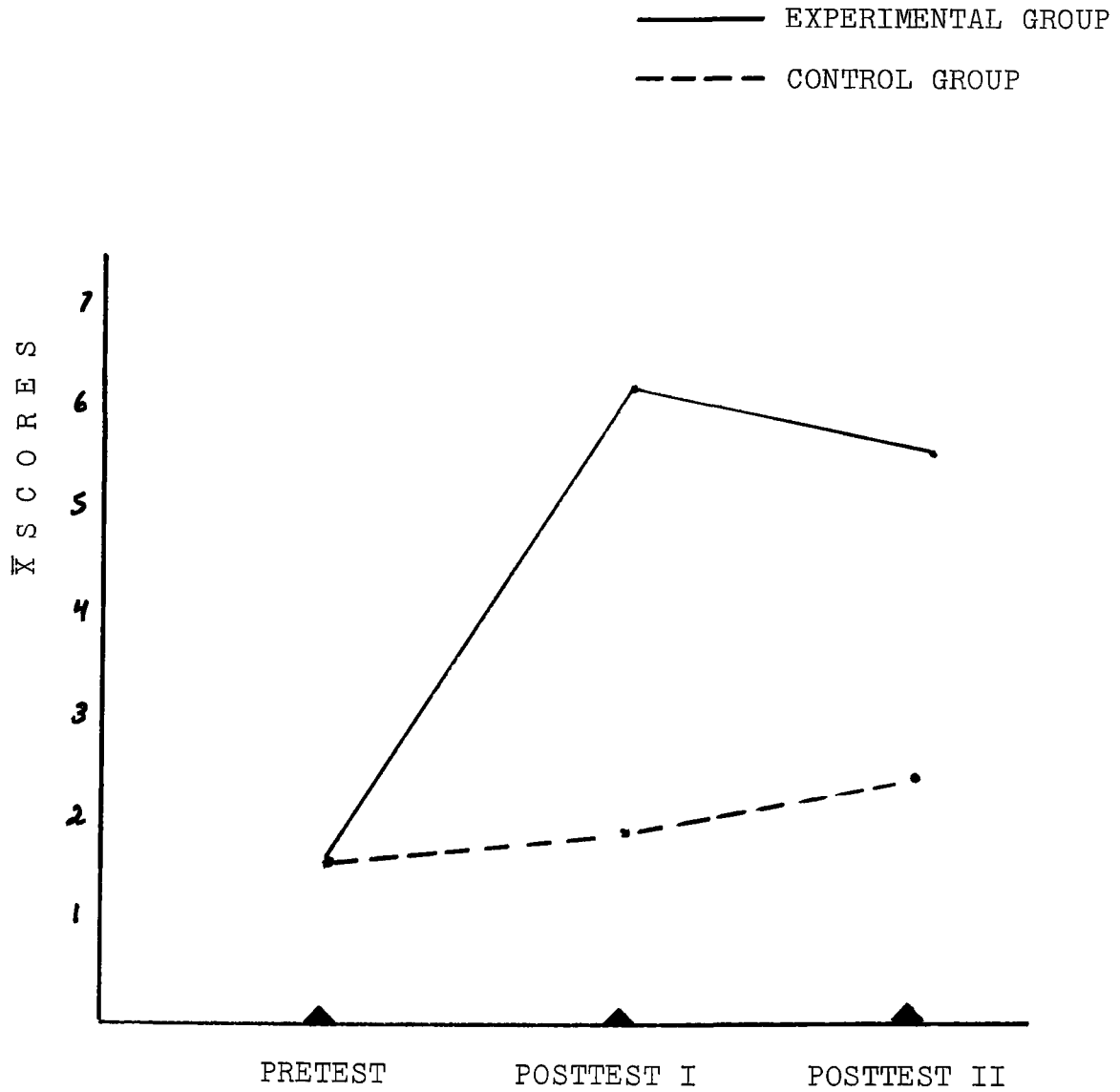
Group	\bar{X} pre- test	\bar{X} post- test I	\bar{X} post- test II	t-Test ^a Value
EXPERIMENTAL:-				
pretest vs posttest I:	1.23	5.37		4.40***
pretest vs posttest II:	1.23		4.90	3.90***
posttest I vs posttest II:		5.37	4.90	1.10
CONTROL:-				
pretest vs posttest I:	1.24	1.57		1.11
pretest vs posttest II:	1.24		1.51	0.86
posttest I vs posttest II:		1.57	1.51	0.47

a Two-tailed test of significance
*** p. < .01.

Table XIV.- Analysis of Variance Between Experimental and Control Groups on Pre-and Posttest I of Receptive Concept Acquisition.

Group	df	\bar{X} pre- test	\bar{X} post- test I	SD pre- test	SD post- test I	t-Test ^a Value (pretest)	t-Test ^b Value (posttest)
Experimental:	22	1.66	6.21	2.49	3.92	0.16	7.03****
Control:	22	1.61	2.00	2.58	3.12		

a and b two-tailed test of significance
 **** p. < .001.



Comparison of Experimental and Control Group Performance On Pre-and Posttests of Receptive Concept Acquisition.

Figure 4

group ($\bar{X} = 1.31$)⁴. These results are reported in Table XV. A line graph (Cf. Figure 5) further illustrates Experimental-Control group difference in daily Set III performance.

Analysis of within-group variance revealed a significant difference in pretest ($\bar{X} = 1.66$) vs posttests I ($\bar{X} = 6.21$) and II ($\bar{X} = 5.52$) scores for the Experimental group (t 's = 7.18 and 6.90, respectively, both $p. < .01$), indicating concept acquisition. Moreover, a non-significant difference was obtained between the first and second posttest ($t = 1.70$, $p. > 0.2$) further revealing retention effects. Equivalent results were not produced by the Control group. The change from pretest ($\bar{X} = 1.61$) to posttests I ($\bar{X} = 2.00$) and II ($\bar{X} = 2.47$) was not significant (respective t -values = 1.62 and 2.18, both $p. > 0.2$). A significant increase in concept acquisition was not produced in the control condition. These findings are summarized in Table XVI.

The above findings indicate rejection of the second null hypothesis (see p. 50).

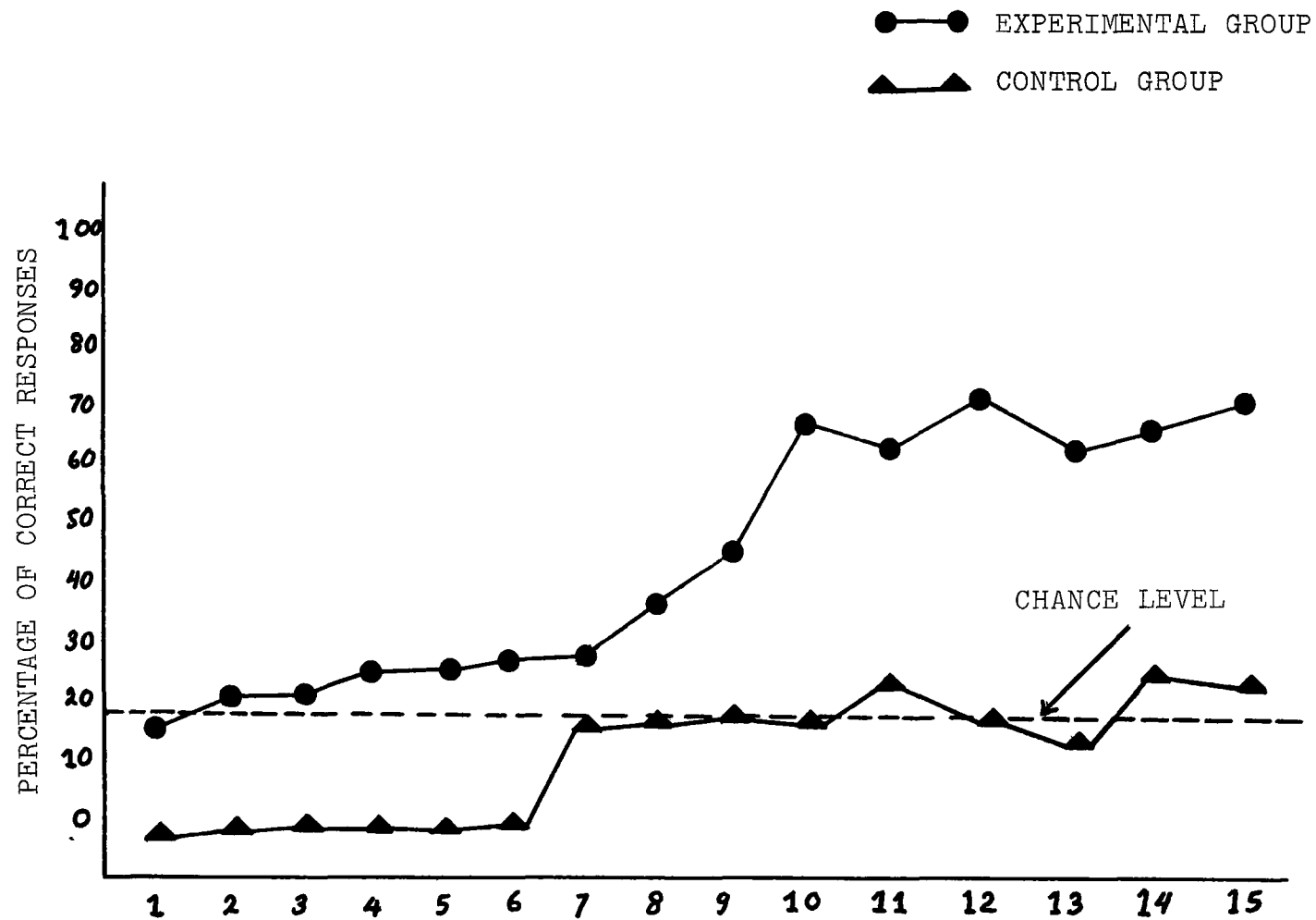
(NOTE:- A within-group analysis of variance for each concept as well as a series of learning curves for all Subjects, is contained in Appendices 3 and 4).

⁴ A significant difference ($t = 2.76$, $p. < .02$) between day 1 ($\bar{X} = 1.61$) and day 15 ($\bar{X} = 7.40$) performance was indicated for the Experimental group. The Control group, to the contrary, did not vary significantly in their Set III performance from day 1 ($\bar{X} = 0.52$) to day 15 ($\bar{X} = 2.36$), ($t = 1.78$, $p. > 0.1$).

Table XV.- Difference in Mean Set III Performance
Between Experimental and Control Groups.

df	\bar{X} E: Group	\bar{X} C: Group	SD E: Group	SD C: Group	(t-Test) ^a Value
22	4.51	1.31	3.05	1.67	7.75****

a Two-tailed test of significance
**** p. < .001.



Daily Mean Set III Performance For Experimental and Control Groups:
Receptive Concept Acquisition.

Figure 5

Table XVI.- Summary Analysis of Within Group Variance For Experimental and Control Groups: Receptive Concept Acquisition.

Group	\bar{X} pre- test	\bar{X} post- test I	\bar{X} post- test II	t-Test ^a Value
EXPERIMENTAL:-				
pretest vs posttest I:	1.66	6.21		7.18****
pretest vs posttest II:	1.66		5.52	6.20****
posttest I vs posttest II:		6.21	5.52	1.70
CONTROL:-				
pretest vs posttest I:	1.61	2.00		1.62
pretest vs posttest II:	1.61		2.47	2.18
posttest I vs posttest II:		2.00	2.47	1.12

a Two-tailed test of significance
**** p. < .001.

3. Required Training Time.

A significant difference in total concept training time was obtained between Experimental ($\bar{X} = 208.58$) and Control ($\bar{X} = 231.16$) groups ($t = -3.31$, $p. < .01$), with the former requiring less time to complete the three instructional sets (i.e. the Experimental Subjects received a \bar{X} of 13.90 minutes of concept instruction per day to the Control group's 15.40). This finding rejected the third null hypothesis. (Refer to Table XVII, and to Appendix 1, Table XXII).

4. Interrelationships Among Critical Variables and Behavioral Measures.

A correlation matrix containing interrelationships among critical variables and behavioral measures is presented in Table XVIII. The results suggest the predictive quality of the S-B Picture Vocabulary Test (S-B PVT) as well as the task-specific pretests. Both revealed a positive, statistically significant relationship with higher posttest I and II performance.

A negative relationship between training time and general pre-posttest performance was obtained, indicating that the "brighter" Subjects took less time for concept instruction. Furthermore, a high correlation between posttests I and II ($r = .91$, $p. < .01$) suggests that those who demonstrated acquisition effects on posttest I tended to maintain their performance

Table XVII.- Difference in Total Training Time Between the Experimental and Control Groups.

df	\bar{X} E: Group	\bar{X} C: Group	SD E: Group	SD C: Group	(t-Test) ^a Value
22	208.58	231.16	19.1	12.02	-3.31***

a Two-tailed test of significance
*** p. < .01.

Table XVIII.- Correlation Matrix of Critical Variables and Behavioral Measures.

	CA	MA	Length of Institut.	S-B PVT ^a	Time	Pre- test	Post- test I
CA							
MA	-.12						
Period of Institution- alization	.31	.09					
S-B PVT	-.40	-.51	-.08				
Training Time	.17	.06	-.11	-.60*			
Total Pre- Test	-.13	.00	.25	.81***	-.61**		
Total Post- Test I	.16	-.13	.34	.57*	-.84***	.73***	
Total Post- Test II	-.06	-.23	.07	.62**	-.90***	.56*	.91***

^a Stanford-Binet Picture Vocabulary Test

* p. < .05.

** p. < .025.

*** p. < .01.

on the second posttest.

Other significant correlations were found between the S-B PVT and total pretest results ($r = .81$, $p. < .01$) and between the S-B PVT and concept instruction time ($r = -.60$, $p. < .05$).

Finally, neither CA, MA, or length of institutionalization was found to be related to or predictive of posttest performance.

5. Summary Statement of Results.

The foregoing findings permit rejection of the three null hypotheses. Across group differences in expressive-receptive concept acquisition as well as required training time were indicated. A within-group analysis of variance further demonstrated a significant difference between pre- and posttest scores for the Experimental group. Equivalent pre-posttest differences were not produced in the Control condition. Finally, interrelationships among various task-specific and predictor variables were revealed.

CHAPTER IV

DISCUSSION AND INTERPRETATION OF RESULTS

In discussing and interpreting the results of this investigation attention will be directed first to the acceptance and/or rejection of the research hypotheses and, second, to observations regarding perseverative behavior control and general behavioral differences between Experimental and Control groups. Factors predictive of concept acquisition, various methodological considerations, and recommendations for future research will be the final discussion topics.

1. Evaluation of Null Hypotheses.

Three hypotheses were investigated in this study. Their acceptance or rejection will be dealt with in this section.

The hypotheses that there would be no difference in 'expressive' and 'receptive' concept acquisition between and within the Experimental and Control groups (i.e. Hypotheses I and II), were rejected. In both 'expressive' and 'receptive' concept formation the Experimental group demonstrated significant learning gains over the Control group. This difference was apparent on both posttest I of retention (and

generalization)¹ as well as in mean Set II and III performance during the 15 days of concept training. In terms of training performance, the Experimental group revealed progressive learning effects while the matched Control group did not.

The within-group analysis of variance also suggested the difference between Experimental and Control groups in 'expressive'-'receptive' concept acquisition. Whereas the former demonstrated a significant positive change from pre- to posttest performance, the Control group did not. Thus, level of concept mastery was not increased in the latter condition.

The concept acquisition demonstrated by the Experimental group appears to be the consequence of operant procedures and apparatus which promoted the Subject's attending behavior and his tendency to respond to the instructional stimuli. The engineering of attention and motivation via such procedures as fading, stimulus diversity, inappropriate behavior control, inhibition of extraneous stimulation, and reinforcement seems to be useful in concept training with the profoundly retarded. This proposal is supported by many studies

¹ Posttest I (and II) could be considered measures of generalization as well as retention since the test items differed from those used in the instructional sets in terms of size, color, figure complexity, and randomized mode of presentation.

(e.g. 2,3,4,5,6,7).

Inspection of the individual acquisition curves (Appendix 4) indicates that there is much within-Subject variability in daily performance on Sets II and III. It should not be assumed that all Subjects progressed at the same rate or that all Experimental Subjects acquired the concepts and that none of the Control group Subjects did so. Concerning the former, individual differences in rate of learning were evident. Some Subjects required as little as 5 days of training to attain the criterion while others needed the full 15 days of instruction. Furthermore, although all Experimental

2 B.J. House and D. Zeaman, "A Comparison of Discrimination Learning in Normal and Defective Children", Child Development, Vol. 29, No. 5, 1958, p. 411-416.

3 -----, "Visual Discrimination Learning and Intelligence", American Journal of Mental Deficiency, Vol. 65, No. 1, 1960, p. 51-58.

4 D. Zeaman and B.J. House, "The Role of Attention in Retardate Discrimination Learning", Handbook of Mental Deficiency, New York, McGraw-Hill, 1963, p. 159-223.

5 -----, and R. Orlando, "Use of Special Training Conditions in Visual Discrimination Learning With Imbeciles", American Journal of Mental Deficiency, Vol. 63, No. 5, 1958, p. 453-459.

6 T. Linde, "Techniques for Establishing Motivation Through Operant Conditioning", American Journal of Mental Deficiency, Vol. 63, No. 5, 1958, p. 437-440.

7 J.S. Birnbrauer, M.M. Wolf, J.D. Kidder, and C.E. Tague, "Classroom Behavior of Retarded Pupils With Token Reinforcement", Journal of Experimental Child Psychology, Vol. 2, No. 4, 1965, p. 219-235.

group Subjects demonstrated some 'receptive' concept learning, three Subjects failed to verbally identify the stimulus items. Finally, two Subjects in the Control group revealed consistent Set II and III learning effects, suggesting that they were able to profit apart from the explicit operant procedures and apparatus employed here.

The hypothesis that there would be no difference between the Experimental and Control groups in required instruction time (i.e. Hypothesis three), was rejected. The Experimental group required less instruction time than did the Control group. This again suggests the effect of the attention-securing and motivation-producing procedures and apparatus used here. Contingent reinforcement tended to promote and sustain the Subject's rate of responding to the instructional stimuli. This is in accord with the operant principle that reinforcement of any specific behavior tends to increase the frequency (probability of occurrence) of that behavior⁸.

Before concluding this section, it should be noted that the candy reward, contrary to the observations of Miller and Estes⁹, did not appear either distracting or time

8 B.F. Skinner, The Behavior of Organisms, New York, McGraw-Hill, 1938.

9 C.B. Miller and B.W. Estes, "Monetary Reward and Motivation in Discrimination Learning", Journal of Experimental Psychology, Vol. 61, No. 6, 1961, p. 501-504.

consuming. Subjects were not preoccupied with counting or "worrying over their hoards", and temporal delay in responding to subsequent instructional stimuli was minimal.

2. Effects of Applied Aversive Stimulation.

Electrical shock was applied to Experimental group Subjects contingent upon perseverative behavior. Although there was only a total of six aversive stimulus presentations distributed to two Subjects during the 15 days of concept training, they appeared to be effective in the termination of the perseverative response. Following shock application, the two Subjects directed their attention first to the shocked ankle and then to the task. Adverse side effects of negative emotional states and/or disruption of the Experimenter-Subject relationship were not apparent. These observations are in accord with those of Gardner¹⁰, but they are only suggestive in view of the infrequent application of the aversive stimulus.

¹⁰ W.I. Gardner, "Use of Punishment Procedures With The Severely-Retarded: A Review", American Journal of Mental Deficiency, Vol. 74, No. 1, 1969, p. 86-103.

3. General Behavioral Differences Between Experimental and Control Groups.

The Experimental and Control groups differed not only in terms of posttest results and mean Set II and III performance, but also in "task motivation" and "social responsiveness" to the Experimenter.

Most of the Subjects were long-term residents within the institutional setting. Thus, they were not accustomed to individual attention, much less to the receiving of candy rewards and social praise for their achievements. Both conditions appeared to facilitate task-related cooperation for at least ten of the twelve Experimental Subjects. They worked hard to gain both the candy and the Experimenter's approval. Furthermore, these Subjects tended to be socially responsive to the Experimenter. They would greet him upon entering their ward, often clasping his hand and leading him to the experimental room.

In contrast to this group, the Control Subjects were generally unresponsive to the task situation and to the Experimenter. In the daily sessions they appeared to tire quickly, and it was difficult to sustain their attention or even to keep them in their seats. Even though non-contingent candy was administered to these Subjects, they were not cooperative with the Experimenter. With few exceptions, their initial delight to get out of their usually overcrowded room and to receive individual attention was short-lived. At least half of the

Subjects within this group manifested various forms of aggressive behavior including the throwing of stimulus materials and the hitting or kicking of the Experimenter.

The above behaviors may have been generated by the failure of the control condition to apply effective reinforcement procedures contingent with each stimulus presentation. A decrease in Subject's attention and an increase in inappropriate competing behaviors could be the direct consequences.

4. Factors Predictive of Concept Acquisition.

A:- MA and IQ:-

Ward personnel within institutions for the mentally retarded have known for sometime that the test constructs of MA-and-IQ are not predictive of the rehabilitative and learning capacities of the retarded. Yet, many psychologists still assume that children with very low MA and IQ ratings are automatically incapable of learning and can benefit only from custodial care. Although there are studies which lend some support to this conclusion^{11,12},

11 O.P. Kolstoe, "Language Training of Low-Grade Mongoloid Children", American Journal of Mental Deficiency, Vol. 63, No. 1, 1959, p. 17-30.

12 H. Goldstein, "Lower Limits of Eligibility For Classes For Trainable Children", Exceptional Children, Vol. 22, No. 4, 1956, p. 226-227.

other investigations^{13,14,15} have reported low or negative correlations between intelligence test scores and actual learning task performance. This study also found test scores to be poor predictors. It is apparent that under 'appropriate' environmental-instructional conditions, degree and/or cause of retardation notwithstanding, the retardate can profit from concept training.

B:- Length of Institutionalization:-

Although many studies have reported a strong relationship between length of institutionalization and limited language skills, none appear to have demonstrated a relationship between the former and the actual capacity of the retarded to acquire either language or concepts^{16,17}. The present study

13 R.G. Buddenhagen, Operant Conditioning As A Technique For Establishing Vocal Verbal Behavior In Non-Talking Institutionalized Mongoloid Children, doctoral thesis presented to the University of Rochester, U.S.A., 1967, 286 p.

14 M. Woodrow, et al., "The Ability To Learn", Psychological Review, Vol. 53, No. 2, 1946, p. 147-158.

15 H.N. Sloane, et al., "Remedial Procedures For Teaching Verbal Behavior To Speech Deficient Or Defective Young Children", Operant Procedures In Remedial Speech and Language Training, Boston, Houghton Mifflin, 1968, p. 120-124.

16 W.R. Blount, "Language and The More Severely-Retarded: A Review", American Journal of Mental Deficiency, Vol. 73, No. 1, 1968, p. 21-29.

17 O. Spreen, "Language Functions In Mental Retardation: A Review To Language Development, Types of Retardation, and Intelligence Level", American Journal of Mental Deficiency, Vol. 73, No. 3, 1969, p. 330-340.

did not find such a relationship; correlation between the length of time a child was institutionalized and the extent to which learning took place (as manifested during posttest I and II performance) was low.

C:- Chronological Age:-

CA was not found here to be related to superior post-test performance, suggesting that the age of the child was not indicative of his capacity to form concepts. This conclusion is supported by the results of other studies^{18,19,20}.

D:- Task-Specific Variables:-

The relationship between the Subject's concept repertoire (as measured by the pretest assessment) and the S-B Picture Vocabulary Test with posttest I and II performance, was evident. While the standard demographic predictor variables (i.e. IQ, MA, CA) were not related to concept learning, the task-specific measures were. These findings support those of Bricker and Bricker²¹.

18 Kolstoe, Op. Cit., p. 17-30.

19 Buddenhagen, Op. Cit., p. 286.

20 W.A. Bricker and D.D. Bricker, "Development of Receptive Vocabulary in Severely-Retarded Children", American Journal of Mental Deficiency, Vol. 74, No. 6, 1970, p. 599-606.

21 Id., Ibid..

Summary Statement:-

Sloane, et al.²², in an article concerned with devising remedial procedures for teaching the mental retardate verbal behavior, discuss the role of traditional diagnostic evaluation in planning treatment. Their following proposal tends to coincide with, and sum up the above conclusions.

They state:

Classification in terms of supposed etiology or "type" of disorder (e.g. psychosis vs brain damage vs familial mental retardation) or in terms of severity of behavioral deficit (e.g. IQ or MA scores, classification as severely retarded) were not found to have implications for treatment. Such labels did not help in deciding where to start treatment or in making other decisions concerning treatment. Actual specification of the current repertoire did prove useful. Evaluations of "psychological functioning" or "personality" were also not of much help....neither was the evaluation of needs or drives in a psychodynamic framework.

The implications of this point of view suggest that for training purposes there should be concern with identifying observable and manipulable conditions and not with the formulation of hypothetical explanations of behavior. While the former emphasis enables the diagnostician to specify concrete remedial procedures, the latter approach only generates clinical speculation and the false security that in fact something has

22 H.N. Sloane, M.K. Johnson, F.R. Harris, "Remedial Procedures For Teaching Verbal Behavior to Speech Deficient Or Defective Young Children", Operant Procedures In Remedial Speech and Language Training, Boston, Houghton Mifflin, 1968, p. 100.

been explained.

5. Theoretical Considerations: Two Behavioristic Theories Of Concept Formation.

Working within the Hullian framework, Arthur Staats²³ has formulated an elaborate, although hypothetical, neo-behavioristic analysis of concept development. He begins by defining concept formation as the process whereby a verbal habit-family is formed usually (although not always) on the basis of a class of stimulus objects having identical elements. He then proceeds to delineate the principles governing the formulation of a verbal habit-family. They are in brief:

a) When a word is contiguously presented with a stimulus object some of the unconditioned sensory, autonomic, and motor responses elicited by the object will be conditioned to the word. These responses when stably conditioned become the "meaning" of the word. It is suggested that:

"some stimulus objects elicit sensory responses in organisms, parts of which may be conditioned. Thus, parts of the "seeing", "hearing", or "feeling" responses, for example, elicited by the appropriate stimulus on an unconditioned basis may be conditioned to other neutral stimuli, including verbal stimuli.

.....
Following the conception that sensory responses may be conditioned, the pairing of the auditory

23 A.W. Staats, "Verbal Habit Families, Concepts, And The Operant Conditioning Of Word Classes", Psychological Review, Vol. 68, No. 3, 1961, p. 190-204.

presentation of the word BALL and the visual presentation of the object "ball", as an example, would be expected to condition the child to respond to the auditory verbal stimulus with part of the visual responses elicited by the "ball" itself. The word stimulus would now be meaningful"²⁴.

b) If an organism, while sensorily responding to a stimulus object, is reinforced for verbally labeling this object, then an association is established between the stimuli produced by the sensory responses to the object and the speech response. Thus, in accord with the above example:

"the conditional sensory responses elicited by the "ball", through classical conditioning, are conditioned to the word response BALL. In addition, when the child is reinforced for saying BALL while looking at the "ball", the verbal response is conditioned to the same sensory responses. Thus, the word response BALL tends to elicit sensory response components, but the sensory component also tends to elicit the word response"²⁵.

c) Sensory responses elicited by an object come to control more than one tacting response. The anticipatory meaning response component evoked by a stimulus (i.e., the sensory responses produced by a physical stimulus), has a tendency to elicit a class of word responses. For example, the stimulus object "ball" will elicit a number of associated responses including round, circular, spherical, red, big, and others. Staats refers to this principle as the Divergent Mechanism.

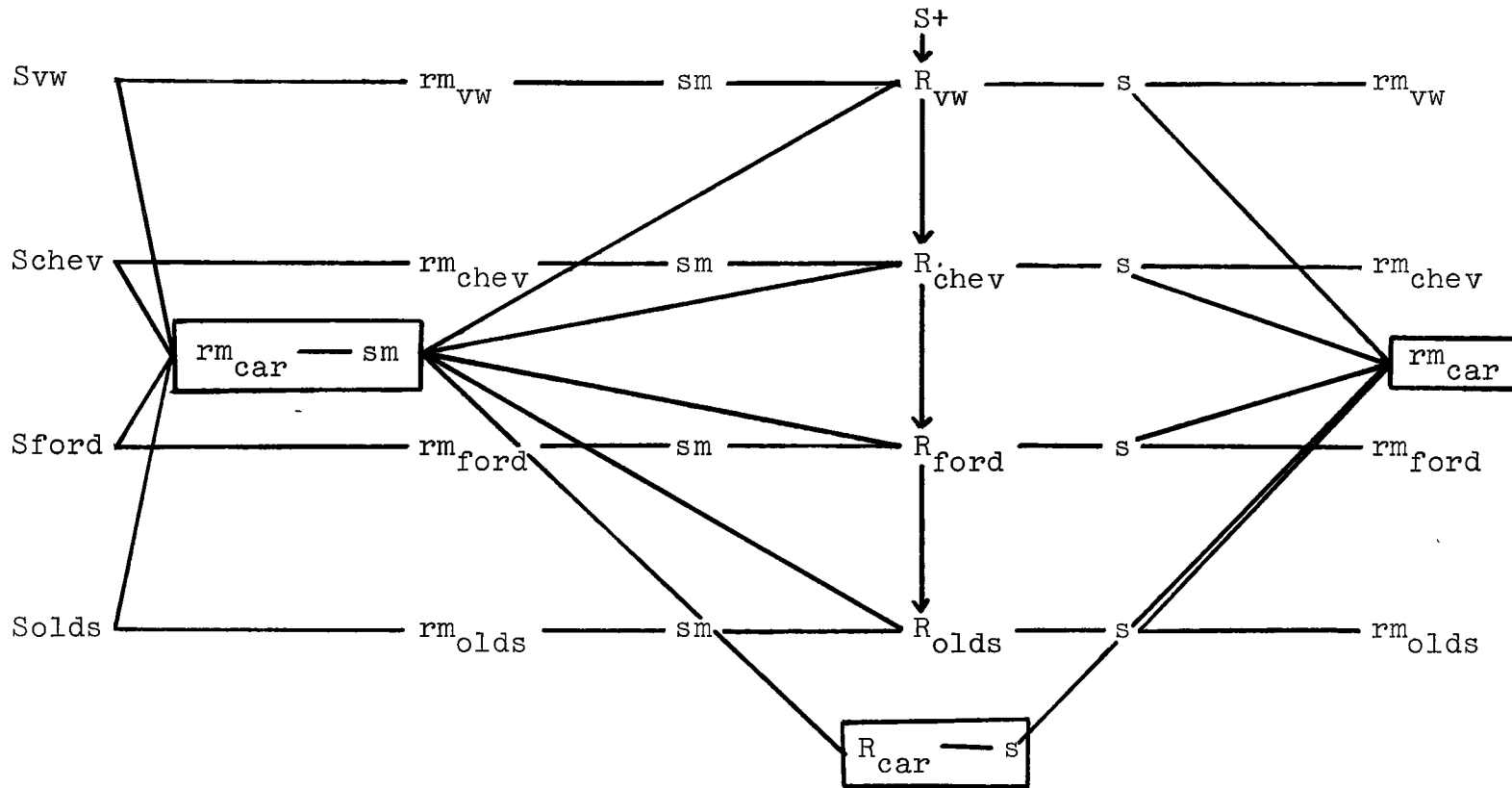
²⁴ A.W. Staats, Op. Cit., p. 163.

