DOCUMENT RESUME

ED 023 208 40 EC 002 500

By-Martin, Clessen J.

Associative Learning Strategies Employed by Deaf, Blind, Retarded and Normal Children. Final Report.

Michigan State Univ., East Lansing. Coll. of Education.

Spons Agency-Office of Education (DHEW), Washington, D.C. Bureau of Research.

Report No-ER-38; R-069

Bureau No-BR-5-0405

Pub Date Jun 67

Grant-OEG-5-0405-4-11-3

Note-219p.

EDRS Price MF-$1.00 HC-$11.05

Descriptors-Associative Learning, Average Students, Blind, *Cognitive Processes, Educable Mentally Handicapped, *Exceptional Child Research, *Learning, Learning Processes, *Mentally Handicapped, Paired Associate Learning, Remedial Instruction, Retention, Verbal Development, Verbal Learning, Visually Handicapped

Eight experiments studied the following aspects of associative strategies in learning: classification; verbalization at three developmental levels; verbaliz... on by normal and educable children, facilitation of associative learning among ...ucable retardates; effectiveness of familiarization and differentiation training on the successful employment of associative strategies among educable retardates; conditionability among educable retardates, verbalization by blind children; and administration to educable retardates in word recognition learning. From the results of the series, it was concluded that the storage process can be greatly facilitated; that retarded children preponderantly use less efficient strategies, that successful performance was dependent upon the identification of learning strategies appropriate to the tasks in question, that experimenter-supplied strategies facilitate retention, and that remediation of associative learning is possible. The studies are discussed in detail. Four appendixes, 31 tables, and 18 figures present data, a bibliography lists 38 items. (DF)

Educational Research Series, Number 38
July 1967

Associative Learning Strategies Employed by Deaf, Blind, Retarded and Normal Children

ER 38

Educational Publication Services
College of Education
Michigan State University
East Lansing, Michigan

FINAL REPORT
Project No. R-069
Grant No. 5-0405-4-11-3

ASSOCIATIVE LEARNING STRATEGIES EMPLOYED BY DEAF, BLIND, RETARDED AND NORMAL CHILDREN

June 1967

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

ASSOCIATIVE LEARNING STRATEGIES EMPLOYED BY DEAF, BLIND, RETARDED AND NORMAL CHILDREN

Project No. R-069
Grant No. 5-0405-4-11-3

Clessen J. Martin

June 1967

The research reported herein was performed pursuant to a grant with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorships are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

Michigan State University

East Lansing, Michigan

ACKNOWLEDGEMENTS

The regularly employed members of the staff were as follows:

First year	---	Frederick Boersma, David Cox, Cornelius VanderVeen
Second year	---	Dr. Rosaria Bulgarella, Daniel Berch, Robert Hohn, Cornelius VanderVeen
Third year	---	Dr. Rosaria Bulgarella, Daniel Berch, Jennifer Butler, Robert Hohn, Cornelius VanderVeen

The study would not have been possible without the continued cooperation of the local public school systems. Special mention is due:

Dr. David Haarer, Assistant Superintendent of Special Education, Ingham County Intermediate Schools,

Mrs. Stella Menner, Coordinator Specialist for the Mentally Handicapped, Lansing Public Schools,

Miss Grace Van Wert, Director of Division of Elementary Education, Lansing Public Schools,

Mr. Marvin Beekman, Director of Special Education, Lansing Public Schools,

Dr. Robert Thompson and his staff at the Michigan School for the Blind,

and to Dr. Robert Langton and Mr. George Jacobs of the Department of Instructional Research for the Detroit Public Schools.

Special acknowledgement should be given to Dr. Rosaria Bulgarella, project director, for her diligent and scholarly contribution to this project. Finally, without the industriousness of a competent staff, a project of this magnitude would have been impossible.

TABLE OF CONTENTS

		Page
LIST OF TABLES		iv
LIST OF FIGURES		vi
LIST OF APPENDICES		viii
INTRODUCTION		1
Experiment I.	Classification of Associative Strategies	16
Experiment II.	Verbalization of Associative Strategies at Three Developmental Levels	24
Experiment III.	Verbalization of Associative Strategies by Normal and Educable Retarded Children	51
Experiment IV.	Facilitation of Associative Learning Among Educable Retardates	66
Experiment V.	Effectiveness of Familiarization and Differentiation Training on the Successful Employment of Associative Strategies Among Educable Retardates	83
Experiment VI.	Conditionability of Associative Strategies Among Educable Retardates	105
Experiment VII.	Verbalization of Associative Strategies by Blind Children	118
Experiment VIII.	Administration of Associative Strategies to Educable Retardates in Word Recognition Learning	126
SUMMARY AND CONCLUSIONS		143
REFERENCES		156
APPENDICES		A-1

LIST OF TABLES

Table		Page
1.	A suggested ordering of the types of human learning (From Gagne, 1964)	3
1.1	Classification of associative strategies	19
2.1	Sample Characteristics and treatment designations for the nine classes	26
2.2	Paired-associate list and strategy aids for criterion task	27
2.3	Classification of associative strategies	30
2.4	Mean correct responses and variances for criterion task	35
2.5	Mean correct responses and variances on B pairs for C and E-4 treatment conditions	38
2.6	Mean correct responses for fast and slow learners on practice task	42
2.7	Mean correct responses for fast and slow learners on criterion task	44
3.1	Distribution of Ss in each group using strategy levels 1 or 2	58
3.2	Distribution of Ss in each group using strategy levels 3, 4, or 5	59
3.3	Distribution of Ss in each group using strategy levels 6 or 7	59
4.1	Paired-associate list and strategy aids for criterion task	71
4.2	Distribution of Ss in each group reporting strategy levels 1 or 2	76
4.3	Distribution of Ss in each group reporting strategy levels 3, 4, or 5	77
4.4	Distribution of Ss in each group reporting strategy levels 6 or 7	77
5.1	The relevant stimuli and their embedded words	89
5.2	The irrelevant stimuli and their embedded words	90
5.3	The A and B pairs of the criterion task and the strategy aid given for each pair	91

Table		Page
5.4	Means and standard deviations of the number of correct responses on the practice task..	92
5.5	Means and standard deviations of the number of correct responses for the five groups on the aided pairs of the criterion task.....	94
5.6	Means and standard deviations of the number of correct responses for the five groups on the unaided pairs of the criterion task...	95
5.7	Means and standard deviations of the number of correct responses for the five groups on the criterion task........................	97
7.1	Means and standard deviations of the number of correct responses on the criterion task..	123
7.2	Percent frequency of strategy level reported for the two groups..	124
8.1	Criterion and cue words for the criterion list and the corresponding syntactical strategies....................................	131
8.2	Means and standard deviations of the number of correct responses on the pretest for the twelve cue words.........................	136
8.3	Means and standard deviations of the number of correct responses on the pretest for the twelve large words.......................	136
8.4	Means and standard deviations of the number of correct responses for the three groups on the criterion task......................	136
8.5	Means and standard deviations of the number of correct responses for the three groups on the first retention trial...............	139
8.6	Means and standard deviations of the number of correct responses for the three groups on the two relearning test trials...........	139

LIST OF FIGURES

Figure		Page
1.1	Mean number of correct responses per item for Experiments Ia and Ib, and Experiments Ia and Ib combined as a function of strategy classification	20
2.1	Mean number correct responses by strategy level for each control group	33
2.2	Fourth, sixth, and eighth grade acquisition curves for all treatments	37
2.3	Fourth, sixth, and eighth grade acquisition curves for A and B pairs in all treatment conditions	39
2.4	Fourth, sixth, and eighth grade acquisition curves for fast and slow learners in all treatment conditions	43
3.1	Performance curves for the normal and retarded groups on the criterion task	55
3.2	Percent usage of each of the seven strategy classifications reported by the normal and retarded groups	57
3.3	Relationship between strategy emission latency and the seven strategy classifications	62
3.4	Relationship between strategy emission latency and the number of times a pair was given correctly by subject during the five criterion test trials	63
4.1	Mean number correct responses by trials for each group on acquisition and retention	74
5.1	Mean number total correct responses on the criterion task	96
5.2	Mean number correct responses on aided and unaided pairs on the criterion task	98
5.3	Mean number correct responses on aided and unaided pairs for the five groups	99
6.1	Percentage of verbal reports by LS and HS groups in the seven different categories on the conditioning task	109
6.2	Mean correct responses on acquisition for the LS and HS groups of Experiment VI and the aided and unaided groups of Experiment IV	111

Figure		Page

6.3 Percentage of verbal reports by LS and HS groups in the seven different categories on the associative strategy task... 113

7.1 Mean number correct responses on acquisition for aided and unaided groups.. 122

8.1 Mean number correct responses for each group on acquisition, retention, and relearning.................................. 138

LIST OF APPENDICES

		Page
APPENDIX A.	The Role of Associative Strategies in the Acquisition of P-A Material: An Alternate Approach to Meaningfulness	A-1
APPENDIX B.	Analysis of Variance Summary Tables for Experiments II-VIII	B-1
II.1	Summary of analysis of variance of the number of correct responses for the three control groups on the criterion task	B-1
II.2	Summary of analysis of variance of the number of correct responses for the three control groups on the retention task	B-1
II.3	Summary of analysis of variance of the number of correct responses on the practice task	B-2
II.4	Summary of analysis of variance of the number of correct responses for each group on the criterion task	B-2
II.5	Summary of analysis of variance of the number of correct responses on the B pairs for the control and E-4 groups over all grade levels	B-3
II.6	Summary of analysis of variance of the number of correct responses on the B pairs for the control and E-4 groups of the 6th and 8th grades	B-3
II.7	Summary of analysis of variance of the number of correct responses for each group on the retention task	B-4
II.8	Summary of analysis of variance of the number of correct responses on the practice task for fast and slow learners over all grade levels and treatment groups	B-4
II.9	Summary of analysis of variance of the number of correct responses on the criterion task for fast and slow learners over all grade levels and treatment groups	B-5
III.1	Summary of Lindquist Type I analysis of variance of the number of correct responses on the criterion task	B-5
IV.1	Summary of analysis of variance of the number of correct responses on the practice task	B-6
IV.2	Summary of Lindquist Type III analysis of variance of the number of correct responses on the criterion task	B-6

APPENDIX B cont.

		Page
IV.3	Summary of Lindquist Type I analysis of variance of the number of correct responses on the criterion task for the normal and LE aided groups	B-7
IV.4	Summary of analysis of variance of the number of correct responses on the retention task	B-7
V.1	Summary of analysis of variance of the number of correct responses on the practice task	B-8
V.2	Summary of analysis of variance of the number of correct responses on the criterion task	B-8
V.3	Summary of analysis of variance of the number of correct responses on the aided pairs	B-9
V.4	Summary of analysis of variance of the number of correct responses on the unaided pairs	B-9
V.5	Summary of analysis of variance of the number of correct responses on the aided pairs of the criterion task	B-10
V.6	Summary of analysis of variance of the number of correct responses on the unaided pairs of the criterion task	B-10
V.7	Summary of analysis of variance of the number of correct responses on the criterion task	B-10
V.8	Summary of Lindquist Type I analysis of variance of the number of correct responses on the criterion task for the five groups	B-11
V.9	Summary of Lindquist Type I analysis of variance of the number of correct responses on the first three trials of the criterion task	B-11
V.10	Summary of Lindquist Type I analysis of variance of the number of correct responses on the aided and unaided pairs for the five groups	B-12
V.11	Summary of analysis of variance of the number of correct responses on the criterion task for the three groups	B-12
V.12	Summary of analysis of variance of the number of correct responses on the unaided pairs of the criterion task for the three groups	B-12
V.13	Summary of analysis of variance of the number of correct responses on the aided pairs of the criterion task for the three groups	B-13

APPENDIX B cont. | Page

V.14 Summary of analysis of variance of the number of correct responses on the differentiation task.................... B-13

V.15 Summary of analysis of variance of the number of correct responses on the unaided pairs of the differentiation task.. B-14

VI.1 Summary of Lindquist Type I analysis of variance of the number of correct responses on the criterion task for the LS and HS groups.................................... B-14

VI.2 Summary of Lindquist Type I analysis of variance of the number of correct responses on the criterion task for the four groups....................................... B-15

VIII.1 Summary of analysis of variance of the number of cue words known on the pretest.................................. B-15

VIII.2 Summary of analysis of variance of the number of criterion words known on the pretest........................... B-15

VIII.3 Summary of analysis of variance of the number of correct responses on the criterion task.......................... B-16

VIII.4 Summary of analysis of variance of the number of correct responses on the retention task.......................... B-16

VIII.5 Summary of analysis of variance of the number of correct responses on the relearning task......................... B-16

VIII.6 Summary of analysis of variance of the number of correct responses on the last trial of the relearning task......... B-17

APPENDIX C. Description of Ss from Experiment V.

V.1 Means and standard deviations of CA for the five groups.... C-1

V.2 Means and standard deviations of IQ for the five groups from the Detroit Tests of Learning Aptitudes.............. C-1

V.3 Means and standard deviations of IQ for the five groups from the Stanford-Binet Scale............................. C-2

V.4 Means and standard deviations of reading achievement grade equivalents for the five groups from the Metropolitan Achievement Tests.. C-2

V.5 Means and standard deviations of reading achievement grade equivalents for the five groups from the Iowa Tests of Basic Skills.. C-2

Page

APPENDIX D.	Original data for Experiments I-VIII	D-1
	Data for Experiment I	D-1
	Data for Experiment II	D-3
	Data for Experiment III	D-10
	Data for Experiment IV	D-12
	Data for Experiment V	D-16
	Data for Experiment VI	D-19
	Data for Experiment VII	D-20
	Data for Experiment VIII	D-22

INTRODUCTION

Statement of the Problem

The concept of an association has occupied a central role in most psychological theories of learning. Nearly all theoretical writing on the topic of learning has assumed that one of the most basic processes in learning involves the formation of an association. Research resulting from this view can be characterized as attempts to investigate the variables which influence the formation of associations. Frequently such studies are criticized as being extremely limited, artificial, and not at all representative of more realistic learning situations encountered by the learner outside the laboratory. Two quite different criticisms have been made by learning practitioners of the existing research in learning. One criticism is based upon the assumption that laboratory learning tasks have no analogs in learning situations outside the laboratory. The other criticism is concerned with the basic conceptualization of learning. The latter is aimed primarily at the emphasis upon the associative basis of the learning process. Non-associationistic critics commonly argue that more complex forms of learning are not analyzable in terms of simpler associative processes.

Learning is a complex phenomena, but to deny the possibility of understanding learning processes is to guarantee lack of progress in this vitally important field. Notable attempts have recently been made in the analysis of complex learning tasks. One such attempt has been made by Gagné (1964, 1965). In Gagné's analysis of learning, the association is considered to be the fundamental mechanism forming the basis of all learning. Gagné (1964) assumes that a complex form of human learning, such as problem solving, is related to simpler types of learning. Table 1. presents various types of learning paradigms and descriptions of the processes involved. Commenting on Table 1., Gagné states:

> ". . . learning ranges from the relatively simple response learning to complex problem solving. Increasing complexity is seen to reside not so much in what is learned, as in the nature of what has to be preavailable. . ., in order for various types of learning to occur. Thus, verbal paired-associate learning in its pure form occurs when the responses (or response-connections) are already available. . ., originally made so, presumably, by previous learning. Concept learning is in turn based upon the assumption, or actual establishment, of preavailable verbal 'labels,' which have previously been acquired as paired associates are . . ., and so on until the most complex form, problem solving, is reached, which depends upon the preavailability of capabilities acquired in all the other forms of learning.

There are some rather immediate implications of Gagné taxonomy of learning types for facilitating learning and for remediation of specific learning problems. One implication of his model is that criterion performance on a learning task is dependent upon the acquisition of subtasks. Consequently, more trials on the criterion task per se may not be a sufficient condition for learning to occur. What may be required is more trials on a component subtask. A second, and perhaps more important, implication of his taxonomy is the necessity of a task analysis approach in any attempt to facilitate learning. This means that one begins with the criterion task and works backward to simpler component tasks. Commenting on this approach, Gagné (1962) says, "the approach. . . of proceeding backwards by analysis of an already existing task, has much to recommend it as a way of understanding the learning of school subjects. . . Naturally, every human task yields a different hierarchy of learning sets when this method of analysis is applied."

Table 1. A suggested ordering of the types of human learning. (From Gagné, 1964).

Type	Paradigm[a]	Description
Response learning	S-R	Establishment of a response-connection to a stimulus specified along physical dimensions.
Chaining	S-R⌒S-R	Establishment of chains of response-connections.
Verbal learning (paired-associates)	S-r⌒[s-R]	Establishment of labeling responses to stimuli varying physically within limits of primary stimulus generalization. Previous "response learning" assumed (as indicated by brackets).
Concept learning	S-r⌒s S-r⌒s → Concept S-r⌒s	Establishment of mediating responses to stimuli which differ from each other physically ("classifying").
Principle learning	Concept Concept → Rule	Establishment of a process which functions like a rule "If A, then B," where A and B are concepts.
Problem solving	Rule Rule → Higher order rule	Establishment of a process which "combines" two or more previously learned rules in a "higher-order rule."

[a]The paradigms shown have been designed to depict what is learned, and not the learning situation which leads to this result. In addition, it may be noted that beginning with concept learning, only the central portions of the inferred chains are shown.

Remediation may then be conceptualized as consisting of two major aspects. One aspect involves a delineation of the subtasks within a specified criterion task. The other aspect involves determining what subtasks the learner has or has not acquired. In other words, with reference to a specific task, where in the hierarchy of Table 1. is the individual learner? This approach places as much emphasis upon the examination of the learning task as it does upon the examination of the learner.

Inspection of Table 1. reveals the primacy of the association. According to this taxonomy, if simple critical associations are not formed, then more complex forms of learning become impossible. However, successful performance on many tasks may only require the formation of associations. One of the earliest stages in learning to read involves the formation of an association between a letter grapheme and the identifying response (e.g. saying the "name" of a letter). Learning to recognize a word, a later stage in learning, also requires the formation of an association between the printed word and either an overt or covert pronunciation of the word. The formation of associations is also an important process in learning to spell. Spelling can be conceptualized as a process of forming associations between adjacent letters, phonemes or syllables. When a student learns new words or when he learns a foreign language, the formation of verbal associations is an integral aspect of successful performance.

Because the learning of complex tasks may be dependent upon the formation of more elementary associations, an investigation into the factors facilitating associative learning becomes central. Remediation must begin at the lower associative levels if any sort of proficiency is to be achieved at the higher levels. The focus of this research then is logically at the associative level. The extent to which learning can be facilitated at the associative level will determine the degree of remediation obtainable at the higher levels.

The central purpose of this research is to identify the processes involved in learning verbal associations. Relatively few studies have focused upon the problem of how verbal associations are formed. Consequently, the critical underlying factors in the development of verbal associations are practically unknown. This research represents a systematic attempt to assess the critical factors involved in the formation of associations by normal children at three developmental levels, by educable mentally retarded children (EMRs) and by blind children. Samples from these three populations were included in order to examine the similarities and differences in associational development among the three groups.

A basic assumption about the nature of association formation is that, when required to learn new associations, the individual does not respond passively, but actively imposes some type of meaning and organization into the material to be learned. The particular way in which the individual organizes and learns the associational material can be defined as a strategy. Operationally defined, strategy is the reported activity which intervenes between the presentation of the material and the occurrence of the learned response.

The purpose of this research, then, is to describe the strategies employed in verbal associative learning and to assess the relative effectiveness of different types of strategies upon learning and retention. It is believed that inquiry into the nature of the strategies employed by fast learners may provide opportunities to offer improved strategies for the slow learner. That is, strategies found to be efficient for the fast learner may also be highly effective for handicapped children. As a result, through the identification of efficient ways in which verbal associative learning occurs, it may be possible to give instruction to the slow learner which would enable him to more efficiently organize and learn verbal materials.

Related Research

Unless the learner possesses eidetic imagery (the so-called photographic mind), the formation of verbal associations creates some imposition upon memory. The limited span of immediate memory imposes rather severe limitations on one's capacity to store and retrieve information. However, the presence of rather large individual differences in the capacity to store information in memory suggests that memory limitations are not comparable for all persons. In fact, memory span has long been a standard item in intelligence tests and is considered a primary mental ability (Thurstone & Thurstone, 1958).

Although severe restrictions are imposed upon one's ability to store information, learners may and do compensate for this limitation. One such compensatory mechanism has been referred to as "recoding" by Miller (1956). Recoding refers to a process whereby the individual groups or organizes incoming information into familiar units or chunks. An extremely important aspect in recoding is the organization of the incoming information. Miller (1962, p. 171) explains further:

"The particular associations that people exploit when they try to fix a memory permanently are apt to be somewhat personal and idiosyncratic, but the general strategy they follow is fairly clear. New experience is categorized in terms of familiar concepts shared by the culture and symbolized by the language; then the symbolically transformed experience is related to, and interwoven with, other things previously learned and remembered in terms of these categories and this language. In a new situation it is sometimes difficult to know how best to exploit previous learning, but after a little thought we can usually discover a rule that transforms the novel into the familiar."

From Miller's description of the processes involved in recoding, one would expect large individual differences in the ability to employ such a compensatory mechanism. In addition, the positing of such a mechanism as recoding produces a somewhat more complicated picture of associative learning. Although the concept of recoding complicates what might otherwise be considered a fairly simple process, it is a useful concept to consider when examining the research on individual differences in associative learning.

Recoding is a process originating in the learner. The extent to which this process is engaged in by the learner may depend primarily upon two factors. One factor is, of course, the individual learner. The other factor is related to the nature of the learning task. It may be that, if the learning task involves nonverbal familiar materials, then recoding is not likely to occur spontaneously. At least, the extent of unprompted reorganization ought to be less with familiar materials than with unfamiliar materials. Therefore, one would expect individual differences in learning to be minimized in learning tasks involving familiar nonverbal materials. On the other hand, in tasks involving unfamiliar verbal materials, individual differences should be maximized. There is some experimental support for this notion.

Two reviews of the research by McPherson (1948, 1958) and one by Denny (1964) comparing the learning of normal and retarded Ss have indicated that there are not consistent differences between them in performance. According to Denny, (1964, p. 121), ". . . given well differentiated stimuli and responses, the association is established about as readily in the defectives as well as in the normals; and the importance of this finding should not be underestimated." Generally, studies such as Eisman (1958) and Akutagawa & Benoit (1959) using common objects as stimuli and responses demonstrate no differences between retarded and normal Ss. In the Eisman study, a retarded group, an average normal group and a superior normal group, all matched on CA, learned materials consisting of seven pairs of <u>pictures</u> of common <u>objects</u>, such as BASKET-HAMMER and SUITCASE-FLOWER. Because the material was nonverbal and familiar, little, if any, recoding was necessary for the Ss. Eisman found no significant differences in the learning and retention of these paired-associate materials. Akutagawa & Benoit (1959), using materials similar to Eisman's, compared average children at two CA levels with institutionalized EMRs at the same CA levels. The three lists consisted of eight pairs of familiar pictures and varied in difficulty. Again, while there was a difference in learning between the two CA levels, no difference was found between average and EMR groups within the same CA level.