²⁵ Id., Ibid., p. 164-165.

d) Each of the stimulus words associated with a given stimulus object will be conditioned to elicit the same and response component, their common meaning. In accord with the previous examples, each of the word responses associated with the stimulus object "ball" (e.g. spherical, circular, and others), has the tendency to elicit the same common meaning response component, namely, "roundness". This principle is designated as the Convergent Mechanism.

The above principles can be applied to the present research. Take, for example, the concept CAR. Each of the stimulus objects in its class (i.e. Volkswagen, Ford, and others), has certain identical elements (e.g. wheels, doors, steering column) and the objects in the class will thus elicit sensory response components which also have identical elements. Consequently, part of the anticipatory meaning response component conditioned to the stimulus object 'Volkswagen' ($rm - s$) will be identical to those which are conditioned to the stimuli "Oldsmobile, Chevrolet, and Ford". This common response, according to Staats, would be called the CAR meaning response component (rm_{car} in Figure 6). The development of this common response is for him the essence of concept formation.

In addition, each stimulus object elicits conditionable sensory response components which the other objects in the class do not. Consequently, each of the individual cars comes to elicit a car meaning response component shared by the others.



The CAR concept illustrated in accord with the theoretical analysis of concept formation proposed by Staats. The general terms in the Paradigm are defined as follows: S, the physical stimulus; rm - sm, the sensory response component elicited by the physical stimulus and which is anticipatory to the terminal response; R, the verbal label associated with the physical stimulus; S+, positive reinforcement contingent with responding to the physical stimulus via the verbal label; rm, the meaning component derived from the S - rm - s - R relation.

Figure 6

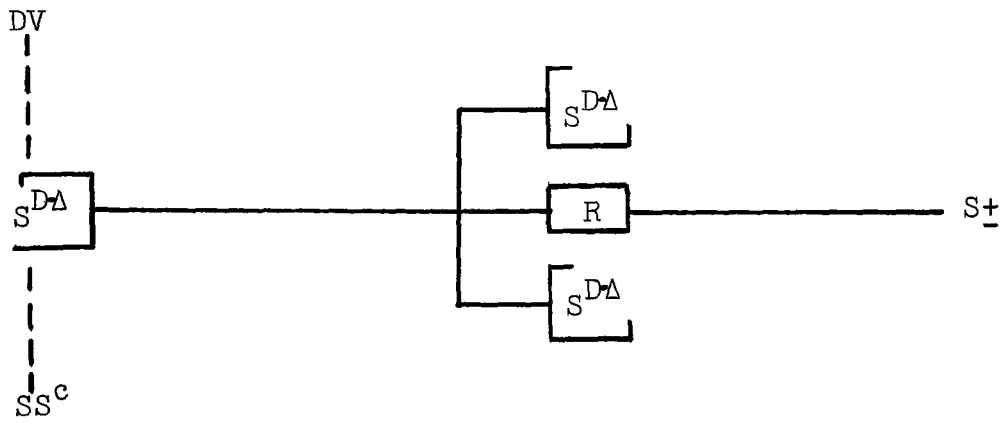
and also a specific meaning response component which none of the others elicit (rm_{vw} , rm_{chev} , rm_{ford} , or, rm_{old} , in Figure 6).

When, as in this study, each of the stimulus objects (e.g. VW, Olds) is contiguously presented with the modeled verbal label CAR, and this association is reinforced, the common conditionable sensory response component elicited by all the "cars", the so-called car component, will be strongly conditioned to the word CAR, and each of the specific conditionable response components elicited by only one of the "cars" will be weakly conditioned to the word CAR. In this manner, characteristics common to all cars are abstracted from a series of discrete, specific cars and the concept CAR formed (refer to Figure 6).

A theory of concept acquisition is suggested by Goldiamond²⁶, in which inferred mediational processes, such as those proposed by Staats, are eliminated. This is illustrated in Figure 7.

The terms within this paradigm are in accord with stringent operant principles. The notation S^D/S^Δ refers to the discriminative stimuli in whose presence behavior is reinforced (S^D) or not reinforced (S^Δ). The response is designated

26 I. Goldiamond, "Perception, Language, and Conceptualization Rules", Problem Solving: Research, Method and Theory, New York, Wiley, 1966, p. 180-201.



Goldiamond's Paradigm For Human Concept Formation.

Figure 7

by R. The designation S^{\pm} refers to the consequences which maintain or attenuate behavior by being contingent with it. These consequences may be reinforcing (+) or non-reinforcing (-). DV, or deprivation variable, is used here to include not only food deprivation but also other forms of deprivation, including social deprivation, which affect the intensity and frequency with which an organism responds to the experimental condition and to the discriminative stimuli. Also, "the experimental constraints, which when altered produce the disruption of the behavior pattern hitherto established and attributed to stimulus change or novel stimuli, are represented as the constant stimuli, SS^{c27} . Finally, two different sets of discriminative stimuli are posited: instructional stimuli and dimensional stimuli. The former serve "to restrict the response alternatives to the dimension along which the experimenter presents his other discriminative stimuli", (i.e., the dimensional stimuli).

In human concept training a complex set of procedures is utilized in which only the discriminative stimuli are varied, along with systematically related differential reinforcement. With time, the organism will respond to a given series of stimuli only in terms of certain of their properties, as evidenced by his labeling and classifying stimuli according to

27 I. Goldiamond, Op. Cit., p. 197.

a common principle. Stated differently, the organism's responses now come under the control of the instructional stimuli. This, according to Goldiamond, is essentially abstraction or concept formation. He proposes that when we state an organism has developed an abstraction or concept we are in fact stating:

that he is behaving as if he has imposed upon himself a set of instructional stimuli, which now govern the dimensions along which he will respond with regard to the dimensional stimuli.²⁸ He has, so to speak, given himself an "Einstellung".

Conceived in terms of Skinner's analysis of verbal behavior, the instructional stimuli here serve as a "mand". When the organism comes under its control, that is, when he responds differentially to dimensional discriminative stimuli, he is "tacting".

Applying Goldiamond's paradigm to the present research, the dimensional stimuli would include the size, color, complexity, and others, of the experimental objects; while the instructional stimuli would consist of the verbal and non-verbal designation of these objects in terms of one dimension, namely, the concept class to which they are members. For example, if the Subject is presented with the stimulus object Volkswagen, he would be required to identify it in terms of the concept category CAR in order to receive positive reinforcement.

28 I. Goldiamond, Op. Cit., p. 199-200.

A description of the Volkswagen's physical properties (dimensional stimuli) and/or other extraneous responding would not be contingent with reward. In this manner, the Subject comes under the control of the instructional stimuli and a concept is formed.

(Other theorists, including Charles Osgood²⁹, Albert Goss³⁰, Bruner, et al.³¹, and Maltzman³² have formulated similar analyses of abstraction and concept formation. Because they are beyond the scope of this discussion they will not be presented).

The foregoing was an application of Arthur Staats' and Israel Goldiamond's behavioristic analyses of concept development. Both theories could be used to describe the resultant concept acquisition of those Subjects in this investigation described as "learners".

29 C. Osgood, "A Behavioristic Analysis of Perception and Language As Cognitive Phenomena", Contemporary Approaches To Cognition, Cambridge, Mass., Harvard University Press, 1957, p. 75-118.

30 A.E. Goss, "Verbal Mediating Response and Concept Formation", Psychological Review, Vol. 68, No. 5, 1961, p. 248-274.

31 J.S. Bruner, J.J. Goodnow, and G.A. Austin, A Study of Thinking, New York, John Wiley and Sons, 1956, p. 120-136.

32 I. Maltzman, "Thinking From A Behavioristic Point of View", Psychological Review, Vol. 62, No. 5, 1955, p. 275-276.

Yet, for purposes of the present research it may be sufficient merely to state that a given subject, under a specified set of treatment conditions, either acquired or did not acquire a concept, without invoking unproven theory to explain why he did or did not make the acquisition. It is assumed here, that the primary emphasis of applied research is to discern the effectiveness of a treatment condition, not the hypothetical formulation of how a given behavior may have been developed.

6. Methodological Considerations.

A list of procedural difficulties and considerations relevant to the interpretation of the results is presented below.

a) No attempt was made to isolate variables. This research was not designed to make across group comparisons on specific procedural variables such as fading, type of reinforcement, and the like. Thus, the results of this experiment would not indicate whether social praise was more effective than candy as a reinforcing agent. These and similar questions have undergone abundant empirical analysis and consequently, were not investigated here. Instead, the present research attempted to determine only if one formal set of operant procedures could produce concept formation in profoundly retarded children.

b) Only two groups were used in this research: an operantly trained Experimental group, and a matched Control group trained apart from the specific operant apparatus and procedure. A second Control group, a "do-nothing" group, could have been employed for additional comparisons. However, there was a shortage in the number of Subjects which met the sample criteria (p. 36), and it was procedurally impractical to add another group. It is also doubtful that such "Control Groups" would facilitate empirical analysis with any degree of efficiency.

c) Objective audiological data were not available for most of the Subjects, and since the adequacy of the ear is paramount in the development of language, especially in expressive concept acquisition, a standard audiological examination might have been performed. This was an oversight on the part of the Experimenter. Consequently, the extent to which actual auditory defects influenced the results of this experiment cannot be determined, although it is assumed that if Subjects with such defects did exist they were randomly assigned to both groups.

Visual examinations might also have been desirable. Again, because of Experimenter oversight they were not performed. As in the above case, only informal evaluations by the Experimenter were performed.

d) The generalization of training to the ward setting was not evaluated. Practical considerations including time consumption, inability of ward personnel to make systematic assessments, and the general lack of opportunity in the institutional setting to use the learned concepts, prohibited such an analysis.

e) The consistency of the fading procedure could be questioned on the grounds that it did not result in a reduction of stimulus support. The final stage of fading (i.e. the projection of images on a screen), could be viewed as an actual increase in available cues in that a picture of the "real" object was produced. If the fading procedure is evaluated in terms of a progression from the real-to-the-less-real, than an inconsistency is apparent -- the last fading stage is misplaced. If, to the contrary, fading is viewed as the progression of instructional stimuli from the concrete, tangible, three-dimensional to the more abstract, intangible, two-dimensional then the consistency of the fading sequence would be upheld. It is in accord with the latter rationale that the fading procedure employed here was formulated, but an empirical evaluation would be desirable in any case; and

f) Blount³³ makes a distinction between concept formation (or concept acquisition) and concept usage. He contends that the former carry the assumption that a concept is acquired in the experimental situation--that they refer to situations in which concepts are "built into" the subject during the experiment. Concept usage is reserved for all situations in which it is assumed that the concept has been formed outside the immediate experimental setting and the investigator is only interested in tapping the repertoire of concepts or in studying them in use.

The Experiment~~er~~ considers the above distinction artificial and subtly ambiguous and as such, did not comply with it. Instead, he preferred to withdraw from the "semantic battlefield" by not differentiating between concept acquisition (concept formation) and concept usage.

7. Recommendations For Future Research.

This research was only an early step in the investigation of operant procedures and apparatus in the concept training of the profoundly retarded. The need for more theoretical and applied research in this area is obvious. With this in mind, the following recommendations for future research are presented.

33 W.R. Blount, "Concept Usage Research With The Mentally Retarded", Psychological Bulletin, Vol. 69, No. 4, 1968, p. 281-294.

(i) The number of concepts taught should be increased. Using a single subject, the same procedures and apparatus could be used in a long-term training program employing an extended list of concepts. This would yield an indication of the extent to which the operant approach is effective with profoundly retarded children in the development of a large concept repertoire. The intensive and orderly program of Premack³⁴ utilizing a chimpanzee as a subject provides a model for this approach.

(ii) Verbal behavior could be established in retardates having no speech using the procedural outline suggested by Sloane, et al.³⁵, coupled with fading and reinforcement techniques. The operant instructor would begin by reinforcing general motor imitation as well as, specific movements of the vocal musculature and associated structures. Next, a sound would be required along with the non-vocal motor response. The final steps in the training program would include the development of specific speech sounds and sound chains, tacting objects with added imitative auditory Sd's, fading imitative auditory Sd in simple tacting, the development of single word mands and later, word chains. The currently used operant

³⁴ A. Premack, "A Functional Analysis of Behavior", Journal of The Experimental Analysis of Behavior, Vol. 14, No. 1, 1970, p. 107-125.

³⁵ Sloane, et al., Op. Cit., p. 77-91.

apparatus could be employed to maintain the child's attention and responsiveness to the task.

(iii) The apparatus used in this research could be improved in several ways. The auditory signal could be amplified through the use of dual earphones and a microphone built into the conditioning desk. Attention would be promoted by a decrease in extraneous auditory stimulation. Also, foot-pedals instead of push buttons could be used in the delivery of reinforcement. This would enable the Experimenter to interact more freely with the retardate. Finally, it may be possible to automate a concept (or language) training program using taped verbal commands and an apparatus which could introduce the stimulus items, reinforce the correct response, and control for inattentive behavior via instructor operation of a control console. In this manner, six to eight children could be trained at one time.

SUMMARY AND CONCLUSIONS

The present research attempted to investigate the applicability of the operant approach to the concept training of children with profound retardation. A single Experimental-Control group design matched on critical variables was employed. The Experimental group received concept training in accord with a specified set of operant procedures and apparatus. Subjects in the Control condition were exposed to the same stimulus materials for approximately the same amount of time, but without the explicit operant procedures and apparatus. Both groups underwent 15 days of concept training involving three common object concepts and three geometric concepts. The individual stimulus items were visually presented to the Subject who was required to verbally and non-verbally identify them according to their appropriate concept class. The training period was preceded by a pre-testing phase and was followed by two posttests (identical to the pretest), one and 21 days after the last day of concept instruction. Between and within group comparisons were made using selective t-Tests. Descriptive statistics were also employed.

Three null hypotheses were investigated. They were:

a) There is no difference in 'expressive' concept acquisition between and within the Experimental and Control groups.

b) There is no difference in expressive concept acquisition between and within the Experimental and Control groups, and,

c) There is no difference between the Experimental and Control groups in required concept instruction time.

All of the above hypotheses were rejected. The Experimental group demonstrated significant learning gains over the Control group in expressive and receptive concept acquisition. This difference was indicated on both posttests as well as in final (day 15), Set II and III performance. A within group variance analysis further revealed a significant positive change from pretest to posttest I and II performances for the Experimental group. Equivalent results were not evident in the Control condition--a significant increase in concept acquisition was not indicated by either posttest. Finally, the Experimental group required significantly less total concept instruction time than did its counterpart.

Experimental-Control group differences were also observed in task motivation and social responsiveness. While the Experimental subjects tended to cooperate with the Experimenter and tried hard to please him, the Control group did not. In general, the latter appeared to tire quickly and manifested various forms of aggression.

Interrelationships among critical variables and behavioral measures revealed that the task-specific pretests

and the task-related S-B Picture Vocabulary Test were predictive of superior posttest performance. The variables CA, MA, and length of institutionalization were not. These findings are in agreement with other studies in this area.

In conclusion, the commonplace assumption that children with profound retardation are unmodifiable--that they do not profit from training--was not supported. Although the above findings are necessarily tentative and require replication and procedural refinement, they do suggest the efficacy of a specific operant program in the concept training of the profoundly retarded child. Level of retardation notwithstanding, it is apparent that under optimal environmental-instructional conditions adaptive behaviors can be acquired.

BIBLIOGRAPHY

Bijou, Sidney W., "Studies in the Experimental Development of Left-Right Concepts in Retarded Children Using Fading Techniques", quoted by Norman R. Ellis, Ed., International Review of Mental Retardation, New York, Academic Press, Vol. 3, 1968, p. 65-96.

Concerned with determining the most optimal materials and procedures necessary for the development of left-right 'concepts' in the retardate. Precise, well-controlled research which focuses on the development of discrimination skills rather than on concept formation per se.

Blount, William R., "Language and the More Severely Retarded: A Review", American Journal of Mental Deficiency, Vol. 73, No. 1, Issue of November, 1969, p. 21-29.

A recent, comprehensive review of the language development and psycho-linguistic abilities of children with severe retardation.

Bricker, William A. and Diane D. Bricker, "Development of Receptive Vocabulary in Severely Retarded Children", American Journal of Mental Deficiency, Vol. 75, No. 6, Issue of June, 1970, p. 599-607.

Reported the effective use of operant conditioning procedures in the development of receptive vocabulary skills with retarded subjects identified as "learners". Sophisticated in design and pre-post treatment measures.

Buddenhagen, Ronald G., Operant Conditioning As A Technique For Establishing Vocal Verbal Behavior In Non-Talking, Institutionalized Mongoloid Children, Doctoral Thesis presented to the University of Rochester, U.S.A., 1967, ix-298 p.

The only study, to the knowledge of this writer, which attempted to teach profoundly retarded, non-verbal subjects, language. Yet, suffers from the deficits specific to the case study approach.

Brown, Lou, Jerry Hermanson, Hope Klemme, Paul Haubrich, John P. Ora, "Using Behavior Modification Principles to Teach Sight Vocabulary", Teaching Exceptional Children, Vol. 2, No. 3, Issue of March, 1970, p. 120-128.

Basic sight vocabulary was taught to "trainable" retarded children using the Behavior Modification principles of modeling and contingent reinforcement. A well-designed study demonstrating the applicability of the operant approach.

Denny, M. Ray, "A Theoretical Analysis", quoted by Norman R. Ellis, Ed., International Review of Mental Retardation, New York, Academic Press, Vol. 2, 1966, p. 3-25.

An excellent outline of the 'optimal' conditions for the language training of the mental retardate. Basically a theoretical discussion-actual case study or experimental data were not presented.

Ellis, Norman R. Ed., International Review of Research In Mental Retardation, New York, Academic Press, Vol. 1-3, (1966-1968), approx. 1-900 p.

Provided a ready source of relatively current information on research and theory development in the field of mental retardation. "Behavioral" research is stressed.

Goldstein, Herbert, "Lower Limits of Eligibility For Classes For Trainable Children", Exceptional Children, Vol. 22, No. 6, Issue of May, 1956, p. 226-227.

Reported the lowest level of retardation capable of acquiring language. Concluded that retardates with mental ages and IQs below two and 25 respectively, do not profit from language training. The present research is in direct opposition with these findings.

Guess, Doug, et al., "An Experimental Analysis of Linguistic Development: The Productive Use of the Plural Morpheme", Journal of Applied Behavior Analysis, Vol. 1, No. 4, Issue of January, 1968, p. 297-306.

The authors describe an operant program in which plural morphemes were developed in a severely retarded girl. A good illustration of the use of modeling techniques coupled with differential reinforcement.

Headwick, Mary W., "Operant Conditioning In Mental Deficiency", American Journal of Mental Deficiency, Vol. 67, No. 2, Issue of May, 1963, p. 924-929.

A cursory review of the literature dealing with operant behavior in mental retardates. Somewhat dated, but still useful as a very brief, incomplete literature review.

Kerr, Nancy, Lee Meyerson, and Jack Michael, "A Procedure For Shaping Vocalizations In A Mute Child", quoted by L. Ullman and L. Krasner, Eds., Case Studies In Behavior Modification, New York, Holt, 1965, p. 366-370.

Using contingent reinforcement, the authors demonstrated the applicability of Behavior Modification procedures by training an elective mute to vocalize freely after only two hours of conditioning. A significant study in that it was one of the first to use an operant approach in low-functioning children in the production of speech.

Kolstoe, Oliver, "Language Training of Low-Grade Mongoloid Children", American Journal of Mental Deficiency, Vol. 3, No. 1, Issue of September, 1959, p. 17-30.

An early, poorly controlled attempt to develop a language program for severely retarded mongoloids. Defects in experimental design and measuring instruments are evident.

Lovaas, Q. Ivar, John P. Berberich, Bernard Perloff, Benson Schaeffer, "Acquisition of Imitative Speech by Schizophrenic Children", Science, Vol. 151, No. 7, Issue of February, 1966, p. 705-707.

A monumental pilot study in which two mute schizophrenic children were taught imitative speech within an operant conditioning framework.

MacAulay, Barbara Dana, "A Program For Teaching Speech and Beginning Reading To Nonverbal Retardates", quoted by Howard N. Sloane and Barbara Dana MacAulay, Eds., Operant Procedures In Remedial Speech and Language Training, Boston, Houghton Mifflin, 1968, p. 102-124.

A Case study report in which reinforcement contingencies, programming, and color-coding were used to teach beginning reading to retardates. Unfortunately, lacking in formal baserate and control measures.

Risley, Todd and Montrose Wolf, "Establishing Functional Speech In Echolalic Children", quoted by Howard Sloane and Barbara MacAulay, Eds., Operant Procedures In Remedial Speech and Language Training, Boston, Houghton Mifflin, 1968, p. 157-184.

Demonstrated that low-functioning children benefit from language if instructional efforts are structured and used simultaneously with appropriate reinforcement techniques.

Robinson, Halbert, B., and Nancy M., Robinson, The Mentally Retarded Child, New York, McGraw-Hill, 1965, iv-456 p.

An excellent source book for general data on mental retardation. All topics are treated from an empirical frame of reference.

Ross, Dorothea, "Incidental Learning of Number Concepts In Small Group Games", American Journal of Mental Deficiency, Vol. 75, No. 6, Issue of June, 1970, p. 718-725.

Described the use of a nine-month game program in the teaching of number concepts to 20 EMR children. The significance of this study lies in the group-application of operant conditioning techniques.

Skinner, B.F., Verbal Behavior, New York, Appleton-Century-Crofts, 1957, vii-481 p.

A behavioristic analysis of language. A classic in this area.

Sloane, Howard N., Margaret K. Johnson, Florence R. Harris, "Remedial Procedures For Teaching Verbal Behavior To Speech Deficient Or Defective Young Children", quoted by Howard N. Sloane, Barbara Dana MacAulay, Eds., Operant Procedures In Remedial Speech and Language Training, Boston, Houghton Mifflin, 1968, p. 77-100.

Described a language program consisting of a ten stage imitative sequence, fading techniques, and contingent positive and negative reinforcement. Treatment effects were significant.

Spreen, Atfried, "Language Functions In Mental Retardation: A Review I, Language Development, Types of Retardation, and Intelligence Level", American Journal of Mental Deficiency, Vol. 69, No. 5, Issue of January, 1965, p. 482-494.

A good review of language functions in mental deficiency. Deals with incidence, cause and consequences of language deficit rather than with assessment, treatment and other more specific questions of speech pathology.

Talkington, Larry W., Sylvia Hall, "Matrix Language Program With Mongoloids", American Journal of Mental Deficiency, Vol. 75, No. 1, Issue of May, 1970, p. 88-91.

Reported a successful language and concept formation program for moderately retarded mongoloid children.

Wheeler, Andrew J. and Beth Sulzer, "Operant Training and Generalization of A Verbal Response Form In A Speech-Deficient Child", Journal of Applied Behavior Analysis, Vol. 3, No. 2, Issue of March, 1970, p. 139-147.

A program consisting of a combination of chaining, imitative prompting, and differential reinforcement was employed by the authors to promote syntax in an eight-year-old retardate. The results of this study suggests the efficacy of the operant approach in the promotion and development of complex verbal behaviors in retarded children.

APPENDIX 1
SUBJECT DATA

Table XIX.- Daily Medication Administered To The Experimental Group.

Subject	Drug(s)	Dosage	Frequency of Administration	Nature of the Drug
Bob	Mellaril	25mg ^a	TID ^b	Tranquilizer
Tom	Mellaril	75mg	TID	Tranquilizer
Henry	Phenobarb.	30mg	TID	Seizure Depressant
Brian	Phenobarb. Nozinan	30mg 15mg	TID BID ^c	Seizure Depressant Tranquilizer
Bill	Phenobarb. Dilantin Mellaril	30mg 75mg 20mg	TID BID BID	Seizure Depressant Seizure Depressant Seizure Depressant
Art	Mellaril Phenobarb.	10mg 50mg	TID BID	Tranquilizer Seizure Depressant
Paul	Dilantin Mysoline Mellaril Phenobarb.	30mg 250mg 10mg 30mg	TID TID OD ^d BID	Seizure Depressant Anticonvulsant Tranquilizer Seizure Depressant
Ken	Phenobarb. Largactil Dilantin	30mg 25mg 25mg	TID TID BID	Seizure Depressant Tranquilizer Seizure Depressant
Larry	Phenobarb.	15mg	TID	Seizure Depressant
Sam	NOTHING	--	--	---
Dave	NOTHING	--	--	---
Louis	NOTHING	--	--	---

a milogram; b three times daily; c two times daily;
d once daily.

Table XX.- Daily Medication Administered To The Control Group.

Subject	Drug(s)	Dosage	Frequency of Administration	Nature of the Drug
Joe	Phenobarb.	50mg ^a	TID ^b	Seizure Depressant
	Dilantin	50mg	TID	Seizure Depressant
Roy	Phenobarb.	30mg	TID	Seizure Depressant
	Nozinan	25mg	TID	Tranquilizer
	Dilantin	50mg	BID ^c	Seizure Depressant
Tony	Mellaril	25mg	TID	Tranquilizer
John	Phenobarb.	15mg	TID	Seizure Depressant
Jack	Phenobarb.	15mg	TID	Seizure Depressant
	Dilantin	30mg	TID	Seizure Depressant
	Dilantin D.L. ^d	100mg	E ^e	Seizure Depressant
Jim	Phenobarb.	15mg	TID	Seizure Depressant
	Nozinan	75mg	TID	Tranquilizer
Fred	Mellaril	10mg	TID	Tranquilizer
Doug	Mellaril	25mg	TID	Tranquilizer
George	Mellaril	10mg	TID	Tranquilizer
Jerry	NOTHING	--	--	---
Russ	NOTHING	--	--	---
Dan	NOTHING	--	--	---

a milogram; b three times daily; c two times daily;
d delayed action; e evenings.

Table XXI.- Number of Correct Responses On The
Stanford-Binet Picture Vocabulary Test.

Subject	Experimental Group Correct Responses S-BPVT	Subject	Control Group Correct Responses S-BPVT
Bob	0	Joe	7
Tom	2	Roy	0
Henry	0	Tony	0
Brian	0	John	4
Bill	4	Jack	5
Art	0	Jim	0
Paul	7	Fred	0
Ken	9	Doug	9
Larry	0	George	0
Sam	3	Jerry	12
Dave	7	Russ	2
Louis	2	Dan	2
Σ	34		41

Table XXII.- Amount of Time Required During The 15 Day Training Period.

Subject	Experimental Group		Subject	Control Group	
	Total Time: \bar{X} (minutes)	Time Per Day: (minutes)		Total Time: \bar{X} (minutes)	Time Per Day: (minutes)
Bob	204	13.60	Joe	229	15.26
Tom	186	12.40	Roy	245	16.33
Henry	237	15.80	Tony	231	15.40
Brian	227	15.13	John	213	14.20
Bill	210	14.00	Jack	224	14.93
Art	223	14.86	Jim	234	15.60
Paul	183	12.20	Fred	240	16.00
Ken	209	13.93	Doug	207	13.80
Larry	226	15.06	George	234	15.60
Sam	215	14.33	Jerry	229	15.26
Dave	175	11.66	Russ	243	16.20
Louis	208	13.86	Dan	245	16.33
Total Minutes Per Group:	2503	Group Mean: 13.90		2774	Group Mean: 15.40

APPENDIX 2
ORGANIZATION OF RAW DATA

Table XXIII.- Summary of Pre-test, Posttest, and D-Scores Results For Experimental and Control Groups: Expressive Concept Acquisition.

Group:	Experimental						Control					
	C	S	M	▲	■	○	C	S	M	▲	■	○
\bar{X} Pre-test Performance	2	2.66	2.75	0	0	0	2.12	2.58	2.75	0	0	0
\bar{X} Posttest Performance	6.72	2.83	5.91	3.50	3.62	5.37	3.29	2.66	2.95	0	.41	.12
D-Scores: (Pre-test vs Posttest I)	61.5	47.	40.5	42.	41.	64.5	18.5	-.5	7.5	0	5.	1.5
Sum of D-Scores: (Pre-test vs Posttest I)	(296.5)						(32.0)					
\bar{X} Posttest II Performance	6.62	6.45	6.45	2.75	2.04	5.37	2.83	3.25	2.75	.25	0	0
D-Scores: (Pre-test vs Posttest II)	55.5	45.5	42.5	33.	24.5	64.5	7.5	6.0	0	3	0	0
Sum of D-Scores: (Pre-test vs Posttest II)	(265.50)						(16.50)					
D-Scores: (Posttest I vs Posttest II)	-2	.5	-1.5	-9.0	-19.0	0	0	16.5	3	3.	-5	-1.5
Sum of D-Scores: (Posttest I vs Posttest II)	(-31)						(16.0)					

Table XXIV.- Summary of Pre-test, Posttest, and D-Scores Results For Experimental and Control Groups: Receptive Concept Acquisition.

Group:	Experimental						Control					
	C	S	M	▲	■	○	C	S	M	▲	■	○
\bar{X} Pre-test Performance	3.25	3.33	3.41	0	0	0	3.12	3.20	3.37	0	0	0
\bar{X} Posttest Performance	8.87	8.37	8.45	3.41	3.29	4.62	4.33	3.70	3.41	.16	.29	.12
D-Scores: (Pre-test vs Posttest I)	62.	61.	64.5	41.	39.5	57.5	6.0	8.0	9.5	2.	3.	2.
Sum of D-Scores: (Pre-test vs Posttest I)			(325.5)						(23.5)			
\bar{X} Posttest II Performance	7.54	7.54	7.37	3.12	3.20	4.29	4.66	4.58	4.58	.33	.25	.41
D-Scores: (Pre-test vs Posttest II)	53.5	50.5	47.5	37.5	38.5	47.	18.5	16.5	14.5	4.0	3.0	5.0
Sum of D-Scores: (Pre-test vs Posttest II)			(274.50)						(61.50)			
D-Scores: (Posttest I vs Posttest II)	-15.	-6.	-13.	-3.5	-1.	-4.	4.	.5	14.	2.0	-.5	3.5
Sum of D-Scores: (Posttest I vs Posttest II)			(-42.5)						(23.5)			

Table XXV.- Pre-test Results For Experimental Group: Expressive Concept Acquisition.

Subject	Pre-test I (A.M.)						Pre-test II (P.M.)						\bar{X} Pre-test Performance ^a					
	C	S	M	▲	■	○	C	S	M	▲	■	○	C	S	M	▲	■	○
Bob	0	1	1	0	0	0	0	1	3	0	0	0	0	1	4	0	0	0
Tom	0	0	1	0	0	0	0	2	1	0	0	0	0	1	1	0	0	0
Henry	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
Brian	0	1	0	0	0	0	4	3	4	0	0	0	2	2	2	0	0	0
Bill	5	7	7	0	0	0	9	7	9	0	0	0	7	7	8	0	0	0
Art	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paul	8	5	9	0	0	0	8	9	5	0	0	0	8	7	7	0	0	0
Ken	1	3	3	0	0	0	3	3	5	0	0	0	2	3	4	0	0	0
Larry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sam	0	4	0	0	0	0	0	6	0	0	0	0	0	5	0	0	0	0
Dave	5	5	5	0	0	0	5	5	9	0	0	0	5	5	7	0	0	0
Louis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Σ	19	27	26	0	0	0	29	37	36	0	0	0	24	32	33	0	0	0
\bar{X}	1.58	2.25	2.16	0	0	0	2.41	3.08	3.	0	0	0	2	2.66	2.75	0	0	0

a Pre-test I + Pre-test II \div 2.

Table XXVI.- Pre-test Results For Control Group: Expressive Concept Acquisition.

Subject	Pre-test I (A.M.)						Pre-test II (P.M.)						\bar{X} Pre-test Performance ^a					
	C	S	M	▲	■	○	C	S	M	▲	■	○	C	S	M	▲	■	○
Joe	5	1	6	0	0	0	5	4	8	0	0	0	5	3	7	0	0	0
Roy	0	0	0	0	0	0	0	4	0	0	0	0	0	2	0	0	0	0
Tony	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
John	3	3	6	0	0	0	3	9	7	0	0	0	3	6	6.5	0	0	0
Jack	3	7	3	0	0	0	3	6	5	0	0	0	3	6.5	4	0	0	0
Jim	1	2	0	0	0	0	2	1	1	0	0	0	1.5	1.5	.5	0	0	0
Fred	3	3	0	0	0	0	4	3	4	0	0	0	3.5	3	2	0	0	0
Doug	1	3	4	0	0	0	5	3	8	0	0	0	3	3	6	0	0	0
George	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0
Jerry	4	6	3	0	0	0	4	4	7	0	0	0	4	5	5	0	0	0
Russ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dan	2	0	2	0	0	0	3	0	2	0	0	0	2.5	0	2	0	0	0
Σ	22	25	24	0	0	0	29	36	42	0	0	0	25.5	31	33	0	0	0
\bar{X}	1.83	2.08	2	0	0	0	2.41	3	3.5	0	0	0	2.12	2.58	2.75	0	0	0

a Pre-test I + Pre-test II \div 2.

Table XXVII.- Pre-test Results For Experimental Group: Receptive Concept Acquisition.

Subject	Pre-test I (A.M.)						Pre-test II (P.M.)						\bar{X} Pre-test Performance ^a					
	C	S	M	▲	■	○	C	S	M	▲	■	○	C	S	M	▲	■	○
Bob	0	0	4	0	0	0	0	2	6	0	0	0	0	1	5	0	0	0
Tom	3	1	4	0	0	0	3	3	4	0	0	0	3	2	4	0	0	0
Henry	2	0	0	0	0	0	4	2	0	0	0	0	3	1	0	0	0	0
Brian	1	5	4	0	0	0	1	5	2	0	0	0	1	5	3	0	0	0
Bill	7	8	8	0	0	0	9	6	8	0	0	0	8	7	8	0	0	0
Art	5	0	2	0	0	0	3	0	2	0	0	0	4	0	2	0	0	0
Paul	4	7	5	0	0	0	6	7	7	0	0	0	5	7	6	0	0	0
Ken	3	3	0	0	0	0	5	3	0	0	0	0	4	3	0	0	0	0
Larry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sam	3	5	4	0	0	0	3	9	4	0	0	0	3	7	4	0	0	0
Dave	5	8	3	0	0	0	5	8	7	0	0	0	5	6	5	0	0	0
Louis	3	1	3	0	0	0	3	1	5	0	0	0	3	1	4	0	0	0
Σ	36	38	37	0	0	0	42	46	45	0	0	0	39	40	41	0	0	0
\bar{X}	3	3.16	3.08	0	0	0	3.50	3.83	3.75	0	0	0	3.25	3.33	3.41	0	0	0

a Pre-test I + Pre-test II \div 2.

Table XXVIII.- Pre-test Results For Control Group: Receptive Concept Acquisition.

Subject	Pre-test I (A.M.)						Pre-test II (P.M.)						\bar{X} Pre-test Performance ^a					
	C	S	M	▲	■	○	C	S	M	▲	■	○	C	S	M	▲	■	○
Joe	4	5	6	0	0	0	8	7	8	0	0	0	6	6	7	0	0	0
Roy	0	1	0	0	0	0	0	3	0	0	0	0	0	2	0	0	0	0
Tony	1	0	1	0	0	0	1	2	1	0	0	0	1	1	1	0	0	0
John	3	5	8	0	0	0	9	5	6	0	0	0	6	5	7	0	0	0
Jack	5	6	6	0	0	0	5	6	8	0	0	0	5	6	7	0	0	0
Jim	2	5	3	0	0	0	2	7	2	0	0	0	2	6	2.5	0	0	0
Fred	1	1	1	0	0	0	1	1	1	0	0	0	1	1	1	0	0	0
Doug	5	2	7	0	0	0	5	4	7	0	0	0	5	3	7	0	0	0
George	1	2	0	0	0	0	2	1	0	0	0	0	1.5	1.5	0	0	0	0
Jerry	5	4	8	0	0	0	5	6	6	0	0	0	5	5	7	0	0	0
Russ	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0
Dan	4	1	0	0	0	0	6	1	2	0	0	0	5	1	1	0	0	0
Σ	31	32	40	0	0	0	44	44	41	0	0	0	37.5	38.5	40.5	0	0	0
\bar{X}	2.58	2.66	3.33	0	0	0	3.66	3.66	3.41	0	0	0	3.12	3.20	3.37	0	0	0

^a Pre-test I + Pre-test II \div 2.

Table XXIX.- Posttest I Results For Experimental Group: Expressive Concept Acquisition.

Subject	Posttest I (A) (A.M.)						Posttest I (B) (P.M.)						\bar{X} Posttest I Performance ^a					
	C	S	M	▲	■	○	C	S	M	▲	■	○	C	S	M	▲	■	○
Bob	10	10	10	1	2	10	9	9	10	5	4	10	9.5	9.5	10	3	3	10
Tom	10	10	10	10	10	10	10	9	9	10	10	10	10	9.5	9.5	10	10	10
Henry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brian	8	1	4	0	0	0	6	0	4	0	0	0	7	.5	4	0	0	0
Bill	10	10	10	2	2	3	10	10	10	6	7	4	10	10	10	4	4.5	3.5
Art	1	0	0	0	0	0	0	0	0	0	0	0	.5	0	0	0	0	0
Paul	10	10	10	9	9	10	10	10	10	10	10	10	10	10	10	9.5	9.5	10
Ken	10	10	10	0	0	6	10	9	9	1	0	7	10	9.5	9.5	.5	0	6.5
Larry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sam	10	10	2	0	10	10	10	10	1	0	9	8	10	10	1.5	0	9.5	0
Dave	10	10	10	8	6	6	10	10	10	8	8	7	10	10	10	8	7	6.5
Louis	10	10	6	6	0	8	10	10	7	8	0	10	10	10	6.5	7	0	9
Σ													80.70	34.00	71.00	42	43.50	64.50
\bar{X}													6.72	2.83	5.91	3.5	3.62	5.37

^a Posttest I (A) + Posttest I (B) ÷ 2.

Table XXX.- Posttest I Results For Control Group: Expressive Concept Acquisition.

Subject	Posttest I (A) (A.M.)						Posttest I (B) (P.M.)						\bar{X} Posttest I Performance ^a					
	C	S	M	▲	■	○	C	S	M	▲	■	○	C	S	M	▲	■	○
Joe	8	2	10	0	0	0	6	4	10	0	0	0	7	3	10	0	0	0
Roy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tony	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
John	5	8	4	0	0	0	5	6	6	0	0	0	5	7	5	0	0	0
Jack	6	10	0	0	0	0	0	3	1	0	0	0	3	6.5	.5	0	0	0
Jim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fred	4	0	0	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0
Doug	10	6	1	0	8	0	10	10	10	0	2	3	10	8	5.5	0	5	1.5
George	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Jerry	10	8	6	0	0	0	10	9	4	0	0	0	10	7.5	5	0	0	0
Russ	1	0	0	0	0	0	1	0	1	0	0	0	1	0	.5	0	0	0
Dan	1	0	10	0	0	0	0	0	8	0	0	0	.5	0	9	0	0	0
Σ													39.5	32	35.5	0	5	1.5
\bar{X}													3.29	2.66	2.95	.41		.12

a Posttest I (A) + Posttest I (B) ÷ 2.

APPENDIX 2

Table XXXI.- Posttest I Results For Experimental Group: Receptive Concept Acquisition.

Subject	Posttest I (A) (A.M.)						Posttest I (B) (P.M.)						\bar{X} Posttest I Performance ^a					
	C	S	M	▲	■	○	C	S	M	▲	■	○	C	S	M	▲	■	○
Bob	10	10	10	1	5	10	10	10	9	0	6	9	10	10	9.5	.5	5.5	9.5
Tom	10	10	10	10	10	10	10	10	8	9	10	10	10	10	9	9.5	10	10
Henry	8	9	10	0	1	0	10	7	10	0	0	0	9	8	10	0	.5	0
Brian	3	2	4	0	0	0	4	5	6	0	1	0	3.5	3.5	5	0	.5	0
Bill	10	10	10	3	4	2	10	10	10	3	4	6	10	10	10	3	4	4
Art	9	7	5	0	0	0	9	6	7	0	0	1	9	6.5	6	0	0	.5
Paul	10	10	10	9	8	10	10	10	10	10	10	10	10	10	10	9.5	9	10
Ken	10	10	10	6	1	3	10	9	10	5	1	5	10	9.5	10	5.5	1	4
Larry	5	3	0	0	0	0	5	2	0	0	1	0	5	3	2	0	.5	0
Sam	10	10	10	5	1	5	10	10	10	5	3	6	10	10	10	5	2	5.5
Dave	10	10	10	6	6	6	10	10	10	5	6	10	10	10	10	5.5	6	8
Louis	10	10	10	3	0	3	10	10	10	2	1	5	10	10	10	2.5	.5	4
Σ													106.5	100.5	101.5	41	39.5	55.5
\bar{X}													8.86	8.37	8.45	3.41	3.29	4.62

a Posttest I (A) + Posttest I (B) ÷ 2.

Table XXXII.- Posttest I Results For Control Group: Receptive Concept Acquisition.

Subject	Posttest I (A) (A.M.)						Posttest I (B) (P.M.)						\bar{X} Posttest I Performance ^a					
	C	S	M	▲	■	○	C	S	M	▲	■	○	C	S	M	▲	■	○
Joe	9	10	8	0	1	0	10	9	8	0	1	0	9.5	9.5	8	0	.5	0
Roy	1	0	0	0	0	1	0	0	1	0	1	0	.5	0	.5	0	.5	.5
Tony	5	0	1	0	0	0	1	1	0	0	0	0	3.	.5	.5	0	0	0
John	9	10	10	1	0	0	10	10	10	0	1	0	9.5	10	10	.5	.5	0
Jack	1	1	0	0	0	0	4	3	4	0	0	0	2.5	2	2	0	0	0
Jim	0	0	0	0	0	0	0	1	1	0	0	0	0	.5	.5	0	0	0
Fred	4	1	0	0	0	0	5	0	0	0	0	0	4.5	.5	0	0	0	0
Doug	5	5	5	0	1	0	10	10	10	2	1	1	7.5	7.5	7.5	1	1	.5
George	2	2	1	0	0	0	1	2	2	0	0	0	1.5	2	1.5	0	0	0
Jerry	6	5	5	0	1	0	5	5	6	1	0	0	5.5	5	5.5	.5	.5	0
Russ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dan	8	7	6	0	0	0	8	7	7	0	1	1	8	7	5	0	.5	.5
Σ													52	44.5	41	2	35	1.5
\bar{X}													4.33	3.70	3.41	.16	.29	.12

^a Posttest I (A) + Posttest I (B) ÷ 2.

Table XXXIII.- Posttest II^a Results For Experimental Group: Expressive Concept Acquisition.

Subject	Posttest II (A) (A.M.)						Posttest II (B) (P.M.)						\bar{X} Posttest II Performance ^b					
	C	S	M	▲	■	○	C	S	M	▲	■	○	C	S	M	▲	■	○
Bob	10	10	10	0	0	10	10	9	10	0	0	9	10	9.5	10	0	0	9.5
Tom	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
Henry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Brian	2	1	0	0	0	0	2	3	1	0	0	0	2	2	.5	0	0	0
Bill	10	9	9	7	0	0	10	10	10	5	0	1	10	9.5	9.5	6	0	.5
Art	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paul	10	10	10	7	0	10	9	10	9	7	1	10	9.5	10	9.5	7	.5	10
Ken	10	10	10	0	0	9	10	10	10	0	0	9	10	10	10	0	0	9
Larry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sam	10	9	5	0	6	7	9	9	8	0	5	6	9.5	9	6.5	0	5.5	6.5
Dave	9	9	10	8	9	10	10	10	10	8	8	9	9.5	9.5	10	8	8.5	9.5
Louis	9	8	10	2	0	10	9	8	9	2	0	9	9	8	9.5	2	0	9.5
Σ													79.5	77.50	77.50	33	24.50	64.50
\bar{X}													6.62	6.45	6.45	2.75	2.04	5.37

a Three week retention test; b Posttest II (A) + Posttest II (B) ÷ 2.

Table XXXIV.- Posttest II^a Results For Experimental Group: Receptive Concept Acquisition.

Subject	Posttest II (A) (A.M.)						Posttest II (B) (P.M.)						\bar{X} Posttest II Performance ^b					
	C	S	M	▲	■	○	C	S	M	▲	■	○	C	S	M	▲	■	○
Bob	10	10	10	1	1	10	10	10	9	1	2	9	10	10	9.5	1	1.5	5
Tom	10	10	10	10	10	10	10	10	9	10	9	9	10	10	9.5	10	9.5	9.5
Henry	7	6	7	1	0	0	7	6	6	1	0	0	7	6	6.5	1	0	0
Brian	1	1	0	0	0	0	1	1	1	0	0	0	1	1	.5	0	0	0
Bill	10	10	10	4	1	1	9	10	10	3	2	2	9.5	10	10	3.5	1.5	1.5
Art	5	5	5	0	0	0	3	4	3	0	0	0	4	4.5	4	0	0	0
Paul	10	10	10	8	8	9	10	10	10	9	9	9	10	10	10	8.5	8.5	9
Ken	10	10	10	1	2	8	9	8	9	1	3	8	9.5	9	9.5	1	2.5	5
Larry	1	1	0	0	0	0	1	0	1	0	0	0	1	.5	.5	0	0	0
Sam	10	10	10	1	1	7	9	10	8	1	1	8	9.5	10	9	1	1	7.5
Dave	10	10	10	5	6	7	10	10	10	5	7	7	10	10	10	5	6.5	7
Louis	10	9	9	7	7	8	10	10	10	6	8	6	10	9.5	9.5	6.5	7.5	7
Σ													91.5	90.5	88.5	37.5	38.5	51.5
\bar{X}													7.62	7.54	7.37	3.12	3.20	4.29

a Three week retention test; b Posttest II (A) + Posttest II (B) ÷ 2.

Table XXXV.- Posttest II^a Results For Control Group: Expressive Concept Acquisition.

Subject	Posttest II (A) (A.M.)						Posttest II (B) (P.M.)						\bar{X} Posttest II Performance ^b					
	C	S	M	▲	■	○	C	S	M	▲	■	○	C	S	M	▲	■	○
Joe	3	4	3	0	0	0	4	5	5	0	0	0	3.5	4.5	4	0	0	0
Roy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tony	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
John	10	10	9	0	0	0	9	10	9	0	0	0	9.5	10	9	0	0	0
Jack	7	7	0	0	0	0	5	8	0	0	0	0	6	7.5	0	0	0	0
Jim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fred	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Doug	6	10	5	2	0	0	5	7	6	4	0	0	5.5	8.5	5.5	3	0	0
George	0	1	0	0	0	0	1	0	0	0	0	0	.5	.5	0	0	0	0
Jerry	10	9	8	0	0	0	8	7	8	0	0	0	9	8	8	0	0	0
Russ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dan	0	0	5	0	0	0	0	0	8	0	0	0	0	0	6.5	0	0	0
Σ													34	39	33	3	0	0
\bar{X}													2.83	3.25	2.75	.25	0	0

a Three week retention test ; b Posttest II (A) + Posttest II (B) ÷ 2.

Table XXXVI.- Posttest II^a Results For Control Group: Receptive Concept Acquisition.

Subject	Posttest II (A) (A.M.)						Posttest II (B) (P.M.)						\bar{X} Posttest II Performance ^b					
	C	S	M	▲	■	○	C	S	M	▲	■	○	C	S	M	▲	■	○
Joe	4	5	5	1	1	1	4	6	7	0	0	1	4	5.5	6	.5	.5	1
Roy	1	1	0	0	0	0	0	0	0	0	0	0	.5	.5	0	0	0	0
Tony	4	5	5	1	0	0	4	6	5	0	1	0	4	5.5	5	.5	.5	0
John	10	10	10	1	0	0	10	10	10	0	0	0	10	10	10	.5	0	0
Jack	9	6	4	1	0	0	9	8	9	1	1	0	9	7	6.5	1	.5	0
Jim	5	4	6	0	0	0	1	0	0	0	0	0	3	2	3	0	0	0
Fred	2	2	0	0	0	0	3	0	0	1	0	0	2.5	1	0	.5	0	0
Doug	7	8	8	0	0	3	9	10	1	1	2	0	8	9	9	.5	1	1.5
George	0	1	0	0	0	0	0	0	0	0	0	0	0	.5	0	0	0	0
Jerry	10	10	10	0	1	5	10	10	9	0	0	0	10	10	9.5	0	.5	2.5
Russ	0	0	0	0	0	0	0	0	1	1	0	0	0	0	.5	.5	0	0
Dan	6	4	5	0	0	0	4	4	6	0	0	0	5	4	5.5	0	0	0
Σ													56	55	55	4	3	5
\bar{X}													4.66	4.58	4.58	.33	.25	.41

a Three week retention test; b Posttest II (A) + Posttest II (B) ÷ 2.

Table XXXVII.- Individual Mean Performance During The 15 Day Training
 Period: Set I.

Group: Subject	Experimental						Subject	Control					
	C	S	M	▲	■	○		C	S	M	▲	■	○
Bob	9.06	8.80	8.06	6.86	6.80	7.13	Joe	7.20	6.0	7.33	.86	1.06	.66
Tom	9.46	9.33	9.46	7.93	7.73	7.33	Roy	.06	0	.06	0	0	0
Henry	2.80	1.26	1.60	.80	.60	.33	Tony	0	0	0	0	0	0
Brian	2.20	.46	1.53	.13	.46	.06	John	8.46	8.06	7.80	.33	.20	0
Bill	9.53	9.20	9.60	8.73	8.66	8.40	Jack	8.26	7.80	6.73	.46	.60	.26
Art	.13	0	0	0	0	0	Jim	0	0	0	0	0	0
Paul	9.60	9.40	9.40	8.40	8.53	7.80	Fred	6.80	5.46	6.73	.66	1.06	1.13
Ken	8.73	8.53	9.26	3.40	3.66	4.80	Doug	8.20	8.00	6.60	7.06	8.06	7.53
Larry	1.06	.26	.53	.06	.06	.06	George	.46	.26	.40	.40	.46	.26
Sam	9.46	9.13	6.93	3.86	7.93	6.13	Jerry	9.40	9.33	9.33	3.33	1.66	1.80
Dave	9.53	9.26	9.53	9.06	8.80	8.66	Russ	3.06	2.26	.40	0	0	0
Louis	9.13	8.93	8.86	6.60	3.73	5.80	Dan	1.80	.66	7.00	0	0	0
Σ	30.69	74.50	74.82	55.83	56.96	56.90		53.70	47.83	52.38	13.10	13.84	11.64
	Total \bar{X} 399.76							Total \bar{X} 180.85					

APPENDIX 2

Table XXXVIII.- Individual Mean Set II Performance During The 15 Day Training Period.

Group: Subject	Experimental						Subject	Control					
	C	S	M	▲	■	○		C	S	M	▲	■	○
Bob	8.40	8.46	7.20	2.13	1.06	1.53	Joe	6.13	4.40	6.53	0.00	0.00	0.00
Tom	8.80	8.73	8.93	6.80	6.26	5.73	Roy	1.26	0.00	0.00	0.00	0.00	0.00
Henry	1.46	1.06	.20	0.00	0.00	0.00	Tony	0.00	0.00	0.00	0.00	0.00	0.00
Brian	1.93	.80	1.46	.06	.06	.06	John	5.53	5.46	5.40	.06	0.00	0.00
Bill	9.33	9.00	9.40	7.26	3.26	3.73	Jack	6.26	6.66	2.06	0.00	0.00	0.00
Art	0.00	0.00	0.00	0.00	0.00	0.00	Jim	0.00	0.00	0.00	0.00	0.00	0.00
Paul	9.33	9.06	8.93	6.53	7.53	7.33	Fred	1.53	.73	1.06	0.00	0.00	0.00
Ken	8.93	8.40	8.60	.66	.13	3.46	Doug	6.46	7.00	4.20	2.26	5.40	5.80
Larry	.33	.06	0.00	0.00	0.00	0.00	George	.33	.13	.06	.06	0.00	0.00
Sam	8.06	8.06	3.00	.20	3.60	4.46	Jerry	7.66	7.26	4.20	.06	0.00	0.00
Dave	9.13	9.00	8.60	7.33	6.80	6.13	Russ	.80	1.33	.26	0.00	0.00	0.00
Louis	6.73	5.60	6.00	2.20	.66	2.33	Dan	.86	.20	2.46	0.00	0.00	0.00
Σ	72.43	68.23	62.32	33.17	29.36	34.76		36.82	33.17	26.23	2.44	5.40	5.92
	Total \bar{X} 300.27							Total \bar{X} 109.99					

APPENDIX 2

Table XXXIX.- Individual Mean Set III Performance During The 15 Day Training Period.

Group: Subject	Experimental						Subject	Control					
	C	S	M	▲	■	●		C	S	M	▲	■	●
Bob	7.00	8.33	6.73	2.60	2.86	2.73	Joe	4.86	3.60	5.86	.06	.06	.13
Tom	.26	8.20	9.40	5.33	6.46	5.26	Roy	.26	.93	1.00	.20	.06	0
Henry	2.93	4.20	3.60	.13	0.00	.06	Tony	1.00	1.06	.86	.13	.13	.06
Brian	1.46	2.33	2.36	.26	.06	.06	John	3.00	2.93	2.80	1.20	.86	.93
Bill	9.20	8.73	9.53	5.00	3.40	3.20	Jack	5.46	5.26	5.13	0.00	.26	.13
Art	1.20	1.33	1.20	.06	.13	.13	Jim	.06	.06	0.00	.06	0.00	.06
Paul	9.06	8.00	9.93	6.46	6.60	5.46	Fred	1.06	1.33	1.00	.06	.06	.06
Ken	6.33	6.80	7.80	3.60	2.29	4.06	Doug	3.13	2.66	3.33	1.46	1.86	1.73
Larry	3.80	4.73	4.13	.06	.13	.06	George	.60	.80	.66	0.00	0.00	0.00
Sam	8.06	8.26	6.60	2.86	3.00	3.53	Jerry	5.40	4.80	5.20	.20	.20	.73
Dave	8.33	9.26	9.13	5.66	4.73	4.00	Russ	.40	1.33	.13	.06	0.00	0.00
Louis	6.20	7.20	6.26	3.26	3.06	2.86	Dan	1.73	1.80	.26	.06	.13	.06
Σ	72.83	77.37	75.57	35.28	32.72	31.41		27.89	27.96	27.69	3.62	3.75	3.89
	Total \bar{X} 325.18							Total \bar{X} 94.80					

APPENDIX 2

APPENDIX 3
ADDITIONAL STATISTICAL TREATMENTS

Table XL.- Difference in Mean Set I Performance
Between The Experimental and Control Groups.

df	\bar{X} E: Group	\bar{X} C: Group	SD E: Group	SD C: Group	(t-Test) ^a Value
22	500.00	240.83	338.21	228.66	2.10*

a Two-tailed test of significance

* p. < .05.

Table XLI.- Individual Concept Analysis of Variance^a
 Summary For Experimental Group: Expressive Concept Acquisition.

Concept		Sd	t ¹
A) "CAR"	1. Pre-test vs Posttest I: (\bar{X} = 2) (\bar{X} = 7.25)	1.66	3.16**
	2. Pre-test vs Posttest II: (\bar{X} = 2) (\bar{X} = 6.62)	1.66	2.78*
	3. Posttest I vs Posttest II: (\bar{X} = 7.25) (\bar{X} = 6.62)	1.66	0.37
B) "SPOON"	1. Pre-test vs Posttest I: (\bar{X} = 2.66) (\bar{X} = 6.58)	4.8	0.81
	2. Pre-test vs Posttest II: (\bar{X} = 2.66) (\bar{X} = 6.45)	4.8	0.78
	3. Posttest I vs Posttest II: (\bar{X} = 6.58) (\bar{X} = 6.45)	4.8	0.02
C) "MAN"	1. Pre-test vs Posttest I: (\bar{X} = 2.79) (\bar{X} = 5.91)	1.69	1.86
	2. Pre-test vs Posttest II: (\bar{X} = 2.79) (\bar{X} = 6.29)	1.69	2.09
	3. Posttest I vs Posttest II: (\bar{X} = 5.91) (\bar{X} = 6.29)	1.69	0.22
D) "TRIANGLE"	1. Pre-test vs Posttest I: (\bar{X} = 0) (\bar{X} = 3.50)	1.31	2.67*
	2. Pre-test vs Posttest II: (\bar{X} = 0) (\bar{X} = 2.75)	1.31	2.09
	3. Posttest I vs Posttest II: (\bar{X} = 3.50) (\bar{X} = 2.75)	1.31	0.57
E) "SQUARE"	1. Pre-test vs Posttest I: (\bar{X} = 0) (\bar{X} = 3.62)	1.33	2.72*
	2. Pre-test vs Posttest II: (\bar{X} = 0) (\bar{X} = 2.04)	1.33	1.53
	3. Posttest I vs Posttest II: (\bar{X} = 3.62) (\bar{X} = 2.04)	1.33	1.18
F) "CIRCLE"	1. Pre-test vs Posttest I: (\bar{X} = 0) (\bar{X} = 5.37)	1.53	3.50***
	2. Pre-test vs Posttest II: (\bar{X} = 0) (\bar{X} = 4.58)	1.53	2.99**
	3. Posttest I vs Posttest II: (\bar{X} = 5.37) (\bar{X} = 4.58)	1.53	0.51

^a Scheffe's Method of Variance Analysis

* p < .05

** p < .025

*** p < .01.

Table XLII.- Individual Concept Analysis of Variance^a
 Summary For Control Group: Expressive Concept Acquisition.

Concept		Sd	t ¹
A) "CAR"	1. Pre-test vs Posttest I: (\bar{X} = 2.12) (\bar{X} = 3.29)	1.88	0.62
	2. Pre-test vs Posttest II: (\bar{X} = 2.12) (\bar{X} = 2.83)	1.88	0.37
	3. Posttest I vs Posttest II: (\bar{X} = 3.29) (\bar{X} = 2.83)	1.88	0.24
B) "SPOON"	1. Pre-test vs Posttest I: (\bar{X} = 2.58) (\bar{X} = 2.66)	1.38	0.05
	2. Pre-test vs Posttest II: (\bar{X} = 2.58) (\bar{X} = 3.25)	1.38	0.48
	3. Posttest I vs Posttest II: (\bar{X} = 2.66) (\bar{X} = 3.25)	1.38	0.42
C) "MAN"	1. Pre-test vs Posttest I: (\bar{X} = 2.75) (\bar{X} = 2.95)	1.39	0.14
	2. Pre-test vs Posttest II: (\bar{X} = 2.75) (\bar{X} = 2.75)	1.39	0
	3. Posttest I vs Posttest II: (\bar{X} = 2.95) (\bar{X} = 2.75)	1.39	0.14
D) "TRIANGLE"	1. Pre-test vs Posttest I: (\bar{X} = 0) (\bar{X} = 0)	0	0
	2. Pre-test vs Posttest II: (\bar{X} = 0) (\bar{X} = 0)	0	0
	3. Posttest I vs Posttest II: (\bar{X} = 0) (\bar{X} = 0)	0	0
E) "SQUARE"	1. Pre-test vs Posttest I: (\bar{X} = 0) (\bar{X} = 0)	0	0
	2. Pre-test vs Posttest II: (\bar{X} = 0) (\bar{X} = 0)	0	0
	3. Posttest I vs Posttest II: (\bar{X} = 0) (\bar{X} = 0)	0	0
F) "CIRCLE"	1. Pre-test vs Posttest I: (\bar{X} = 0) (\bar{X} = 0)	0	0
	2. Pre-test vs Posttest II: (\bar{X} = 0) (\bar{X} = 0)	0	0
	3. Posttest I vs Posttest II: (\bar{X} = 0) (\bar{X} = 0)	0	0

a Scheffe's Method of Variance Analysis.

Table XLIII.- Individual Concept Analysis of Variance^a
 Summary For Experimental Group: Receptive Concept Acquisition.