There are, however, some studies which present questionable evidence for the codability interpretation presented above. Ring & Palermo (1961) using materials similar to the Eisman's, found differences between normal and retarded groups which they believed were significant. However, the difference was "significant at less than the .06 level" for normal Ss and EMRs matched on CA rather than the .05 level established for significant differences. Consequently, it can only be concluded that the difference approached the level of significance. Another study which presents contradictory evidence was conducted by Berkson & Cantor (1960). The stimulus members in this study consisted of numbers, and the responses were either pictures of common objects or different colored hexagons. The Ss were EMRs and average IQ children of approximately the same CA. Each S learned three lists in the A-B, B-C, A-C mediational paradigm, i.e., numbers-objects, objects-colors, and numbers-colors. The groups did not differ in trials to criterion and errors on the first list. On the second list, however, retardates made significantly more errors, and on the third list, retardates needed significantly more trials to learn and again made significantly more errors. It appears, then, that the results of the first list are consistent with those obtained by Eisman (1958) and others, but on list three the retardates showed inferior performance. The latter results could be interpreted as conflicting with the codability notion. According to Denny (1964, p. 122), however, "It would seem more profitable, for the time being at least, to entertain the notion that the connections between readily distinguishable stimuli and common responses are established as readily in defectives with IQs above 50, if not below, as they are in normals."

Thus far in this review, the results indicate that in CA comparisons involving EMRs and average children, either marginal or no differences in learning ability exist when nonverbal familiar materials are used. This conclusion is also appropriate in studies making equal MA comparisons.

Iscoe & Semler (1964), Cantor & Ryan (1962), and Ring & Palermo (1961) found no differences in learning ability between retardates and normals matched on MA. The latter three studies employed either pictures or photographs of familiar objects.

It is posited that one of the critical factors influencing individual differences in learning is the "recoding ability" of the individual learner. Furthermore, the nature of the learning task (e.g. the nature of the materials to be learned) may determine the extent to which recoding becomes a necessary condition for learning to occur. When the learning materials are already familiar and nonverbal in nature, as mentioned previously, recoding becomes less critical. If retarded Ss are deficient in the ability to recode incoming sensory information, such deficiencies ought to be less obvious when the material is nonverbal and familiar. Ability to recode becomes much more important when materials are verbal and unfamiliar.

Denny (1964) arrived at a similar conclusion on the basis of his review of verbal learning studies employing retarded Ss. His summary of such studies is as follows: ". . . as long as the rote-learning materials are nonverbal and familiar there is insufficient evidence of a learning deficit in the mentally retarded with IQ's of 50 and above. As soon as a verbal or symbolic element is introduced there is consistent evidence of a sizable LOW-MA-LOW-IQ deficit and rather tenuous evidence for a small LOW-IQ deficit." Spitz (1966) in a later review also arrives at the same conclusion. He states, ". . . there is evidence that . . . IQ interacts with the meaningfulness and association value (organizational amenability) of the pairs to be learned. That is, the lower the IQ, the more meaningful and more highly associable must be the material for retardates to approach the performance of equal MA normals."

Very little research has been conducted in which retardates are compared to normals on unfamiliar verbal materials. Such research is practically impossible with severely retarded Ss since they are unable to recognize individual letters, let alone syllables or words. One solution to this problem might be an auditory presentation of the syllables or words. In such a situation, no "reading response" would be required. However, many EMRs are capable of reading syllables and some words, thus permitting a visual presentation of verbal materials. Johnson & Blake (1960) found that a mentally retarded sample (IQ range = 50-75) performed significantly more poorly on a paired-associate task than an MA matched normal group. Their materials consisted of three pairs of nonsense syllables. But most other studies employing verbal materials have been serial learning studies. This is somewhat unfortunate if one is primarily interested in tasks which require some degree of recoding. There is some evidence which suggests that paired-associate learning involves a different type of recoding from serial learning (Jensen & Rohwer, 1963a) and is probably more complex (Young, 1962).

Facilitation of associative learning among the retarded is clearly possible. Jensen & Rohwer (1963b) investigated the effect of providing mediational aids to a sample of mentally retarded adults (mean IQ = 54.90) in a paired-associate task. Their materials also consisted of pictures of common objects. One group was given mediating verbalizations. A second group received no mediating verbalizations. The Ss were required to form associations between pictures of common objects such as

FORK-SOAP. In the mediation condition, the E supplied a sentence for each pair on the first trial. For example, the following phrase was provided for FORK-SOAP, "I washed the FORK with the SOAP." Providing the Ss with such sentences greatly facilitated learning. Ten days after original learning, Ss were tested for retention of the mediating set. No differences were obtained between the mediation and non-mediation condition. Although the mediating sentences greatly facilitated acquisition, no transfer occurred to a new set of materials. The authors concluded that retarded Ss do not spontaneously employ organizational aids in the learning of such tasks.

Jensen (1965), in a later study, reached the same conclusion. Using the same type of pictures and mediational aids, he found that retardates given the mediating sentences performed significantly better than an MA matched group of retardates given no mediating instructions. Also, mediating sentences had no effect upon serial learning for either retardates or normals. Jensen concludes, "The marked effect of mediation on PA learning suggests the hypothesis that a good deal of the difference between normals and retardates in PA learning may be due to the occurrence of spontaneous mediation among a larger proportion of the normal Ss."

Two hypotheses have been formulated by Flavell, Beach, & Chinsky (1966) to account for developmental differences in learning among normal children. One, similar to Jensen's, is referred to as the "production-deficiency hypothesis." This hypothesis simply states that younger children tend not to produce the relevant words in a specific task. Furthermore, they state, "It is stipulated that he 'knows' the relevant words and that he can and does produce them in some situations; his deficiency here consists solely of the fact that this particular task fails to elicit them." Production deficiency, then, is an all-or-none matter. That is, mediation does or does not occur.

The alternative hypothesis offered by Flavell et al. (1966) is referred to as the "mediational-deficiency hypothesis." This hypothesis asserts that the younger children do produce verbal mediators in the task situation, but these mediators fail to have their expected effect on overt behavior. According to the above authors, the mediational-deficiency hypothesis, "predicts that the young child's operant verbalizations tend to be deficient in mediational power." However, they do not elucidate the reasons why the child's verbalizations are deficient. It may be that the answer can be found in the way in which the younger child or the retarded child recodes incoming information. A particular task may elicit various types of recoding strategies, but some strategies may be more efficient than other strategies. The difficulty experienced by the young child or the slow learner on a particular task may be due to the fact that the types of strategies employed by them are qualitatively inferior. Whereas Jensen's (1965) interpretation of his data relies primarily upon the occurrence or non-occurrence of spontaneous mediation, the alternative explanation is possible. Jensen's unaided Ss may have been mediating, but the quality of their mediation was inferior to that of his mediation groups and, consequently, these Ss showed inferior performance.

Objectives

Although the original purpose was to examine the types of associative strategies employed by blind and deaf children as well as normal and retarded Ss, the major focus of the project became the educable mentally retarded child. No deaf or hard-of-hearing children were tested. One study investigated the types of strategies employed by blind Ss and the influence of experimenter-supplied strategies upon rate of learning for these Ss.

The general objective of this research was to obtain information regarding the ways in which normal, blind, and educable mentally retarded children learn verbal associations. The goal of this research was to describe the kinds of cues which subjects from these populations employ while learning verbal associations. The different types of cues and the manner in which they are employed were the basis for classifying various types of associative strategies. In addition, the effectiveness of the different kinds of strategies upon learning and retention was determined.

There were four specific objectives which this research project attempted to accomplish. The first objective was to develop a classification system which would permit the categorization of Ss' reported associative strategies. Another aspect of this objective was to determine the relationship between the types of strategies reported and the rate at which the material is learned and retained. This phase of the project involved the testing of college Ss. The rationale for using these Ss was to facilitate the development of a comprehensive classification of associative strategies. It was assumed that they would be able to provide rather detailed verbal reports concerning the types of cues which they employed during learning.

The second objective was to determine the types of strategies employed by children who have sensory or intellectual handicaps. As mentioned previously, the major focus was upon the types of strategies employed by mildly retarded Ss. The relationship between the types of strategies reported and the rate of learning was also examined with these Ss. Also of interest was the relationship between the types of strategies reported at the conclusion of original learning and the amount of retention several days after original learning.

The third objective was to investigate the types of strategies which are employed by normal children at various developmental levels. More specifically, this phase involved determining the number of different types of strategies employed at various developmental levels. Of primary interest, in addition, was the determination of those strategies which are most efficient at each developmental level with respect to the rate at which the material is learned and retained.

The final and most important objective concerned the extent to which learning and retention can be facilitated by giving slow learners training in the use of various associative strategies. By identifying the types of strategies employed by normal children at various developmental levels, it was thought possible to facilitate the learning of educable retardates by giving them instruction in the use of the most efficient strategies. According to the Gagné model presented earlier, remediation of more complex learning tasks involving the formation of verbal associations is dependent to a great extent upon the degree of remediation possible on simpler associative tasks. The ultimate objective of this project was to determine the degree of remediation possible in the learning of verbal associations by educable retardates.

Experiment I

Classification of Associative Strategies

ABSTRACT. The major purpose of this experiment was to develop a reliable classification scheme of the associative strategies reported by college Ss. At the conclusion of the learning session, the Ss were asked to describe how they had attempted to form each verbal association. A seven category classification scheme was developed which permitted the categories to be ordered along an apparent continuum of cue complexity. The results indicated that independent judges were able to reliably classify the reported associative strategies. Furthermore, the results revealed a statistically significant correlation between total strategy score and number of correct responses.

Problem

Verbal learning research involving non-handicapped Ss has demonstrated that numerous variables, such as meaningfulness, formal similarity of the materials, and the rate of presentation, affect the rate at which verbal associations are learned. There has been relatively little verbal learning research involving handicapped children, but where such research does exist, there seems to be some correspondence in the effective variables reported and the relationships that have been identified with normal children. However, little research has been done with either normal or handicapped Ss which has been aimed at identifying exactly how individuals learn verbal associations. Although studies by Underwood & Schulz (1960), Montague, Adams & Kiess (1966) and Bugelski (1962) demonstrate that Ss use associative devices frequently, no research has attempted to determine the qualitative differences among various types of associative strategies.

Although the simplest way to determine how a person has learned a task is to ask him, most investigators do not question Ss about such matters. When such questioning does occur, it is seldom done systematically. The appropriateness of asking people what they did while attempting to master a task has been discussed by Miller, Galanter & Pribram (1960). Moreover, several recent studies have shown that a significant portion of the variance in the learning task can be accounted for on the basis of Ss' verbal reports (Farber, 1963; Eagle & Leiter, 1964; Underwood & Schulz, 1960).

The major purpose of the two studies reported in Experiment I was to develop a reliable classification system of the associative strategies reported by college Ss in the learning of verbal associations constructed from unfamiliar verbal materials. The effectiveness of the various strategies was determined by examining the relationship between the types of strategies reported and rate of learning.

Experiment Ia

Experiment Ia was undertaken to develop a systematic and reliable procedure for analyzing and classifying verbal reports obtained at the conclusion of a paired-associate task consisting of low meaningful material. It was believed that these reports would provide important data concerning the relationship between types of strategies reported and rate of acquisition.

Method

Thirty-nine advanced educational psychology students served as Ss in the experiment. They were presented, in a group, a paired-associate learning task consisting of eight pairs of low meaningfulness (m) paralogs selected from Noble's (1952) list: Meardon-Zumap, Sagrole-Polef, Rennet-Quipson, Volvap-Nares, Neglan-Gokem, Tarop-Gojey, Latuk-Brugen, Bodkin-Nostaw.

The items were placed on thermofax transparencies and presented on an overhead projector in different random orders for all learning and test trials. Ten learning and ten test trials were alternately presented at a three second rate for the learning trials and at a four second rate for the test trials. A recognition procedure was employed for the test trials during which each stimulus was successively presented with all eight responses. The responses on the test transparencies were randomized to avoid any serial position effect, and Ss were provided with test booklets in which to record their answers.

At the conclusion of the learning session, Ss were again shown each pair and given 60 seconds to report in writing how they attempted to form each association.

Results

An examination of the verbal reports suggested seven different categories, differing with respect to an apparent underlying continuum of cue complexity. The categories and their rank order are presented in Table 1.1.

Figure 1.1 shows the relationship between the ranks of the strategies and the mean number of correct responses per item for ten trials. Inspection of Figure 1.1 reveals an increasing relationship between the complexity of the associative strategy and correct performance on individual items. A total strategy level score was also obtained for each S. This score was computed by assigning to each verbal report the appropriate category level and then summing over the eight pairs of items. For example, if the S reported using a repetition strategy on three pairs (3 pairs learned by a 2 level strategy) and a syntactical strategy on

Table 1.1. Classification of associative strategies.

Category Level	Type of Cue Subject Reported Using	Example of Verbal Report
1. No Reported Associations	S was not able to state how he managed to make the association.	Sagrole-Polef: "Don't know how I learned this pair."
2. Repetition	S reported rehearsing the pair	Volvap-Nares: "Just kept repeating these words to myself."
3. Single Letter Cues	S reported using a single letter in each of the paralogs in making the association.	Tarop-Gojey: "Noticed that each word contained an O."
4. Multiple Letter Cues	S reported using multiple letters in each of the paralogs.	Sagrole-Polef: "Each word contains an OLE."
5. Word Formation	S reported that an actual word was embedded in one or both of the paralogs and made use of these words in making the association.	Meardon-Zumap: "The word EAR is contained in meardon and learned that EAR goes with Zumap."
6. Superordinate	S reported selecting elements from each of the two paralogs that had some relationship to each other.	Sagrole-Polef: "Sagrole begins with S and Polef with P, thought of State Police."
7. Syntactical	S reported selecting elements from each of the two paralogs and embedding these ëlements into a sentence, phrase or clause.	Rennet-Quipson: "Changed Rennet to Bennet and saw Quips in Quipson-thought: Bennet Cerf Quips on TV."

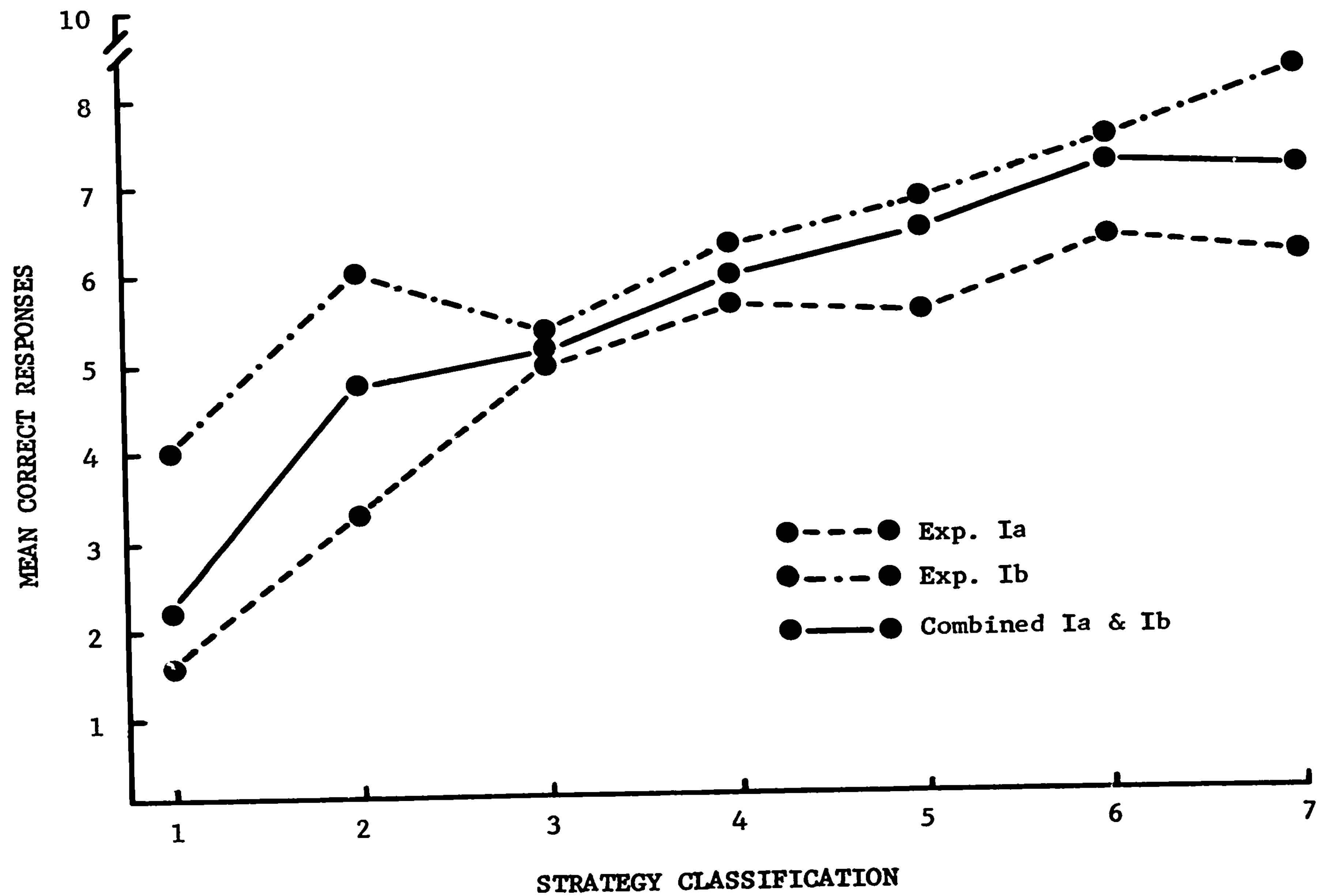

Fig. 1.1 Mean number of correct responses per item for Experiments Ia and Ib, and Experiments Ia and Ib combined as a function of strategy classification.

five pairs (5 pairs learned by a 7 level strategy), his total strategy score would be 41. A Spearman rank correlation coefficient was computed to determine the relationship between total strategy level scores and number of correct responses on eight items in ten trials. The resulting coefficient (r_s = .62) was statistically significant beyond the .01 level and indicated a positive relationship between performance on the learning task and complexity of strategy level reported.

The reliability of the classification scheme was checked by having two judges independently rate all verbal reports. A Pearson correlation coefficient was then computed between the separate total strategy level scores obtained for each individual. The coefficient (r = .95) indicated high agreement between the two sets of independent ratings.

Experiment Ib

Experiment Ib was a replication of Experiment Ia.

Method

Forty-seven students enrolled in an introductory educational psychology class were used as Ss in this experiment. The material and procedure were exactly the same as those employed in Experiment Ia.

Results

The Ss' verbal reports were classified according to the system developed in Experiment Ia. Here again, Figure 1.1 shows an increasing relationship between complexity of strategy level employed and performance on individual items. A Spearman rank correlation was also computed between total strategy level scores and total number of correct responses. This coefficient (r_s = .63) was significant beyond the .01 level. Moreover, reliability of the classification system was checked, as in Experiment

Ia, by having two judges independently rate all verbal reports. The Pearson coefficient (r = .95) between the judges' ratings was similar to that obtained in Experiment Ia.

Discussion

One of the characteristics of the classification scheme developed in Experiment Ia was the apparent underlying continuum of cue complexity. Assuming this hierarchical relationship among the seven categories, some attempt at quantifying associative strategies appeared reasonable. Therefore, mean number of correct responses per item was plotted against the respective categories to see whether there was any relationship between cue complexity and performance. The resulting plot revealed an increasing relationship between the ordering of the categories and mean number correct responses. Although this relationship was observed in both experiments, a more stable indication of it is presented in the combined curve in Figure 1.1. Thus, the data suggested that an ordinal scale was underlying the dimension of cue complexity and consequently, that the different types of strategies could be quantified in an ordinal manner.

A Spearman rank correlation was computed between Ss' total strategy level scores and number of correct responses on the learning task. For both experiments, the coefficient was statistically significant beyond the .01 level, showing better performance to be associated with the higher level strategies. In addition, the results suggest that associative strategies may be an important way to look at individual differences in performance on a paired-associate learning task.

The percent frequency of strategy level use for the two experiments combined was also computed: No association 12%, Repetition 11%, Single letter cue 14%, Multiple letter cue 10%, Word formation 6%, Superordinate 29%, and Syntactical 18%; and as previously mentioned, the agreement between raters was extremely high. Thus, the data indicate that idiosyncratic verbal reports can be reliably classified and that, while most categories are used with about equal frequency, there appears to be a tendency to use more high level strategies.

A further study which is reported in Appendix A demonstrated the generality of the classification system developed in this study. The major difference between Experiment I and the study reported in Appendix A is that the latter study examined the types of strategies reported by college Ss when different types of paired-associate lists were constructed. These lists differed in the meaningfulness (m) of the stimuli and responses. The results of this latter study indicated that the strategies reported by the Ss who learned various types of lists could be reliably categorized within the classification scheme developed in Experiment I.

In summary, the results of Experiments Ia and Ib showed that it was possible to categorize Ss' idiosyncratic verbal reports in a reliable and systematic manner. Furthermore, the resulting classification system appears to represent qualitatively different types of associative strategies which are related to systematic differences in rate of learning among the various categories. It appears that this classification scheme may prove to be a valuable technique for studying individual differences in verbal associative learning.

Experiment II

Verbalization of Associative Strategies at Three Developmental Levels[1]

ABSTRACT. A reliable classification scheme (Experiment I) has been developed which permits the classification of Ss' verbal reports obtained at the conclusion of paired-associate learning tasks. The seven category scheme allows categorization of the reported associative cues along an apparent continuum of cue complexity and permits the calculation of a strategy level score. Verbal reports were obtained from Ss in grades 4, 6, and 8 at the conclusion of a paired-associate task. A significant relationship between strategy level score and number of correct responses was obtained in all three grades. In addition, the complexity of associative cues reported increased as a function of grade level. Learning was greatly facilitated as a result of providing associative cues to six experimental groups.

Problem

The present study incorporated the method used in Experiment I in order to examine the associative strategies of children and the developmental changes of these reported strategies with age. It was believed that older children who generally perform better than younger ones would be better able to recode or impose organization on the associative materials to be learned. That is, older children would tend to report more high level (complex) associative strategies than younger children. This experiment was also designed to investigate the effects of providing children with high level strategy aids, i.e., recoding the material for the child. Previous studies have shown that aids facilitating mediational links in PA learning result in an improvement in performance (Jensen and Rohwer, 1963a; 1963b; Spiker, 1960). No studies, however, were found which systematically investigate the effect of giving the same mediational aids to children at different age levels.

[1]This paper is based on a master's thesis submitted to the College of Education at Michigan State University by David L. Cox.

In addition, the present study investigated the effects of giving strategy aids for only half, as well as all, of the paired associates in the criterion task list. It is hypothesized that, as a result of receiving a partially aided list, the Ss tend to develop high level strategies similar to the aids given by E for the unaided pairs. Consequently, the unaided pairs in a partially aided list are learned faster than the same pairs in an unaided list. A final aspect examined is the effect of the strategy aids upon the performance of fast and slow learners, defined as such by previous performance on a practice task. It is hypothesized that aids affect the performance of these learners differentially; if slow learners were able to effectively employ the cues given, their performance would be improved so as to resemble that of fast learners.

More specifically, the main hypotheses tested are as follows: 1) older children tend to report higher level strategies more often than the younger ones; 2) strategy aids given by E facilitate the performance of children in PA learning; 3) unaided items in a partially aided list are learned faster than items in an unaided list; and 4) slow learners benefit more from aid than fast learners.

Method

Subjects. Two hundred forty-two students, 130 males and 112 females from three 4th, 6th, and 8th grade classes in a suburban community, were tested in their classrooms using a group procedure. Table 2.1 presents characteristics of the classes at each grade level. All Ss were naive with respect to PA learning tasks.

Table 2.1. Sample Characteristics and treatment designations for the nine classes.