Concept		Sd	t ¹
A) "CAR"	1. Pre-test vs Posttest I: (\bar{X} = 3.25) (\bar{X} = 8.87)	1.42	3.95***
	2. Pre-test vs Posttest II: (\bar{X} = 3.25) (\bar{X} = 6.79)	1.42	2.49
	3. Posttest I vs Posttest II: (\bar{X} = 8.87) (\bar{X} = 6.79)	1.42	1.46
B) "SPOON"	1. (Pre-test vs Posttest I: (\bar{X} = 3.33) (\bar{X} = 8.37)	1.26	4.00***
	2. Pre-test vs Posttest II: (\bar{X} = 3.33) (\bar{X} = 7.54)	1.26	3.34***
	3. Posttest I vs Posttest II: (\bar{X} = 8.37) (\bar{X} = 7.54)	1.26	0.65
C) "MAN"	1. Pre-test vs Posttest I: (\bar{X} = 3.41) (\bar{X} = 8.45)	1.14	4.42***
	2. Pre-test vs Posttest II: (\bar{X} = 3.41) (\bar{X} = 7.37)	1.14	3.47***
	3. Posttest I vs Posttest II: (\bar{X} = 8.45) (\bar{X} = 7.37)	1.14	0.94
D) "TRIANGLE"	1. Pre-test vs Posttest I: (\bar{X} = 0) (\bar{X} = 3.41)	1.19	2.86*
	2. Pre-test I vs Posttest II: (\bar{X} = 0) (\bar{X} = 3.12)	1.19	2.62*
	3. Posttest I vs Posttest II: (\bar{X} = 3.41) (\bar{X} = 3.12)	1.19	0.24
E) "SQUARE"	1. Pre-test vs Posttest I: (\bar{X} = 0) (\bar{X} = 3.29)	1.20	2.74*
	2. Pre-test vs Posttest II: (\bar{X} = 0) (\bar{X} = 3.20)	1.20	2.66*
	3. Posttest I vs Posttest II: (\bar{X} = 3.29) (\bar{X} = 3.20)	1.20	0.07
F) "CIRCLE"	1. Pre-test vs Posttest I: (\bar{X} = 0) (\bar{X} = 4.62)	2.91	1.58
	2. Pre-test vs Posttest I: (\bar{X} = 0) (\bar{X} = 4.29)	2.91	1.47
	3. Posttest I vs Posttest II: (\bar{X} = 4.62) (\bar{X} = 4.29)	2.91	0.11

a Scheffe's Method of Variance Analysis

* p < .05

*** p < .01.

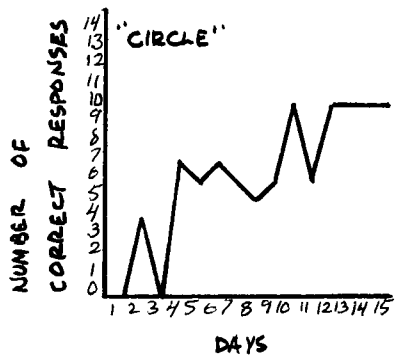
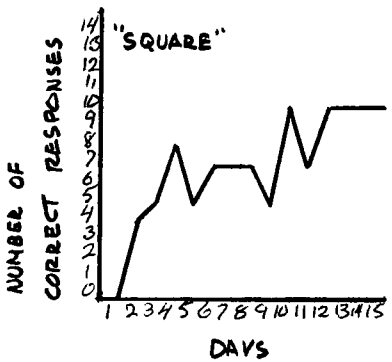
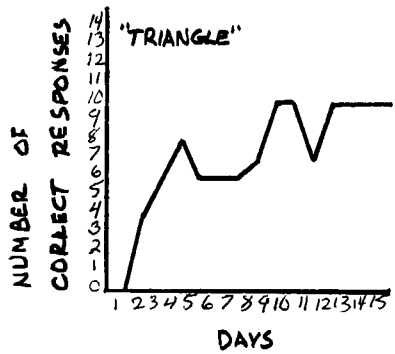
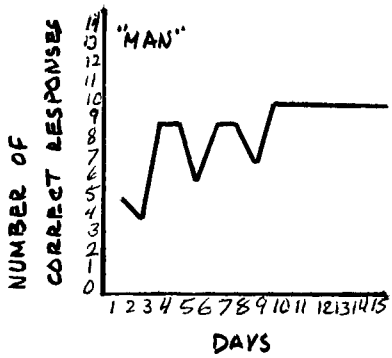
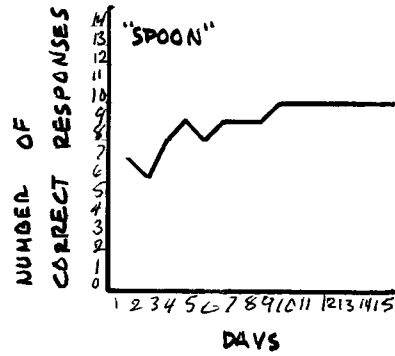
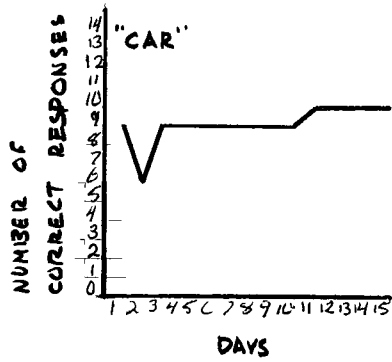
Table XLIV.- Individual Concept Analysis of Variance^a
 Summary For Control Group: Receptive Concept Acquisition.

Concept		Sd	t ¹
A) "CAR"	1. Pre-test vs Posttest I: (\bar{X} = 3.12) (\bar{X} = 4.33)	1.35	0.89
	2. Pre-test vs Posttest II: (\bar{X} = 3.12) (\bar{X} = 4.66)	1.35	1.14
	3. Posttest I vs Posttest II: (\bar{X} = 4.33) (\bar{X} = 4.66)	1.35	0.24
B) "SPOON"	1. Pre-test vs Posttest I: (\bar{X} = 3.20) (\bar{X} = 3.70)	1.37	0.36
	2. Pre-test vs Posttest II: (\bar{X} = 3.20) (\bar{X} = 4.58)	1.37	1.00
	3. Posttest I vs Posttest II: (\bar{X} = 3.70) (\bar{X} = 4.58)	1.37	0.64
C) "MAN"	1. Pre-test vs Posttest I: (\bar{X} = 3.37) (\bar{X} = 3.41)	1.05	0.03
	2. Pre-test vs Posttest II: (\bar{X} = 3.37) (\bar{X} = 4.58)	1.05	1.15
	3. Posttest I vs Posttest II: (\bar{X} = 3.41) (\bar{X} = 4.58)	1.05	1.11
D) "TRIANGLE"	1. Pre-test vs Posttest I: (\bar{X} = 0) (\bar{X} = .16)	.10	1.60
	2. Pre-test vs Posttest II: (\bar{X} = 0) (\bar{X} = .33)	.10	3.30***
	3. Posttest I vs Posttest II:	.10	1.70
E) "SQUARE"	1. Pre-test vs Posttest I: (\bar{X} = .29) (\bar{X} = .25)	.64	0.45
	2. Pre-test vs Posttest II: (\bar{X} = .29) (\bar{X} = .25)	.64	0.39
	3. Posttest vs Posttest II:	.64	0.62
F) "CIRCLE"	1. Pre-test vs Posttest I: (\bar{X} = 0) (\bar{X} = .12)	.20	0.60
	2. Pre-test vs Posttest II: (\bar{X} = 0) (\bar{X} = .41)	.20	2.05
	3. Posttest I vs Posttest II: (\bar{X} = .12) (\bar{X} = .41)	.20	1.45

a Scheffe's Method of Variance Analysis
 *** p < .01.

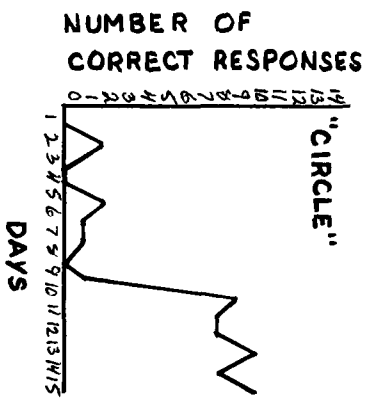
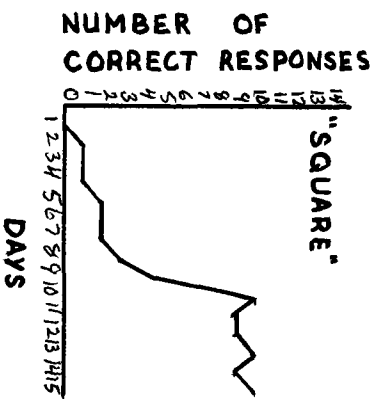
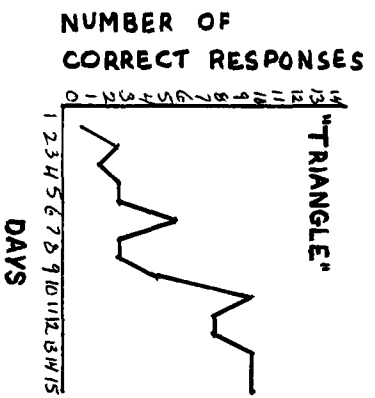
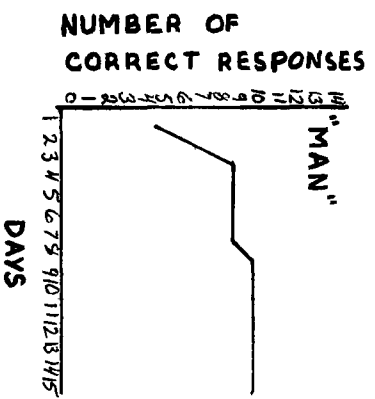
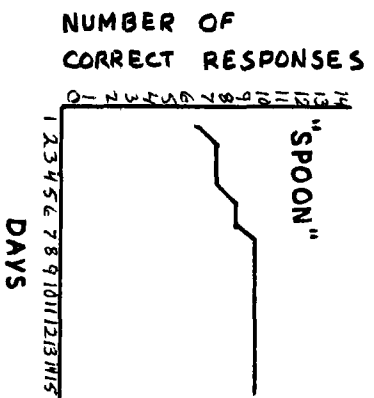
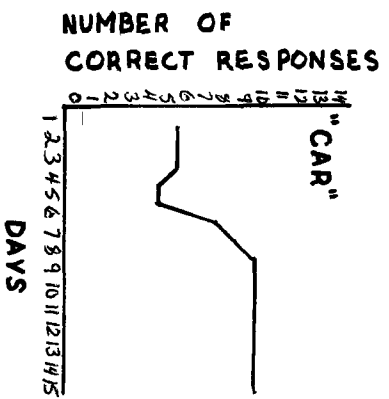
APPENDIX 4
INDIVIDUAL LEARNING CURVES

APPENDIX 4
EXPERIMENTAL GROUP (SETS II AND III)



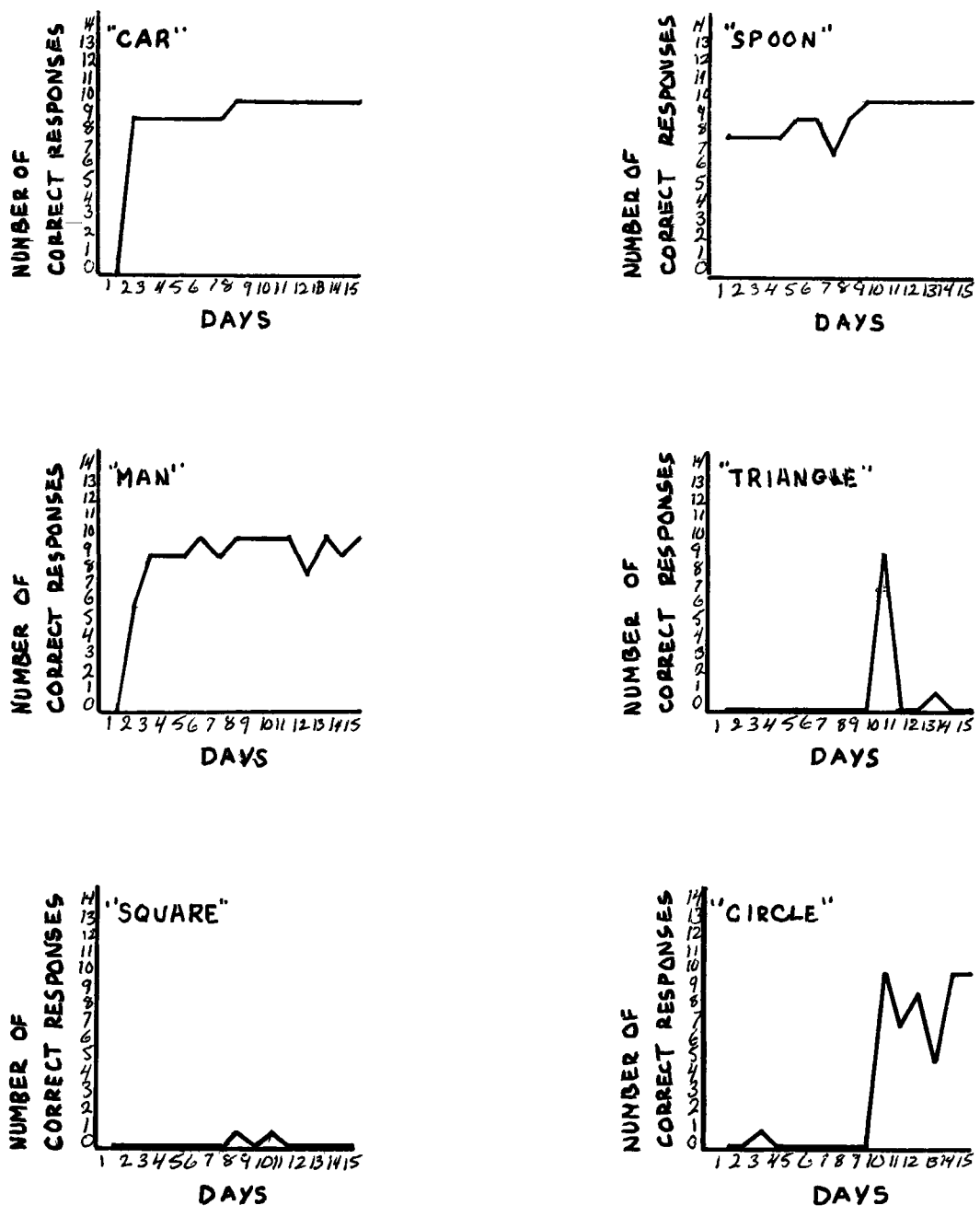
Dave's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 8



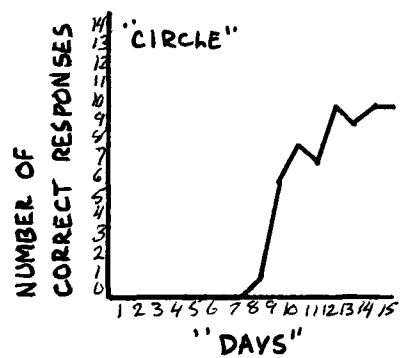
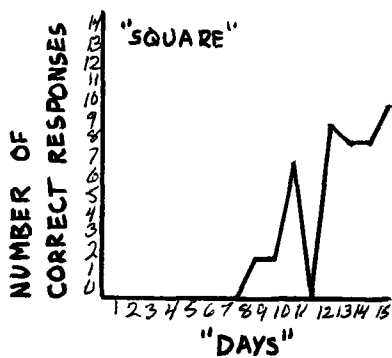
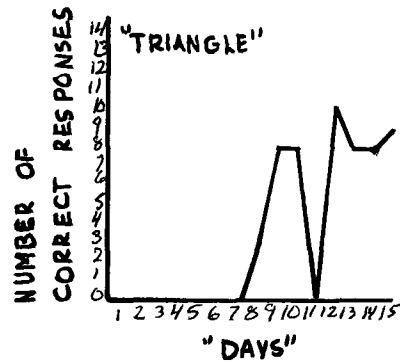
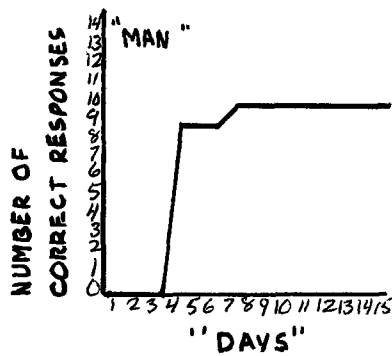
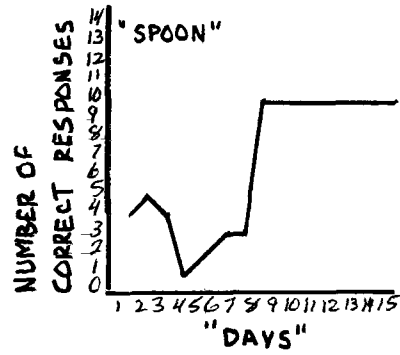
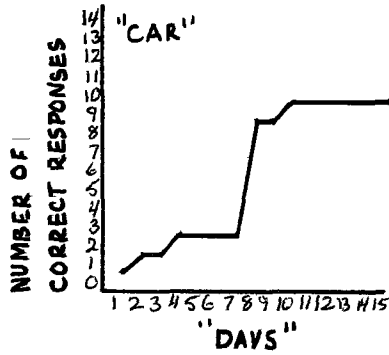
Dave's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 9



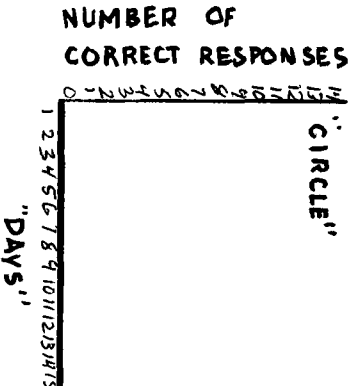
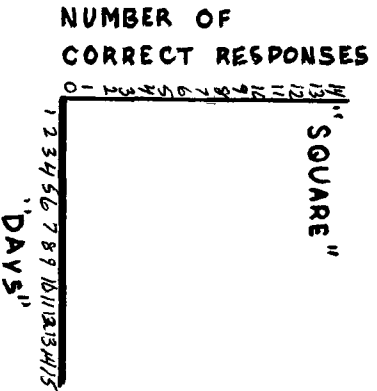
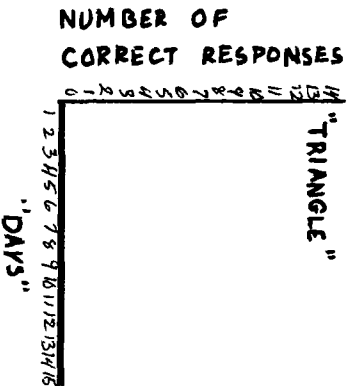
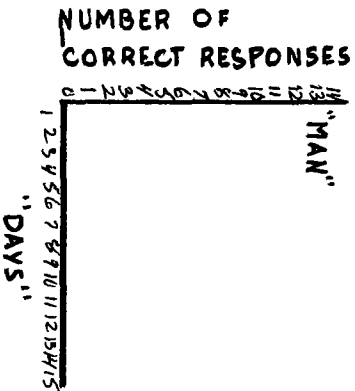
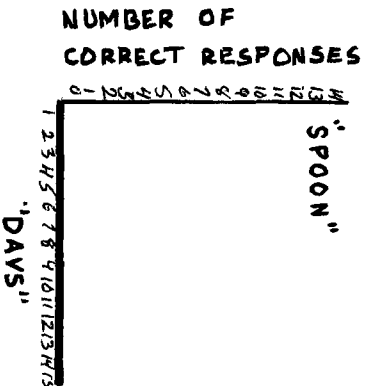
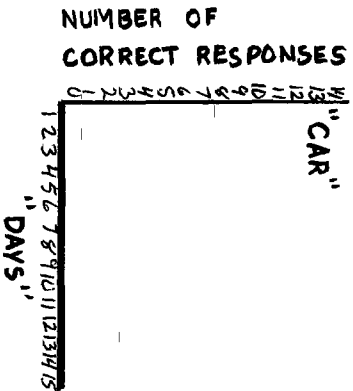
Ken's Correst Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 10



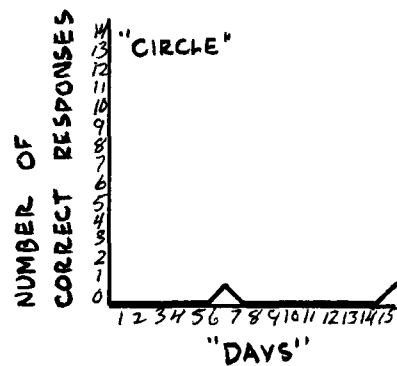
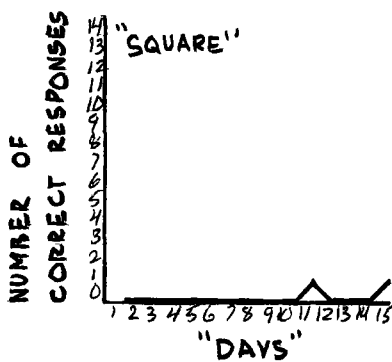
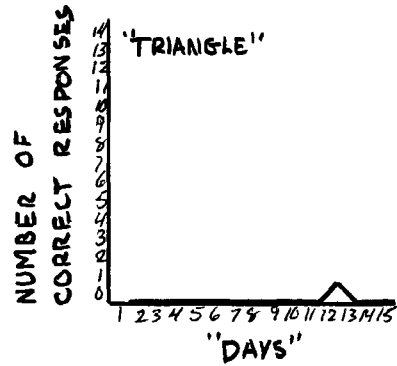
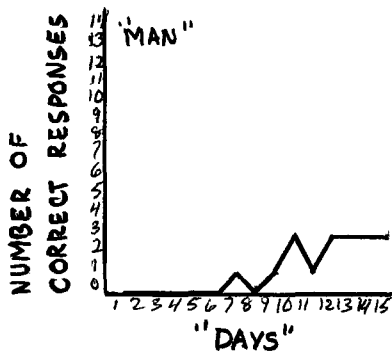
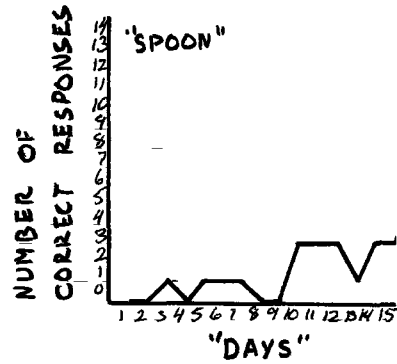
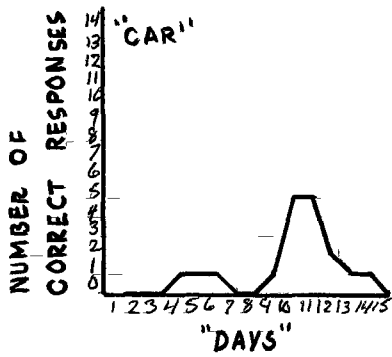
Ken's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE; Set III.

Figure 11



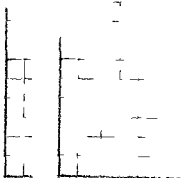
Larry's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II:

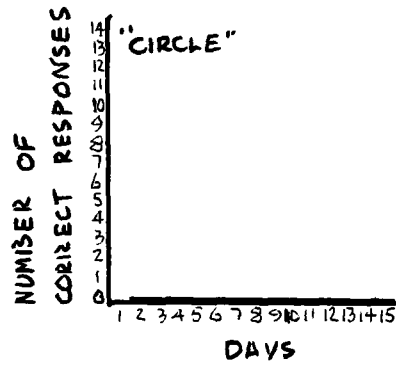
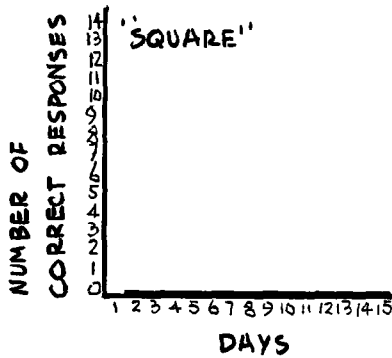
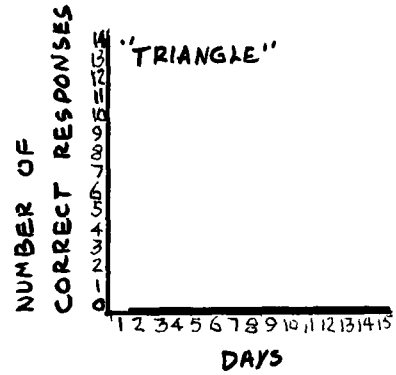
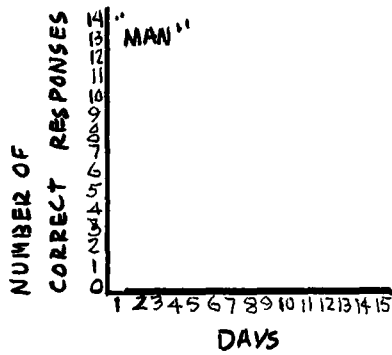
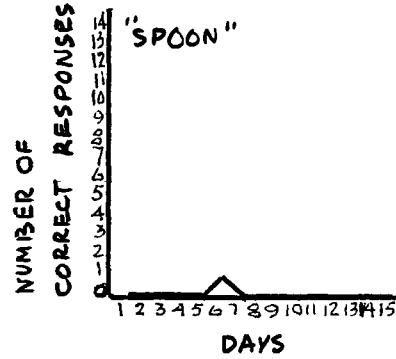
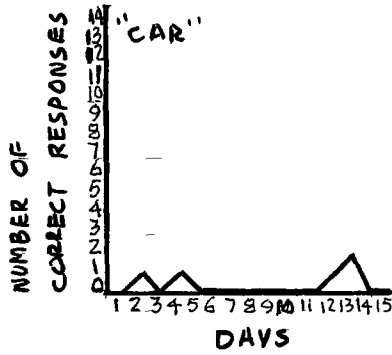
Figure 12



Larry's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

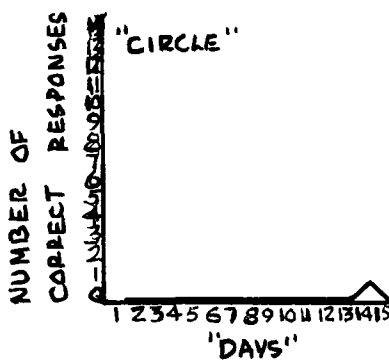
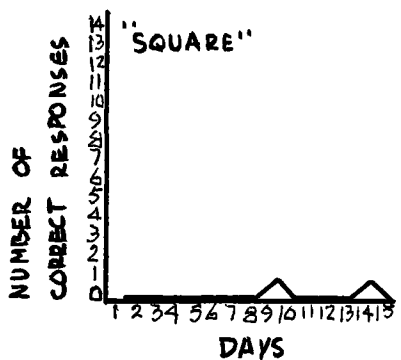
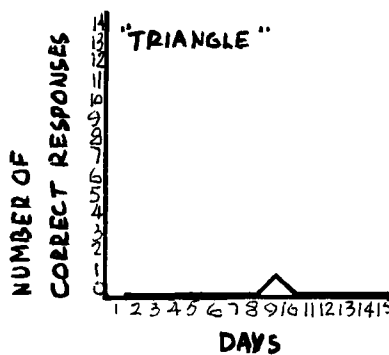
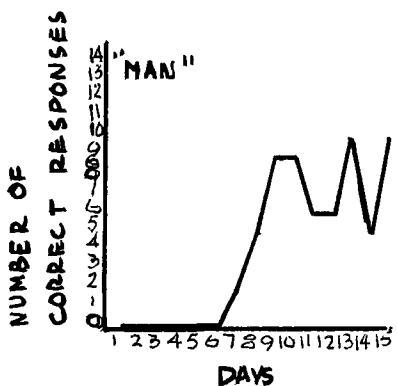
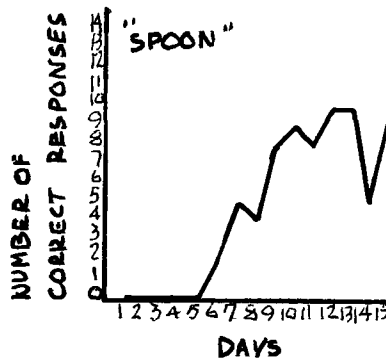
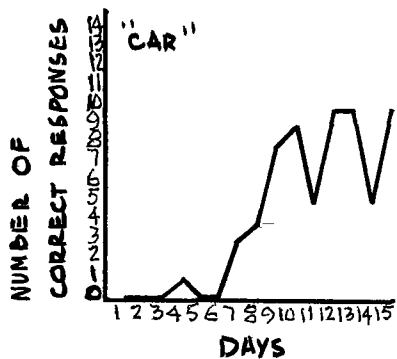
Figure 13





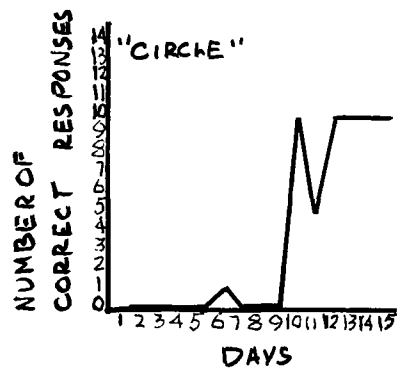
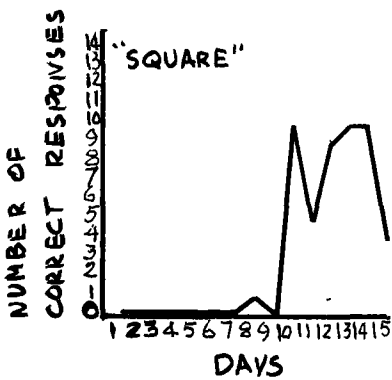
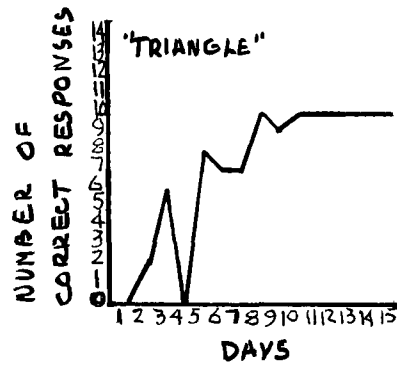
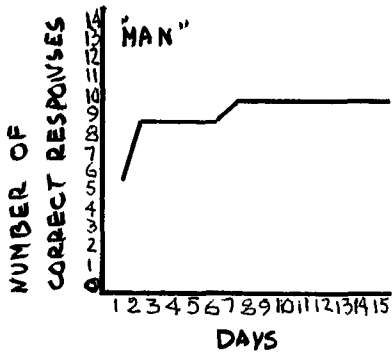
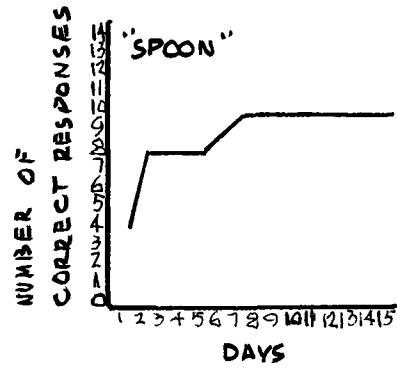
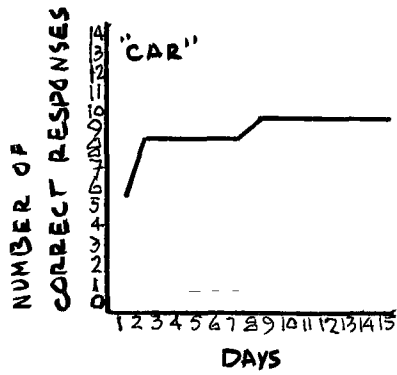
Art's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 14