Grade Level	n	Mean Age	Treatment Condition
4	27	9.7	4-C Control
	24	9.6	4 E-4 Aid on 4 pairs
	34	9.6	4 E-8 Aid on 8 pairs
6	28	11.6	6-C Control
	26	11.8	6 E-4 Aid on 4 pairs
	28	11.7	6 E-8 Aid on 8 pairs
8	28	13.5	8-C Control
	22	13.7	8 E-4 Aid on 4 pairs
	25	13.6	8 E-8 Aid on 8 pairs

Materials. Sixteen paired associates consisting of stimulus items of low meaningfulness *m* and response items of high *m* were constructed from Noble's (1952) list. These sixteen paired associates were divided into two lists of eight pairs, one for the practice task and the other for the criterion task. An effort was made to avoid any obvious association between the items in a pair or among the pairs of a list. The mean *m* values of the stimulus and response items were, respectively, 1.91 and 7.44 for the practice task items and 1.23 and 7.48 for the criterion task items.

The criterion list is shown in Table 2.2. All learning and test materials were presented on slides by means of a Kodak Carousel 700 projector with a Lafayette T-2K automatic timer.

Table 2.2. Paired-associate list and strategy aids for criterion task.

Paired-associate		Strategy aid
NEGLAN	LEADER	"Negro leader"
MEARDON	INSECT	"Meadow insect"
SAGROLE	MONEY	"Role of money"
VOLVAP	JEWEL	"Valuable jewel"
LATUK	OFFICE	"Late to office"
BODKIN	WAGON	"Book in wagon"
TAROP	DINNER	"Tar for dinner"
ZUMAP	KENNEL	"Zoos have kennels"

Procedure. Measures on four separate tasks were obtained from each individual: (1) a practice task, (2) a criterion task, (3) an associative strategy task, and (4) a retention task.

Practice task. The practice task was given to insure that all Ss understood the nature of the criterion task and to assess comparability of groups. Differences on the criterion task could then be attributed to treatments, rather than initial differences, in the learning ability of the groups. In addition, the practice task gave Ss an opportunity to become acquainted with the concept of strategies before the collection of strategy information.

At the beginning of the practice task, Ss were given test booklets containing 32 pages with the 8 response items randomly presented on each page. For the learning trials, each of the eight paired associates was automatically presented at a 4-second rate with a 5-second intertrial interval. For the test trials, however, the timer was switched to manual control so that all Ss had sufficient time to circle a response for each stimulus item in their booklets; exposure time for each test item was approximately 10 seconds. Four learning trials were alternated with four test trials. Duplicate copies of each slide enabled E to randomize the order on all learning and test trials, thus avoiding possible serial-position effects.

At the conclusion of the task, Ss were shown each pair separately and asked if they had used any strategies, or cues, in attempting to learn the pairs. Three different students from each group were asked to describe how they managed to form the associations.

Criterion task. The criterion task was presented 24 hours after the practice task. The procedure was similar to that of the practice task with the following exceptions: (1) a different PA list was used (see Table 2.2), (2) five learning and five test trials were given, (3) exposure time per item was reduced to 3 seconds, and (4) specific instructions were given for the respective treatment conditions.

Criterion treatments were randomly assigned to the three classes at each grade level. Table 2.1 presents the respective treatment assignments. No strategy aids were given for the control treatment in order to provide a standard against which to judge treatment effects. For the E-4 treatment, E gave strategy aids for four of the eight pairs, by verbally describing the strategy for each pair, on learning trials one and two. For the E-8 treatment, strategy aids were presented for all eight pairs. These strategy aids, shown in Table 2.2,were selected from those shown to be effective in a pilot study.

Associative strategy task. After completion of the criterion task, Ss were given a booklet containing each pair printed on a separate page and were instructed to write how they had attempted to form each association. The Ss in the aided groups received additional instructions to write the strategy aids in their booklets, if they had used them. The Ss were allowed 90 seconds per pair to report a strategy.

Retention task. Using a recall method, retention data were collected 48 hours after the criterion task. Each stimulus item from the criterion task was presented separately on a blackboard for 15 seconds. The Ss were instructed to copy the stimulus and write, on the answer sheet, the response item they thought was associated with the stimulus.

Results

Developmental analysis. Since the data from the control groups were not confounded with treatment effects, analyses of these groups were used for description of the developmental effects. The mean total correct responses for the 4-C, 6-C, and 8-C groups were 20.93, 27.43, and 29.04, respectively. A one-way analysis of variance of total correct responses for the three control groups yielded a statistically significant F ratio ($F = 7.84$, $df = 2/80$, $p < .01$). Individual comparisons by means of the Tukey (a) test showed that 8-C and 6-C differed significantly from 4-C

($p < .01$), but not from each other. It appears that ability to perform the task increases at a decreasing rate among children at these age levels.

Four judges independently rated the verbal reports of the 4-C group collected during the associative strategy task. Table 2.3 presents examples of associative strategies reported and their ranks.

Table 2.3. Classification of associative strategies.

Category Level	Type of Cue S Reported Using	Example of Verbal Report
1. No Reported Associations	S was not able to state how he made the association.	Zumap-Kennel: "I couldn't think of anything in this one."
2. Repetition	S reported rehearsing the pair.	Bodkin-Wagon: "I said it over and over until I knew it by heart."
3. Single Letter Cues	S reported using a single letter in each of the dissyllables in making the association.	Neglan-Leader: "Neglan and Leader both have an E right after the first letter."
4. Multiple Letter Cues	S reported using multiple letters in each of the dissyllables.	Sagrole-Money: "They both have an E and an O."

Table 2.3 cont.

5.	Word Formation	S reported an actual word embedded in one or both of the dissyl-lables and used the word in making the association	Tarop-Dinner: "I just sort of associated Tar and Dinner together."
6.	Superordinate	S reported selecting elements from each of the two dissyllables and connecting them by relating them to each other in some way.	Meardon-Insect: "I thought Meardon looked like meadow and insects are found in meadows."
7.	Syntactical	S reported selecting elements from each of the two dissyllables and embedding them into a sentence, clause, or phrase.	Volvap-Jewel: "I thought of valuable jewel."

Each S was then assigned a total strategy score, based on the sum of the strategy ranks for all eight pairs. For example, if an S's verbal reports on three of the eight pairs had been categorized as repetition strategies, he would have received a score of six for these three pairs (three pairs categorized at strategy level two). Moreover, if the verbal reports for the remaining five pairs had been classified as syntactical strategies, he would also have received a score of 35 for these pairs (five pairs categorized at strategy level seven). Thus, his assigned total strategy score would have been 41. The Kendall coefficient of concordance (W) among four judges on total strategy score was .98. Since interjudge reliability was extremely high, only one judge was selected to rate 6th and 8th grade verbal reports. Median total strategy scores for 4-C, 6-C, and 8-C groups were 27.0, 40.0, and 44.5, respectively. A Kruskal-Wallis one-way analysis of variance on total strategy scores for these groups yielded a significant H value ($H = 17.14$, $df = 2$, $p < .001$). Individual comparisons by means of the Mann-Whitney U test, with the significance level adjusted as suggested by Fisher (Tate & Clelland, 1957, p. 105), revealed that 8-C and 6-C were significantly different from 4-C but not from each other.

To examine the relationship between strategy level reported and performance on individual pairs, mean correct responses for each strategy level were computed. These means are plotted for each control group in Figure 2.1. In general, it appears that the higher the strategy level, the better the performance. In order to determine whether this positive relationship held for total strategy scores, Spearman rank correlations between total strategy scores and total number of correct responses on the criterion task were computed. The correlation coefficients for the 4-C, 6-C,

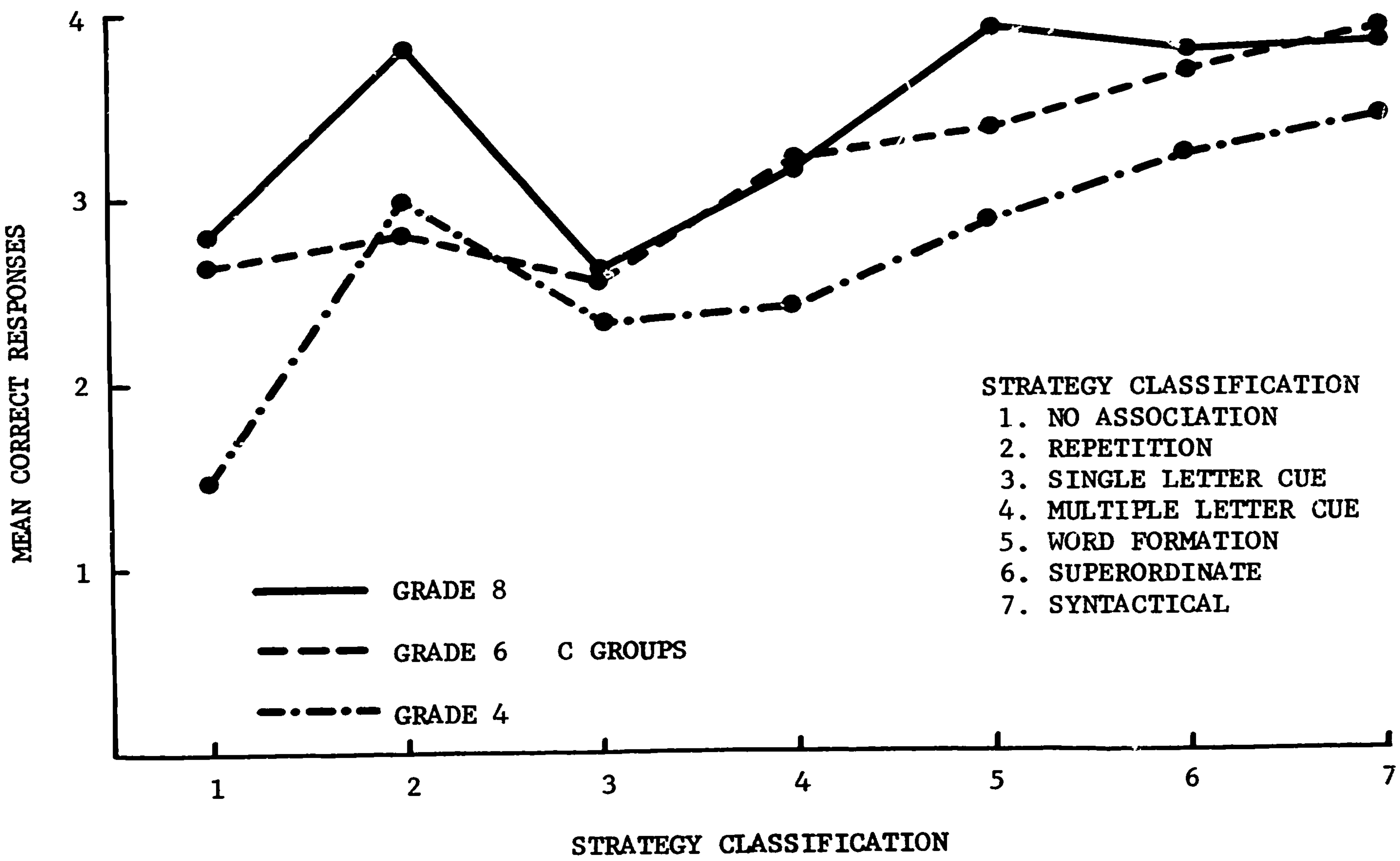

Fig. 2.1 Mean number correct responses by strategy level for each control group.

and 8-C groups were .54, .61, and .45, respectively ($p < .01$ in all groups), indicating that there is a relationship between these two variables.

The results of the retention task were submitted to the same analyses as those of acquisition. A one-way analysis of variance of total retention scores for the three control groups yielded a significant F ratio ($F = 7.21$, $df = 2/80$, $p < .01$). Individual comparisons by means of the Tukey (a) test revealed that both 8-C and 6-C were significantly different from 4-C ($p < .01$ and $p < .05$ respectively) but not from each other.

The relationship between performance on the retention task and strategies used in acquisition was next examined. Spearman rank correlations were computed between total acquisition strategy scores and total correct responses on retention. The correlation coefficients for groups 4-C, 6-C, and 8-C were .57, ($p < .01$), .59 ($p < .01$), and .32 ($p < .05$), respectively.

Analysis of treatment effects. To establish the initial comparability of groups at each grade level, a Grade level by Treatment analysis of variance of total correct responses on the practice task was performed. This analysis revealed only Grade Level as a significant main effect ($F = 19.55$, $df = 2/233$, $p < .01$). The interaction term, however, was also significant ($F = 2.81$, $df = 4/233$, $p < .05$). An examination of the means of the groups within each grade level and use of the Tukey (a) test established the 4-E4 group to be superior to the other two groups at this grade level, thereby accounting for the significant Grade x Treatment interaction term.

Table 2.4. Mean correct responses and variances for criterion task.

Grade Level		Treatment Condition C	E-4	E-8
4	$\bar{X}$	20.93	34.29	37.50
	s^2	75.23	31.61	3.89
6	$\bar{X}$	27.43	32.19	37.61
	s^2	67.51	58.00	9.95
8	$\bar{X}$	29.04	36.95	37.96
	s^2	50.63	8.14	22.54

Table 2.4 shows the mean correct responses and variances for each group on the criterion task. To assess the effect of giving different amounts of aid, i.e., treatment effect, a Grade Level by Treatment analysis of variance of total correct responses on the criterion task was performed. This analysis showed that both main effects, Grade and Treatment, were significant (Grade Level, $\underline{F} = 7.90$, $\underline{df} = 2/233$, $p < .01$; Treatment, $\underline{F} = 84.26$, $\underline{df} = 2/233$, $p < .01$). The interaction term was also significant ($\underline{F} = 5.03$ $\underline{df} = 4/233$, $p < .01$) but this may be attributed to the initial superiority of the 4 E-4 group. The Tukey (a) test was used to make individual comparisons at each grade level. At all grade levels, the E-8 groups differed significantly from the C groups ($p < .01$), and the E-4 groups differed significantly from the C groups

(for the 4th and 8th grade groups, $p < .01$), for the 6th grade groups, $p < .05$). The differences between the E-8 and the E-4 groups were not significant though they were in the expected direction (E-8 > E-4).

The effect of giving different amounts of aid on acquisition can readily be seen in Figure 2.2 which presents the 4th, 6th, and 8th grade acquisition curves for all treatments. In general, the mean number of correct responses increased as aid was increased for each group.

To investigate the hypothesis that Ss perform better on unaided (B) pairs within a list which also contains aided (A) pairs, performance on the four B pairs in the E-4 groups was compared with performance on those same four pairs in the C groups. This comparison was made by means of a 2 x 3 factorial analysis of variance of total correct responses on B pairs for C and E-4 groups over all grade levels. The analysis showed that both main effects and the interaction were significant (Grade Level, $\underline{F} = 4.71$, $\underline{df} = 2/149$, $p < .05$; Treatment, $\underline{F} = 25.93$, $\underline{df} = 1/149$, $p < .01$; Grade Level x Treatment, $\underline{F} = 3.72$, $\underline{df} = 2/149$, $p < .05$). Performance on B pairs was significantly better in the E-4 group. The interaction, resulting from the E-4 group, may be seen in Table 2.5, which presents mean correct responses and variances on B pairs for each group. To investigate the possibility that the significant Treatment effect may be due to the initial superiority of the 4 E-4 group, the same analysis of variance was performed on B pairs for the 6th and 8th grade levels only. Again, the significant Treatment effect showed that performance on B pairs was still better in the E-4 groups ($\underline{F} = 11.37$, $\underline{df} = 1/100$, $p < .01$).

To investigate whether providing strategy cues for half the items may have helped Ss formulate their own high level strategies on the B

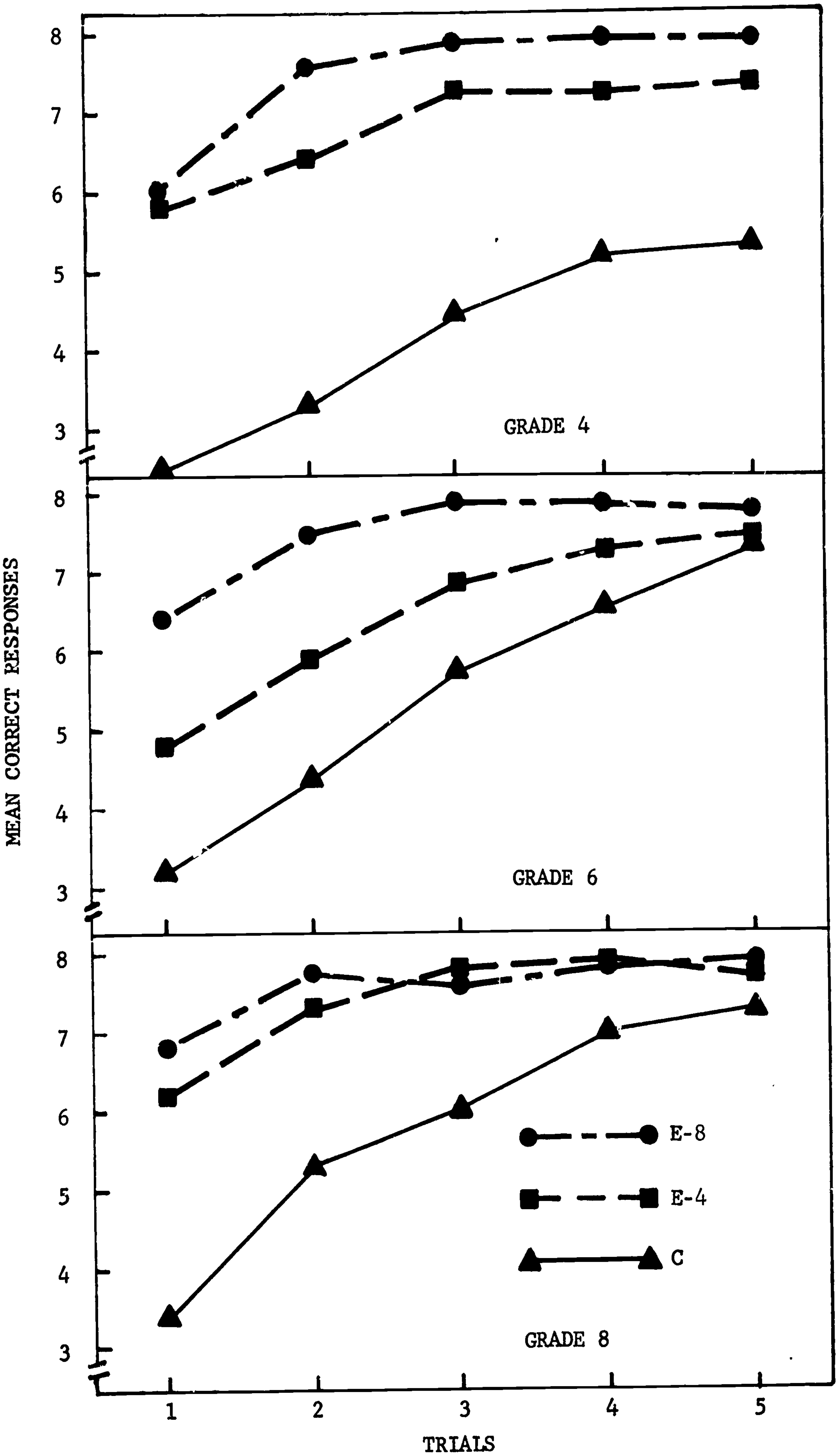

Fig. 2.2 Fourth, sixth, and eighth grade acquisition curves for all treatments.

Table 2.5. Mean correct responses and variances on B pairs for C and E-4 treatment conditions.

Grade Level		Treatment Condition C	Treatment Condition E-4
4	$\bar{X}$	10.74	15.88
	s^2	21.89	18.11
6	$\bar{X}$	13.04	14.85
	s^2	20.33	19.90
8	$\bar{X}$	14.29	17.73
	s^2	14.58	5.73

pairs, the Mann-Whitney U test was used to test differences in total strategy scores between C and E-4 groups on B pairs within each grade level. Only the difference between these groups within the 4th grade was found to be significant ($p < .01$), and this may be accounted for by the initial superiority of the 4 E-4 group.

Figure 2.3 presents the 4th, 6th, and 8th grade acquisition curves for A and B pairs in all treatment conditions. In general, acquisition of the A and B pairs in the E-8 groups appears to be the highest, with the C groups the lowest, and the E-4 B pairs appear to fall between these two. Individual comparisons, by means of the Tukey (a) test, were made between treatments at each grade level for A and B pairs separately. For A pairs at all grade levels, E-4 and E-8 groups were significantly

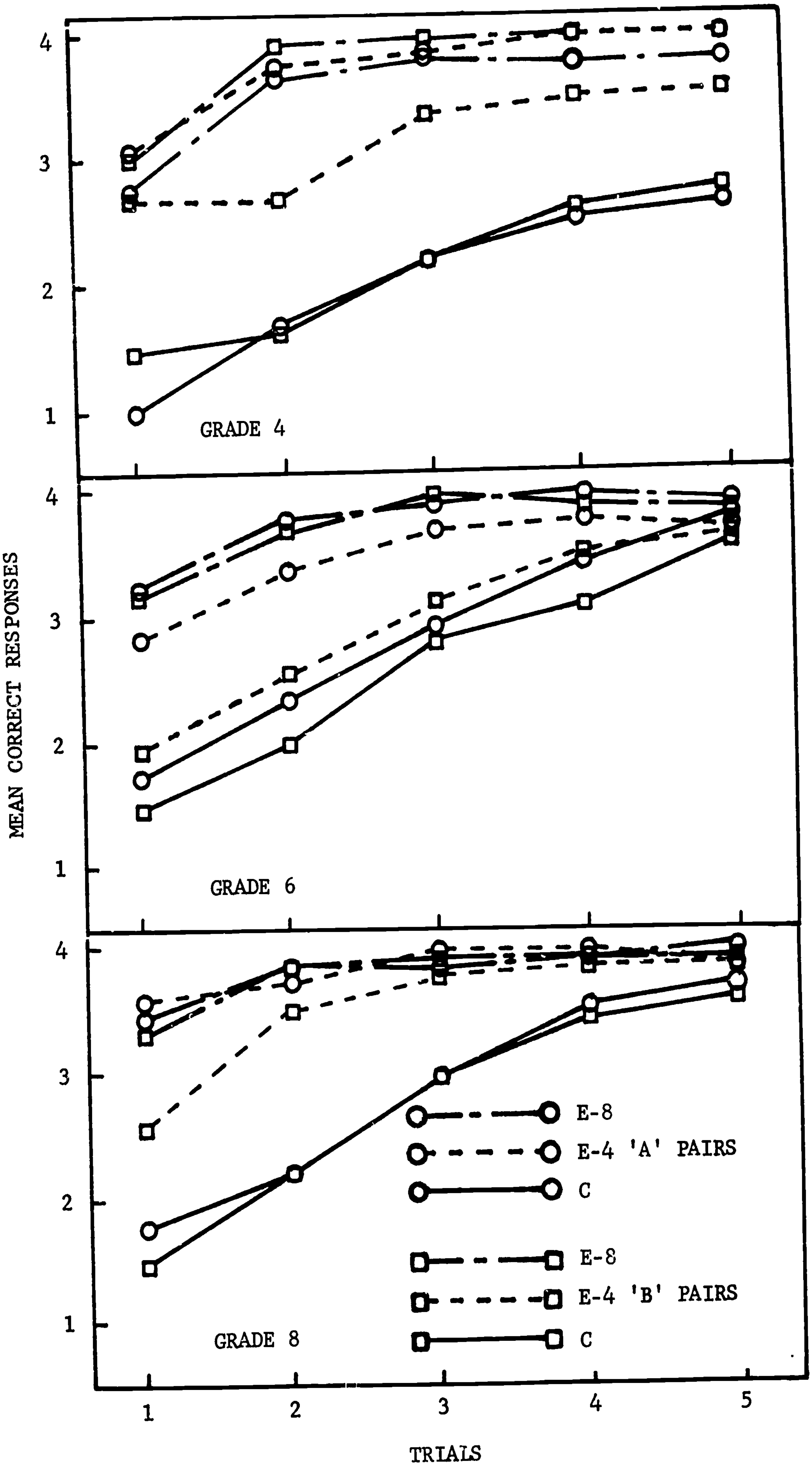

Fig. 2.3 Fourth, sixth, and eighth grade acquisition curves for A and B pairs in all treatment conditions.

different from C ($p < .01$), but not from each other. This was expected, since A pairs were aided in the E-4 and E-8 conditions but not in the C conditions. For B pairs at the 4th grade level, the C, E-4, and E-8 groups were all significantly different from each other ($p < .01$). At the 6th grade level, the E-8 groups were all significantly different from both the E-4 and C groups ($p < .01$), but the difference between E-4 and C was not significant. At the 8th grade level the E-4 and E-8 groups were significantly different from the C group ($p < .01$) but not from each other.