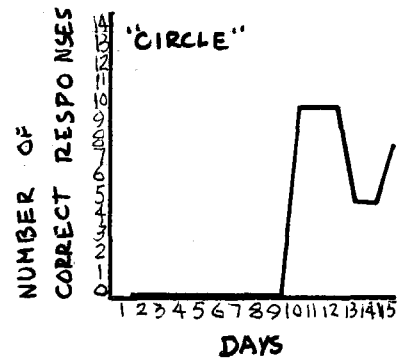
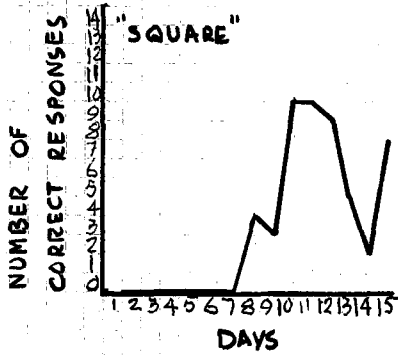
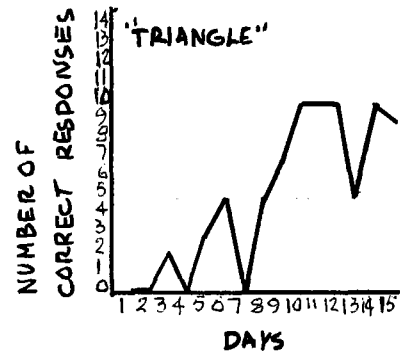
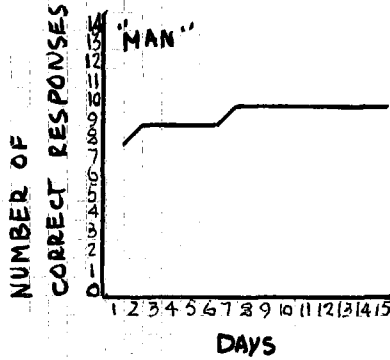
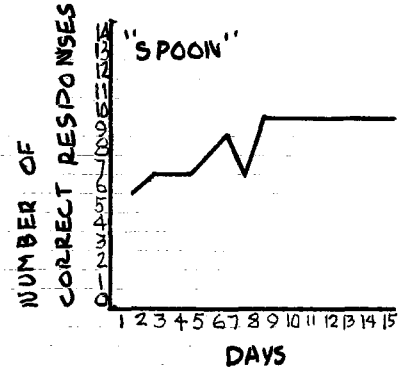
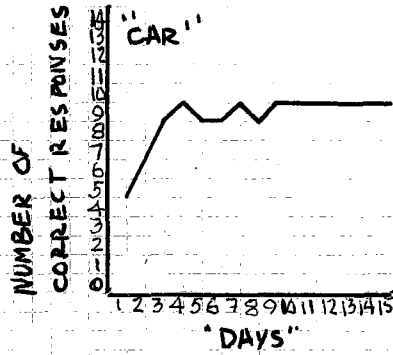
Art's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 15



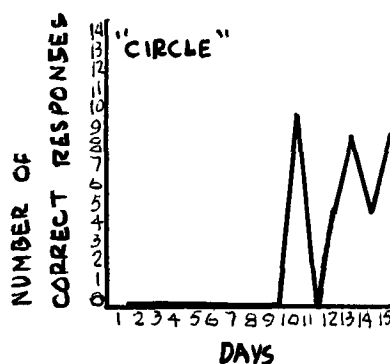
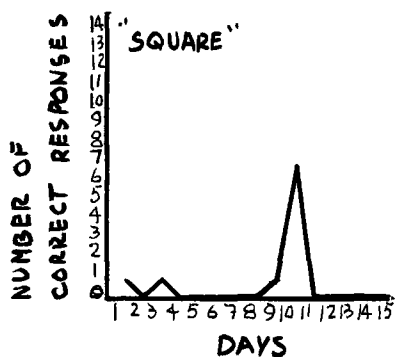
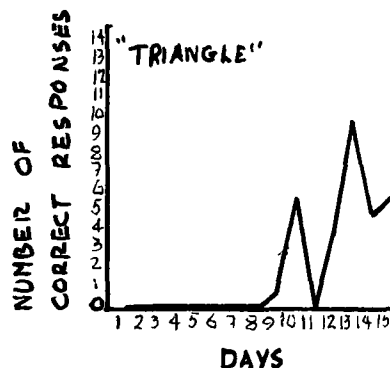
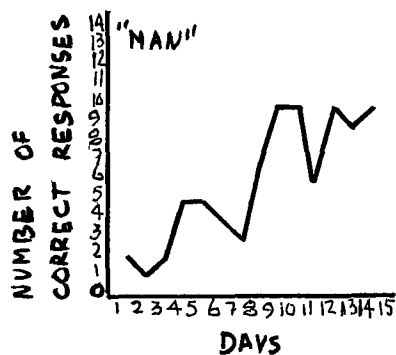
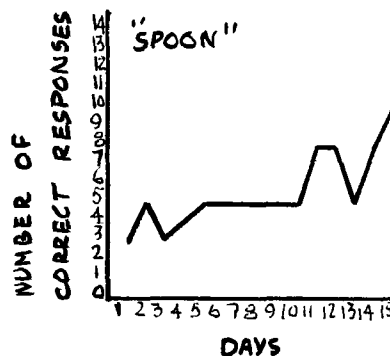
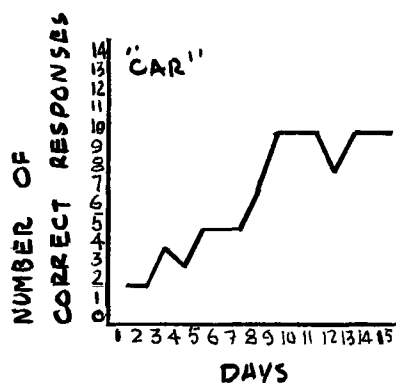
Bill's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 16



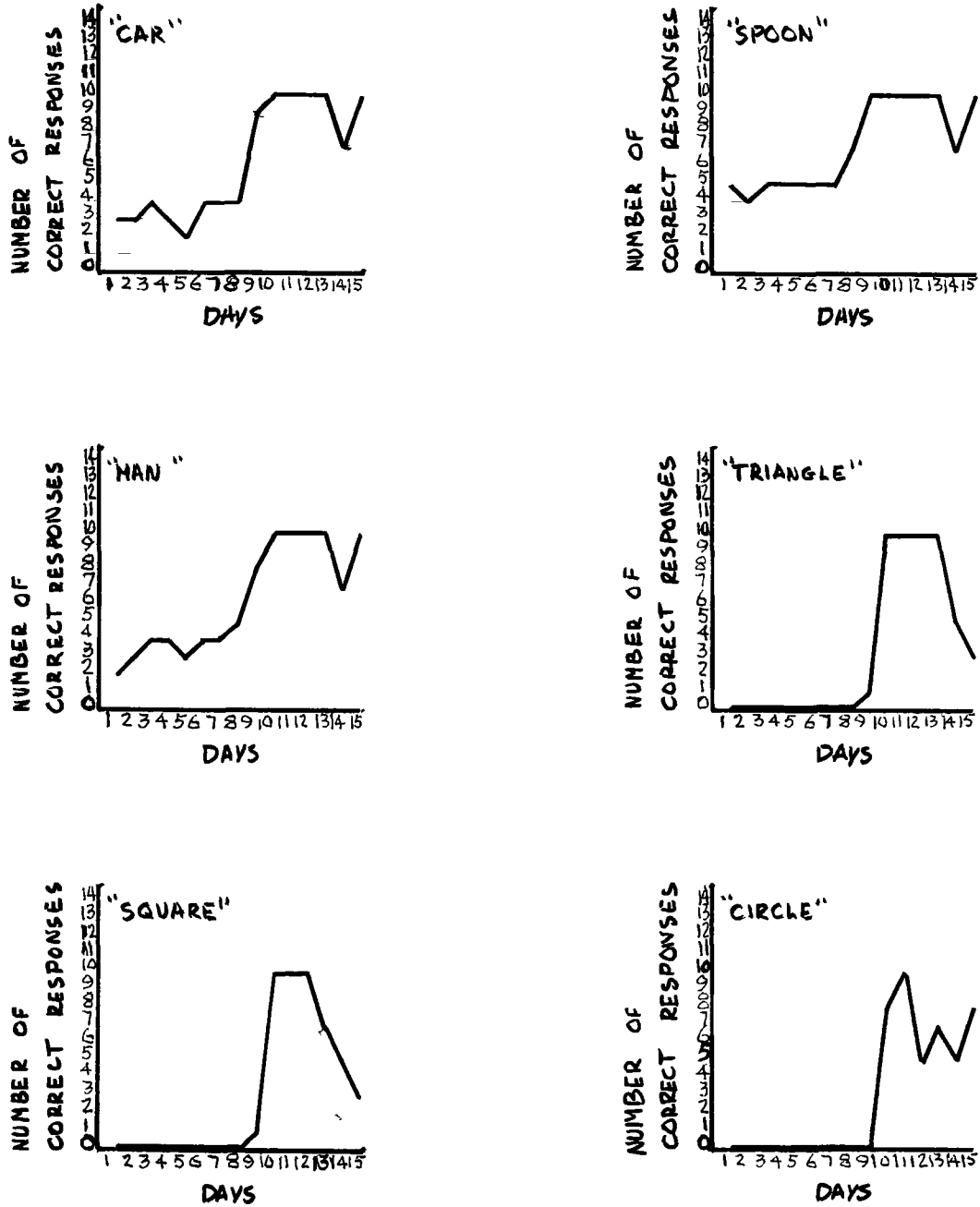
Bill's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 17



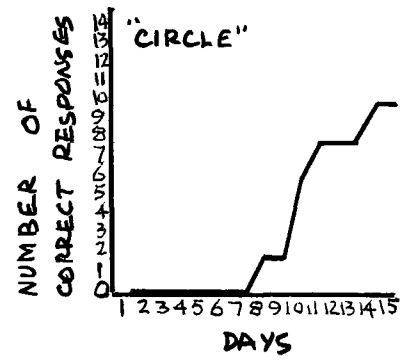
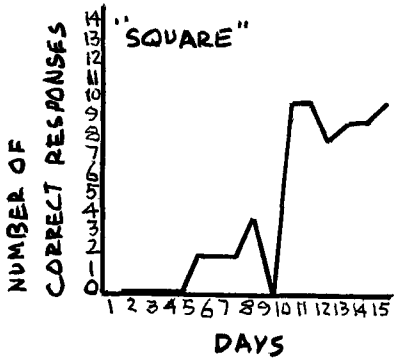
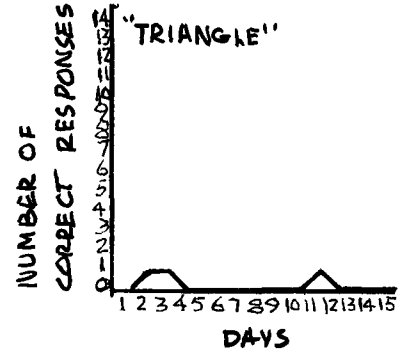
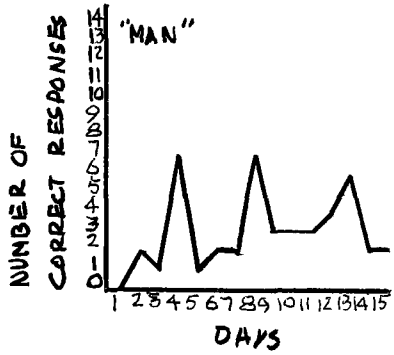
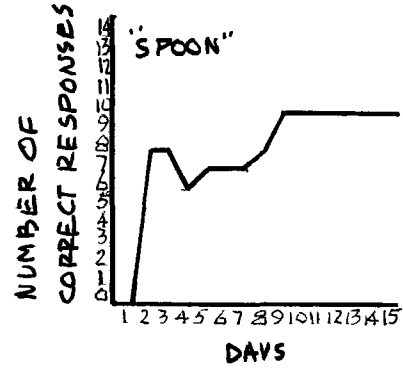
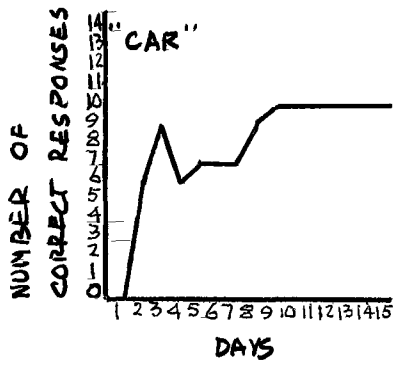
Louis' Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 18



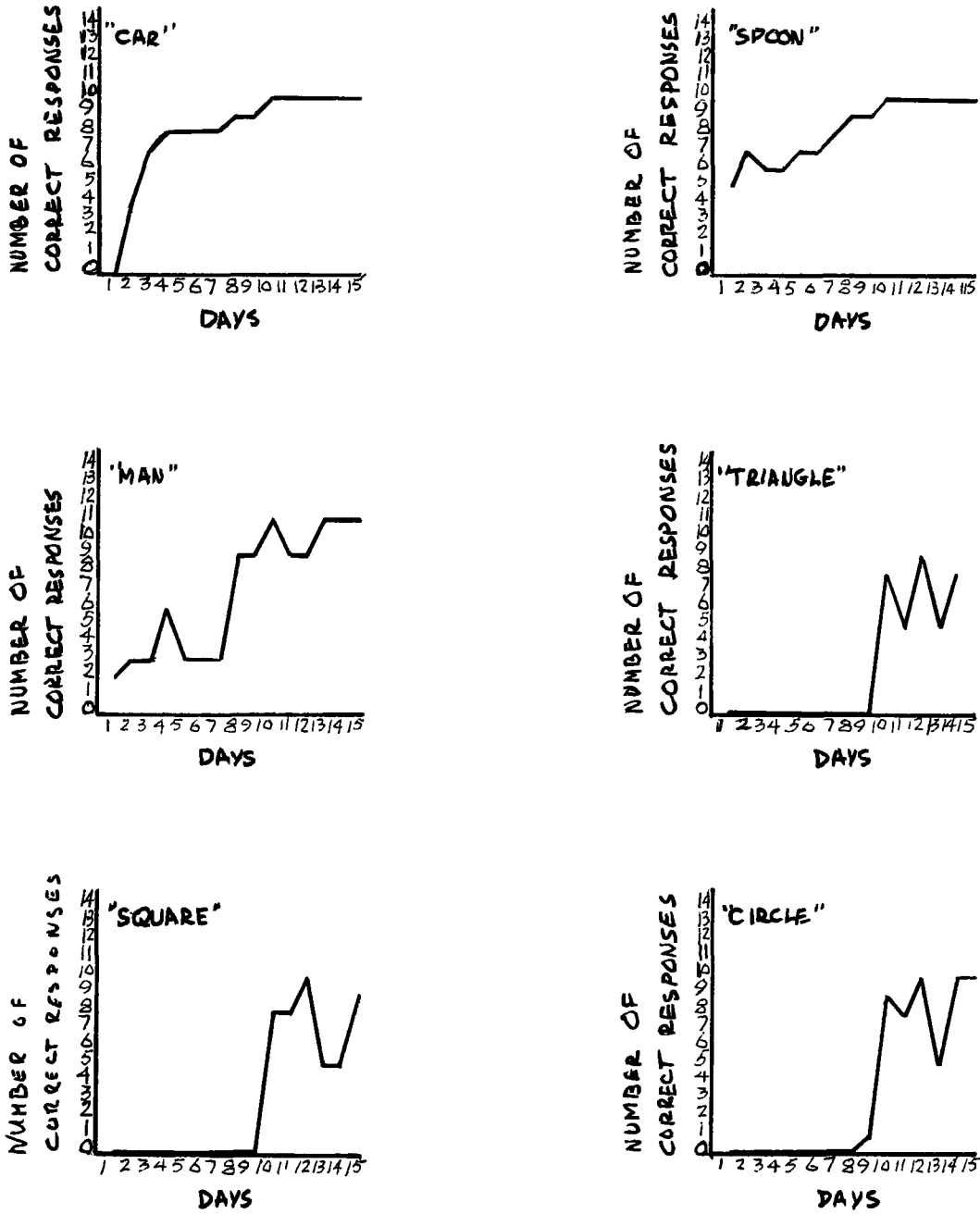
Louis' Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 19



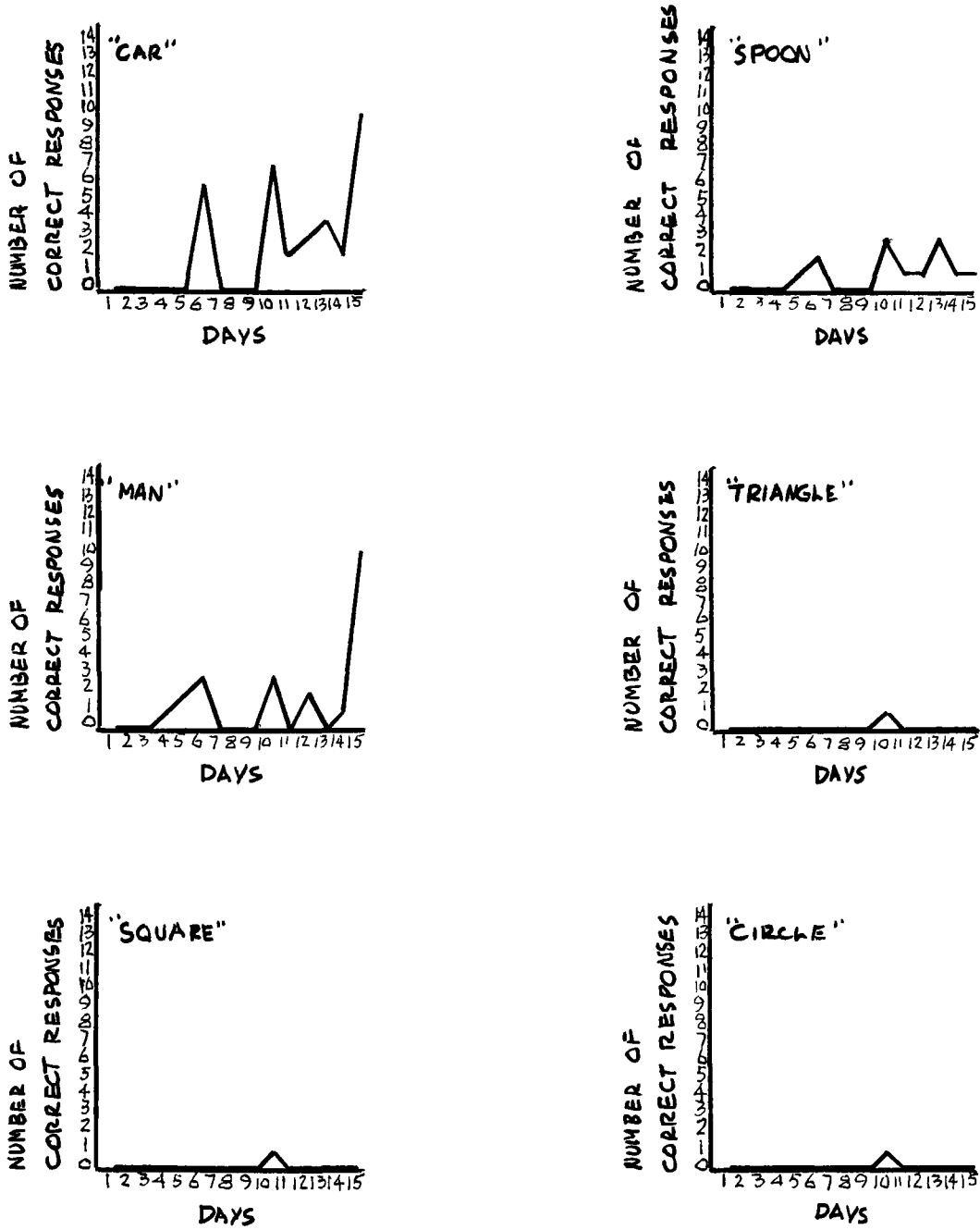
Sam's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 20



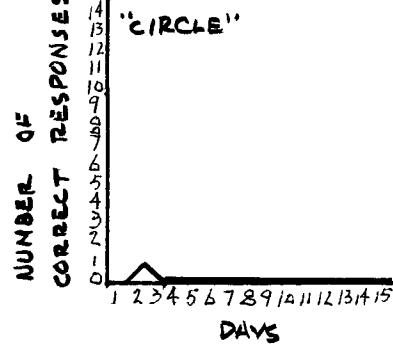
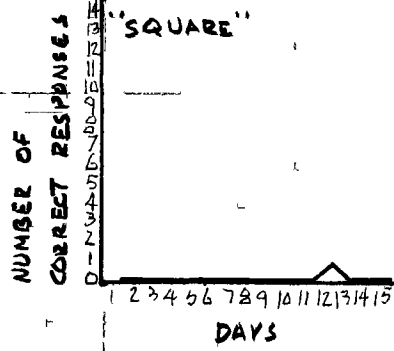
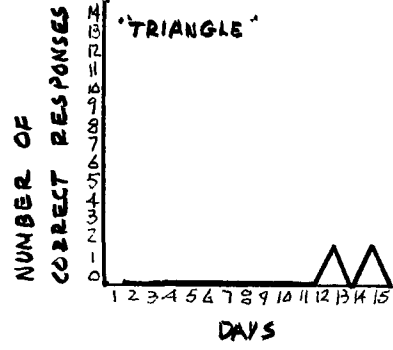
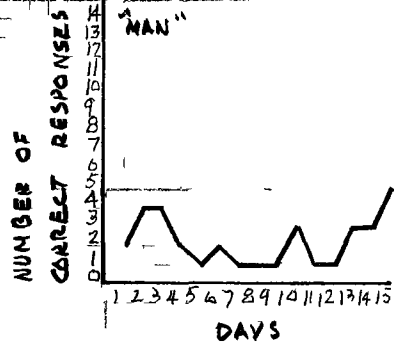
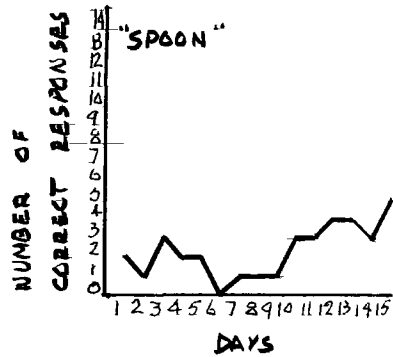
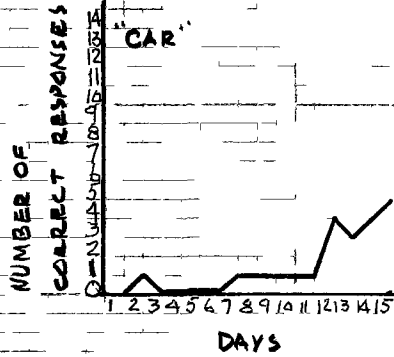
Sam's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 21



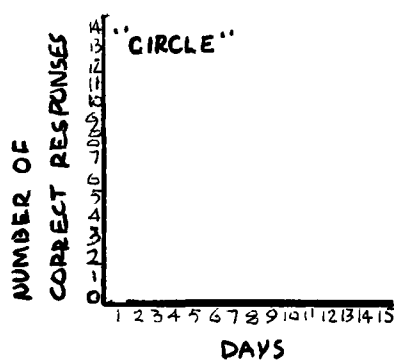
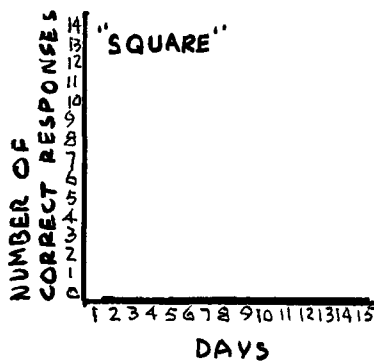
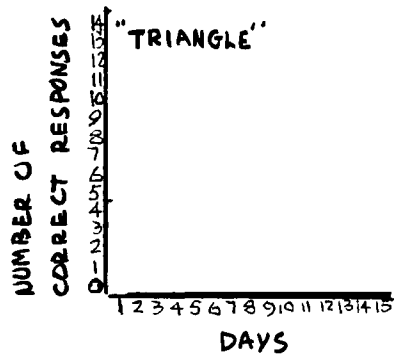
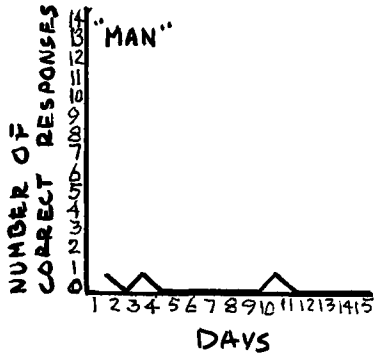
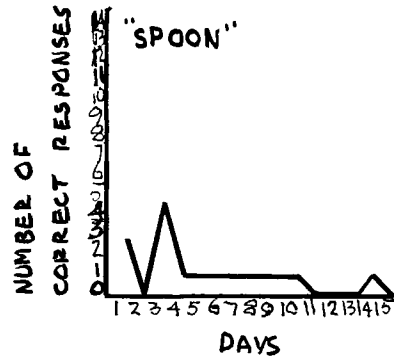
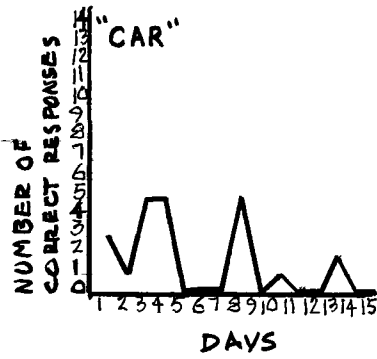
Brian's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 22



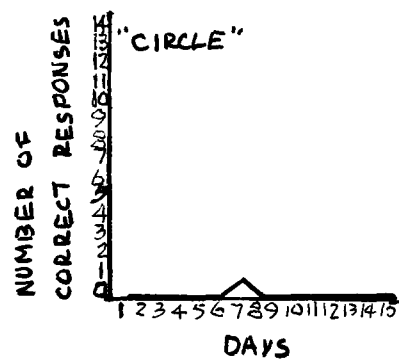
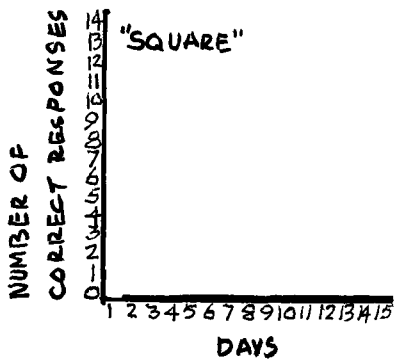
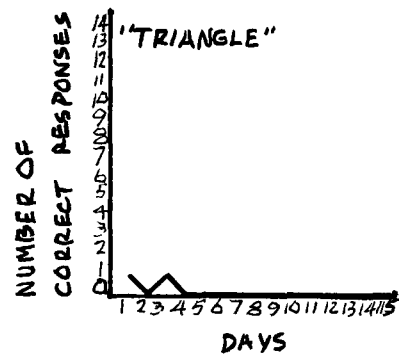
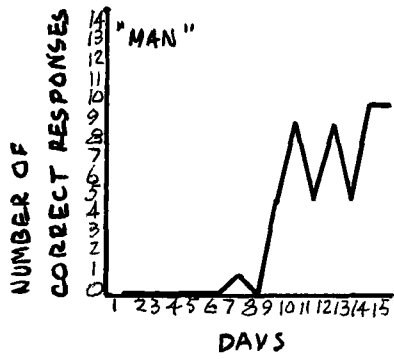
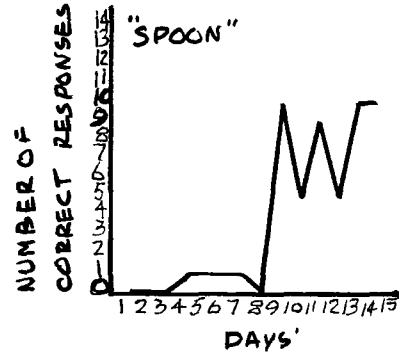
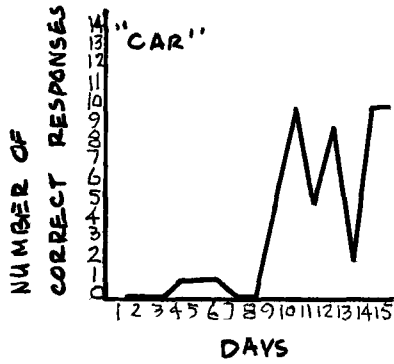
Brian's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 23



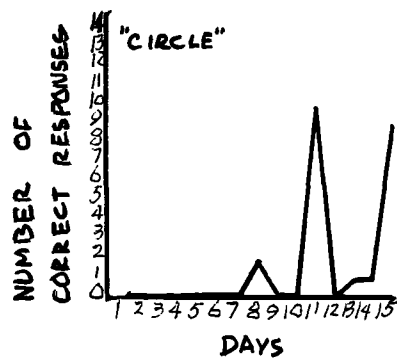
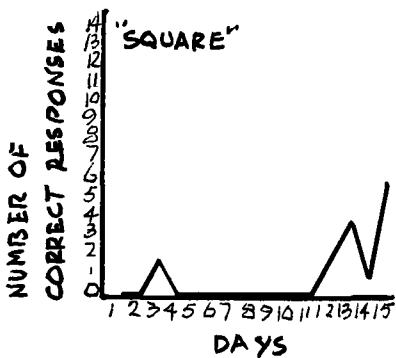
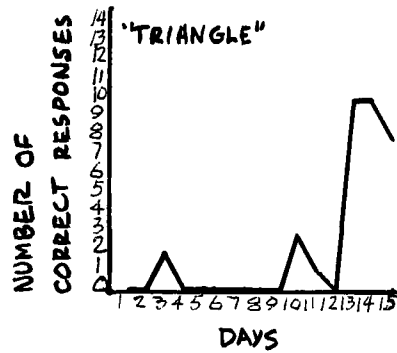
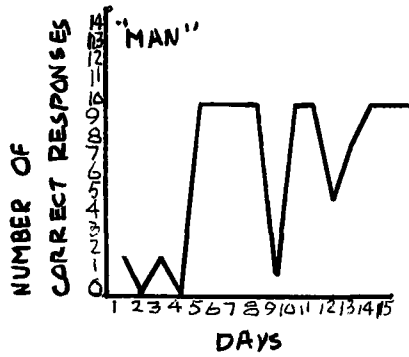
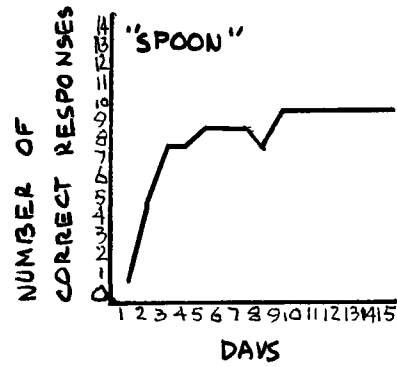
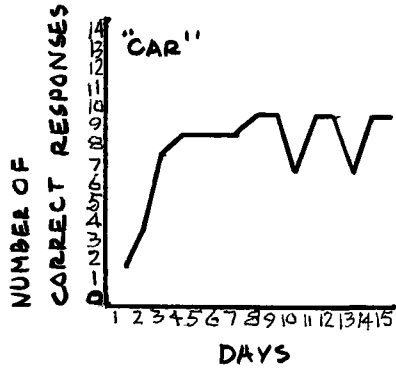
Henry's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 24



Henry's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

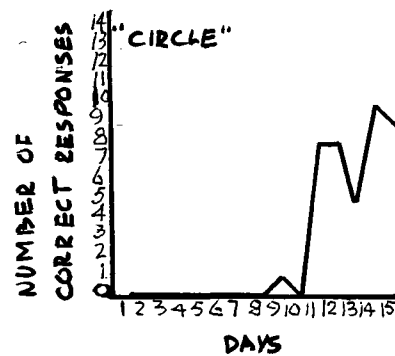
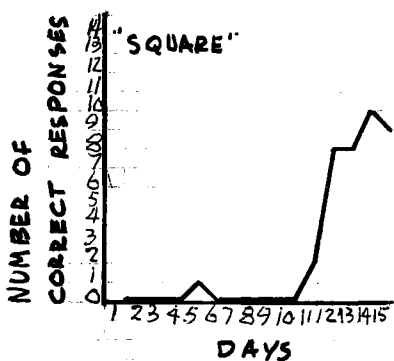
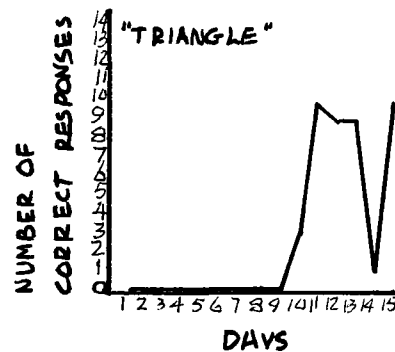
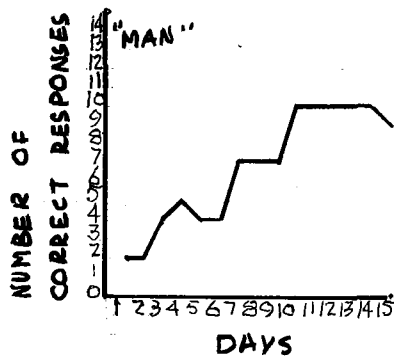
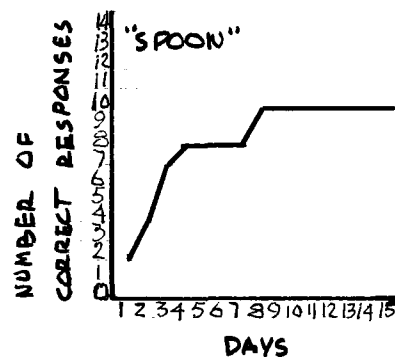
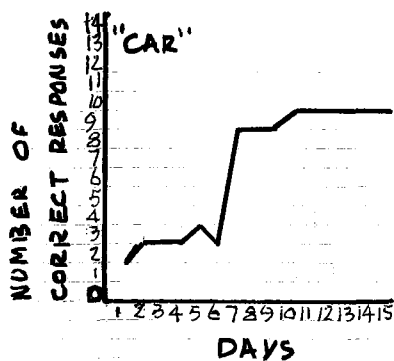
Figure 25



Bob's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

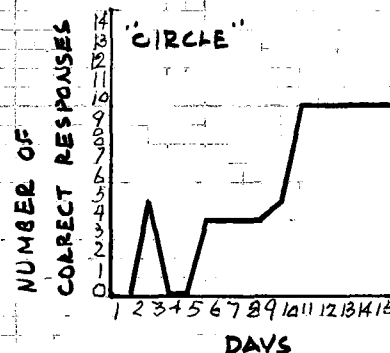
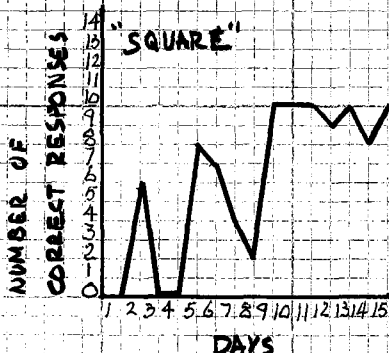
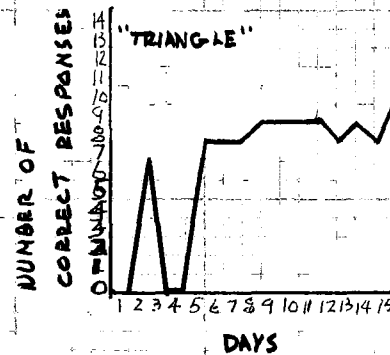
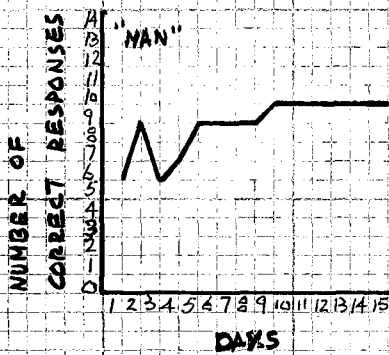
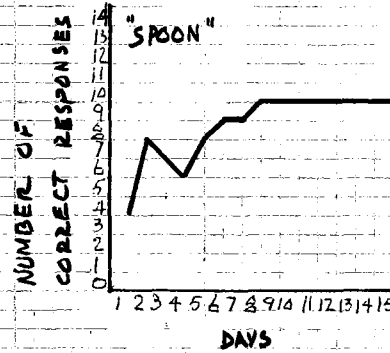
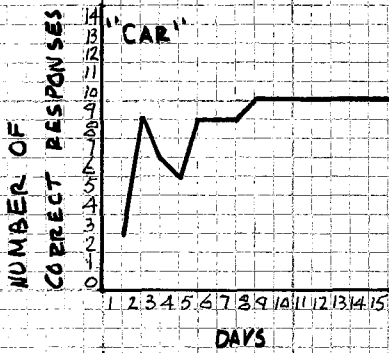
Figure 26

1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	1
9	1
10	1
11	1
12	1
13	1
14	1
15	1



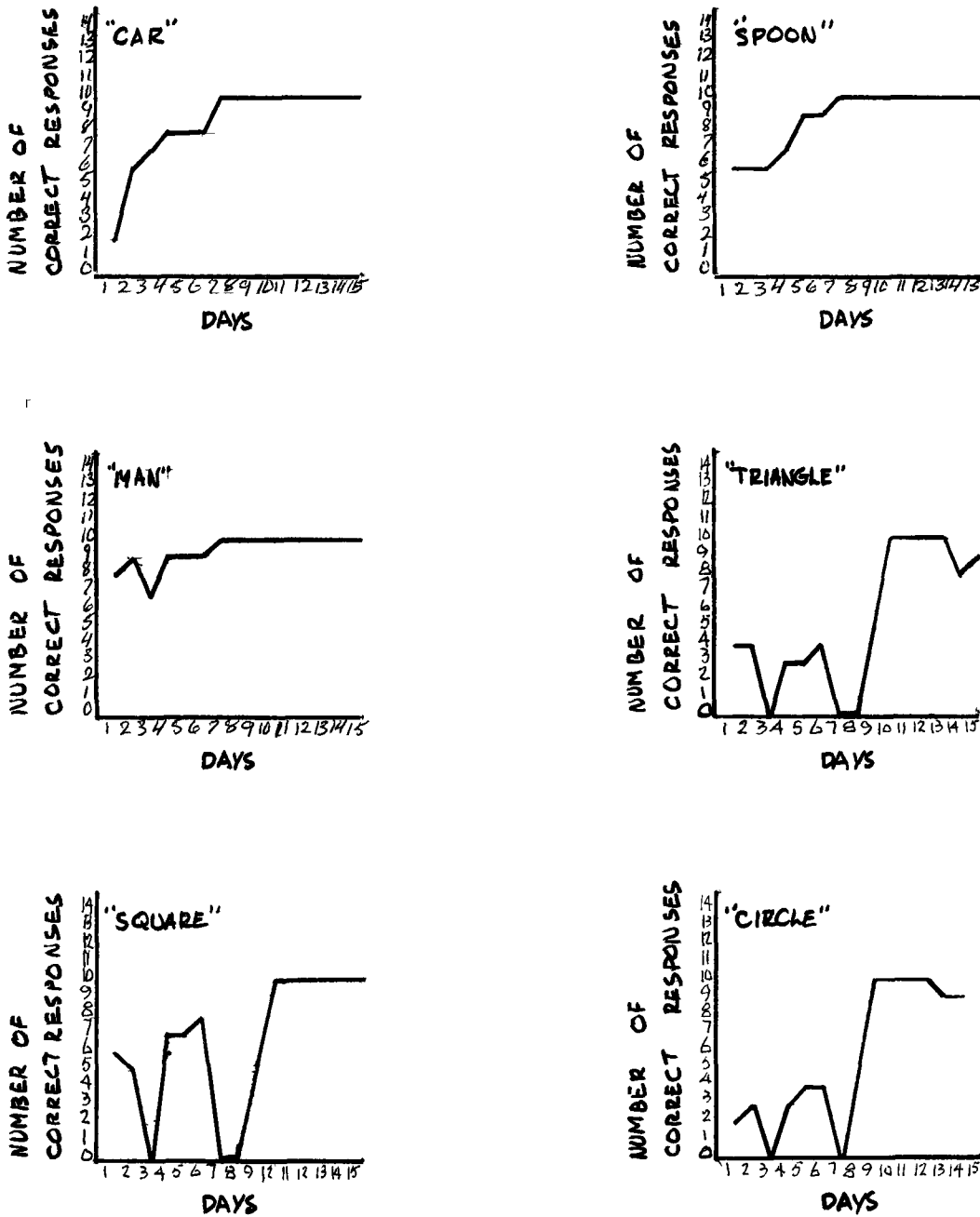
Bob's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 27



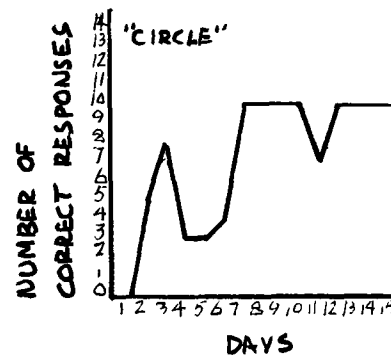
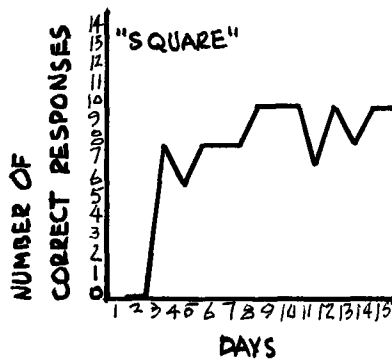
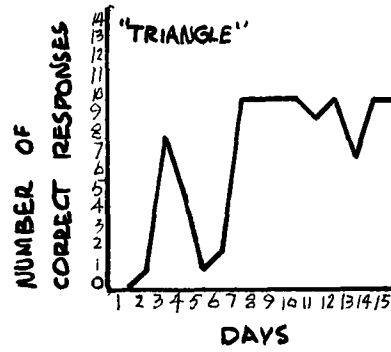
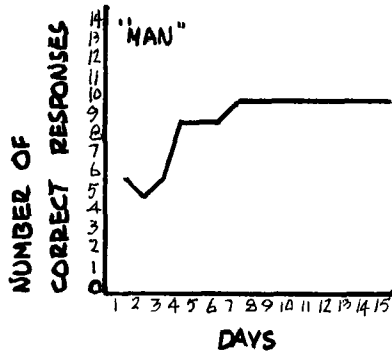
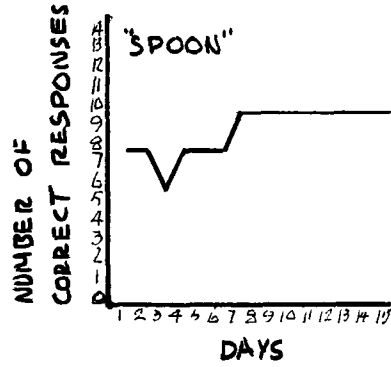
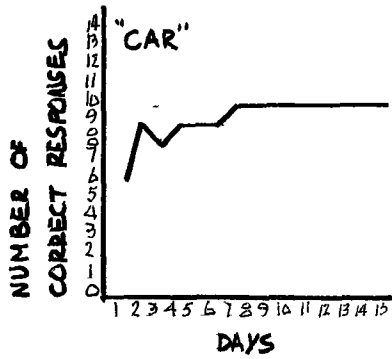
Tom's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 28



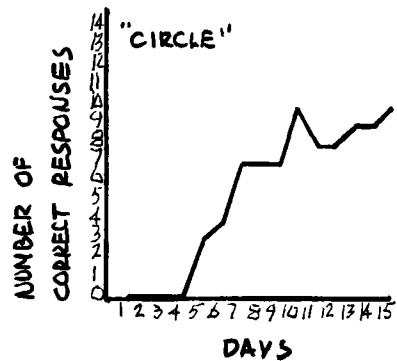
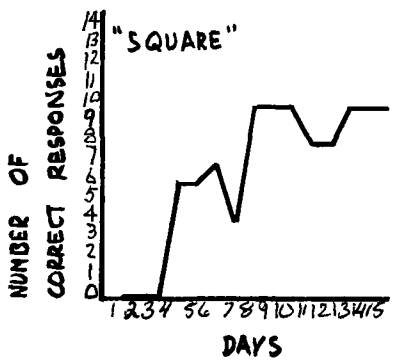
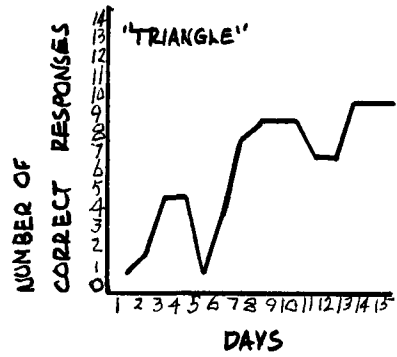
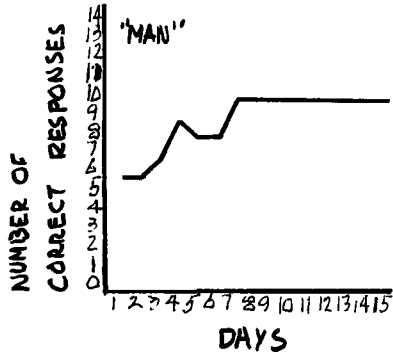
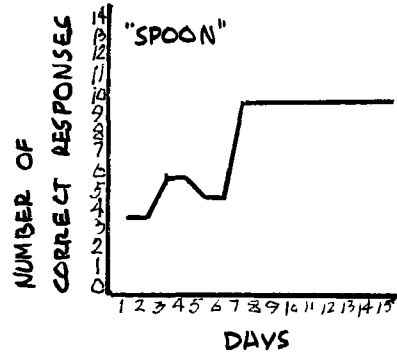
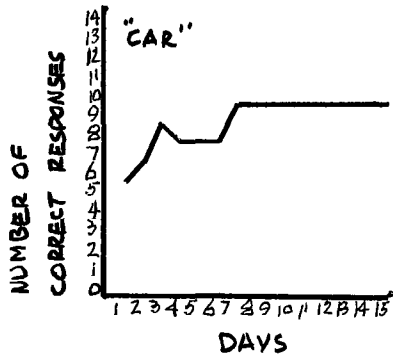
Tom's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 29



Paul's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

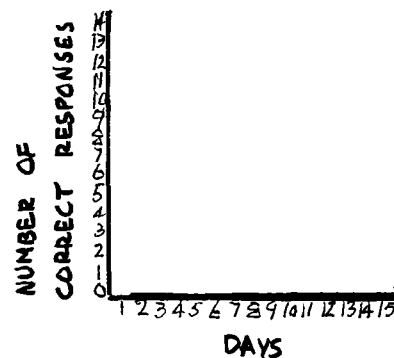
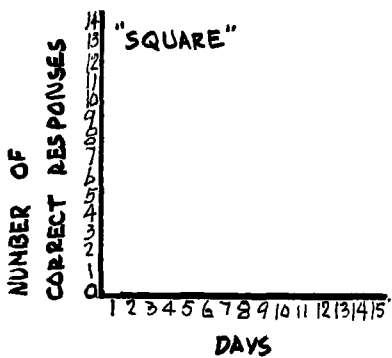
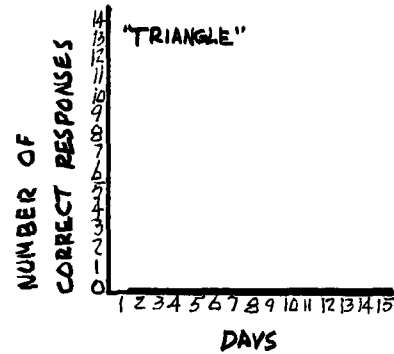
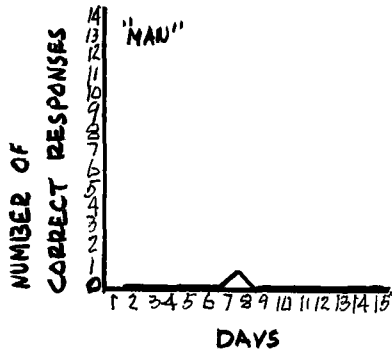
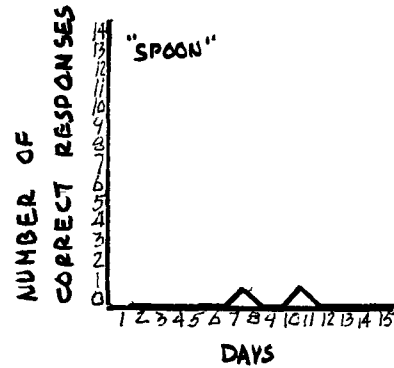
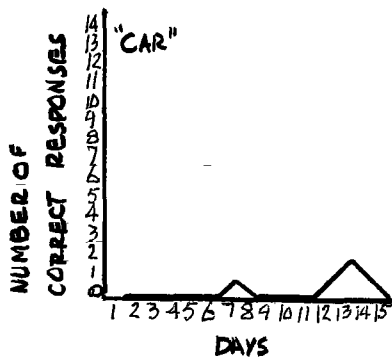
Figure 30



Paul's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

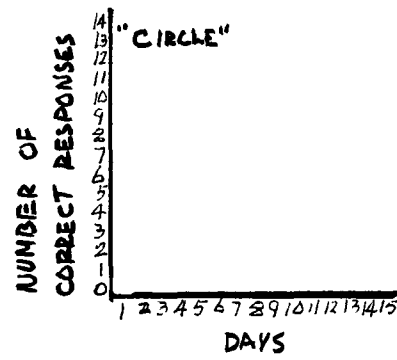
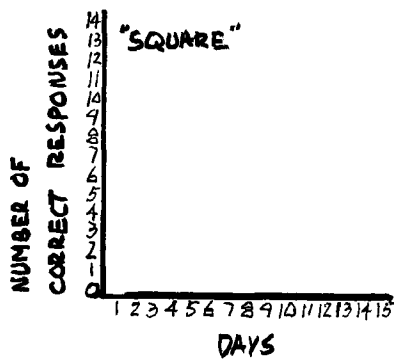
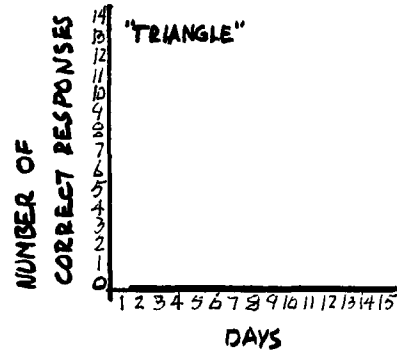
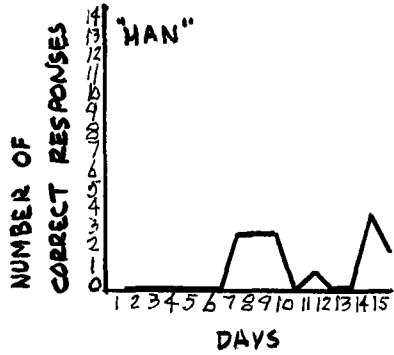
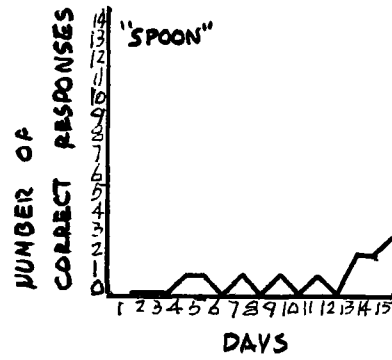
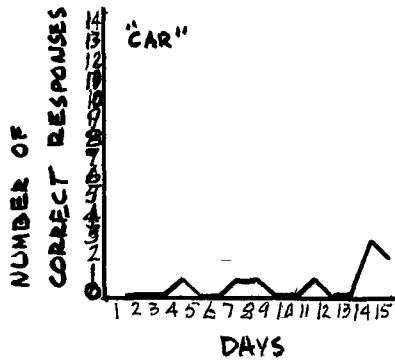
Figure 31

APPENDIX 4
CONTROL GROUP (SETS II AND III)



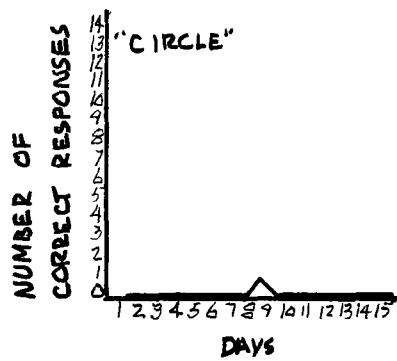
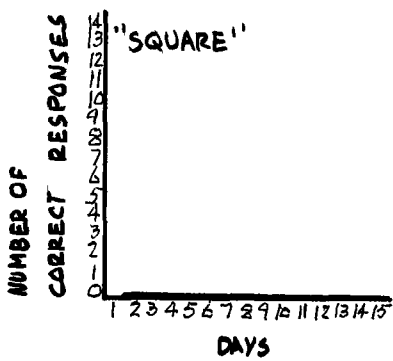
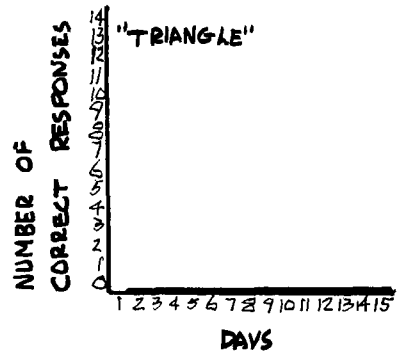
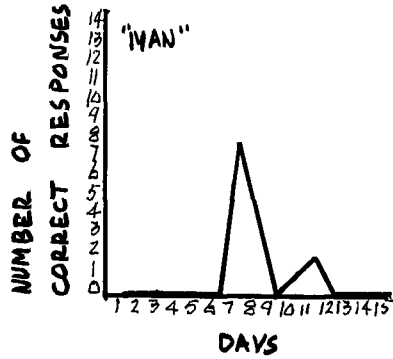
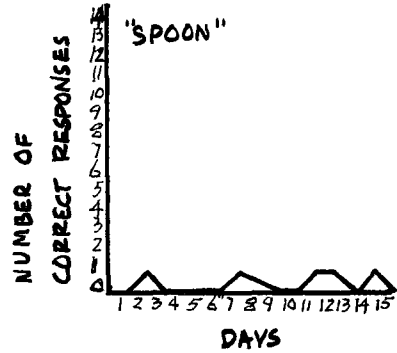
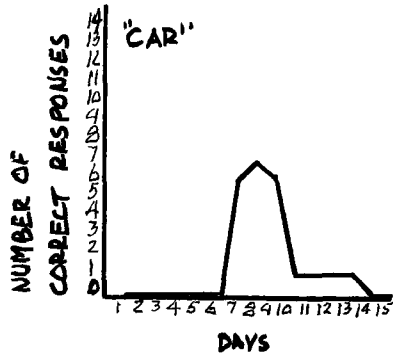
George's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 32



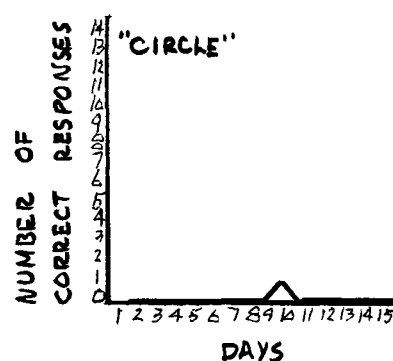
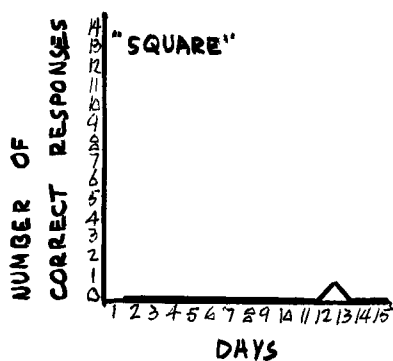
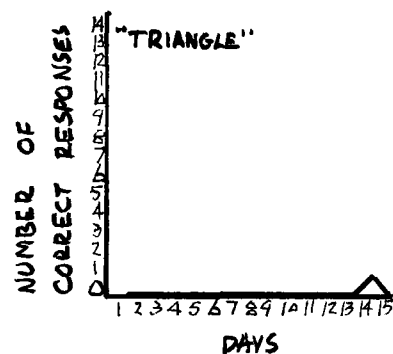
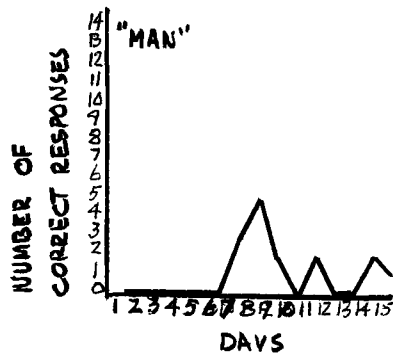
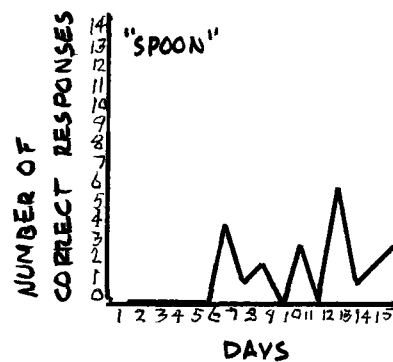
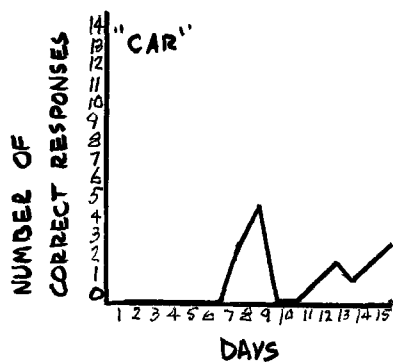
George's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 33



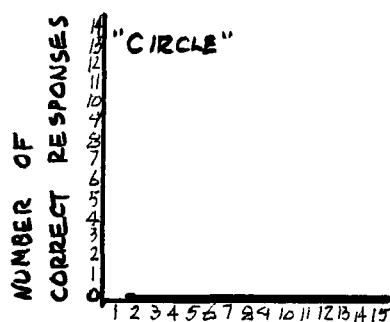
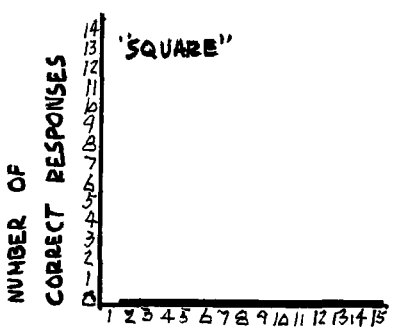
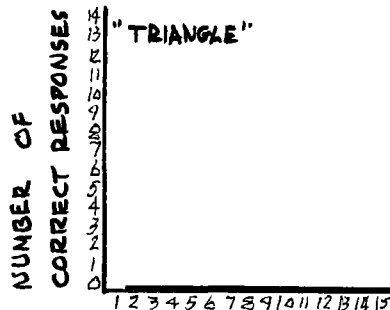
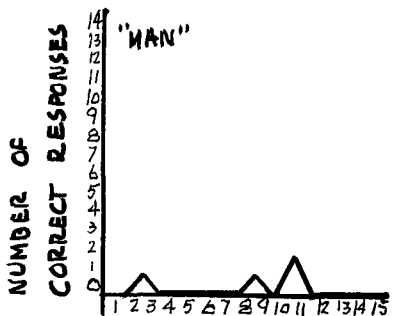
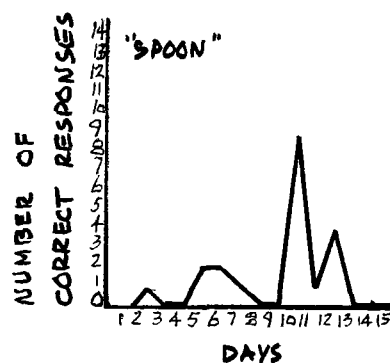
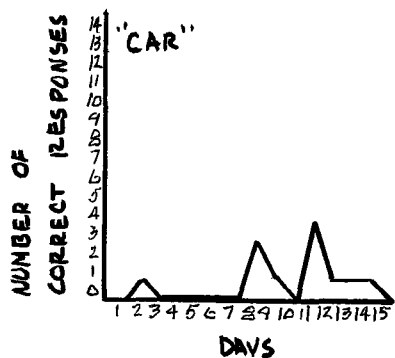
Fred's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 34



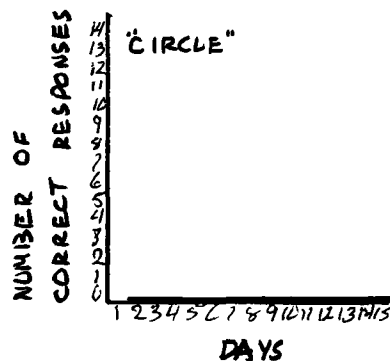
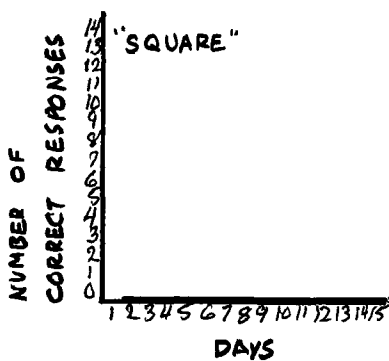
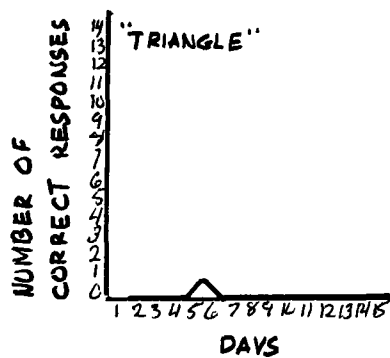
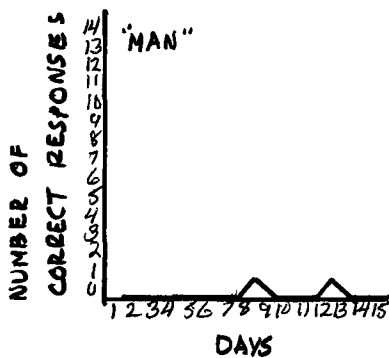
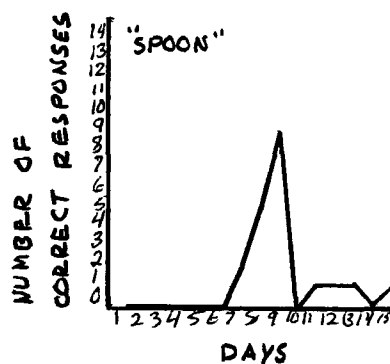
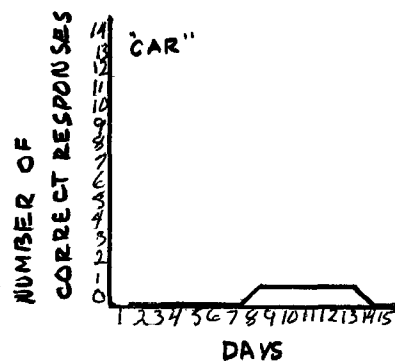
Fred's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 35