To establish whether A and B pairs were of equal difficulty, a t test was performed at each grade level between mean correct responses on A and B pairs in the C group in which there was no treatment effect. The resulting t scores for the 4th, 6th, and 8th grade groups were .43, 1.19, and .46, none of which were significant. Consequently, A and B pairs appeared to be approximately equal in difficulty. Similarly, to establish whether strategy aids were equally effective for the A and B pairs, t tests were performed at each grade level between mean correct responses on A and B pairs in the E-8 groups in which all pairs were aided. The resulting t scores for the 4th, 6th, and 8th grade groups were 1.66, .37, and .41, none of which were significant. It appears that strategy aids for A and B pairs were equally effective.

A 3 x 3 (Grade Level x Treatment) factorial analysis of variance on retention scores was also performed. Both main effects were found to be significant (Grade, $F = 12.55$, $df = 2/230$, $p < .01$; Treatment, $F = 20.92$, $df = 2/230$, $p < .01$), though the interaction was not. To determine whether the aided pairs were retained better than the unaided pairs, retention of A and B pairs was analyzed separately. As in the acquisition analysis, individual comparisons were made, by means of the Tukey (a) test, between the three treatment conditions at each grade level for A and B pairs separately. For A pairs at the 4th and 8th grade levels, retention scores for the E-4 and E-8 groups were significantly better than for the C groups ($p < .01$) but were not significantly different from each other. Likewise, for the 6th grade level, groups E-4 and E-8 were significantly different from group C ($p < .05$) but not from each other.

For the B pairs, individual comparisons at the 4th grade level showed that group E-8 was significantly different from both the E-4 and C groups ($p < .01$), and at the 8th grade level, E-8 was significantly different from group C ($p < .05$). All other comparisons at each grade level were not significant.

Analysis of slow and fast learners. The administration of strategy aids is hypothesized to facilitate the performance of slow learners more than fast learners, since differences in performance may result from the slow learners comparative lack of effective associative strategies. To investigate this hypothesis, Ss from the top and bottom third of each group in total correct responses on the practice task were designated as Fast (F) and Slow (S) learners. Table 2.6 shows the mean correct responses for the fast and slow learners on the practice task. A 3 x 3 x 2 (Grade x Treatment x Type of Learner) factorial analysis of variance was carried out on practice task scores. All main effects, Grade, Treatment, and Type of Learner, were found to be significant beyond the .01 level ($F = 72.50$, $df = 2/140$; $F = 9.18$, $df = 2/140$; and $F = 877.46$, $df = 1/140$, respectively). In addition, two of the interactions, Grade x Treatment and Grade x Type of Learner, were also significant beyond the .01 level ($F = 11.02$, $df = 4/140$; $F = 7.96$, $df = 2/140$, respectively).

Table 2.6. Mean correct responses for fast and slow learners on practice task.

Grade Level		Treatment Condition C	E-4	E-8
4	F	22.89	29.38	21.00
	S	10.33	15.00	8.73
6	F	26.89	27.44	29.78
	S	12.44	11.89	11.22
8	F	29.89	31.29	29.75
	S	19.22	17.00	18.88

However, the interaction term, Treatment x Type of Learner, and the triple interaction term were not significant.

In order to determine whether the significant main effect of treatment was a result of the initial superiority of the 4 E-4 group, individual comparisons between treatment conditions at each grade level were performed separately for F and S learners. At the 4th grade level, group E-4 was significantly different from the C and E-8 groups ($p < .01$) for both F and S learners. In addition, the 6th grade E-8 group was significantly different from group C ($p < .05$) for F learners. All other comparisons were not significant.

Figure 2.4 presents criterion task acquisition curves for these same F and S learners at the 4th, 6th, and 8th grade levels respectively. Table 2.7 presents the mean correct responses for F and S learners on

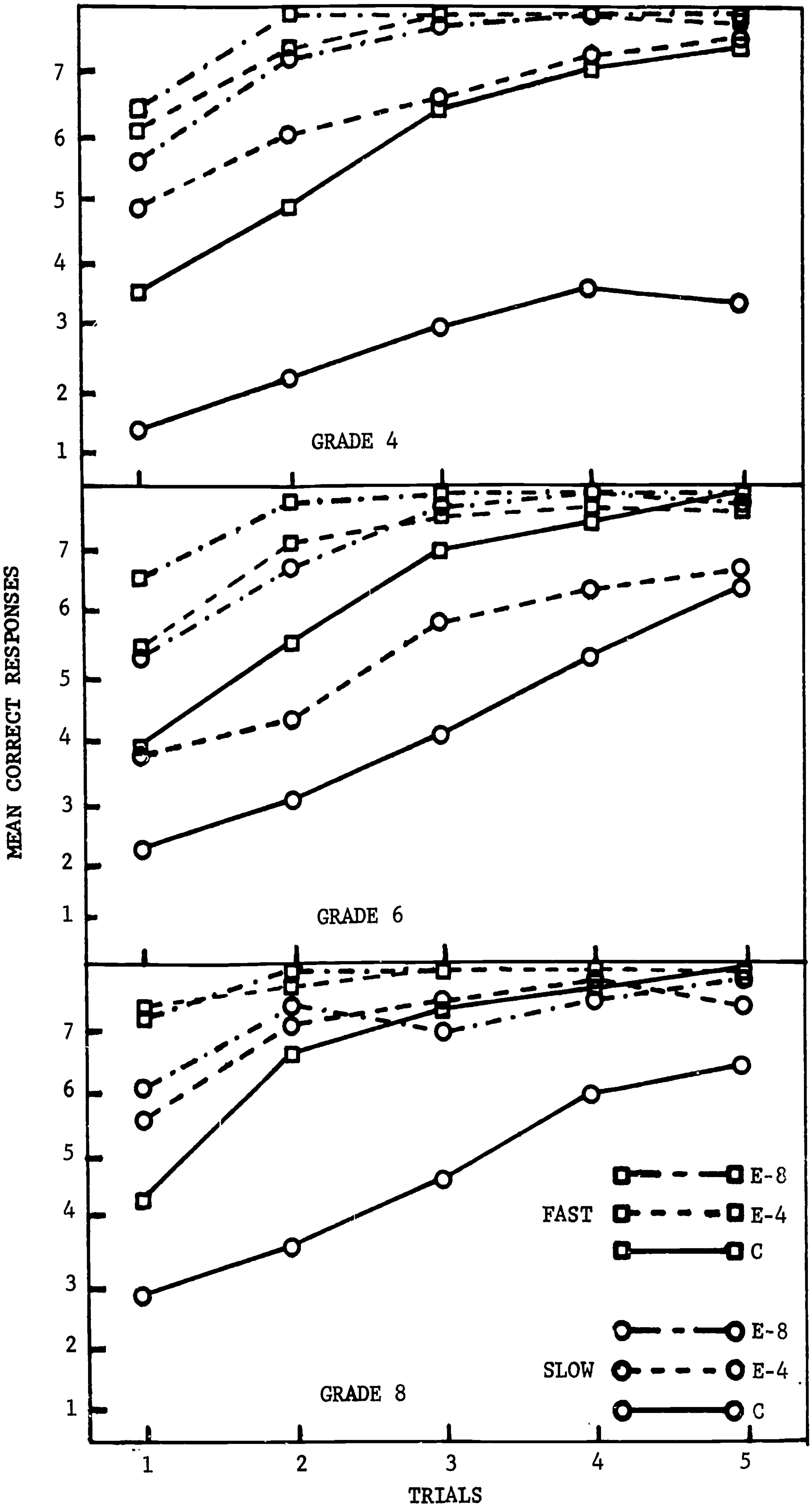

Fig. 2.4 Fourth, sixth, and eighth grade acquisition curves for fast and slow learners in all treatment conditions.

Table 2.7. Mean correct responses for fast and slow learners on criterion task.

Grade Level		Treatment Condition C	E-4	E-8
4	F	29.33	37.38	38.27
	S	13.67	32.25	36.73
6	F	31.78	35.78	38.33
	S	21.44	27.11	35.56
8	F	33.89	38.86	39.00
	S	23.33	35.29	35.38

the criterion task. A 3 x 3 x 2 (Grade x Treatment x Type of Learners) factorial analysis of variance, similar to the practice task analysis, was performed on the number of correct responses on the criterion task. The main effects of Grade, Treatment, and Type of Learner were all found significant (*F* = 3.28, *df* = 2/140, $p < .05$; *F* = 68.72, *df* = 2/140, $p < .01$; and *F* = 63.11, *df* = 1/140, $p < .01$, respectively) as well as the interaction term, Grade x Treatment (*F* = 4.74, *df* = 4/140, $p < .05$). In contrast to the analysis of practice task scores, however, the interaction term, Treatment x Type of Learner, was significant beyond the .01 level (*F* = 11.47, *df* = 2/140), indicating that the difference between F and S learners decreased with aid.

To examine further whether aid was more beneficial to S and F learners, the performances of these learners, on both the practice and criterion tasks, were compared individually at each grade level in the E-8 treatment conditions. On the practice task, the S learners performed significantly poorer ($p < .01$) than the F learners at each grade level. On the criterion task, however, the S learners did not differ significantly from the F learners in performance indicating that S learners may have improved more with aid than did F learners.

Discussion

The first hypothesis predicted that older children would report more high level strategies than younger children. When the strategy scores for the control groups were compared, the significant Kruskal-Wallis one-way analysis of variance and the significant Mann-Whitney U tests showed that the 6th and 8th grades had higher strategy scores than the 4th grade. There was, however, no difference between the reported strategy levels for the 6th and 8th grade control group, nor was there a difference between the two groups on the criterion task.

In addition, Figure 2.1, which presents mean correct responses for each strategy level, shows, in general, the higher the strategy level, the better the performance. The curves do not monotonically increase from strategy level one to seven. The peaks at strategy level two resulted from several subjects at each grade level who did well on the criterion task and reported using repetition to make each association. This may, in fact, be an efficient learning technique for a relatively small portion of Ss. On the other hand, it may be that higher level strategies were used initially, but as the experiment progressed, these high level strategies were no longer needed and consequently were forgotten.

Statistical evidence for the relationship between strategy scores and performance on the learning task was obtained from the significant Spearman rank correlation between these two variables at each grade level. These correlations indicated that individuals who reported high level strategies tended to do better on the learning task than those who reported lower ones. The developmental analysis also revealed that, within each grade level, the same relationship was obtained between retention and strategy scores. The significant rank order correlations between individuals' total strategy scores on acquisition and total correct responses on retention indicated that better performers on the retention task, similar to better performers on the learning task, reported higher level strategies on acquisition.

Numerous findings, obtained in the analysis of the treatment effects, supported the second hypothesis that strategy aids result in increased learning. In general, when Ss were given high level strategy aids at the beginning of the PA task, learning was improved. Figure 2.2, which presents the 4th, 6th, and 8th grade acquisition curves for all groups on the criterion task, shows the appreciable improvement within each grade level when strategy aids were administered. In general, the more items aided, the better the acquisition, although the mean performances of the E-4 and E-8 groups were not significantly different at any grade level. This may have been partially because further improvement by the E-8 groups was limited because of the ceiling effect.

The analysis also revealed that unaided items within a partially aided list were learned significantly faster than those in a completely unaided list. There are two possible interpretations of these results. The first is that aid on half of the pairs essentially reduced the size of the list by allowing the aided items to be learned quickly. The Ss then had more time to concentrate on mastering the unaided pairs. The second interpretation is that the high level strategy aids on half of the pairs provided examples for Ss so that they could better formulate efficient learning strategies for the unaided pairs. In general, the data do not support the latter interpretation. When total strategy scores were compared for the control and E-4 groups, a significant difference was found only for the fourth grade level. Since this difference may be attributed to the initial superiority of the E-4 groups, one cannot conclude that there is evidence for the second interpretation. Hence, it appears that shortening of the list may be the primary reason for better performance on unaided pairs in an aided list.

The results of the retention analysis show that giving strategy aids effectively increased retention, as well as acquisition, of PA learning. Separate analysis of the aided and unaided pairs confirmed the expectation that aided pairs would be retained better than unaided pairs. Scores for the unaided pairs in retention, unlike acquisition, for the E-4 group did not differ significantly from the same pairs for the C group. Thus, it appears that the benefit unaided items received from being in a partially aided list decreased over time.

Further evidence that higher strategy levels facilitate performance on PA tasks resulted from the analysis of fast (F) and slow (S) learners. For those groups administered strategy aids, the change in performance of F and S learners is interesting. Examination of Figure 2.4 shows that S learners not only improved greatly when given strategy aids, but their performance was generally superior to that of the F learners in the unaided control groups. Although F learners also showed improvement with aid, it was not as pronounced as that of the S learners. This is evidenced by the significant Treatment x Type of Learner interaction on the criterion task which was not significant on the practice task. One interpretation of these results is that S learners may not have been as efficient in searching for cues in the materials to be learned and, consequently, did not normally use high level strategies. It is also interesting to note that there was a decrease in variance of criterion task scores as aid was increased, indicating the groups became more homogeneous. It appears that mediational aid had the effect of depressing the difference between F and S Learners. Perhaps, a more reasonable explanation for the significant Treatment x Type of Learner interaction on the criterion task is that it was due to the presence of a ceiling effect for fast learners in the control and experimental conditions. The presence of a ceiling may also account for the lack of significant differences between the E-4 and E-8 conditions in all grades.

One must exercise caution, however, in the interpretation of verbal reports obtained at the conclusion of a learning task. Although there was a significant positive correlation between Ss' reported strategy level scores and performance on the criterion task, there is no guarantee that these verbal reports faithfully represent the type of mediational activity which occurred during learning. In fact, one possible interpretation of such reports is that they are the consequence of learning, rather than its cause. But it is interesting to note that the median strategy level reported by the 4th grade control group was 27.00 as compared to 44.00 for the 8th grade control group. The corresponding mean number of correct responses on the criterion task was 20.93 and 29.04, respectively. However, when the 4th grade Ss were given syntactical type strategies on all eight items (4 E-8 group), the mean number of correct responses was 37.50, which is approximately equivalent to 37.96 mean correct responses for the 8 E-8 group. These results demonstrate the dramatic facilitating effect resulting from experimenter-supplied syntactical strategies. Also, in view of the fact that verbalization of syntactical strategies by the control groups was associated with relatively high performance on the criterion task, the results tend to provide indirect support for the notion that the verbal reports may reflect, to a certain degree, the nature of the mediational activity which occurred during learning.

In summary, the results of this experiment provide convincing evidence that the formation of associative strategies is an important variable in associative learning. The developmental analysis revealed that children were able to verbalize the specific cues which they believed helped them make the association. Using the classification scheme developed in Experiment I, these cues were easily ranked along a continuum of increasing complexity. Older children, who showed better performance on the PA task, tended to report the more complex strategies which appear to be indicative of a higher recoding ability. Moreover, PA learning was significantly enhanced at all three developmental levels by the introduction of complex associative strategies. Three results, combined with the relationship found between performance and strategy scores, indicate that the concept of associative strategies may be a fruitful one to pursue in the general study of associative learning as well as the more specific study of individual and developmental differences in associative learning.

Experiment III

Verbalization of Associative Strategies by
Normal and Educable Retarded Children

ABSTRACT. The types of associative strategies reported by normal and educable mentally retarded children were examined. Verbal reports were classified according to the classification scheme developed in Experiment I. Several differences and similarities were observed between the two groups. The normal Ss were superior in performance and reported more of the high level strategies and fewer of the lower level ones. In addition, normal Ss used less time to verbalize high level strategies. On the other hand, both groups were similar in their use of the intermediate strategy levels as well as in latency to strategy emission. The results indicate that educable retardates do not impose as much organization upon the material in the same number of trials as do normal CA matched Ss.

Problem

The results of Experiment I indicated that those college Ss who reported using complex associative strategies learned at a faster rate than individuals reporting less complex strategies. Although caution must be exercised in the interpretation of these results, the implication is that Ss who learn at relatively fast rates employ efficient associative strategies. The complexity of the higher level strategies is apparently due to the fact that the subjectively imposed organization is greater for these strategies than for the lower level strategies. The greater degree of organization involved in the higher level strategies appears to account for their effectiveness in associative learning. It is quite possible that, with an increase in the organization of the incoming material, there is a corresponding decrease in the imposition which such material makes upon memory.

One of the differences between educable retarded Ss and normal Ss in situations involving associative learning may be due to the inability of the slow learner to impose higher levels of organization upon the material. Experiment II indicated that the younger child's inferior performance in comparison to older children on PA tasks may be a result of his greater use of the lower level strategies. It is likely that retarded children, like the younger children in Experiment II, employ more of the low level strategies which make the storage of associative materials a much greater problem.

The first purpose of the present study was to determine whether educable retarded children could verbalize the types of associational cues employed during learning. A second purpose was the comparison between educable retarded and normal children matched on CA in the types of associative strategies reported.

Method

Subjects. A group of educable retardates and a group of normal children were tested in this study. The normal group contained 14 males and 15 females with an age range of 13-2 to 16-1 years (Mean Age = 14-0). The mean Lorge Thorndike IQ was 105 for the normals with a range of 82 to 123. The retarded group consisted of 13 males and 13 females with an age range of 13-0 to 15-9 years (Mean Age = 14-2). The mean WISC score was 72 for the educable group with a range of 58 to 81. All Ss were enrolled in the same junior high school.

Procedure. Measures on three separate tasks were obtained from each individual.

Practice task. The practice task was administered to the two samples by using a group procedure. It was administered in order to acquaint Ss with the paired-associate learning situation and with the concept of associative strategies before the collection of strategy information. The Ss were presented a seven item paired-associate list constructed from Noble's (1952) list. The stimuli consisted of low m dissyllables (Mean = 1.22), and the responses were high m dissyllables (Mean = 7.76). The pairs and stimuli were printed on individual 5 by 22 inch cards. Each pair was presented manually at approximately a 5 second rate on the learning trials, and each stimulus was presented alone at a 30 second rate on the test trials. A total of three test trials was administered to both samples. However, two learning (LL) trials were alternated with each of the three test (T) trials (LLT, LLT, LLT) for the retarded sample compared to one learning trial with each of the three test trials (LT, LT, LT) for the normal sample. Ss were provided with test booklets in which to record their responses. All responses were printed on the chalk board during the learning and test trials. On the test trial each stimulus was presented in random order, and Ss made their response selection from the chalk board and recorded it in the test booklet.

Upon the completion of the practice task, E explained the types of cues which Ss might have employed in forming the associations. One example from each of the categories in Experiment I was presented in order that Ss would better understand the associative strategy instructions following the criterion task.

Criterion task. The criterion task was administered to each S individually. A six item paired-associate list consisting of low m stimuli and high m responses was constructed from Noble's (1952) list of dissyllables. The list consisted of the following pairs: Kaysen-Captain, Flotsam-Keeper, Femur-Village, Nimbus-Hunger, Welkin-Kitchen, Kupod-Heaven. The mean _m_ values of the low and high _m_ items were 1.91 and 7.19 respectively. The pairs were typed in one-half inch letters on five by eight inch cards and were presented manually by E. A total of 10 learning and 5 test trials was administered. Test trials occurred after the even-numbered learning trials. The items were presented at approximately a 5 second rate during the learning trials with a 10 second intertrial interval. The test booklets contained 30 pages with the six responses randomly presented on each page. A maximum of 20 seconds was allowed each S to circle a response in the test booklet during each stimulus presentation.

Associative strategy task. At the conclusion of the learning task, each pair in the criterion list was again presented. The Ss were then asked to describe what "tricks" or "cues" they used in learning the association. The E pronounced each pair as it was presented. A tape recorder was used to record the entire associative strategy task.

Results and Discussion

The mean scores of normal and retarded Ss on the practice task were 16.66 and 12.04 correct responses respectively. The result of a _t_ test showed that normal Ss performed significantly better ($t = 2.85$, $p < .01$) than the retardates, although the latter had twice as many learning trials.

The performance curves of the normal and retarded groups showing the mean number of pairs correct by trials on the criterion task are presented in Figure 3.1. Though on the first trial the normal group learned more than twice as many pairs (3.90) as the retardates learned (1.38), the amount of improvement after trial one was approximately the same for both groups (normal group, 1.48; retarded group, 1.43). These data were subjected

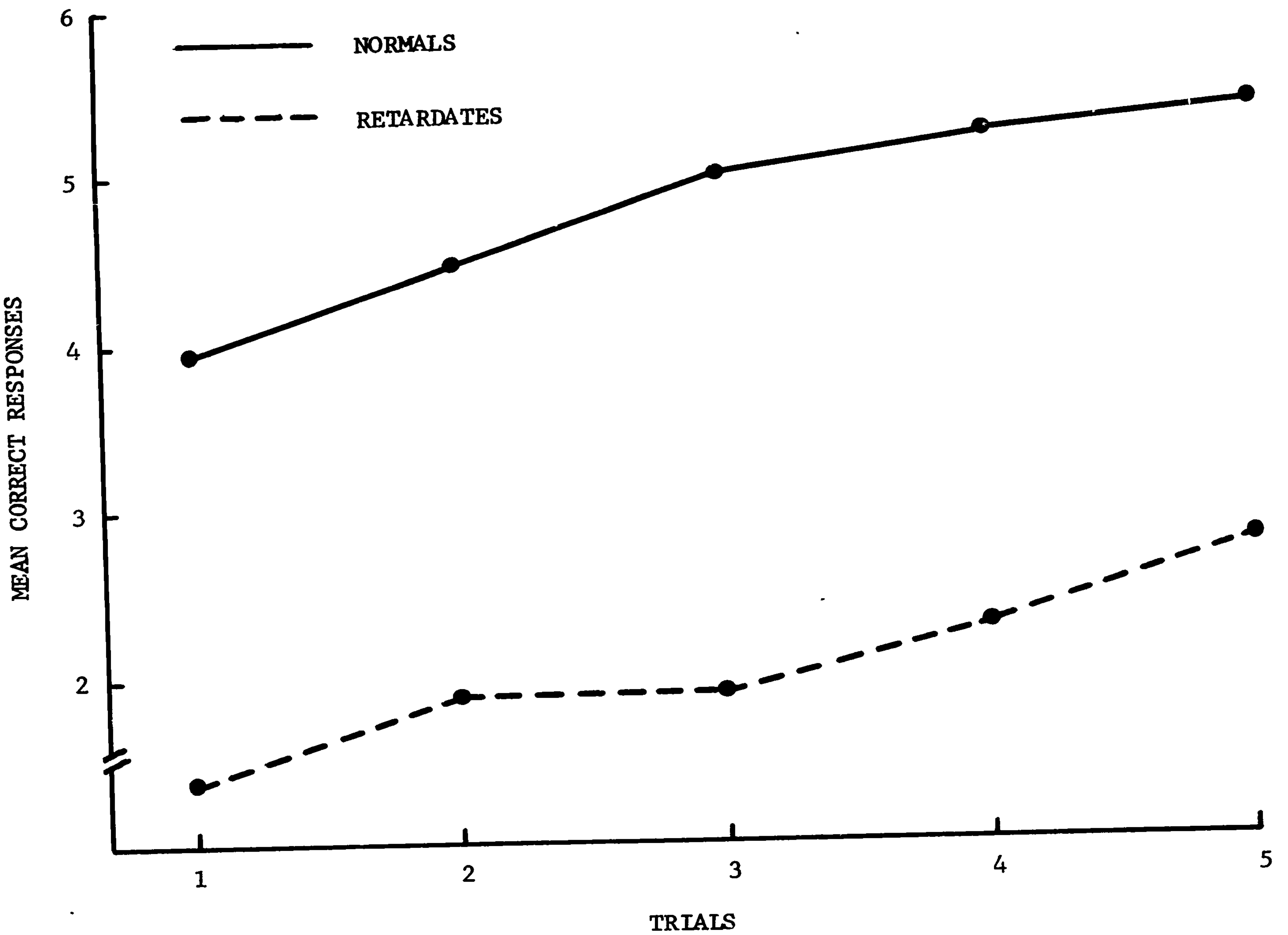

Fig. 3.1 Performance curves for the normal and retarded groups on the criterion task.

to an analysis of variance (Type I Design, Lindquist, 1953). The main effects of Groups and Trials were both statistically significant ($\underline{F}$ = 91.60, $\underline{df}$ = 1/53, $p < .001$ and $\underline{F}$ = 14.92, $\underline{df}$ = 4/212, $p < .001$ respectively). These significant effects indicate that while there was progressive improvement by Ss from trial to trial, normal Ss learned significantly more pairs than retarded Ss. However, the inter action term, Trials x Groups, was not significant, indicating that the performance of both groups increased at approximately the same rate.

Associative strategy reports for each of the six criterion-list pairs were collected from all Ss. These verbal reports were independently ranked by two judges according to the classification scheme developed in Experiment I. For normal Ss, Spearman rank correlation coefficients between the judges for the six paired associates ranged from .82 to .96. Classification of four of the six pairs had correlation coefficients of .95 and .96. Spearman correlation coefficients for retarded Ss similarly ranged from .79 to .99. Classification of five of the six pairs had correlation coefficients of .89 and above. It appears that the judges agreed highly in their assignment of verbal reports to the seven categories for most pairs and that reports of the retardates were as easy to classify as those of normal Ss.

Figure 3.2 shows the percentage of the strategy classifications reported by each group. A total strategy score was computed for each S by summing the S's strategy ratings for all six pairs. The Mann-Whitney $\underline{U}$ test was used to determine whether there was a significant difference between the two groups' total scores. This difference was found to be significant ($\underline{z}$ = 4.76, $p < .001$) in favor of normal Ss having the higher scores.

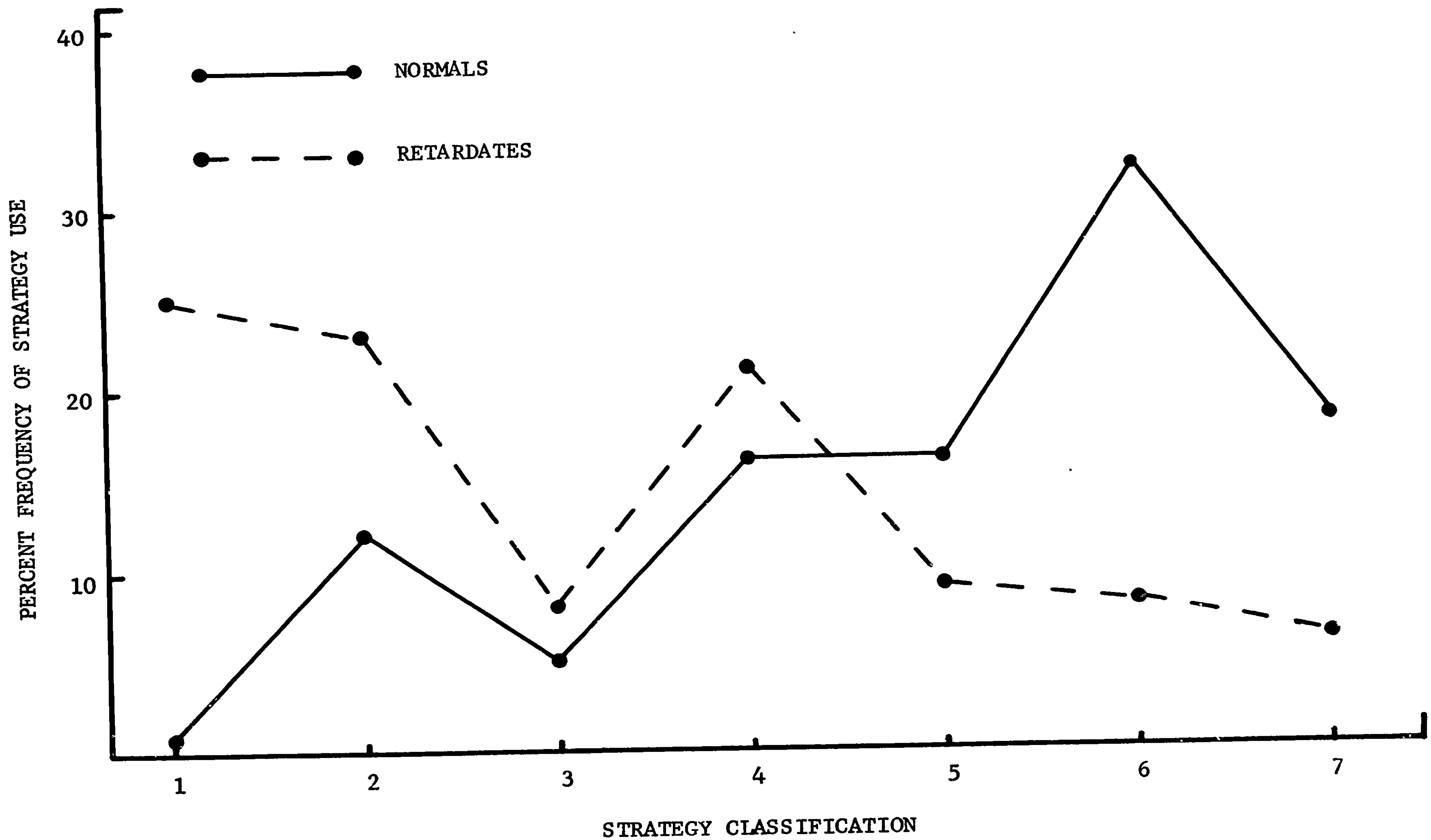

Fig. 3.2 Percent usage of each of the seven strate... classifications reported by the normal and retarded groups.

Since the main purpose of this study was to compare the types of associative strategies reported by the two groups, the distribution of Ss within the normal and retarded groups reporting the various categories was examined. Several adjacent categories exhibiting underlying similarities were combined. Strategy levels 1 and 2 were combined since both of them essentially represent the use of no associative strategy. Levels, 3, 4, and 5 also were combined since they represent an intermediate degree of complexity. Levels 6 and 7 were joined as representing the highest degree of complexity formed by taking an element out of each member of the paired associates and actually relating these to each other in some manner. Table 3.1 shows the distribution of Ss in each group using strategy levels 1 or 2 at least once. The chi-square test was used to determine whether there was approximately the same proportion in each group using levels 1 or 2. The two groups differed significantly in this respect ($\underline{X}^2 = 6.480$, $p < .02$) showing that more retarded Ss reported the lower strategy levels than did normal Ss.

Table 3.1. Distribution of Ss in each group using strategy levels 1 or 2.

Group	No 1s or 2s	At least one 1 or 2	Total
Retarded	4	22	26
Normal	15	14	29
Total	19	36	55

Table 3.2 presents the distribution of Ss reporting the intermediate strategy levels 3, 4, or 5 at least one time. No significant difference

was found between the two groups in the proportion of Ss reporting these categories ($\underline{X}^2 = .303$, $p > .05$).

Table 3.3 presents the distribution of Ss in each group reporting categories 6 or 7 at least once. The two groups differed significantly ($\underline{X}^2 = 17.441$, $p < .001$) indicating that more normal Ss reported the higher strategy levels than did the retarded Ss. In view of these results, the difference between the performance of the two groups on the learning task can perhaps be accounted for by the difference in

Table 3.2. Distribution of Ss in each group using strategy levels 3, 4, or 5.

Group	No 3s, 4s, or 5s	At least one 3, 4, or 5	Total
Retarded	5	21	26
Normal	3	26	29
Total	8	47	55

Table 3.3. Distribution of Ss in each group using strategy levels 6 or 7.

Group	No 6s or 7s	At least one 6 or 7	Total
Retarded	19	7	26
Normal	4	25	29
Total	23	32	55

relative frequency of strategy level use. The significantly poorer performance of retarded Ss may be a result of their preponderant use of the relatively ineffective lower strategy levels. One must also consider, however, the possibility that the number of retarded Ss reporting strategy level 1 may be inflated, since the study was not run to criterion and use of this category may indicate that Ss did not learn the pair. Moreover, retarded Ss' relative disuse of the higher strategy levels may be a result of their small amount of learning.

A Spearman rank correlation for each group was computed to determine the relationship between Ss' total strategy score and Ss' corresponding number of correct responses on the learning task. For the two groups, these correlations were not significant ($r_s = .23$ and $r_s = .29$ for the normal and retarded groups respectively) indicating that in this study there was no clear relationship between total strategy score and amount of learning. This is in contrast to the previous studies, Experiments I and II, in which significant positive correlations were found between performance measures and strategy scores. However, the lack of significant results in this case is not particularly surprising since, as previously mentioned, both groups had a rather restricted range of scores (number correct) on the learning task. It appears that for normal Ss the task was too easy, whereas for retarded Ss the task was rather difficult.

From the tape-recorded sessions of the associative strategy task, it was possible to divide the total report time into two component measures. The first of these was the latency from presentation of the paired associates to the beginning of verbalization by S, i.e., latency to strategy emission. The second measure was the verbalization time or amount of time that S used to describe the strategy. Spearman rank correlations were used to determine whether there was a relationship between these time measures and total strategy scores. For the normal group, there was a significant negative relationship between strategy score and latency as well as strategy score and verbalization time ($r_s = -.38$, $p < .05$; $r_s = -.46$, $p < .01$ respectively). It appears that, for normal Ss, as higher strategy levels were reported, less time was required to report the strategy as well as to verbalize about it.

For the retarded group, a negative relationship similar to that for normal Ss was found between strategy and latency ($r_s = -.58$, $p < .01$). However, a positive relationship was found between strategy and verbalization time ($r_s = .56$, $p < .01$), indicating that retarded Ss used more time to verbalize the strategy when the higher strategy levels were reported. Two possibilities are suggested as explanations for these results. The first of these is that retarded Ss showed very little learning in contrast to normal Ss and, consequently, did not have as much mediational practice. The lack of opportunity to rehearse these higher strategies may account for their longer verbalization time. Since they used lower level strategies more often, these, of course, had lower verbalization time. The second possibility is that because of the retarded Ss' more limited verbal ability, they had greater difficulty verbalizing the higher level strategies.

Latency to strategy emission was also examined in relation to strategy classification (see Figure 3.3) as well as to the total number of times a pair was given correctly by S during the test trials (Figure 3.4). These two graphs show some rather interesting tendencies. Figure 3.3 shows that, in both groups, latency decreased as the higher strategy levels were reported.

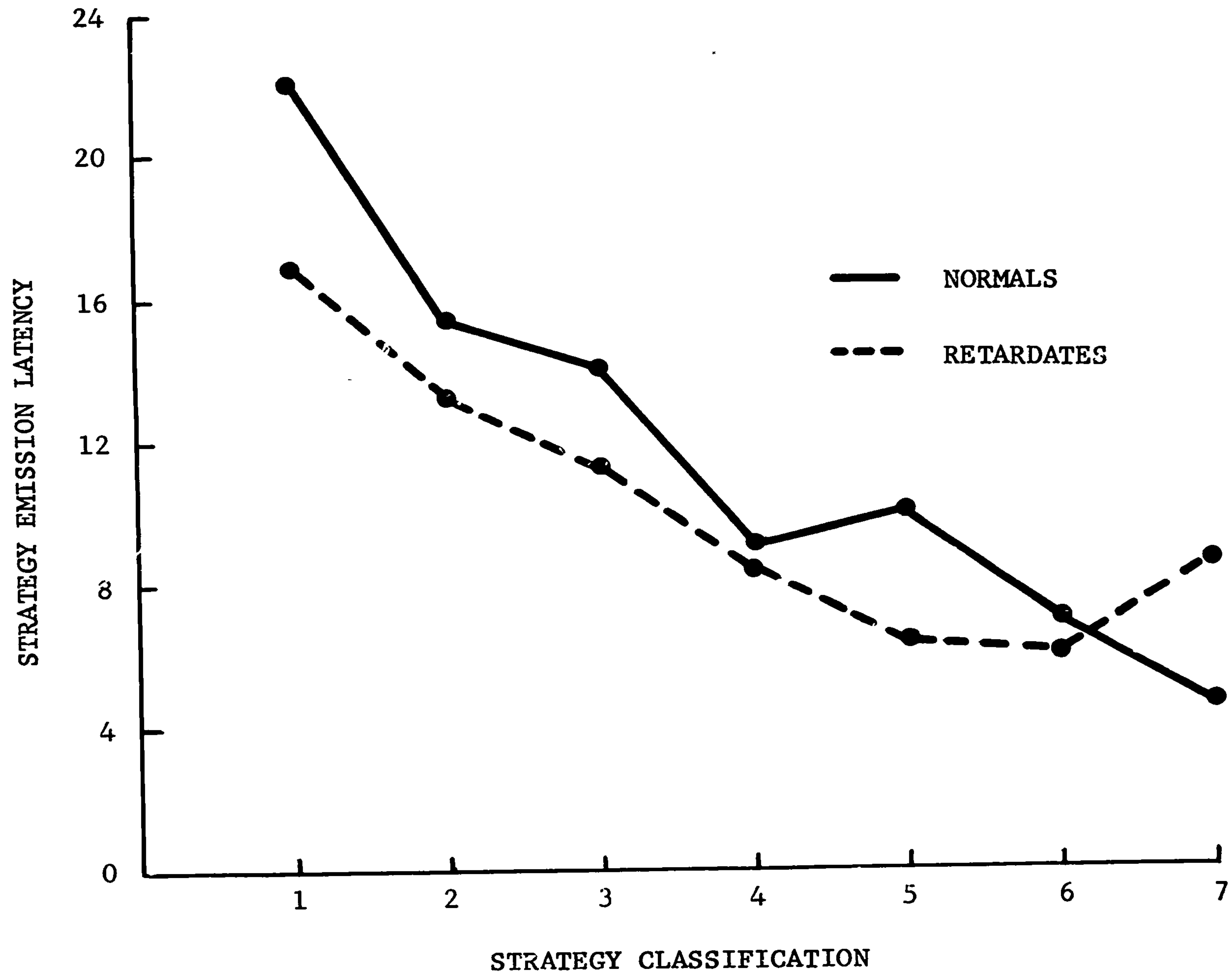

Fig. 3.3 Relationship between strategy emission latency and the seven strategy classifications.

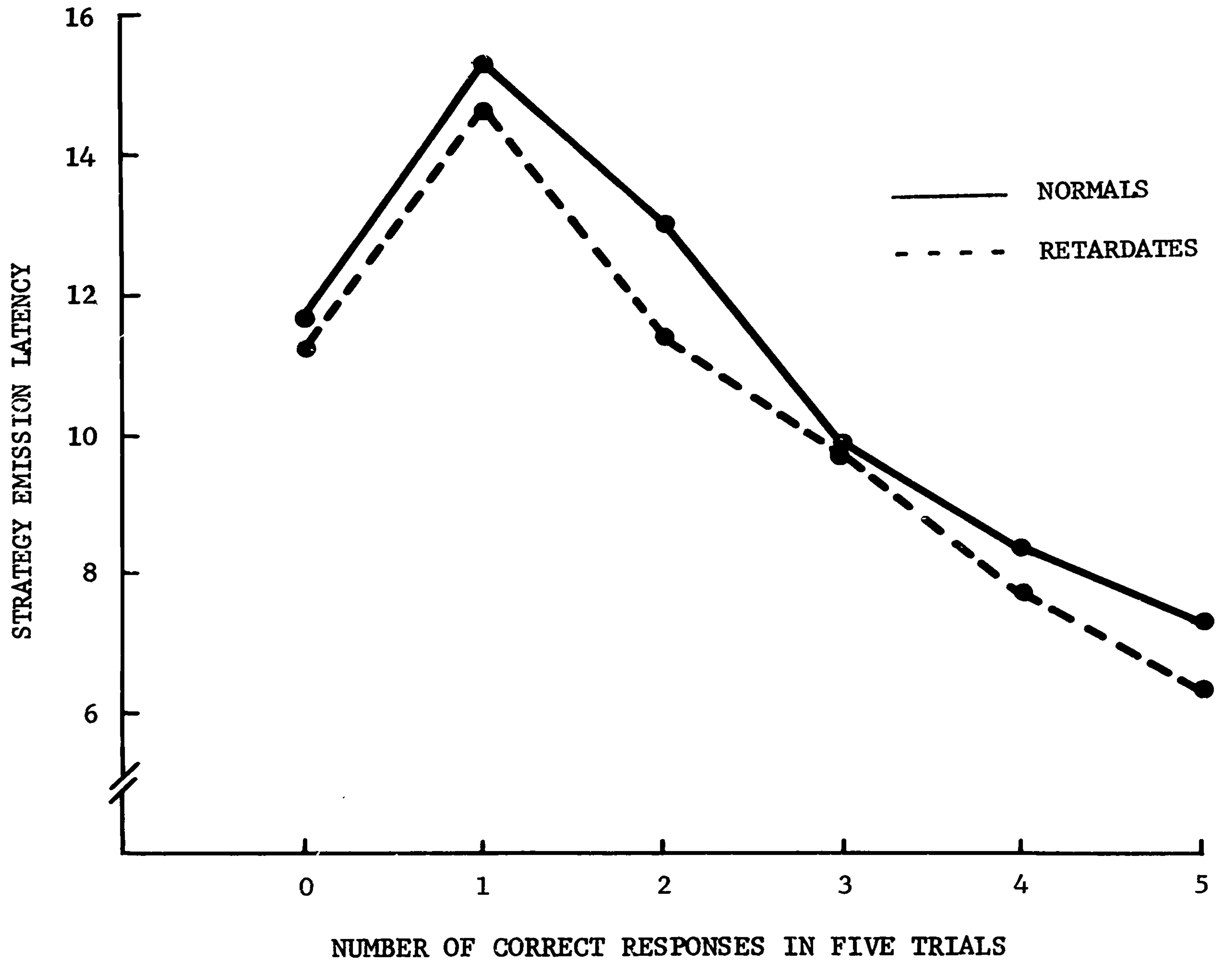

Fig. 3.4 Relationship between strategy emission latency and the number of times a pair was given correctly by Subject during the five criterion test trials.

This, of course, has already been substantiated by the previously-mentioned significant correlations between Ss' total strategy scores and total latency scores. Figure 3.4 indicates that as amount of learning increased, latency to strategy emission decreased. The data from both groups of Ss are remarkably similar for these measures. Latency to strategy emission appears to be a rather stable measure for both groups.

In summary, while certain data obtained in this study demonstrated marked differences between normal Ss and retardates, other data revealed some interesting similarities. The retardates' performance on the criterion task was significantly poorer than that of the normal Ss. In addition, the analysis of Ss' verbal reports indicated that more retardates reported using low level strategies, whereas more normals reported using high level ones. There was, however, no significant difference between the two groups in proportion of Ss reporting the intermediate strategies. The relationship between the strategy emission latency and the level of associative strategy reported was surprisingly similar for the two groups. In both groups, shorter strategy emission latencies were observed at the higher strategy levels. The retardates, however, required more time to verbalize the higher level strategies, in contrast to normal Ss who required less time to verbalize the higher level ones. A further similarity between the retardates and normals was observed when strategy emission latency was plotted as a function of degree of learning on the criterion task. These data indicate that, when the retardates and normals are compared on pairs which are learned to the same degree, latency to strategy emission is similar (Figure 3.4).

Furthermore, Figure 3.4 shows a decrease in strategy emission latency as learning increases for both groups.

In short, this study has demonstrated the differences and similarities between normals and retardates with respect to the verbalization of associative learning strategies. The strategy data revealed that educable retardates do not impose as much organization upon the material in the same number of trials as do normal Ss. However, it is not known what degree of organization would have been reported had the educable Ss attained the same degree of learning as the normal Ss. The systematic collection and analysis of Ss' verbal reports have provided valuable data for comparing normal Ss and retardates on a verbal learning task.

Experiment IV

Facilitation of Associative Learning Among Educable Retardates

ABSTRACT. The present study was designed to determine whether the performance of educable retarded children could be improved by the provision of associative strategy aids. Since Experiment III indicated that more retardates than normal Ss reported low level strategies, it was believed that supplying retardates with high level strategy aids would have a facilitating effect. Later elementary and junior high retardates were given high level associative strategies and compared with retardates of the same CA levels who did not receive aid. The aided retardates performed significantly better than the unaided retardates on both acquisition and retention tasks. However, the aided retardates did not surpass an unaided group of normal control Ss on either acquisition or retention. The lack of difference on retention indicates that it is not the ability to recall previously learned material that separates retarded from normal learners, but rather it is the capacity to develop and utilize strategy aids.

Problem

The results of Experiment III suggested that the inferior performance of EMRs may be a result of their preponderant use of less efficient strategies. When compared with normal children, it was found that significantly more EMRs reported using lower level strategies (categories 1 and 2). Likewise, significantly fewer EMRs reported using high level strategies (categories 6 and 7) than normal children. Thus, it appears that a deficit in learning unfamiliar verbal PA materials is associated with a deficit in recoding ability. In other words, children who are unable to recode or organize the materials in such a way as to overcome memory limitations seem to have more difficulty with PA tasks.

Although Jensen and Rohwer (1963a; 1963b) have demonstrated that learning of familiar nonverbal materials can be facilitated by providing retarded Ss with mediating sentences, no such demonstration exists with respect to learning of unfamiliar verbal materials. The results of Experiment II indicated that learning of the latter materials can be facilitated by providing high level strategies for normal children. Furthermore, experimenter-supplied strategies appeared to facilitate the learning of slow learners (normal Ss designated as such on the basis of a practice task) to such a degree that they performed somewhat better on the learning task than unaided fast learners.

In view of the above results, the present study was designed to determine whether the performance of retarded Ss could be facilitated by experimenter-supplied strategies as much as that of normal Ss. Since retarded children tended to report low level strategies, it was believed that supplying them with high level ones would have a beneficial influence. Also of interest in this study was an examination of the effect that experimenter-supplied strategies have upon retention. If a retention deficit per se exists among EMRs, then more forgetting should occur among EMRs than among normal Ss, in spite of the administration of experimenter-supplied strategies during original learning. Another purpose of the present study was to determine whether there would be retention and transfer of the strategy set to new materials.

The major hypotheses to be tested in this study are as follows: (1) the introduction of experimenter-supplied strategies to EMRs results in significantly faster learning rates when compared with those of unaided EMRs, (2) aided EMRs perform significantly better than unaided normal Ss matched on CA, and (3) the introduction of experimenter-supplied strategies facilitates retention for EMRs.