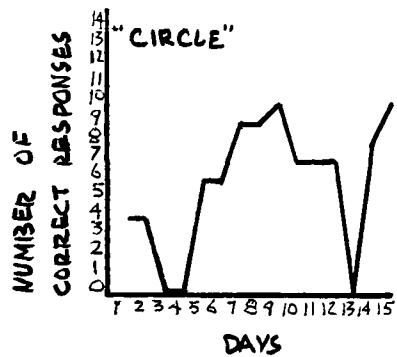
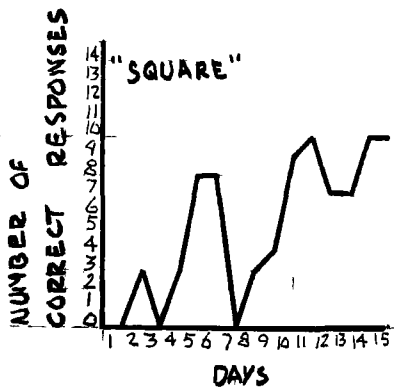
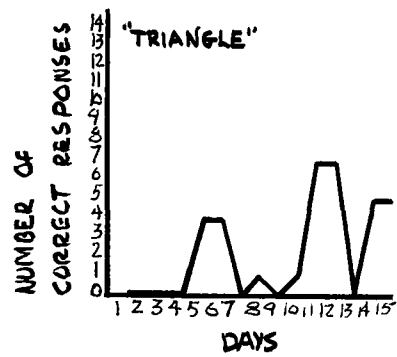
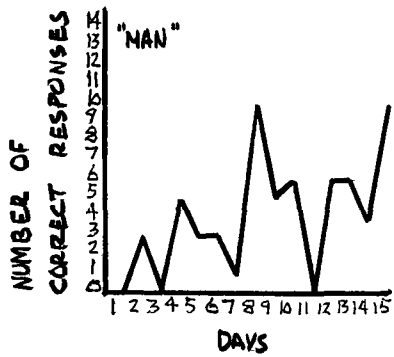
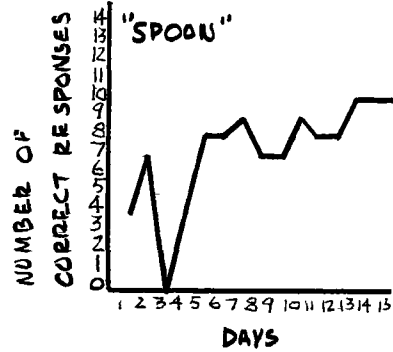
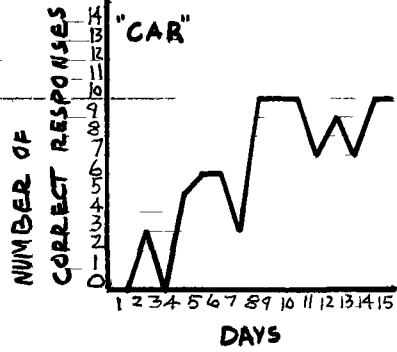
Russ' Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 36



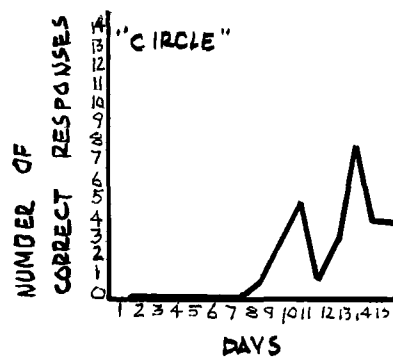
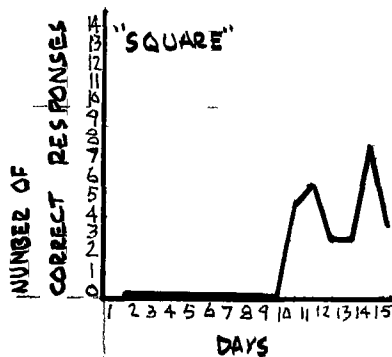
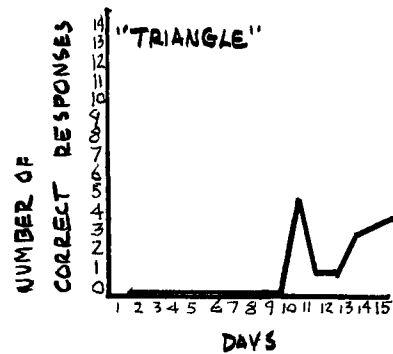
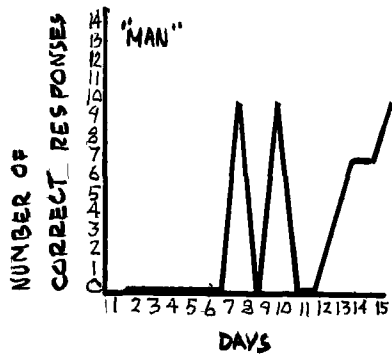
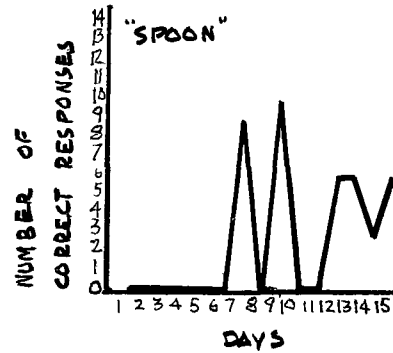
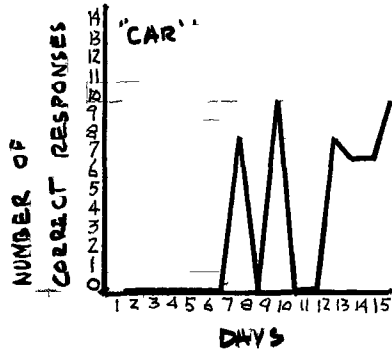
Russ' Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 37



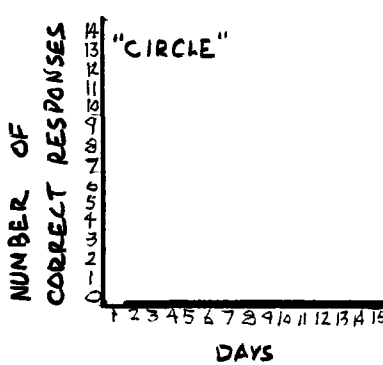
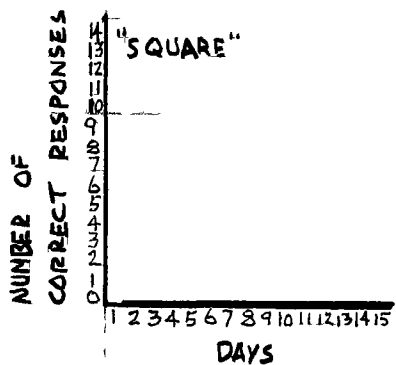
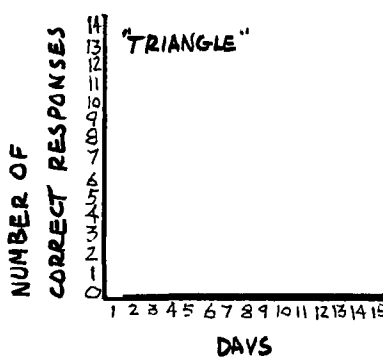
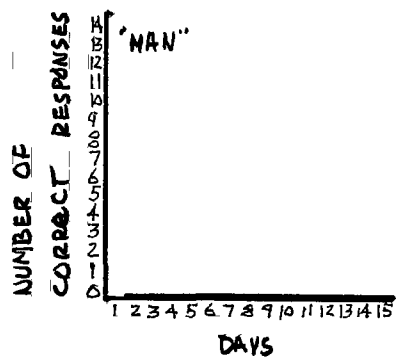
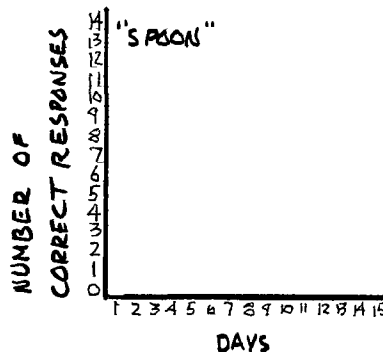
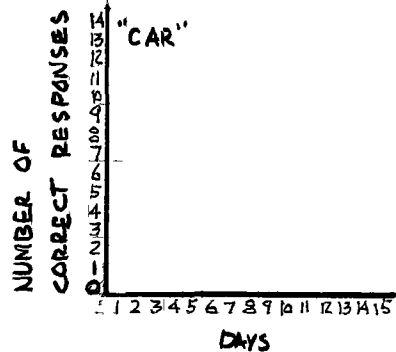
Doug's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 38



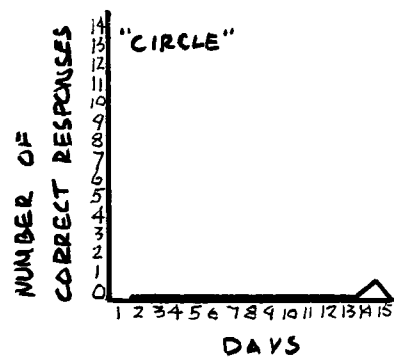
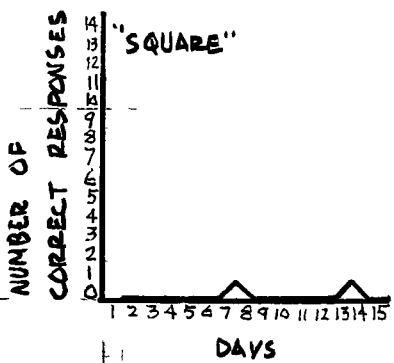
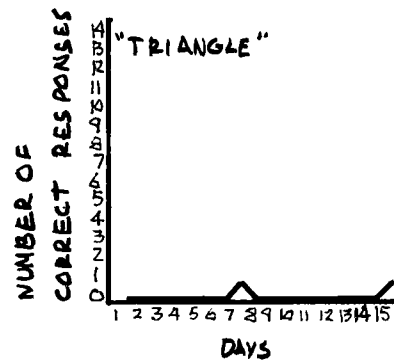
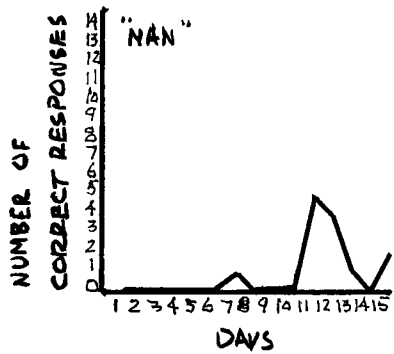
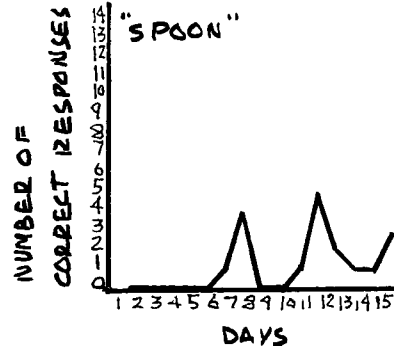
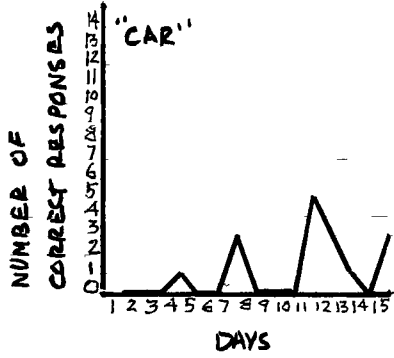
Doug's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 39



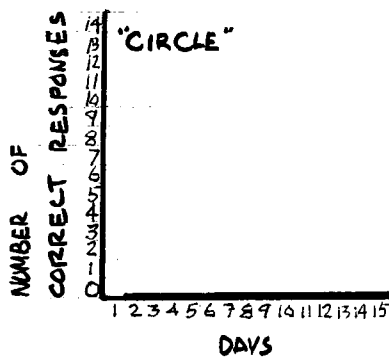
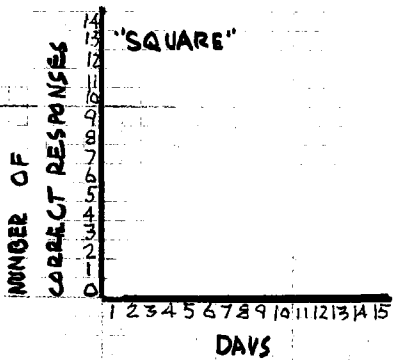
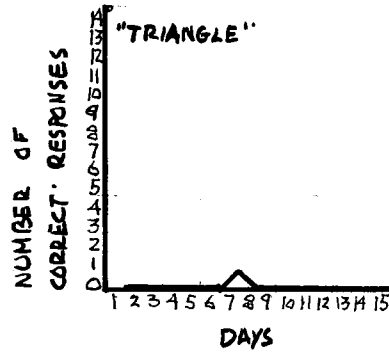
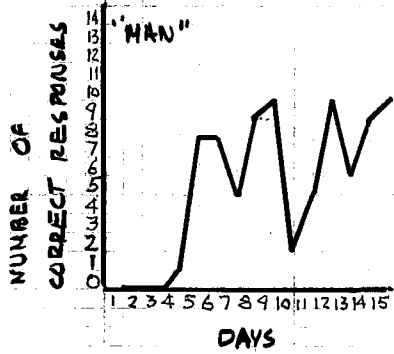
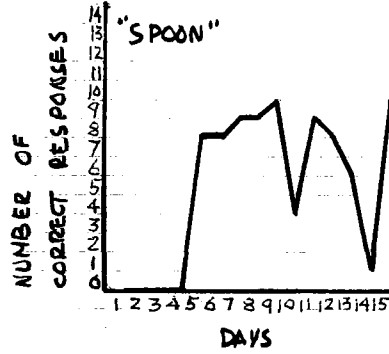
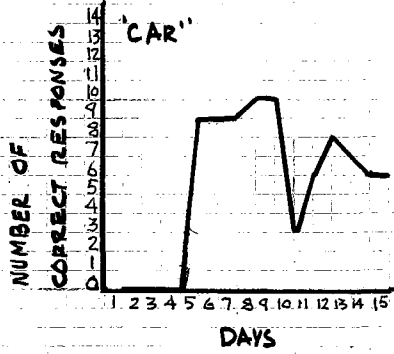
Tony's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 40



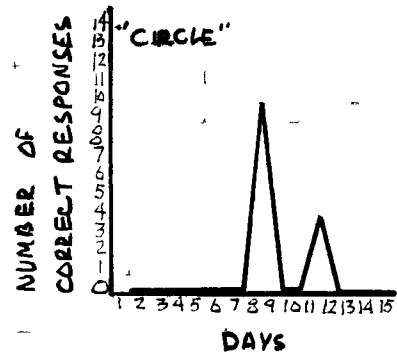
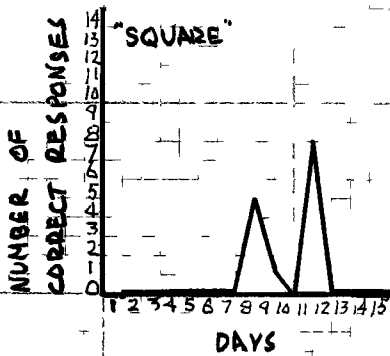
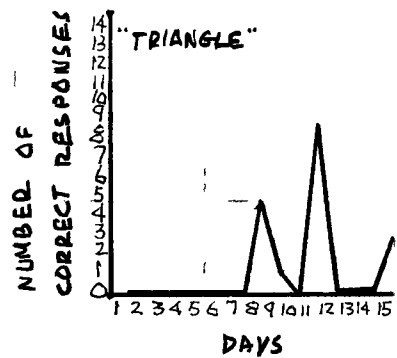
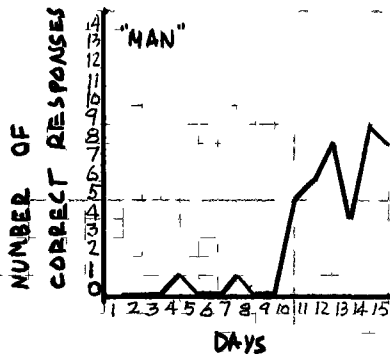
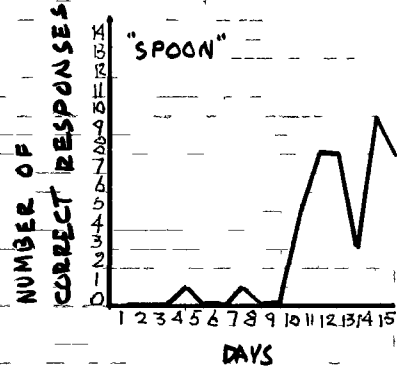
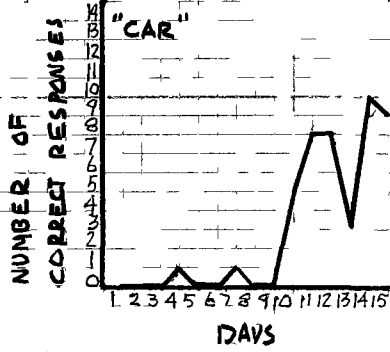
Tony's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 41



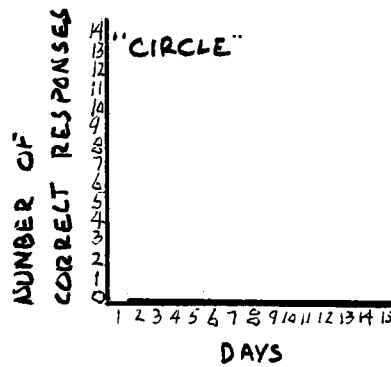
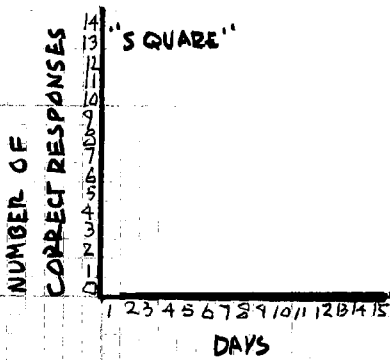
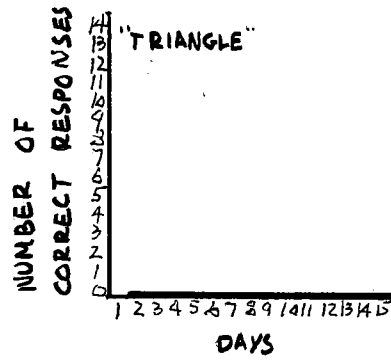
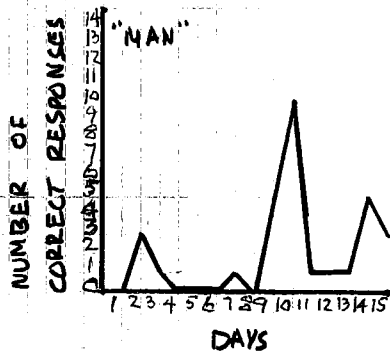
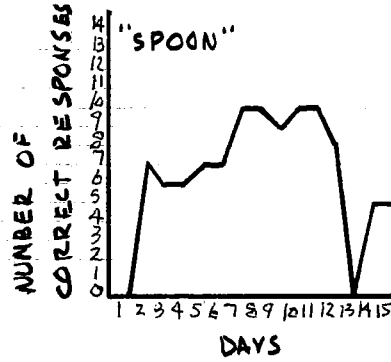
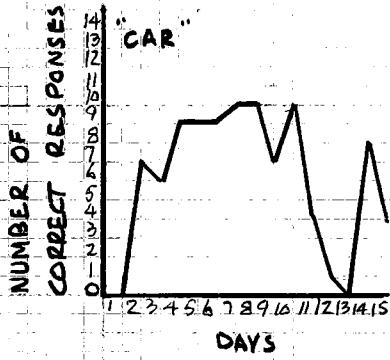
John's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 42



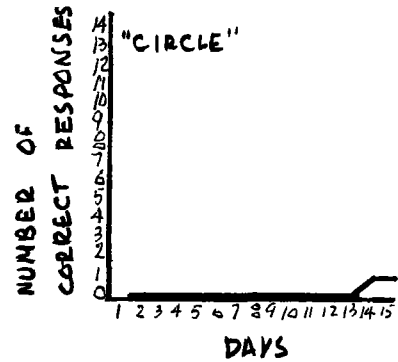
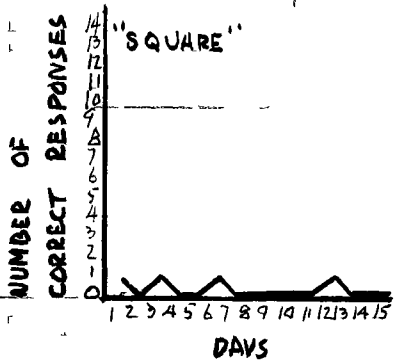
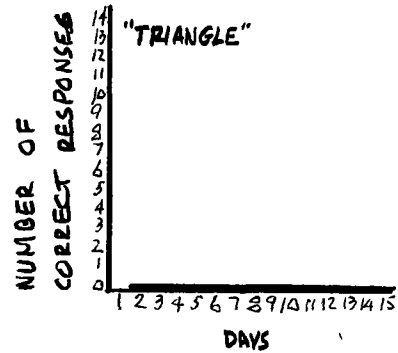
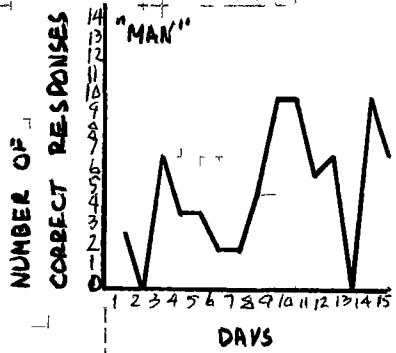
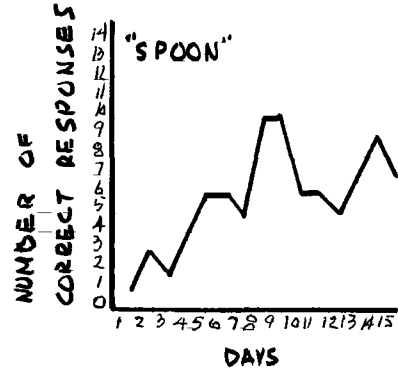
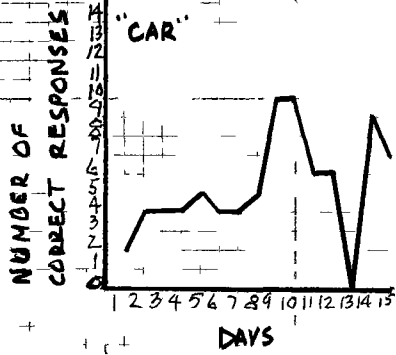
John's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 43



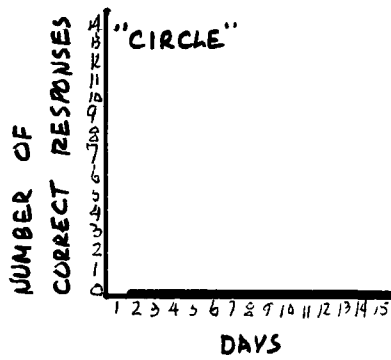
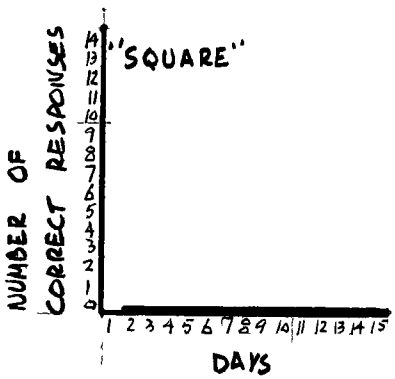
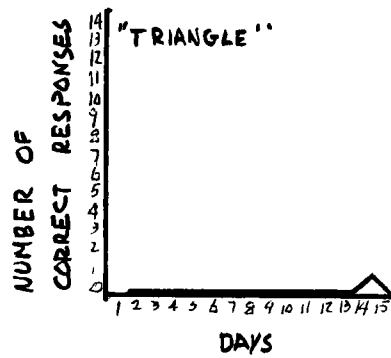
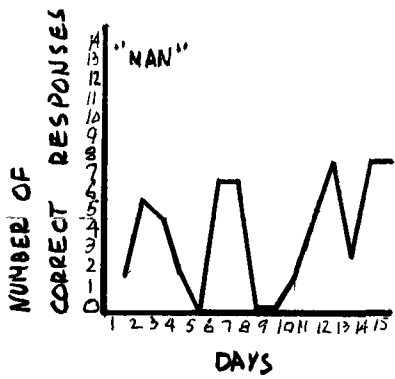
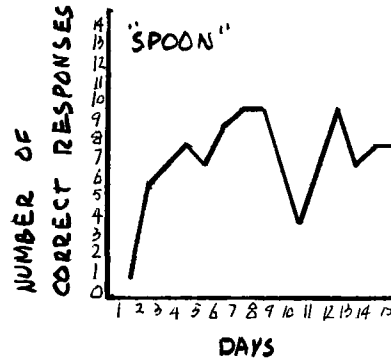
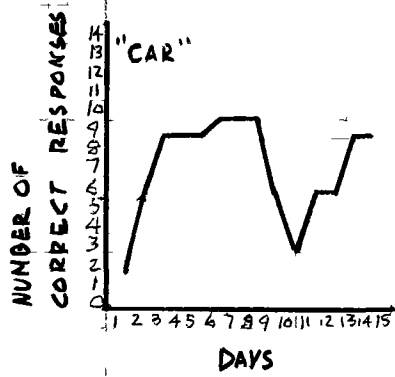
John's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 44



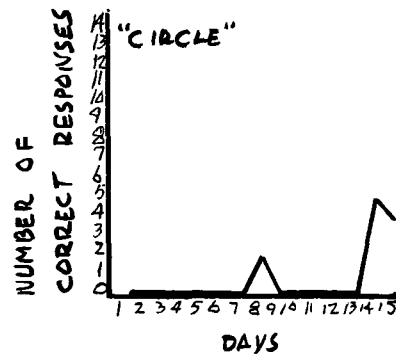
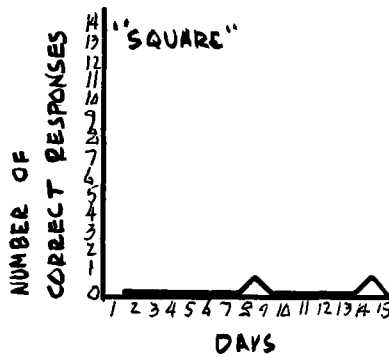
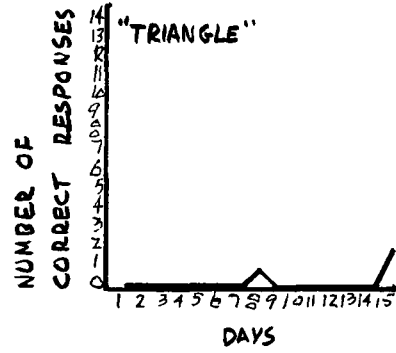
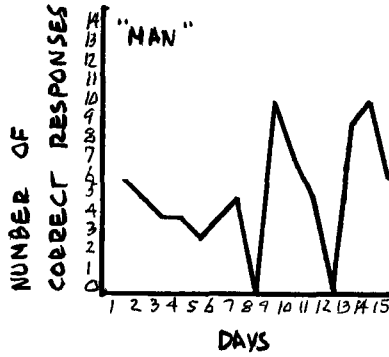
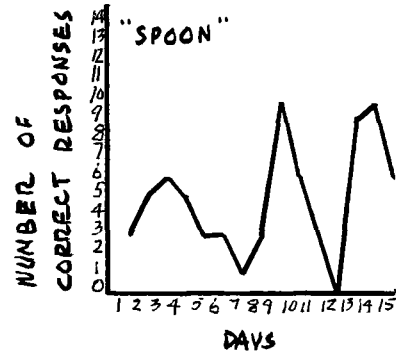
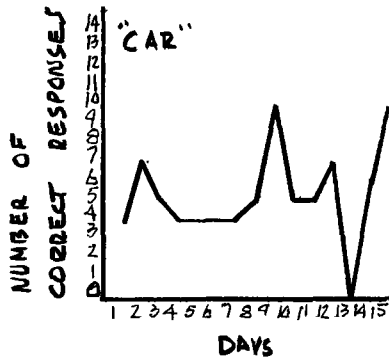
Jack's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 45