Method

Subjects. The Ss, 56 later elementary (LE) and 54 junior high (JH) educable retarded children and 35 normal sixth grade children, were drawn from the Ingham County School District, Ingham County, Michigan. Mean chronological ages (CAs) for the LE and JH retardates were 11-9 (range 9-7 to 13-3) and 14-5 (range 13-0 to 15-11) respectively. Mean CA for the normal group matched on CA with the LE retardates was 11-7 (range 10-10 to 12-4). There was no CA matched normal group for the JH retardates. The mean IQs for the retarded samples were 76 for the LE Ss and 73 for the JH Ss. IQ scores were not obtained for the normal sample, but these Ss were enrolled in normal public school classes.

Materials. Four low-high meaningfulness (m) dissyllabic pairs were constructed for the practice task. The high m response items for this list were words taken from second grade textbooks, whereas the stimulus items were paralogs specifically devised for this task. These paired associates were: Olpret-Balloon, Lenear-Garden, Binest-Outside, and Holbut-Farmer.

For the criterion task, eight low-high m dissyllabic paired associates were constructed from Noble's (1952) list. The mean m values of the stimulus items and response items were 1.54 (range 1.24 to 2.28) and 8.75 (range 6.57 to 9.61) respectively. The criterion list was as follows: Lemur-Kitchen, Flotsam-Army, Bodkin-Wagon, Sagrole-Money, Zumap-Village, Gokem-Uncle, Tarop-Jelly, and Latuk-Dinner.

The individual stimulus-response pairs and test stimuli were made into separate slides for visual presentation. A Kodak 700 Carousel projector with a Lafayette T-2K automatic timer was used for presentation of the materials; Ss verbal reports were recorded by a Sony Tape recorder. All units were connected to a master control board operated by E.

Procedure. All Ss participated in three separate sessions. The practice task session was given first with the criterion and associative strategy session following on the same day. The retention session occurred after a one week interval.

Practice task. The practice task allowed all Ss an opportunity to become familiarized with the concept of paired-associate learning. In addition, it provided a basis for determining the comparability of the groups prior to introduction of the experimental treatments.

The practice task was administered to groups of four to eight Ss, depending upon the size of the available facilities. The Ss were provided with test booklets which contained the four response items on each page. The task was introduced as a game in which Ss were to learn words from another country. For the learning trials, Ss were instructed to study the pairs of words as they appeared on the screen. On the test trials, only the stimulus items were presented, and Ss were asked to circle the correct responses in their test booklets. Odd-numbered pages were printed on yellow paper and even-numbered pages on white, so that E could easily determine whether all Ss were on the correct page.

On learning trials, the pairs were automatically presented at a six second exposure rate per pair. Each learning trial was followed by a test trial. The exposure rate on test trials was manually controlled so that all Ss had ample time to respond. A new stimulus item was not shown until all Ss had circled a response item on the appropriate page. Three learning and three test trials were presented; slides were randomized on all trials in order to eliminate possible serial position effects. As the material appeared on the screen, E read it aloud for the Ss. Two Es conducted the practice task. One operated the equipment, and the other read instructions and supervised group performance.

Criterion task. All Ss were tested individually on the criterion task the same day in which they participated in the practice task. The retarded Ss were randomly assigned to aided or unaided treatment conditions; normal Ss, however, were all unaided. The criterion list consisted of eight new paired-associate items. A total of five learning and five test trials were administered. The criterion procedure was identical to that of the practice task.

All Ss were given preliminary instructions reminding them of the procedure in the practice task. The Ss in the aided groups were given additional instructions about associative strategies, or "tricks." On the first three learning trials, they were given high level associative strategies as aids. Table 4.1 shows the aids given for each pair. Unaided Ss were not provided with any instructions about associative strategies. In all other respects, the same procedure was followed for all groups.

Associative strategy task. Immediately following the criterion task, associative strategies were obtained from all Ss. The concept of associative strategies was briefly explained to the unaided Ss in order to facilitate their verbal report sessions. All Ss were again presented the eight criterion pairs individually and were asked to describe how they learned them. This entire session was tape recorded.

Retention session. Retention data were collected one week after the criterion task. This session consisted of a test trial, a relearning

Table 4.1. Paired-associate list and strategy aids for criterion task.

Paired associates	Strategy Aids
Lemur-Kitchen	Lemon in the kitchen
Flotsam-Army	Sam is in the army
Bodkin-Wagon	Book in the wagon
Sagrole-Money	Roll of money
Zumap-Village	Map of the village
Gokem-Uncle	Go to uncle
Tarop-Jelly	Tar is like jelly
Latuk-Dinner	Late for dinner

trial, and a final test trial. The procedure was the same as that employed in the practice and criterion tasks. Verbal reports of associative strategies were again collected on tape immediately following the retention trials. This task was identical to the associative strategy task described above except that Ss were asked how they remembered, rather than how they learned, each pair.

During the retention session, two additional tests were administered. The first of these was a Stimulus Differentiation Test consisting of the stimulus items broken into three segments and appearing with their respective response words. The stimuli were divided in such a way that one of the segments contained the stimulus element which had been combined with the response to form the strategy aid. For example, the pair, Sagrole-Money, was presented and beneath it, the elements sag gro role appeared.

The Ss were instructed to circle the segment of the stimulus that they had used to remember the response. The stimulus and its segments were not pronounced, and Ss had to depend upon their visual recognition of the stimulus. It was believed that the Stimulus Differentiation Test would be instrumental in distinguishing aided Ss for whom aid was effective from those for whom it was not.

The second test was a Strategy Generalization Test. Eight new paired associates were presented. Four of these pairs were similar to ones used in the criterion task; the stimulus items were identical and the response items were synonymical: Flotsam-Navy, Sagrole-Dollar, Zumap-City, and Latuk-Supper. The other four pairs were novel: Attar-Heaven, Meardon-Office, Nares-Captain, and Neglan-Leader. A one-minute time limit was given for each pair, and Ss were encouraged to report all associative strategies which they might use to learn the pair. It was believed that aided Ss would show tranfer by reporting more high level strategies than the unaided Ss. This test was also recorded on tape.

Results and Discussion

The data from the practice task for the four retarded groups (aided and unaided LE Ss and aided and unaided JH Ss) were subjected to a 2 x 2 (Aid x Grade) analysis of variance in order to assess the initial comparability of the groups. The Aid main effect was not significant showing that aided and unaided groups were similar in performance prior to the introduction of aid. A significant main effect of Grade ($\underline{F} = 4.08$, $\underline{df} = 1/104$, $p < .05$) indicated that Ss with higher CAs did better on the task. The interaction term, Aid x Grade, was not significant. In order to further assess the comparability of groups, the mean reading achievement scores of the aided and unaided groups were examined. The means for these two groups were 3.03 and 3.06 respectively on the Wide Range Achievement Test, indicating the groups were also comparable in this respect. The aided LE retardates and the normal control Ss were compared on the practice task by means of the _t_ test. As expected, the normal Ss performed significantly better ($t = 5.55$, $p < .01$) than the unaided retarded Ss before strategy aids were introduced.

The learning curves for all groups on the criterion task are presented in Figure 4.1. Total number of correct responses from the retardates were subjected to an analysis of variance (Type III, Lindquist, 1953). The main effects of Aid and Trials were significant ($F = 41.68$, $df = 1/104$, $p < .01$; $F = 85.83$, $df = 4/416$, $p < .01$ respectively) showing that, although all groups improved throughout the task, the aided Ss performed significantly better than the unaided ones. The significant Aid x Trials interaction term ($F = 3.03$, $df = 4/416$, $p < .01$) indicated that the aided and unaided groups learned at different rates. None of the other terms were significant.

Total correct responses from the aided LE retardates and their normal control Ss were compared by means of analysis of variance (Type I, Lindquist, 1953). The main effect, Group, was not significant, indicating that the aided retardates and the normal Ss performed at approximately the same level on the criterion task. Since the normal Ss were superior to the retardates on the practice task, it appears that strategy aids enabled the retardates to overcome their original deficit in learning. The hypothesis that aid allows retardates to surpass normal Ss is rejected, however, since the groups did not differ significantly. Although

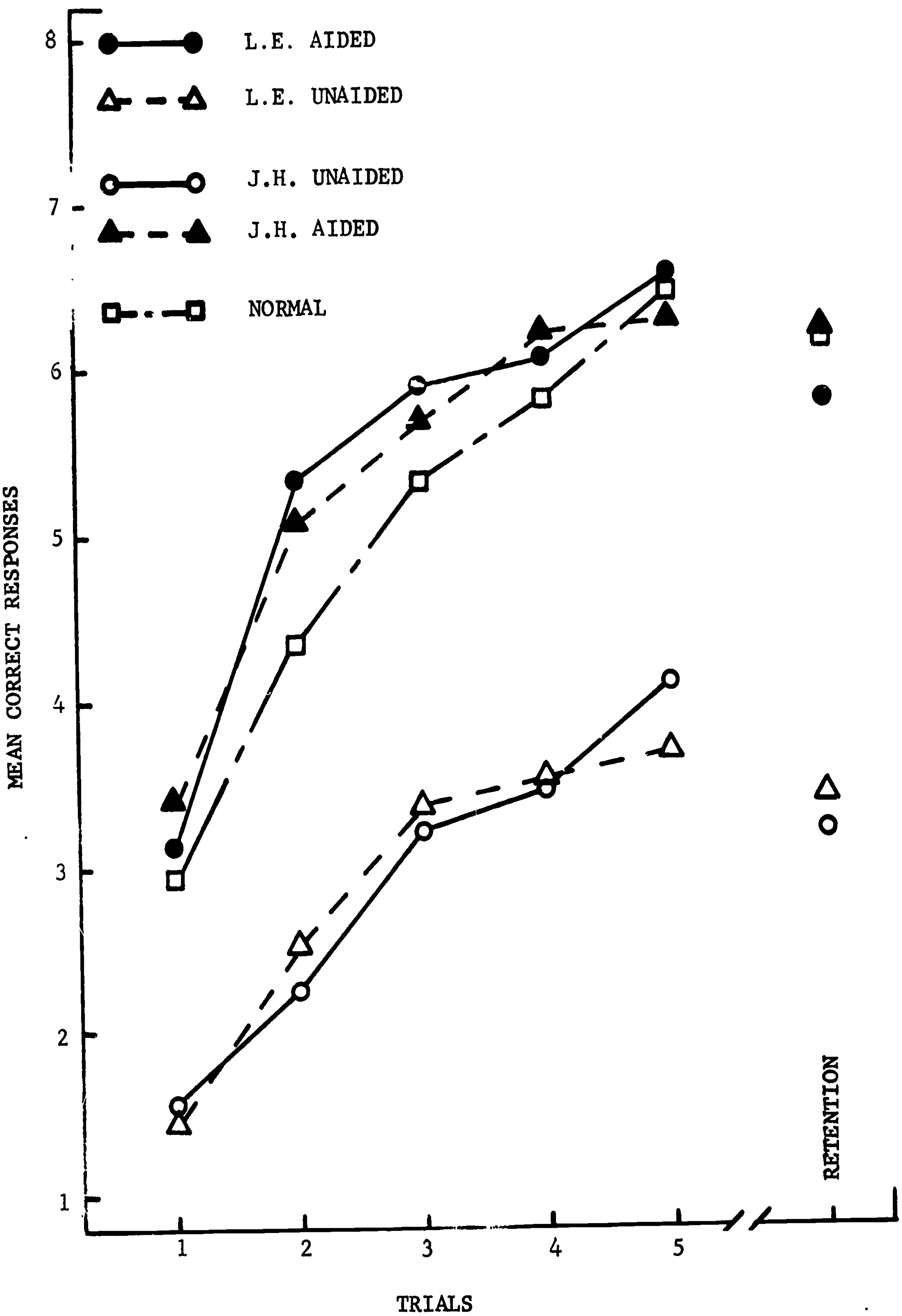

Fig. 4.1 Mean number correct responses by trial for each group on acquisition and retention.

aided LE retardates improved consistently, they were not able to exceed the gains made by the normal Ss. In fact, the only significant term yielded by the analysis of variance was Trials ($\underline{F}$ = 89.95, $\underline{df}$ = 4/240, $p < .001$) showing the general improvement by both groups.

The associative strategy reports for each of the eight criterion list pairs were classified independently by three judges. Interjudge reliability assessed by means of the Kendall coefficient of concordance ($\underline{W}$) ranged from .92 to 1.00, showing that there was extremely high agreement in the assignment of Ss' verbal reports to the seven strategy levels. These high correlation coefficients indicate, once again, that Ss verbal reports can be reliably classified.

A Spearman rank correlation coefficient was computed for each group to determine whether there was a relationship between Ss' total strategy score (the sum of the assigned strategy levels for all eight pairs) and Ss' corresponding number of correct responses on the criterion task. These correlations were significant for the aided groups ($r_s = .75$, $p < .01$, and $r_s = .63$, $p < .01$) for the LE and JH groups respectively). The correlation coefficient was also significant for the unaided LE Ss ($r_s = .45$, $p < .05$) but coefficients for the unaided JH and normal Ss were not ($r_s = .25$ and $r_s = .20$ respectively). It appears that aided Ss who did not report using the high level strategy aids given, i.e., reported their own lower level strategies, tended to learn fewer associations on the criterion task. Moreover, the unaided LE Ss who reported using low level strategies also tended to perform more poorly on the criterion task.

The results of Experiment III indicated that more EMRs reported low level strategies and fewer reported high level strategies than normal

Ss. In order to compare the types of associative strategies reported by the retarded control Ss and normal Ss in the present study, the distribution of Ss reporting the various categories was examined. Since strategy levels 1 and 2 both essentially represent the use of no associative strategy, these were combined. Strategy levels 3, 4, and 5 were also combined since they represent an intermediate degree of complexity. Superordinate and syntactical strategies (levels 6 and 7), representing the highest degree of complexity formed by the combination of elements from each member of the paired associate, were also joined. Table 4.2 shows the distribution of Ss in the unaided retarded and normal groups reporting strategy levels 1 or 2 at least once. A chi-square test revealed no significant difference between the groups ($\underline{X}^2 = 1.46$, $p > .05$) in the proportion of Ss reporting these strategy levels.

Table 4.2. Distribution of Ss in each group reporting strategy levels 1 or 2.

Group	No 1 or 2 Reported	At Least one 1 or 2	Total
Retarded	1	53	54
Normal	2	26	28
Total	3	79	82

Table 4.3 represents the distribution of Ss reporting the intermediate strategy levels 3, 4, or 5 at least once. No difference was found between the two groups in the proportion of Ss reporting these categories ($\underline{X}^2 = 1.64$, $p > .05$). Table 4.4 shows the distribution of

Ss in each group reporting the use of categories 6 or 7 at least once.

Table 4.3. Distribution of Ss in each group reporting strategy levels 3, 4, or 5.

Group	No 3, 4, or 5 Reported	At Least one 3, 4, or 5	Total
Retarded	19	35	54
Normal	6	22	28
Total	25	57	82

Table 4.4. Distribution of Ss in each group reporting strategy levels 6 or 7.

Group	No 6 or 7 Reported	At Least one 6 or 7	Total
Retarded	39	15	54
Normals	6	22	28
Total	45	37	82

The two groups differed significantly ($X^2 = 19.21$, $p < .01$) indicating that proportionately more normal Ss reported the high level strategies than retarded Ss. These results, similar to those obtained in Experiment III, suggest that the difference in performance between normal and unaided retarded Ss may be attributed to the greater use of superordinate and syntactical strategies by the normal Ss. It must be pointed out, however, that total strategy score and number correct on the criterion task did not correlate significantly for the normal group, although these two measures were correlated for the LE unaided retardates.

From the tape-recorded sessions of the associative strategy task, the total strategy report time for all Ss was divided into two component measures. The first of these was latency from the presentation of the paired-associate items to the beginning of Ss verbalization, i.e., latency to strategy emission. The second measure was verbalization time, or the amount of time that S used to describe the strategy. The relationships between these two measures and total strategy score were examined.

For the aided groups, there were significant negative relationships between total strategy score and latency as well as strategy score and verbalization time. The Spearman rank correlation coefficients between strategy score and latency were -.88 ($p < .01$) and -.70 ($p < .01$) for the LE and JH groups respectively, while the correlation coefficients between strategy and verbalization time were -.36 ($p < .05$) and -.57 ($p < .01$) for the same groups respectively. It appears that for the aided Ss, as high strategy levels were used, less time was required to begin reporting the strategy, as well as to verbalize about it. Aided Ss, who failed to employ experimenter-supplied syntactical strategies and had to rely upon lower level strategies, tended to spend more time reporting them. On the other hand, those aided Ss who reported the high level strategies given them tended to have smaller latencies and verbalization time, probably because they had ample time (five trials) to rehearse these strategies.

The normal control Ss showed no relationships between any of the above measures. For the unaided LE and JH groups, no relationships were found between strategy score and latency, but significant positive correlations were found between strategy score and verbalization time ($r_s = .53$, $p < .01$ and $r_s = .49$, $p < .01$ respectively). The latter correlations, similar to those found in Experiment III, indicate that retardates required more time to verbalize the high level strategies. The limited verbal ability of educable retarded children may account for the difficulty in verbalizing high level strategies for these unaided Ss. It is possible, on the other hand, that they might have developed high level strategies only near the end of the criterion task and did not have as much time as the aided Ss to rehearse these strategies.

The retention task scores for Ss in the four retarded groups were subjected to a Treatment x Grade analysis of variance. The main effect of Aid was again significant ($F = 42.50$, $df = 1/104$, $p < .001$) indicating that Ss who received aid on the criterion task recalled the associations better than did unaided Ss. The hypothesis that introduction of strategy aids during PA learning also facilitates the retention of retarded Ss is thus confirmed. The performance of the aided LE retardates on the retention task was compared with that of normal Ss. The two groups did not differ in pairs retained ($t = .50$, $p > .05$). It appears that not only do aided retardates remember more than unaided ones after a one week interval, but they also remember as well as the normal Ss.

The relationship between retention task scores and retention strategies reported was examined by means of Spearman rank correlations. Again, as on the criterion task, high level strategies for retention were associated with better performance for aided Ss (r_s = .57, $p < .01$ and r_s = .53, $p < .01$) for aided LE and JH groups respectively). A similar relationships was also obtained between strategy scores and retention for the unaided JH Ss (r_s = .39, $p < .05$). The correlation coefficients for the unaided LE Ss and the normal control Ss, however, were not significant.

The range of scores on the criterion task for the aided Ss was 4 to 40 correct responses. Aided Ss were divided into two groups on the basis of performance on the criterion task. The Ss whose criterion scores fell within the top third of the range were considered effectively aided Ss, whereas those whose scores fell into the bottom third were called non-effectively aided Ss. Since it was assumed that the ability to visually differentiate the relevant stimulus cue is a factor in Ss' effective use of strategy aids, the performances of these two groups on the Stimulus Differentiation Test were compared. Effectively aided Ss were found to differentiate relevant cues significantly better than the noneffectively aided ones (t = 5.65, $p < .01$). Hence, it appears that Ss who performed better on the criterion task were able to pick out, and thus use, the segment of the stimulus which had been combined with the response to form the strategy. Further examination of these two groups revealed that the effectively aided Ss were superior to the noneffectively aided ones on reading achievement level (t = 2.44, $p < .05$). Moreover, reading achievement was found to correlate significantly with total number correct on the criterion task (r_s = .47, $p < .01$ and r_s = .49, $p < .01$ for aided and unaied Ss respectively). These results indicate that the ability to read may be an important factor in the effective use of high level strategies in verbal associative learning.

The ability to transfer strategy aids to new paired associates was examined for both aided and unaided Ss on the Stimulus Generalization Test. On the pairs which employed identical stimulus items and synonymical response terms, aided Ss reported significantly higher strategies than did unaided Ss (Mann-Whitney U test: $z = 4.87$, $p < .005$). The correlations between total strategy score on the criterion task and total strategy score on the generalization task were highly significant for both groups ($r_s = .76$ for aided Ss, and $r_s = .61$ for unaided Ss). These results indicate that strategies can be transferred to new PA tasks and that the introduction of high level associative strategies during learning is more likely to facilitate subsequent high strategy formation on other tasks.

In summary, two of the three major hypotheses were supported. The introduction of strategy aids substantially increased the performance level of retarded children in a PA learning situation, thereby providing evidence for hypothesis one. Although the retarded Ss were able to perform at about the same level as unaided normal Ss, however, they did not surpass the latter. The result of no significant difference between the normal and aided retarded Ss on the criterion task provided evidence contrary to hypothesis two. Finally, the aided retarded Ss retained the associations after a one week interval better than unaided Ss, providing evidence for hypothesis three. In fact, the aided retardates remembered as well as their normal control Ss, indicating that the formation and use of high level strategies is an important variable in the ability to learn and remember verbal associations. The fact that the aided retardates remembered as well as the normal control Ss matched on

CA indicates that EMRs do not possess a memory deficit per se. Rather, their deficit appears to be related to an inability to generate high level associative strategies. When such strategies are experimentally supplied, learning and retention are comparable to normal unaided Ss.

Experiment V

Effectiveness of Familiarization and Differentiation Training on the Successful Employment of Associative Strategies Among Educable Retardates.[1]

ABSTRACT. The results of Experiment IV indicated that the aided retarded Ss did not make optimal use of the strategy aids. The purpose of this study was to determine if retarded children given prior familiarization with relevant stimulus cues could make maximally effective use of strategy aids in a paired-associate task. The results indicated that strategy aids were effective for all groups regardless of the type of pretraining they had received. Moreover, it was found that Ss who had received pretraining in selecting embedded elements out of the stimulus items (differentiation training) performed significantly better on the learning task than Ss who had been familiarized with entire stimulus items. However, the results were inconclusive regarding the nature of the facilitative effects of differentiation training.

Problem

The results of Experiment II provided conclusive evidence concerning the effectiveness of experimenter-supplied strategies for normal children at three developmental levels. Individual comparisons at each grade level revealed that aided groups made significantly more correct responses than unaided groups. However, the results of Experiment IV were not entirely as expected. While it was found that EMRs receiving experimenter-supplied strategies learned significantly faster than unaided EMRs, the aided retardates did not perform significantly better than the unaided normals. Because of this latter finding, it was concluded that the retarded Ss did not make optimal use of the strategy aids. Furthermore, the results of the Stimulus Differentiation Test in Experiment IV revealed that the ability to recognize the relevant cue in the stimulus

[1]This paper is based on a master's thesis submitted to the College of Education at Michigan State University by Daniel B. Berch.

was related to successful performance in the aided condition. That is, the effectively aided Ss (those whose acquisition scores fell within the top third of the range of all scores) were able to differentiate relevant cues significantly better than Ss not effectively aided (those whose scores fell within the bottom third). It was concluded that the visual differentiation of the relevant stimulus cue was an important factor in effective utilization of strategy aids.

The purpose of the present study was to determine if retarded Ss given prior familiarization training with relevant stimulus cues could make greater use of strategy aids than Ss not given such training. It was assumed that in order to make optimal use of a syntactical strategy aid, such as "map of the village," in learning a dissyllabic pair of low-high m (Zumap-Village), one must first be able to differentiate the more meaningful component "map." "Map," in this case, is the functional stimulus for optimal utilization of the associative strategy.

It is hypothesized, therefore, that differentiation of the relevant meaningful stimulus element in a syntactical strategy leads to maximally effective use of the strategy aid as measured by performance on the criterion task. This treatment (Relevant Cue Differentiation) should result in significantly better performance compared to a Control condition in which strategy aids are given without previous differentiation of the relevant stimulus elements. Moreover, if differentiation of stimulus elements is an important factor in effective strategy utilization, then familiarization training of the entire stimulus ought to inhibit successful employment of experimenter-supplied strategies. It is, therefore, hypothesized that familiarization of the entire stimulus item (Relevant Familiarization) interferes with differentiation of the stimulus components, resulting in the ineffective use of strategy aids and, hence, significantly poorer performance than the control condition.