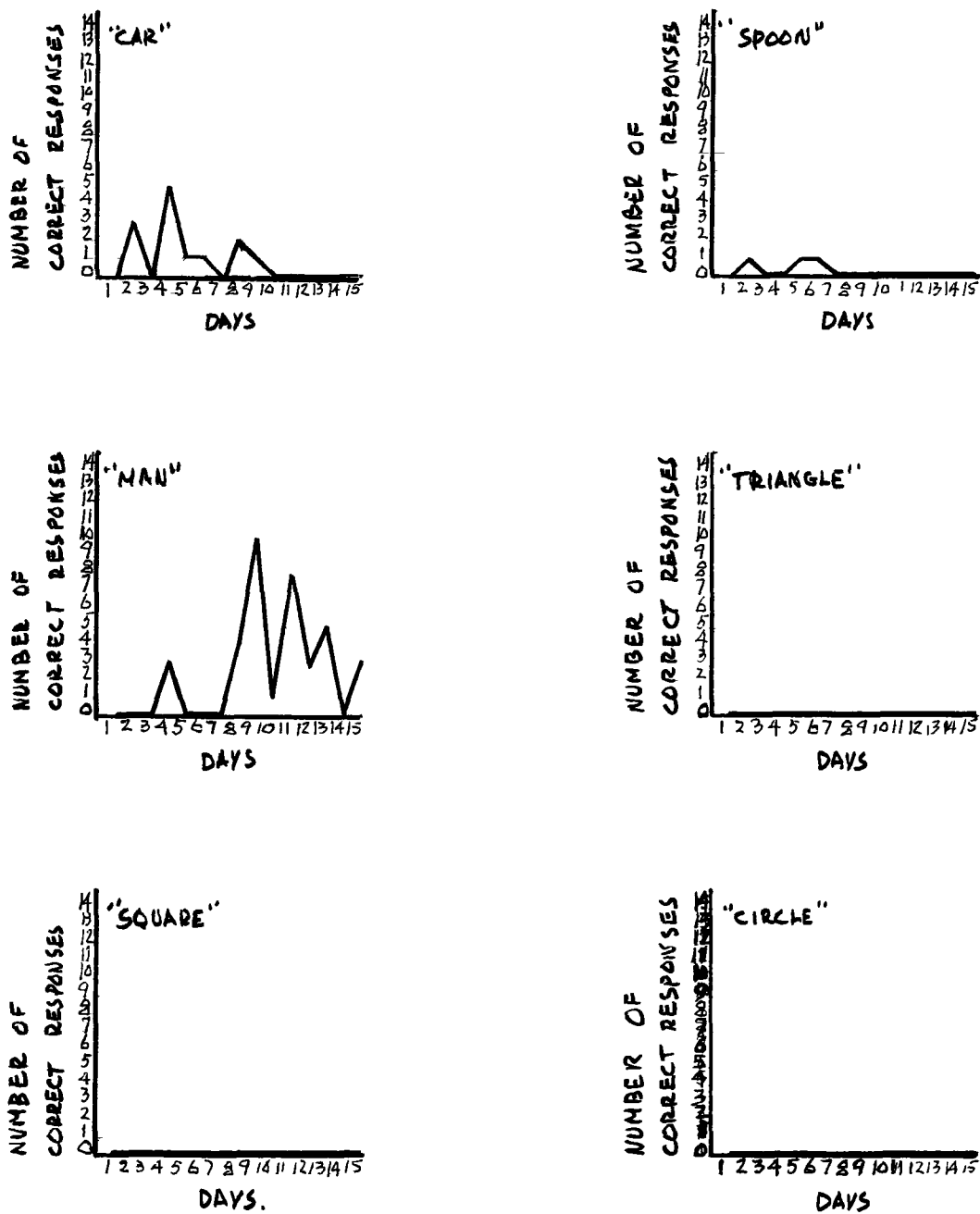
Jerry's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 46



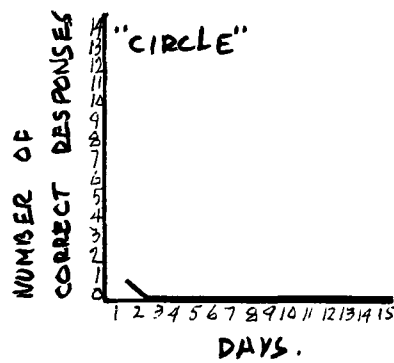
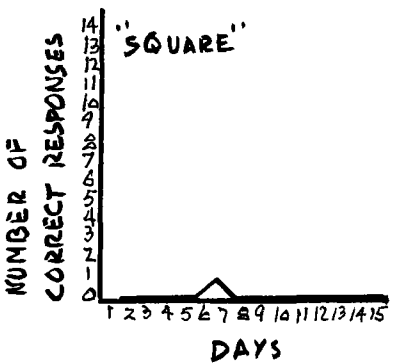
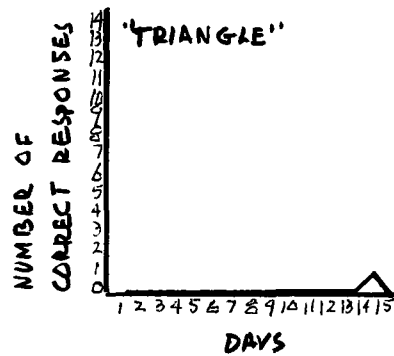
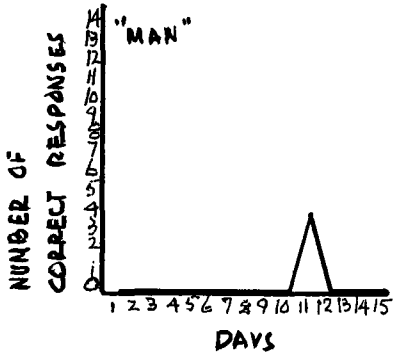
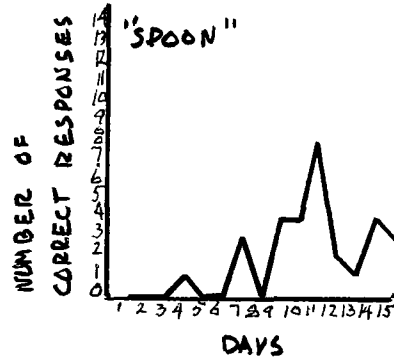
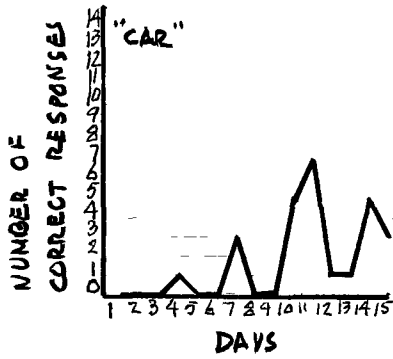
Jerry's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 47



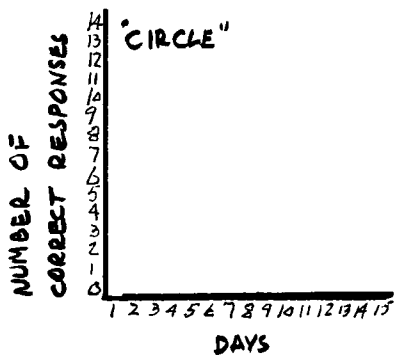
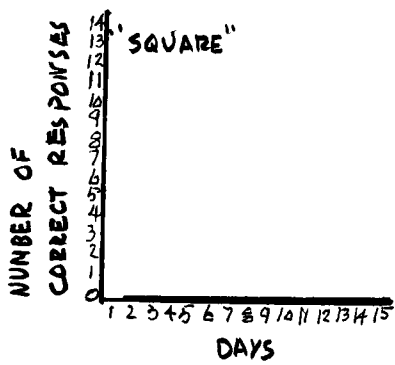
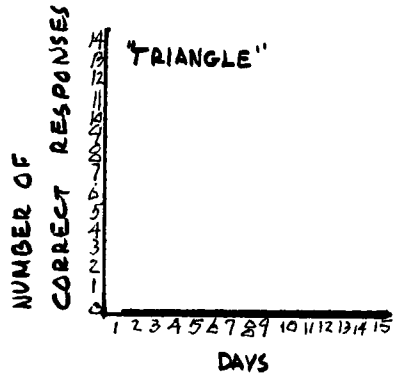
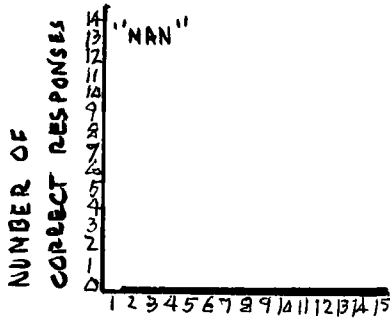
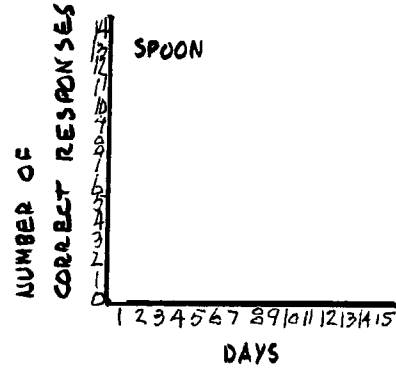
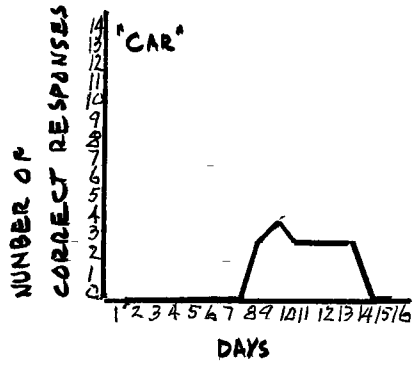
Don's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 48



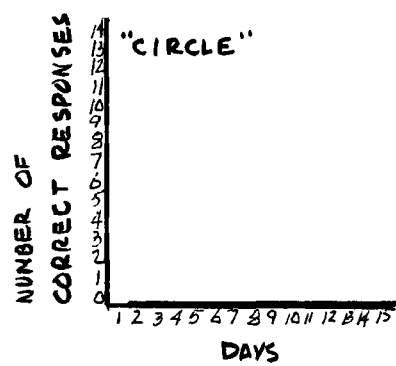
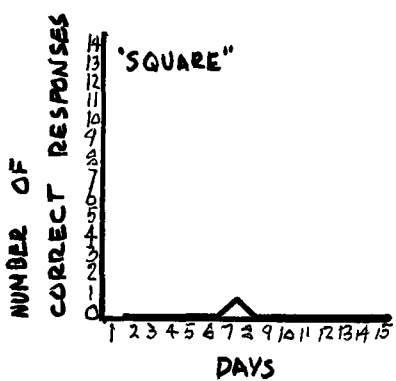
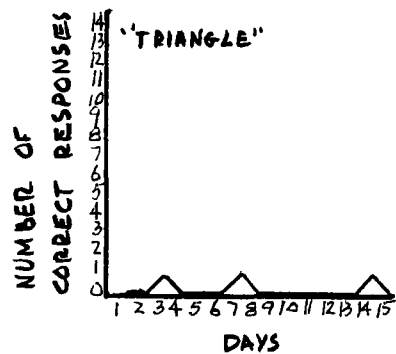
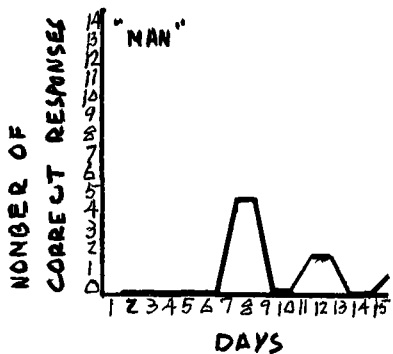
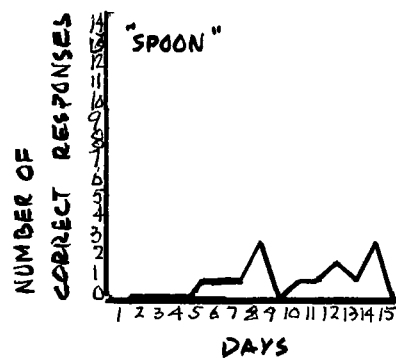
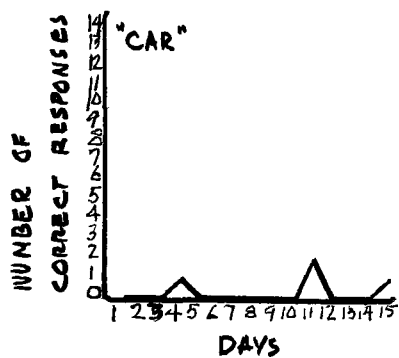
Don's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 49



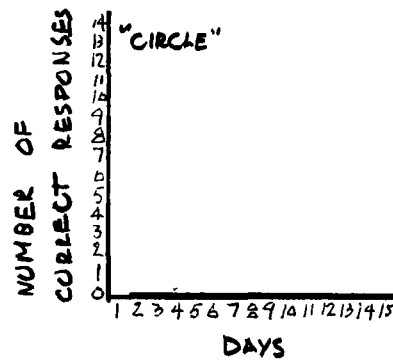
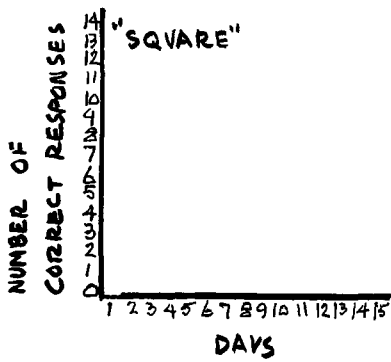
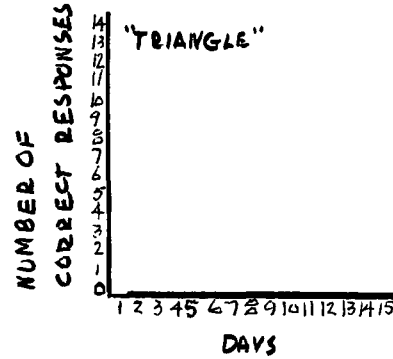
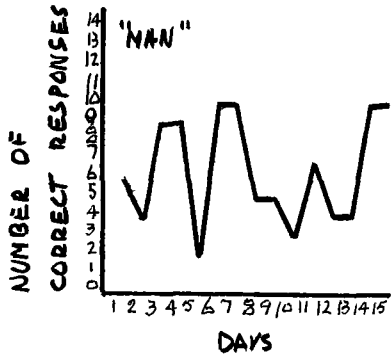
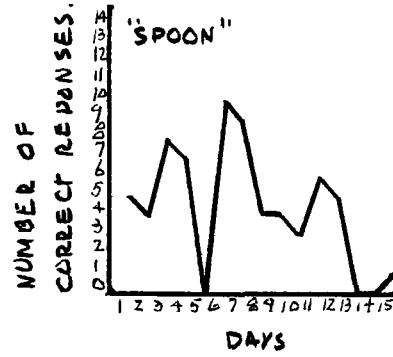
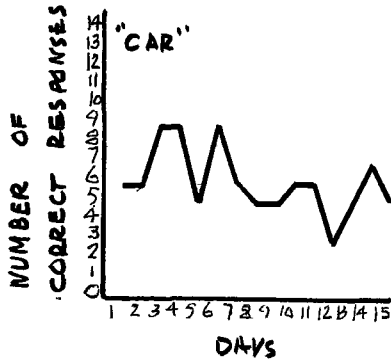
Roy's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 50



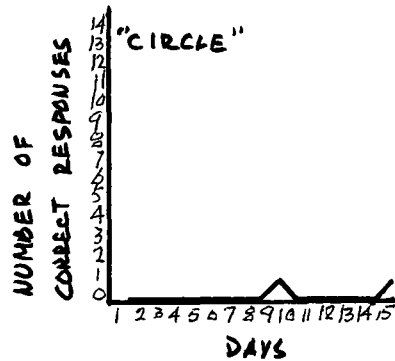
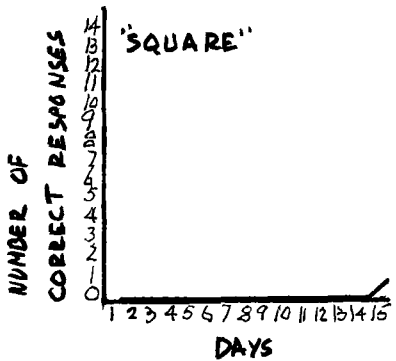
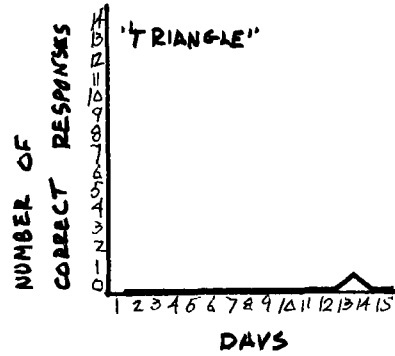
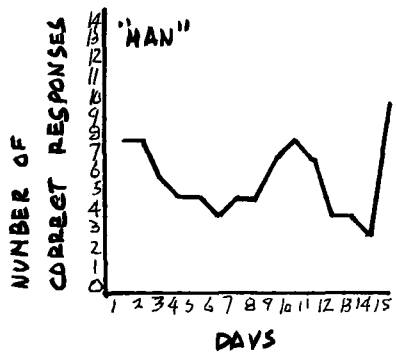
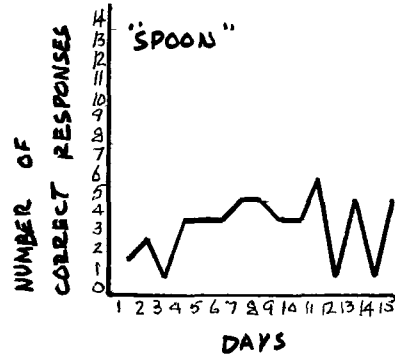
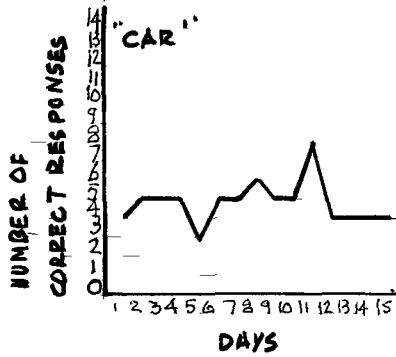
Roy's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 51



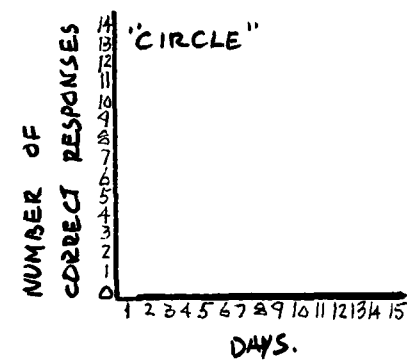
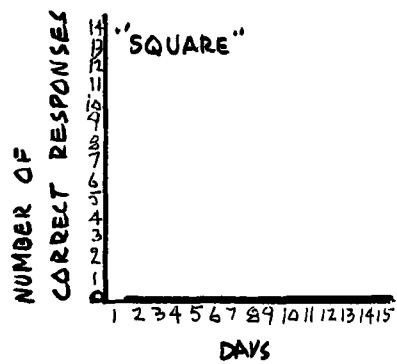
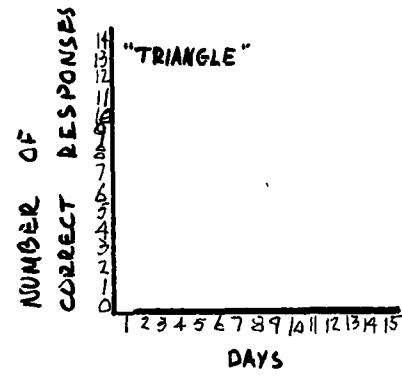
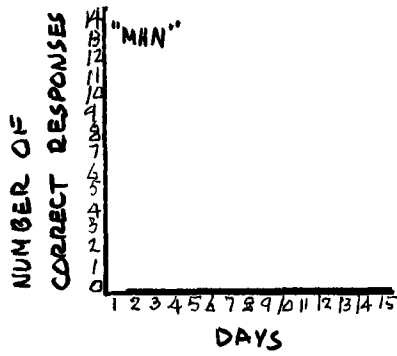
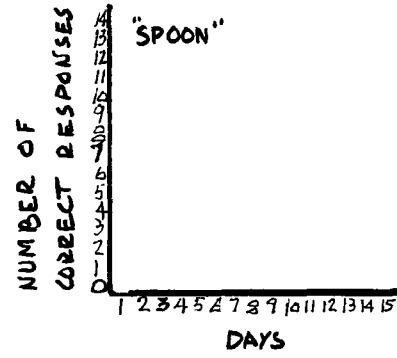
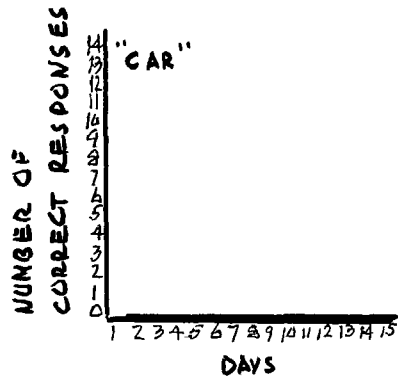
Joe's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 52



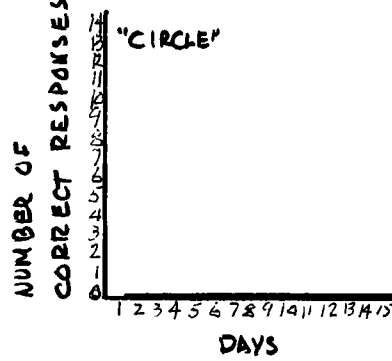
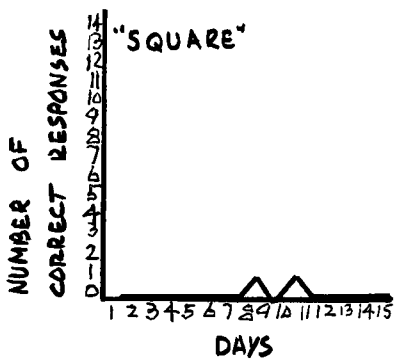
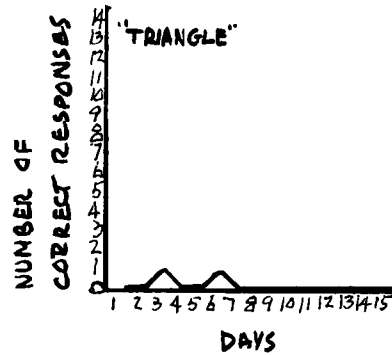
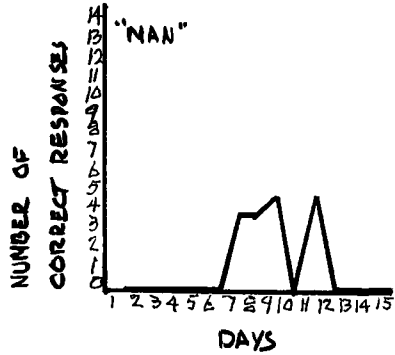
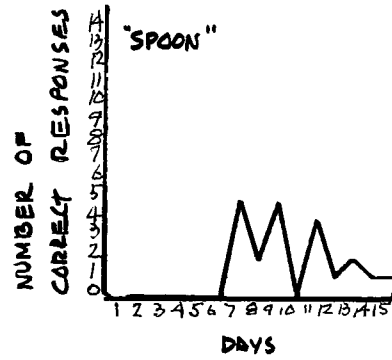
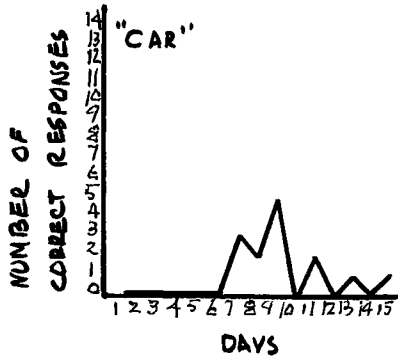
Joe's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 53



Jim's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set II.

Figure 54

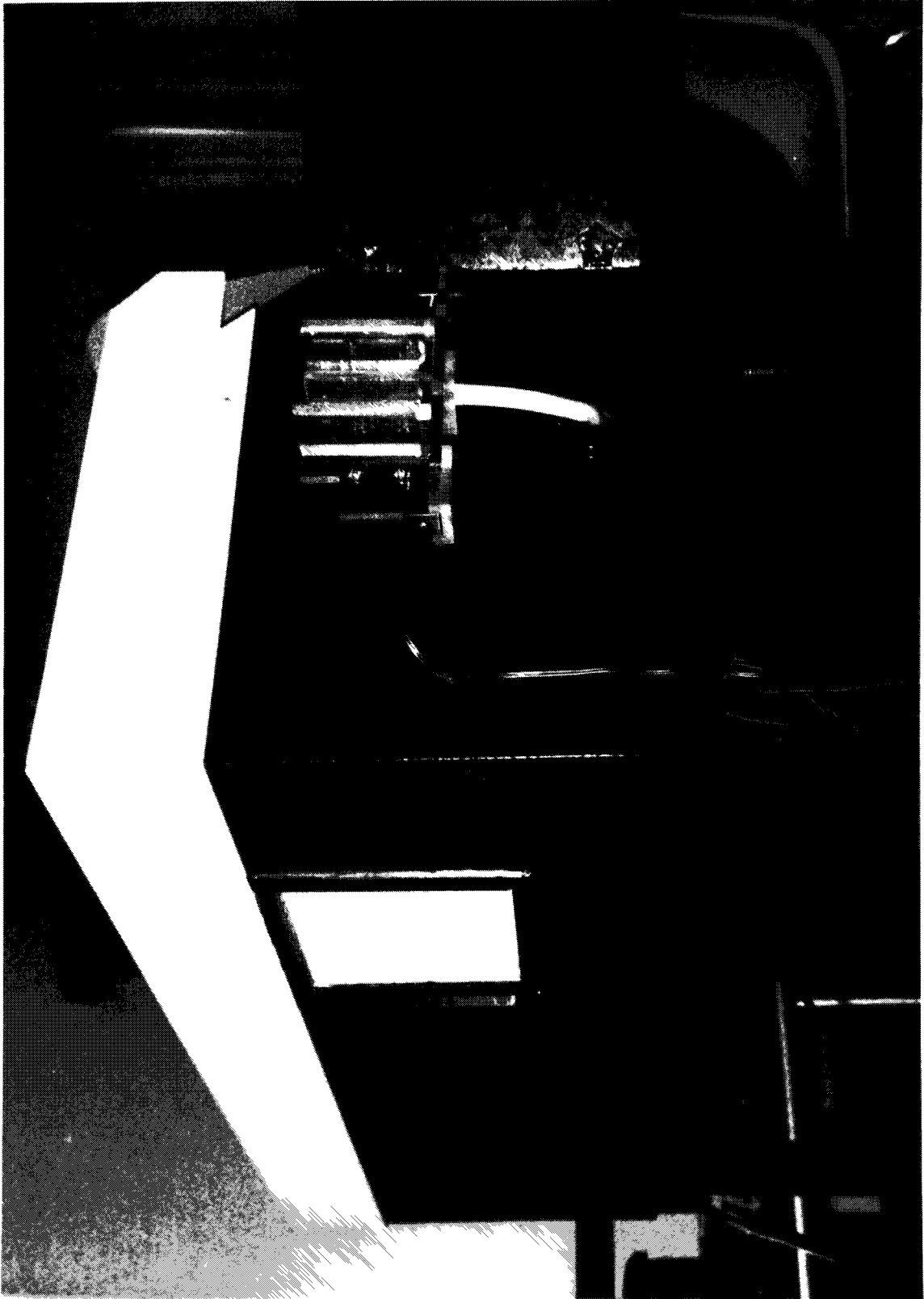


Jim's Correct Responding Over Days On The Concepts CAR, SPOON, MAN, TRIANGLE, SQUARE, CIRCLE: Set III.

Figure 55

APPENDIX 5

PHOTOGRAPHS OF THE OPERANT APPARATUS





APPENDIX 6

ABSTRACT OF:

Operant Conditioning Procedures
With Profoundly Retarded Children In The
Acquisition Of Concepts.

ABSTRACT OF:

Operant Conditioning Procedures
With Profoundly Retarded Children In The
Acquisition Of Concepts¹.

Twenty-four profoundly retarded boys, with IQs below 20 and CAs ranging from 7 to 12 were selected for a controlled study designed to test the efficacy of operant procedures for concept training.

A single Experimental-Control group design matched on critical variables was employed. The Experimental group received concept training in accord with a specified set of operant procedures and apparatus. Subjects in the Control condition were exposed to the same stimulus materials for approximately the same amount of time, but without the explicit operant procedures and apparatus. Both groups underwent 15 days of concept training involving three common and three geometric concepts. The individual stimulus items were visually presented to the Subject who was required to verbally and non-verbally identify them according to their appropriate concept class. The training period was preceded by a pre-testing phase and was followed by two posttests (identical to the pre-test) one and 21 days after the last day of concept instruction. Between and within group comparisons were made

¹ James Bernard Pace, doctoral thesis presented to the Faculty of Psychology of the University of Ottawa, Ontario, February, 1971, xii-190 p.

ABSTRACT OF:

using selective t-tests.

The results rejected the hypotheses that there would be no between-within group difference in 1) 'expressive'- 'receptive' concept acquisition; and, 2) required concept instruction time. The operantly trained Experimental group demonstrated significant gains over the Control group on both posttest measures of 'expressive' and 'receptive' concept formation. A within group analysis further revealed a significant change from pre-to posttests I and II for the Experimental groups. Comparable results were not produced in the Control condition. Finally, the difference between Experimental and Control groups was indicated in required concept instruction time, with the former requiring significantly less training time.

These findings contradicted those of earlier studies which failed to demonstrate the educability of the profoundly retarded.

APPENDIX 7

SOMMAIRE DE:

Operant Conditioning Procedures
With Profoundly Retarded Children In The
Acquisition Of Concepts.

SOMMAIRE DE:

Operant Conditioning Procedures
With Profoundly Retarded Children In The
Acquisition Of Concepts¹.

Cette étude objective se proposait de mesurer l'effet du conditionnement 'operant' sur la formation des concepts. A cet effet, l'Auteur a choisi un groupe de vingt-quatre garçons, retardés profonds, ayant un QI inférieur à 20 et un AC variant de 7 à 12 ans.

Il utilisa la technique du "groupe témoin-expérimental unique" choisi d'après certaines variables critiques. Le groupe Expérimental reçut un entraînement à la formation de concepts selon une série précise de procédés de conditionnement 'operant' et d'appareils. Les sujets du groupe Témoin furent exposés aux mêmes stimuli pendant une période de temps à peu près semblable, mais sans l'usage explicite des procédés de conditionnement 'operant' ni des appareils. Les deux groupes subirent 15 jours d'entraînement à la formation de concepts, comprenant trois concepts communs et trois concepts géométriques. Les stimuli individuels furent présentés visuellement au sujet qui devait les identifier verbalement ou non-verbalement, selon leur classe particulière de concepts. La période d'entraînement, précédée d'un test initial, fut

¹ James Bernard Pace, thèse de doctorat présentée à la Faculté de Psychologie de l'université d'Ottawa, Ontario, février, 1971, xii-190 p.

SOMMAIRE DE:

suivie de deux tests de contrôle (identiques au test initial), 1 jour et 21 jours après la fin de la période d'entraînement. Le t-test permet de faire des comparaisons intra et inter groupes.

Les résultats contredirent les hypothèses qu'il n'y aurait aucune différence inter et intra groupes 1) dans la formation des concepts 'expressifs' et 'réceptifs'; et 2) dans le temps d'enseignement requis. Le groupe Expérimental, soumis à la méthode de conditionnement 'operant', obtint des gains significatifs sur le groupe Témoin dans les résultats des deux tests de contrôle relativement à la formation des concepts 'expressifs' et des concepts 'réceptifs'. De plus, une analyse intra groupe révéla, en faveur du groupe Expérimental, un changement significatif entre les résultats du test initial et ceux des tests de contrôle I et II. Le groupe Témoin n'obtint pas de résultats comparables. Finalement, pour ce qui est de la durée de l'entraînement nécessaire, l'Auteur a trouvé une différence significative en faveur du groupe Expérimental.

Ces données contredisent celles des recherches antérieures lesquelles n'ont pu démontrer l'éducabilité des retardés profonds.

ERRATA

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(Add page 73a. Total pages is thus 190).