In addition to the Control, the Relevant Cue Differentiation, and Relevant Familiarization groups, a fourth group receiving strategy aids was given differentiation training with meaningful elements in stimuli not used for the criterion task (Irrelevant Cue Differentiation). This group was included in the study in order to determine whether there was some general transfer involved in selecting high _m_ components from irrelevant stimuli. If this treatment condition does produce some general transfer, then performance on the criterion task ought to be facilitated when compared with the control group.

A fifth group receiving strategy aids was also given familiarization training with entire stimulus items not used in the criterion task (Irrelevant Familiarization). This group was included in the study to control for the effect of familiarization with relevant items. Since no training in differentiating elements within the stimulus was given, this condition should also result in poorer performance on the criterion task when compared to the control group.

The major hypotheses are: 1) differentiation of stimulus elements relevant to the production of high level strategies results in more effective use of strategy aids and, consequently, better learning, and 2) familiarization training of the entire stimulus item interferes with the differentiation of elements necessary for production of high level strategies and results in poorer performance.

Method

Subjects. The Ss tested in this study were 80 educable retarded children selected from Junior Special B classes in the Detroit public schools. Mean CA of the Ss used in this study was 13-7 (range 11-4 to 15-5) and mean IQ was 71 (range 53-87).

In order to ensure that Ss were able to read the items, only those who had received a grade equivalent of 2.5 or higher on the reading subtest of either the Metropolitan, Iowa, or Stanford achievement tests were selected for the experiment. (See appendix C for further description of Ss).

Materials. Four dissyllabic pairs of low-high m were constructed for the practice task. These pairs were: Lemur-Kitchen, Bodkin-Wagon, Holbut-Farmer, and Olpret-Balloon. The first two pairs consisted of items selected from Noble's (1952) list. Mean m values of the stimulus and response terms were 1.84 and 8.87 respectively. The stimulus items of the last two pairs were specifically constructed to approximate Noble's low m paralogs. The high m response items were taken from second-grade readers.

For the criterion task, eight dissyllabic pairs of low-high m were constructed. These pairs were: Gokem-Uncle, Sagrole-Money, Tarop-Jelly, Zumap-Village, Flotsam-Army, Meardon-Insect, Binest-Outside, and Lenear-Garden. The first six pairs were selected from Noble's (1952) list; mean m values of the stimulus and response items were 1.39 (range 1.05 to 2.19) and 7.89 (range 6.57 to 9.43) respectively. The last two pairs in this list were also devised specifically for this task. Again, the stimulus items were designed to approximate Noble's low m dissyllables, and the response items were selected from second-grade readers. Each stimulus selected for the criterion list contained a familiar word, thus making the pairs easily amenable to the construction of syntactical strategies.

A third list consisting of eight irrelevant stimuli was formed. These low m dissyllables were: Attar, Byssus, Delpin, Sumpage, Endore, Fardel, Standage, and Caratch. The first three items were selected from Noble's (1952) list. Mean m value was 1.48 (range 1.13 to 1.71). The last five items were selected from Cieutat's (1963) list and had a mean association value (a) of .64 (range .49 to .77). These eight irrelevant stimuli, as the eight criterion list stimuli, contained embedded familiar words.

Separate test booklets containing all the appropriate response items in random order on each page were constructed for the practice task and the criterion task. A Kodak 700 Carousel projector with a Lafayette T-2K automatic timer was used to present the individual pairs and test items. Ss' verbal reports at the conclusion of the criterion task were recorded on tape.

Procedure

Practice task. All Ss were given the practice task in order to acquaint them with paired-associate learning and to assess the initial comparability of the treatment groups. The practice task was administered to groups of two to six Ss, depending upon the available facilities. The task was introduced to the Ss as a word game in which they were instructed to learn four associations.

Three learning (L) and three test (T) trials were alternately presented (LTLTLT). During the learning trials, each pair was presented automatically at a six second exposure rate. On the test trials, the exposure rate was controlled manually so that Ss had as much time as they needed to respond. On all learning and test trials, E pronounced the items as they appeared on the screen. Slides for each learning and test trial were presented randomly.

Pretraining conditions. The Ss were individually administered the remaining portions of the experiment. Each S was first given examples of all levels of associative strategies in order to facilitate collection of strategy information after the criterion task. Following discussion of associative strategies, Ss were randomly assigned to one of five treatments prior to the criterion task. The five experimental treatments were:

1) Relevant Cue Differentiation (RD)--Each S was given an example of a dissyllable and shown the familiar word embedded in it. S was then given a relevant differentiation trial with the criterion list stimuli. E pronounced each stimulus as it appeared on the screen and pointed out the embedded word e.g., "Zumap-map." The embedded word later became the first word of the syntactical strategy given for that pair on the criterion task, e.g., for the pair, Zumap-Village, the strategy was "map of the village." Table 5.1 shows the stimulus items and the embedded words. After the relevant differentiation trial, S was given a pronunciation trial in which E again pronounced each stimulus but this time S had to pronounce the embedded words. All Ss received two relevant differentiation trials and two pronunciation trials with a six second exposure rate for each item on all four trials. The same exposure rate was employed for all treatment conditions.

2) Irrelevant Cue Differentiation (ID)--This group received the same instructions and the same treatment as the RD group. However, the list used in this treatment contained irrelevant stimuli. None of the embedded words in the irrelevant stimuli were contained in the syntactical

strategies employed in the criterion task. Table 5.2 presents the irrelevant stimuli and the embedded words.

3) Relevant Familiarization (RF) These Ss were given two relevant familiarization trials alternated with a pronunciation trial on the stimuli from the criterion list. The embedded word was neither pronounced nor pointed out to the S. On the relevant familiarization trials, E simply pronounced each stimulus and on the pronunciation trials S had to pronounce each stimulus after E.

4) Irrelevant Familiarization (IF) This group received the same treatment as the RF group but with the irrelevant stimuli.

5) Control (C) This group received no pretraining of any type. All Ss were randomly assigned to these five conditions.

Table 5.1. The relevant stimuli and their embedded words.

Relevant Stimuli	Embedded Words
gokem	go
sagrole	role
tarop	tar
zumap	map
flotsam	sam
meardon	don
binest	nest
lenear	near

<u>Criterion task</u>. Following the experimental treatment, the same task was administered to all Ss. A total of five learning and five test trials was alternately presented. A six second exposure rate was used for each learning trial. No time limit was imposed on the test trials.

Table 5.2. The irrelevant stimuli and their embedded words.

Irrelevant Stimuli	Embedded Words
attar	at
sumpage	page
delpin	pin
endore	end
standage	stand
byssus	by
caratch	car
fardel	far

All Ss were instructed that E would give them some associative strategies, and that they should try to use these strategies to help them learn which words went together. Each of the five treatment groups was divided into halves. One-half received syntactical strategies on four of the eight pairs (A pairs), and the other half of each group received the same type of aids on the other four pairs (B pairs). Aids were given on the first three trials only. The A and B pairs and their respective strategy aids are presented in Table 5.3.

Associative strategy task. Immediately following the criterion task, each S was again shown the eight criterion pairs separately and was asked to describe how he learned each pair. This session was tape recorded.

Table 5.3. The A and B pairs of the criterion task and the strategy aid given for each pair.

	A & B Pairs	Strategy
A Pairs	Gokem-Uncle	Go to uncle
	Sagrole-Money	Roll of Money
	Binest-Outside	Nest is outside
	Tarop-Jelly	Tar is like jelly
B Pairs	Lenear-Garden	Near the garden
	Zumap-Village	Map of the village
	Flotsam-Army	Sam is in the army
	Meardon-Insect	Don's insect

Differentiation task. After strategy collection, each S was given a sheet of paper containing two columns. The right-hand column consisted of all eight resp ...se items, and the left-hand column consisted of 24 elements contained in the stimulus items from the criterion list. Three elements from each stimulus were selected, one of which consisted of the embedded word used in the syntactical strategy, e.g., Sagrole-sag, gro, role. The 24 elements were arranged so that no three elements of a stimulus appeared successively. S was instructed to select the word on the right which was associated with each element on the left. No time limit was imposed on this task.

Results

The five treatment groups did not differ significantly on CA ($F < 1$, $df = 4/75$, $p > .05$), IQ ($F = 2.00$, df 4/51, $p > .05$) or reading achievement

($\underline{F} < 1$, $\underline{df} = 4/68$, $p < .05$).

The means and standard deviations of the total number of correct responses for the five groups on the practice task are presented in Table 5.4. In order to determine the initial comparability of the five groups, the practice task data were subjected to a 1 x 5 analysis of variance. The analysis yielded a nonsignificant $\underline{F}$ ratio ($\underline{F} = .23$, $\underline{df} = 4/75$, $p > .05$) indicating that the groups did not differ significantly prior to the introduction of the experimental treatments.

Table 5.4. Means and standard deviations of the number of correct responses on the practice task.

	Groups				
	RD	ID	RF	IF	C
Mean	5.88	5.81	5.63	5.38	5.25
S.D.	2.63	1.60	2.28	2.33	2.27

The criterion task data of all groups except control were subjected to three 2 x 2 x 2 factorial analyses of variance. The variables were: 1) Stimulus—Relevant, Irrelevant; 2) Type of pretraining—Differentiation, Familiarization of nominal stimulus; 3) Aided pairs—A, B. A separate analysis was carried out on the total number correct, number correct on aided pairs, and number correct on unaided pairs. In the analysis of total correct responses, the Type of Pretraining main effect was significant beyond the .05 level ($\underline{F}$ = 6.62, $\underline{df}$ = 1/56) indicating that differentiation training was superior to familiarization training. None of the other main effects or interactions approached significance at the .05 level. The nonsignificant main effect of Aided pairs merely indicated that aid was equally effective for both sets of aided pairs. Moreover, the nonsignificant Stimulus main effect (Relevant-Irrelevant) indicated that training on relevant or irrelevant stimuli had the same effect upon the performance on the PA task.

The second 2 x 2 x 2 factorial analysis of variance was performed on the correct responses for aided pairs. Again, the Type of Pretraining main effect was significant at the .05 level ($\underline{F}$ = 5.38, $\underline{df}$ = 1/56). None of the interactions approached significance at the .05 level.

The result of the third 2 x 2 x 2 factorial analysis of variance of correct responses on the unaided pairs paralleled the results of the two preceding analyses. The Pretraining main effect was significant at the .05 level ($\underline{F}$ = 5.66, $\underline{df}$ = 1/56). None of the other main effects or interactions were significant.

Further analysis of the difficulty level of the A and B pairs was performed by means of a $\underline{t}$ test for the control group in which half of the Ss were aided on the A pairs and half on the B pairs. The resulting $\underline{t}$ value comparing the mean number of total correct responses did not approach significance at the .05 level. This finding permitted the pooling within each treatment group of Ss aided on A and B pairs.

The criterion data were then subjected to three 1 x 5 analyses of variance. The means and standard deviations of the number of correct responses for the groups on the aided pairs are presented in Table 5.5.

The analysis of these data revealed a nonsignificant F ratio (F = 1.91, df = 4/75, $p > .05$). Table 5.6 presents the means and standard deviations of number correct on the unaided pairs. The analysis of these data also yielded a nonsignificant F ratio (F = 1.73, df = 4/75, $p > .05$). The means and standard deviations of total number correct are presented in Table 5.7. The analysis of total number correct revealed a nonsignificant F ratio (F = 2.05, df = 4/75, $p > .05$); however, the means of the groups are in the expected direction. Compared to the performance of the control group, RD is the highest group and RF the lowest.

Table 5.5. Means and standard deviations of the number of correct responses for the five groups on the aided pairs of the criterion task.

	Groups				
	RD	ID	RF	IF	C
Mean	16.44	14.94	12.50	13.75	15.31
S.D.	3.37	4.06	5.33	4.82	4.01

In order to determine if the five groups differed in rate of learning, a Type I analysis of variance (Lindquist, 1953) was computed on total number of correct responses. The main effect of Groups did not approach significance though, of course, the Trials effect was significant at the .001 level (F = 1149.82, df = 4/300). Of particular interest was the Groups x Trials interaction which was significant at the .001 level (F = 294.18, df = 16/300). This interaction indicated that the performance of all groups did not increase at the same rate. Performance curves, presented in Figure 5.1 show that the RD group was near asymptote by the third trial. This suggested a ceiling effect which may have minimized differences among groups. To investigate the hypothesis of a ceiling effect, the total number of correct responses on the first three trials was subjected to a 1 x 5 analysis of variance. This analysis yielded an $\underline{F}$ value of 2.46 which approached significance at the .05 level ($\underline{df}$ = 4/75, critical value = 2.49). Thus, it appears that differences among groups may have been minimized by a ceiling effect.

Table 5.6. Means and standard deviations of the number of correct responses for the five groups on the unaided pairs of the criterion task.

	Groups				
	RD	ID	RF	IF	C
Mean	13.56	13.81	10.31	11.56	11.69
S.D.	4.46	4.04	5.35	4.69	3.70

In order to determine whether aid was effective, total number of correct responses was subjected to another Lindquist Type 1 analysis of variance. However, in this analysis the factors were: 1) Groups—RD, ID, RF, IF, C; 2) Pairs—Aided, Unaided. The significant main effect of Pairs ($\underline{F}$ = 44.74, $\underline{df}$ = 1/75, $p < .001$) indicated that aid was highly effective. Of course, the preceding Lindquist Type I

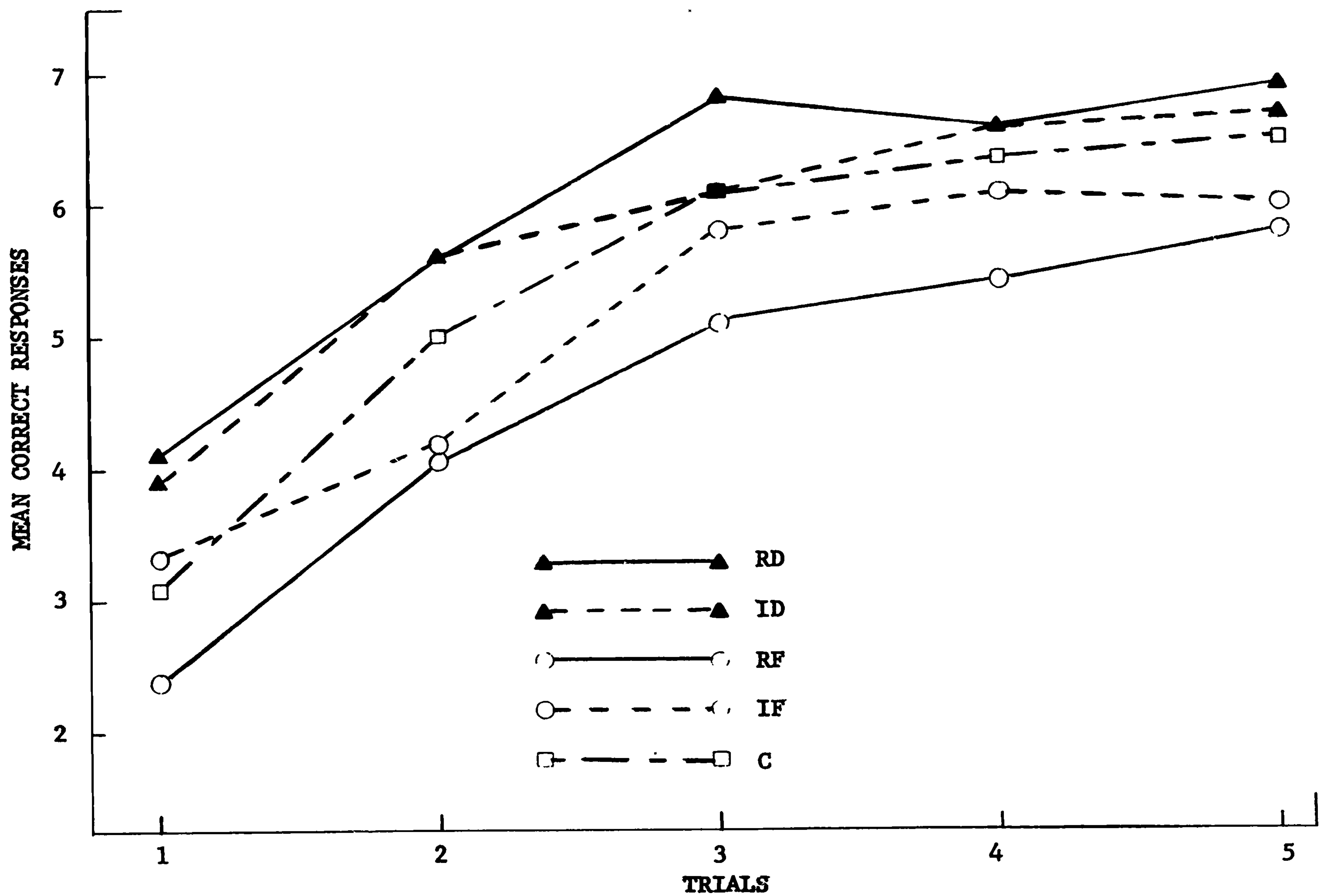

Fig. 5.1 Mean number total correct responses on criterion task.

design indicated no significant differences among the groups. The interaction, Groups x Pairs, however, was also significant (F = 11.00, df = 4/75, $p < .001$). A graphic representation of the interaction is presented in Figure 5.2. It can be observed from Figure 5.2 that, although the ID group was the third highest on the aided pairs, this group performed better than the other groups on the unaided pairs. To investigate further this finding, learning curves were plotted for each group comparing the levels of performance on aided and unaided pairs. These curves are presented in Figure 5.3. Of particular interest is the fact that only the ID group showed approximately the same level of performance on the aided and unaided pairs. This finding suggests that the irrelevant differentiation training may have resulted in general transfer to the stimuli of the unaided pairs, thus aiding the formation of high level strategies for use in learning these associations.

Table 5.7. Means and standard deviations of the number of correct responses for the five groups on the criterion task.

	Groups				
	RD	ID	RF	IF	C
Mean	30.00	28.75	22.81	25.31	27.00
S.D.	6.65	7.75	10.00	8.65	5.91

To assess the reliability of two judges' independent rating of the verbal reports, a Spearman rank correlation coefficient was computed for

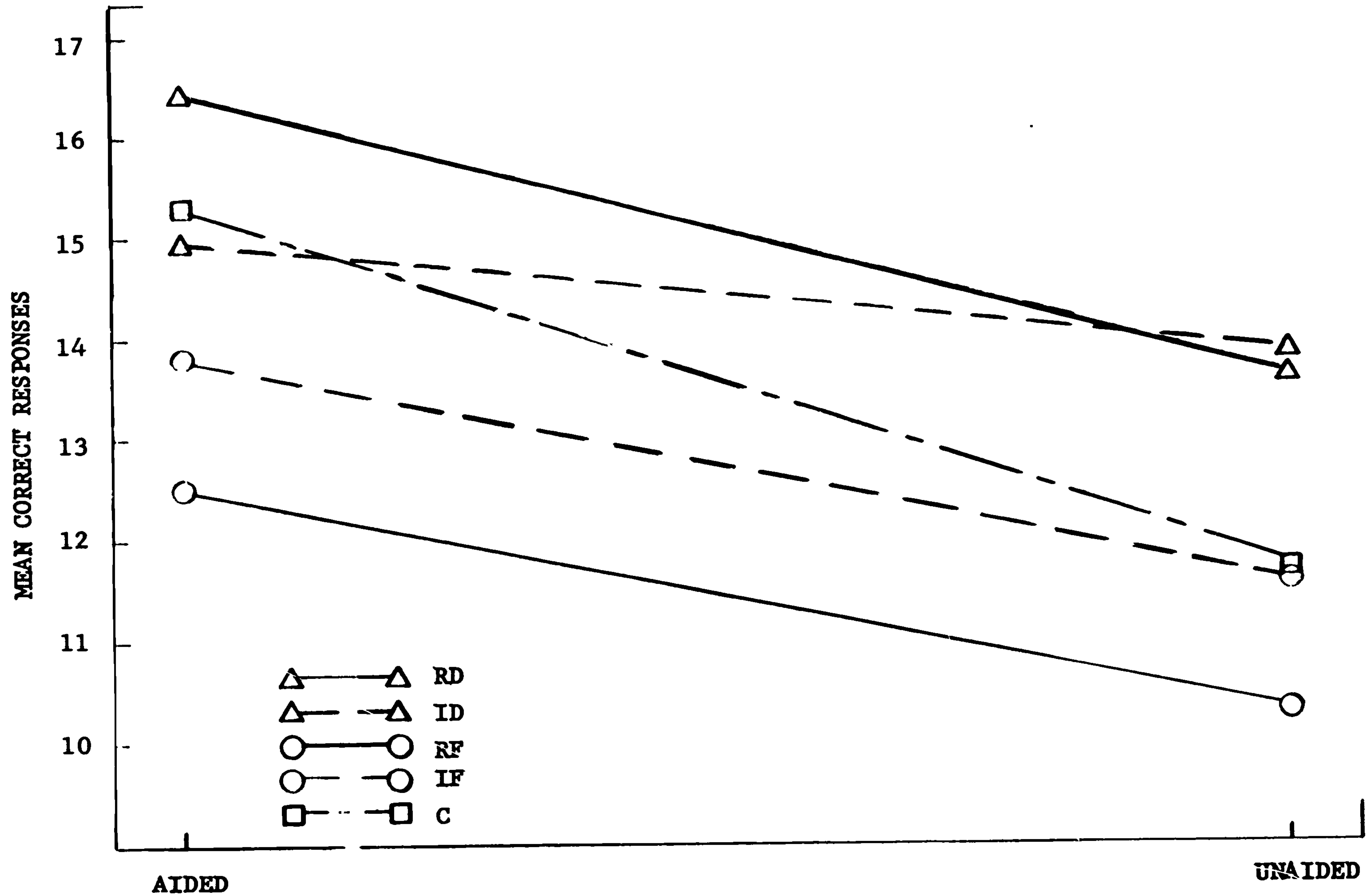

Fig. 5.2 **Mean number correct responses on aided and unaided pairs on criterion task.**

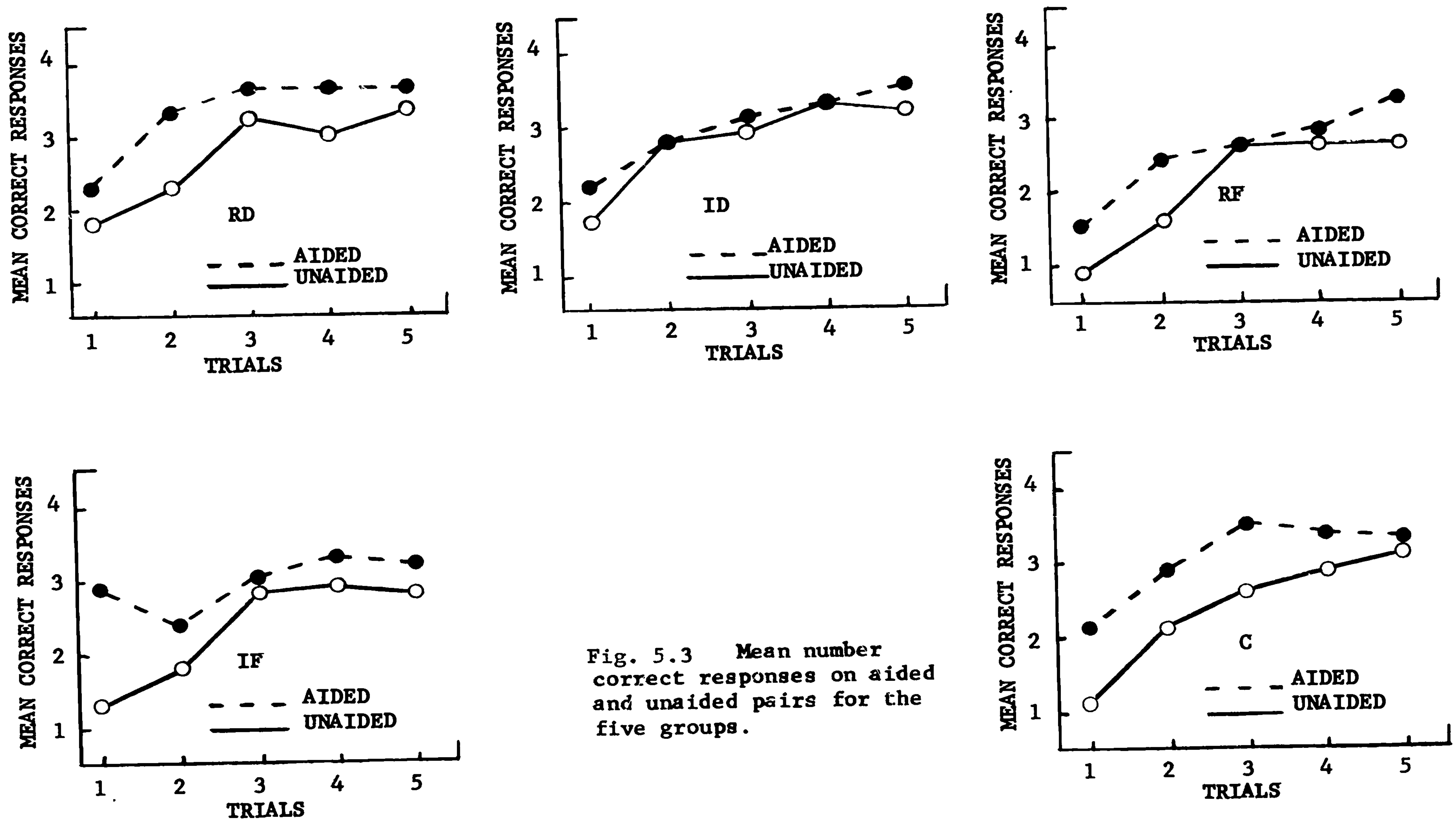

Fig. 5.3 Mean number correct responses on aided and unaided pairs for the five groups.

each pair from 40 Ss. The coefficients ranged from .89 to .99 indicating high agreement between the judges. A total strategy score was then computed from each S's verbal report for the unaided pairs by summing the strategy ratings assigned to each of the four unaided pairs. For example, if an S reported using four 7 level (. tactical) strategies, his total strategy score would be 28.

In order to determine the relationship between performance on the unaided pairs and the complexity of strategies reported for these pairs, three Spearman rank correlation coefficients were computed between number of correct responses on the unaided pairs and total strategy score for these pairs. Because the analysis of variance for number correct on the unaided pairs revealed a significant difference between the combined differentiation groups and the combined familiarization groups, a separate coefficient was computed for each of these groups and the third computed for the control group. The coefficient for the differentiation groups was .14; for the familiarization groups, .34; and for the control group, .53. The latter two were significant beyond the .05 level indicating a significant positive relationship between complexity of reported strategy levels and performance on the unaided pairs.

As discussed previously, when differentiation training was compared with familiarization training by means of the 2 x 2 x 2 factorial analysis of variance, the results based upon total number of correct responses, number correct on aided pairs, and number correct on unaided pairs all revealed that differentiation training resulted in significantly better performance than familiarization training. Because the control condition was excluded from these analyses, three separate 1 x 3 analyses of variance comparing the control group, the combined differentiation groups, and the combined familiarization groups were performed. The $\underline{F}$ values for total number correct and number correct on unaided pairs were significant beyond the .05 level ($\underline{F}$ = 3.65, $\underline{df}$ = 2/77, and $\underline{F}$ = 3.19, $\underline{df}$ = 2/77 respectively). The $\underline{F}$ value for the aided pairs approached significance at the .05 level ($\underline{F}$ = 3.04, $\underline{df}$ = 2/77). Duncan's multiple range test (Winer, 1962) was used to investigate further the significant findings obtained for the two significant dependent variables. The results of both analyses indicated that the differentiation and familiarization treatments differed significantly from each other ($p < .05$), but that neither treatment differed significantly from the control condition.

To examine further the significant difference between the combined differentiation and familiarization groups on total number correct and number correct on the unaided pairs, the data from the differentiation task were subjected to two factorial 2 x 2 x 2 analyses of variance. The factors were: 1) Stimulus—Relevant, Irrelevant; 2) Type of familiarization—Differentiation, Familiarization of nominal stimulus; 3) Aided pairs—A, B. One analysis was computed for number of correct responses on the elements of all pairs, and the other was computed for number correct on elements of the unaided pairs. It was hypothesized that, if Ss from the differentiation groups successfully select the embedded words which were used as cues for syntactical strategies, they should perform significantly better than the familiarization groups on the differentiation task. Both analyses revealed no significant difference between the differentiation and familiarization groups. This result suggested that on the basis of the differentiation task data, the superior performance of the combined differentiation groups on the criterion task cannot be accounted for by a greater ability, resulting from training, to respond correctly to embedded elements in the stimulus items.

Discussions and Conclusion

On the basis of the nonsignificant $\underline{F}$ value obtained from the 1 x 5 analysis of variance for total number correct on the criterion task, the experimental hypotheses were not supported. However, the factorial analysis computed for the first three trials only, yielded an $\underline{F}$ value which approached significance at the .05 level. Considering this result, along with the near asymptotic performance of the RD group by the third trial, it appears that differences among groups were possibly minimized by a ceiling effect. Although neither the combined differentiation groups nor the combined familiarization groups differed significantly from the control, these combined groups differed significantly from each other on total number correct, number correct on aided pairs, and number correct on unaided pairs. Because the differentiation groups were superior to the control group and the familiarization groups were inferior to the control, it appears that differentiation training facilitated learning whereas familiarization training with the nominal stimulus inhibited learning.

Analysis of the data obtained from the differentiation task produced some puzzling results. Two Spearman rank correlation coefficients were computed between the number of correct responses on the unaided pairs on the criterion task and the number of correct responses on the unaided pairs on the differentiation task. One coefficient was computed for the combined differentiation groups and the other for the combined familiarization groups. The resulting correlation for the differentiation groups was .57, which was significant beyond the .001 level. The correlation for the familiarization groups was .60, which was also significant beyond the .001 level. These correlations indicate that Ss who were better able to select the appropriate response to the stimulus elements performed higher on the criterion task.

The differentiation task was originally devised in order to provide additional evidence regarding the mechanism involved in the successful employment of associative strategies. It was assumed that, if Ss from the differentiation groups successfully constructed syntactical strategies for the unaided pairs, they should have performed significantly better than the familiarization groups on the differentiation task. Yet when performance on the unaided pairs on the differentiation task was examined, there was no significant difference between these combined groups. In fact, the performance of the ID group on the unaided pairs was lower than that of any other condition.

Further analysis of the criterion task data showed that, although strategy aids facilitated learning of the unaided pairs for all groups, the ID group performed almost as well on the unaided pairs. The superior performance of the ID group on the unaided pairs of the criterion task may be interpreted as a result of general transfer in that a tendency for selecting out embedded words developed during ID training and transferred to the stimuli of the unaided pairs. Analysis of the differentiation task data, however, did not support this interpretation.

The recurring problem in the interpretation of the results of this experiment pertains to the contradictory findings obtained from the criterion and differentiation tasks. The results, however, of the differentiation task may have been confounded by the lack of a time limit imposed upon this task. It is possible, therefore, that Ss from the familiarization groups had enough time to reconstruct the entire stimulus items, thus not responding solely to the individual elements. Once the stimulus was reconstructed, Ss from the familiarization groups had equal opportunity to select the correct response items as Ss from the differentiation groups.

In conclusion, this experiment has shown that: 1) aid was effective (as demonstrated in previous studies); 2) differentiation training appears to facilitate overall learning, whereas familiarization training appears to inhibit learning; and 3) the results are inconclusive regarding the nature of the facilitative effect of differentiation training upon the successful employment of associative strategies in paired-associate learning.

Experiment VI

Conditionability of Associative Strategies Among Educable Retardates

ABSTRACT. The purpose of this study was to examine whether a set to search for simple or complex mediators could be conditioned so as to later affect retarded Ss' learning of a paired-associate task. Two groups of retarded children were verbally conditioned to search for either high level associative strategies (word formation, superordinate and syntactical strategies) or low level ones (repetition, single, and multiple letter cues). On a succeeding criterion task, Ss who were conditioned to search for high level strategies demonstrated faster learning rates and produced higher strategy level scores. These results indicated that associative strategies are not specific to particular pairs and that it is possible to differentially condition retarded children to search for associative mediators.

Problem

Recent studies (Jensen & Rohwer, 1963a; 1963b; Experiment II; Experiment IV) have shown that strategy aids given to Ss result in better performance on associative learning tasks. These strategy aids can be called experimenter-supplied ones since E presents the child with a means to recode the material. From the results obtained by Jensen and Rohwer (1963b) and Experiment II, it appeared that these experimenter-supplied mediators were specific to the particular pairs for which they were given. That is, high level strategy aids given for certain pairs did not influence Ss to use high level strategies for other pairs. On the other hand, the results of the Stimulus Generalization Test in Experiment IV indicated that there was transfer from strategy aids to new paired associates.

The present study was designed to examine whether strategies are specific to particular paired associates or whether a general set to search for high or low level cues can be conditioned so as to affect retardates' learning of succeeding associative tasks. More specifically, the main purpose of this study is to investigate whether children can provide their own high level strategies in associative learning as a result of an induced or conditioned set to search for cues. Moreover, the effectiveness of these child-produced mediators is compared with that of the investigator supplied ones in Experiment IV. According to Bruner (1961), child-produced mediators are more effective than investigator-supplied ones.

The major hypotheses are as follows: 1) a set to search for high- or low-level strategies can be conditioned in retardates, 2) retardates receiving such conditioning respond differentially so that those reinforced for high level strategies perform significantly better on a succeeding associative learning task, and 3) child-produced mediators are as effective as investigator-produced ones.

Method

Subjects. The Ss consisted of 62 educable retardates in Type A later elementary special education classes. The Ss were randomly divided into a high strategy (HS) and a low strategy (LS) group. The mean CAs were 11.86 and 12.08, and the mean IQs were 72.09 and 69.00 for the HS and LS groups respectively. The mean reading achievement scores for these groups were 2.28 and 2.29 respectively.

Materials. Twenty-eight paired associates for the conditioning task were constructed so that they were amenable to all seven strategy levels. The stimulus items were dissyllables specifically devised for this task which were paired with response items taken from second grade readers. Three pairs were used as examples for practice, and the remaining twenty-five pairs were used for the conditioning task.

Eight paired associates (identical to those in Experiment IV) were used for the criterion task. The stimulus members of low meaningfulness (*m*) and the response members of high *m* were constructed from Noble's (1952) list. All materials, except the three practice pairs on 4 x 6 inch cards, were presented by means of an MTA-100 Scholar and automatic timer. A 40-page test booklet containing all eight criterion responses in random order on each page was used for the criterion test trials.

Procedure. The Ss were tested individually in one session consisting of three different tasks.

Conditioning task. Prior to the conditioning task, Ss were randomly placed into one of two groups, the HS group which was reinforced for high level strategies (categories 5, 6, or 7) or the LS group which was reinforced for low level ones (categories 1, 2, 3, or 4). The Ss from both groups were presented the three practice paired associates as a brief introduction to associative learning and were then familiarized with the seven different strategy levels.

Following this introduction, Ss were shown the twenty-five paired associates successively and asked to give strategies that they might use to help them learn each pair. The HS Ss were reinforced by E giving warm verbal approval (i.e., "Very good," "That's a very good one," etc.) after each report of a high level strategy, whereas the LS Ss were similarly reinforced for low level strategies. The entire conditioning task was tape recorded.

Criterion task. The criterion task immediately followed the conditioning task. Five learning trials with both the stimulus and response members present were alternated with five test trials on which only the stimulus member was present. The procedure was identical to the one reported in Experiment IV except that the materials were presented by means of an MTA-100 Scholar rather than a slide projector. Each paired-associate item was presented automatically at a six second exposure rate. The exposure rate on the test trials, however, was manually controlled so that all Ss had ample time to respond by circling a response for each stimulus in the test booklet.

Associative strategy task. Following the criterion task, the eight paired associates were presented again for the collection of associative strategies. Each pair was pronounced as it was presented, and S was asked to describe the strategy used to learn the pair. This entire task was tape recorded.

Results and Discussion

The Ss' verbal reports of associative strategies for each of the eight paired associates in the criterion task were independently rated by two judges in order to assess interjudge reliability. For the LS group, the average mean of the eight Spearman rank correlation coefficients was .90 (range .71 to 1.00). Moreover, for the HS group, the average of the eight Spearman correlation coefficients was .84 (range .64 to 1.00), indicating a high degree of correspondence among judges in their assignment of verbal reports to the seven strategy levels. Since there was high agreement between judges, only one judge rated the strategies given by all Ss on the conditioning task.

Figure 6.1 shows the percentage of verbal reports from the conditioning task which fell into the different categories for the two groups. The median strategy scores were 90 and 151 for the LS and HS groups

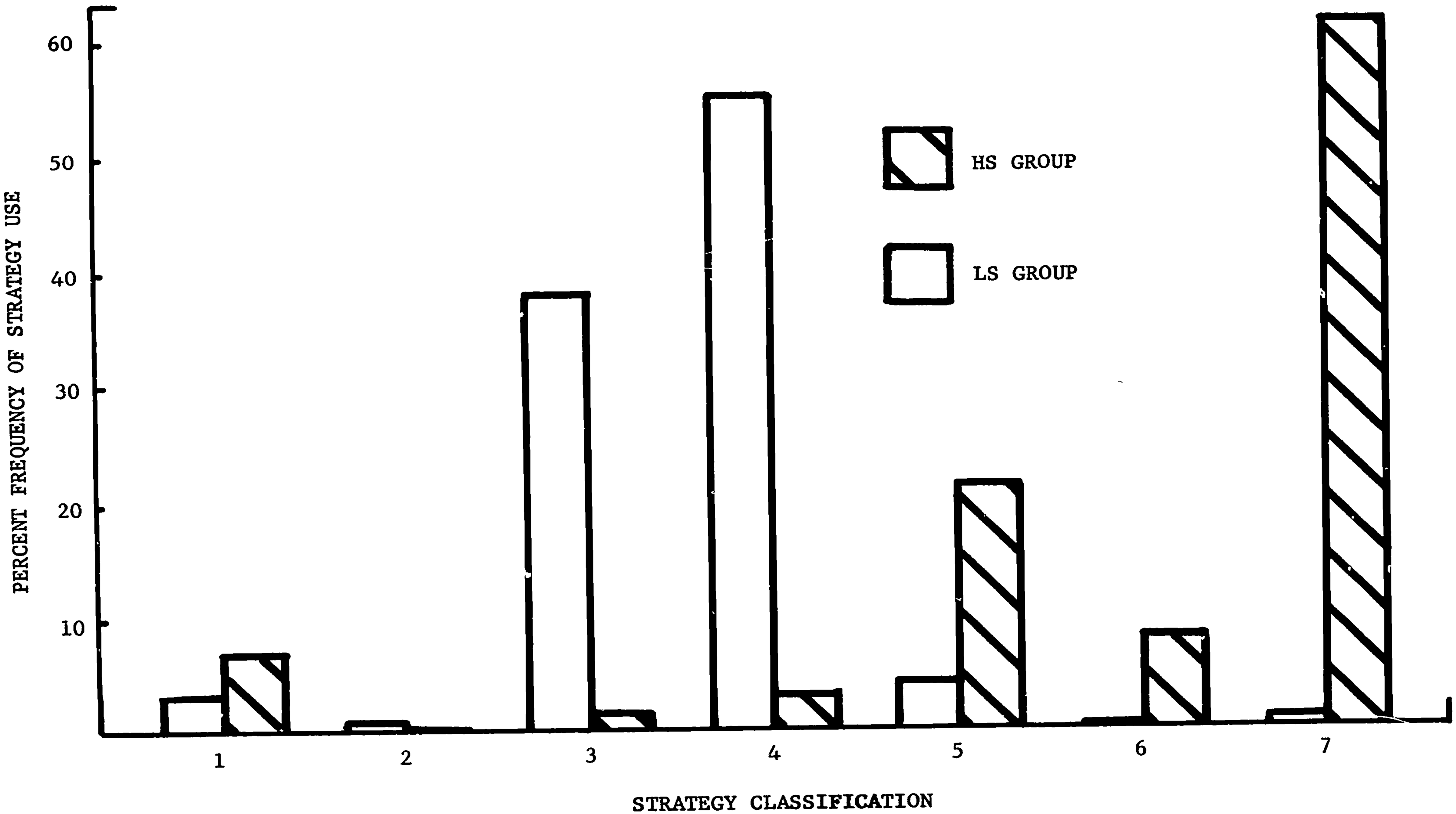

Fig. 6.1 Percentage of verbal reports by LS and HS groups in the seven different categories on the conditioning task.

respectively. This difference was found to be significant ($z = 4.515$, $p < .0001$), indicating that the conditioning task effectively produced differential elicitation of the associative strategies. Therefore, the first hypothesis, that it is possible to condition Ss to search for high or low level strategies, was supported.

The performance curves of the LS and HS group showing the mean number of pairs correct by trials on the criterion task are presented in Figure 6.2. Two additional curves, shown by the broken lines, have been added from Experiment IV, since the list and experimental situations were identical and enabled comparisons with the LS and HS treatments. These added curves represent two groups (aided and unaided LS Ss) which had only a short practice task, instead of the conditioning task, prior to the learning of the eight criterion paired associates. The Unaided group had been merely asked to learn the list using the same procedure as the LS and HS groups. The Aided group, on the other hand, had been given strategy (mediational) aid in the form of high level strategies on the first three criterion learning trials.

The data from the LS and HS groups only were subjected to an analysis of variance (Type I Design, Lindquist, 1953). The main effects of Groups ($F = 11.77$, $df = 1/60$, $p < .01$) and Trials ($F = 25.02$, $df = 4/240$, $p < .01$) were found to be significant showing that, although there was general improvement with trials, the HS group performed significantly better than the LS group on the criterion task. The interaction term, Groups x Trials, was also significant ($F = 4.93$, $df = 4/240$, $p < .01$) indicating that the two groups also differed in rate of learning. Though the conditioning task consisted of only 25 paired associates on which the

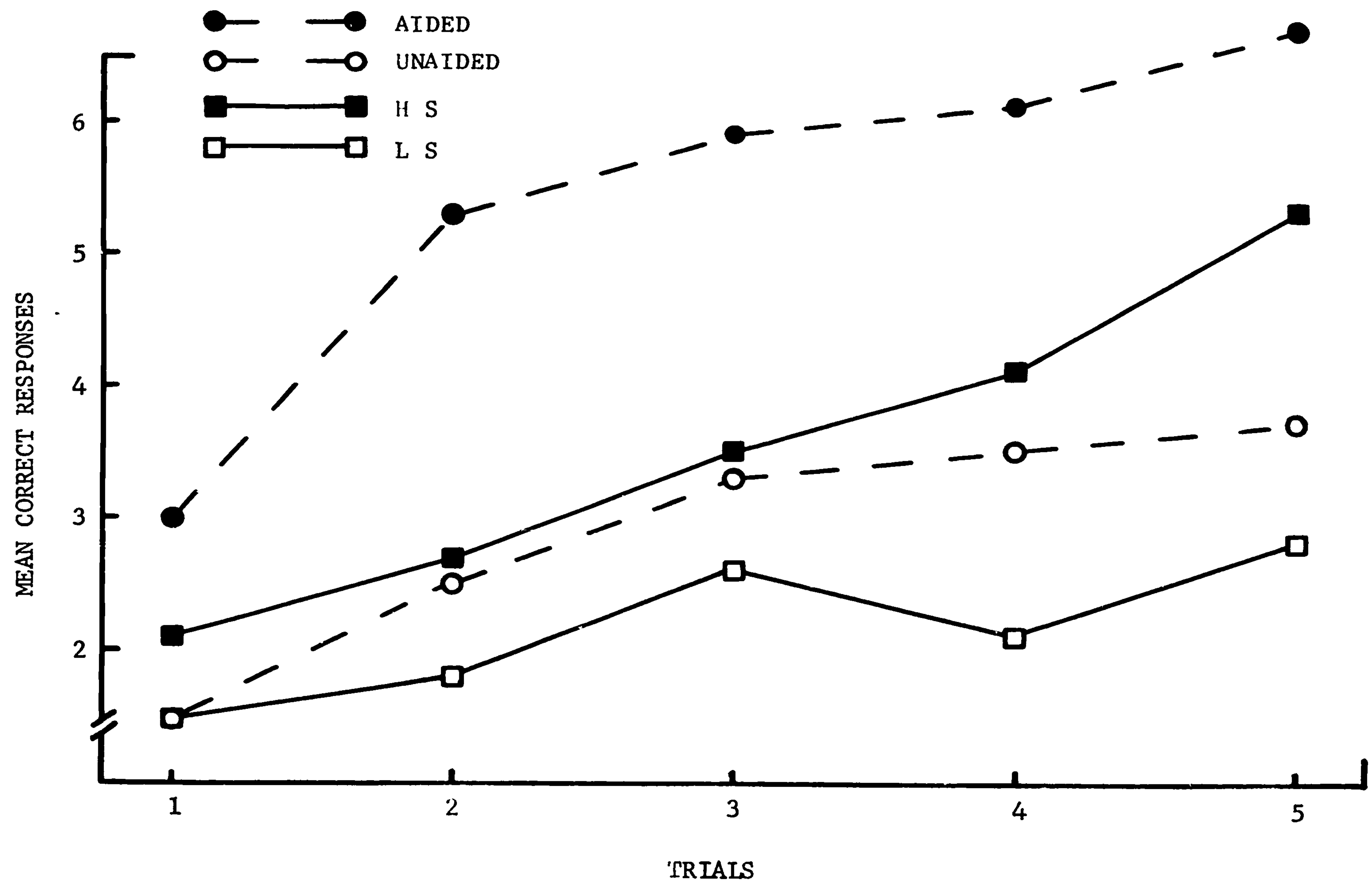

Fig. 6.2 Mean correct responses on acquisition for the LS and HS groups of Experiment VI and the aided and unaided groups of Experiment IV.

Ss were conditioned to search for different types of strategies, it appears that such training had an effect on the succeeding criterion task. Thus, the second hypothesis was also supported.

Figure 6.3 shows the percentage of verbal reports from the associative strategy task which fell into the various categories for the two groups. A total strategy score was also computed for each S on the associative strategy task during which Ss attempted to report the strategies they used to learn the criterion paired associates. These data from the associative strategy task were likewise submitted to the Mann-Whitney U test to determine whether the groups differed significantly in strategy levels reported. The median total strategy scores for the eight criterion paired associates were 20.0 and 36.5 for the LS and HS groups respectively. The results of the Mann-Whitney U test showed that the groups differed significantly ($z = 4.58$, $p < .0001$). It appears that the induced set to search for the different strategies also influenced the types of strategies Ss reported using on the criterion task. It is likely that the HS Ss were superior on the criterion tasks because they used high level strategies as a result of their previous training.

The relationships among the three given tasks were examined. Spearman rank correlation coefficients were computed to determine the relationship between Ss' total strategy scores on the associative strategy task and Ss' corresponding number of correct responses on the criterion task. The correlation coefficients for the two groups were -.11 and .50 for the LS and HS groups respectively. The latter coefficient was found to be significant beyond the .01 level, indicating that the Ss in the HS group who reported the high strategy levels generally showed better performance on the criterion task.

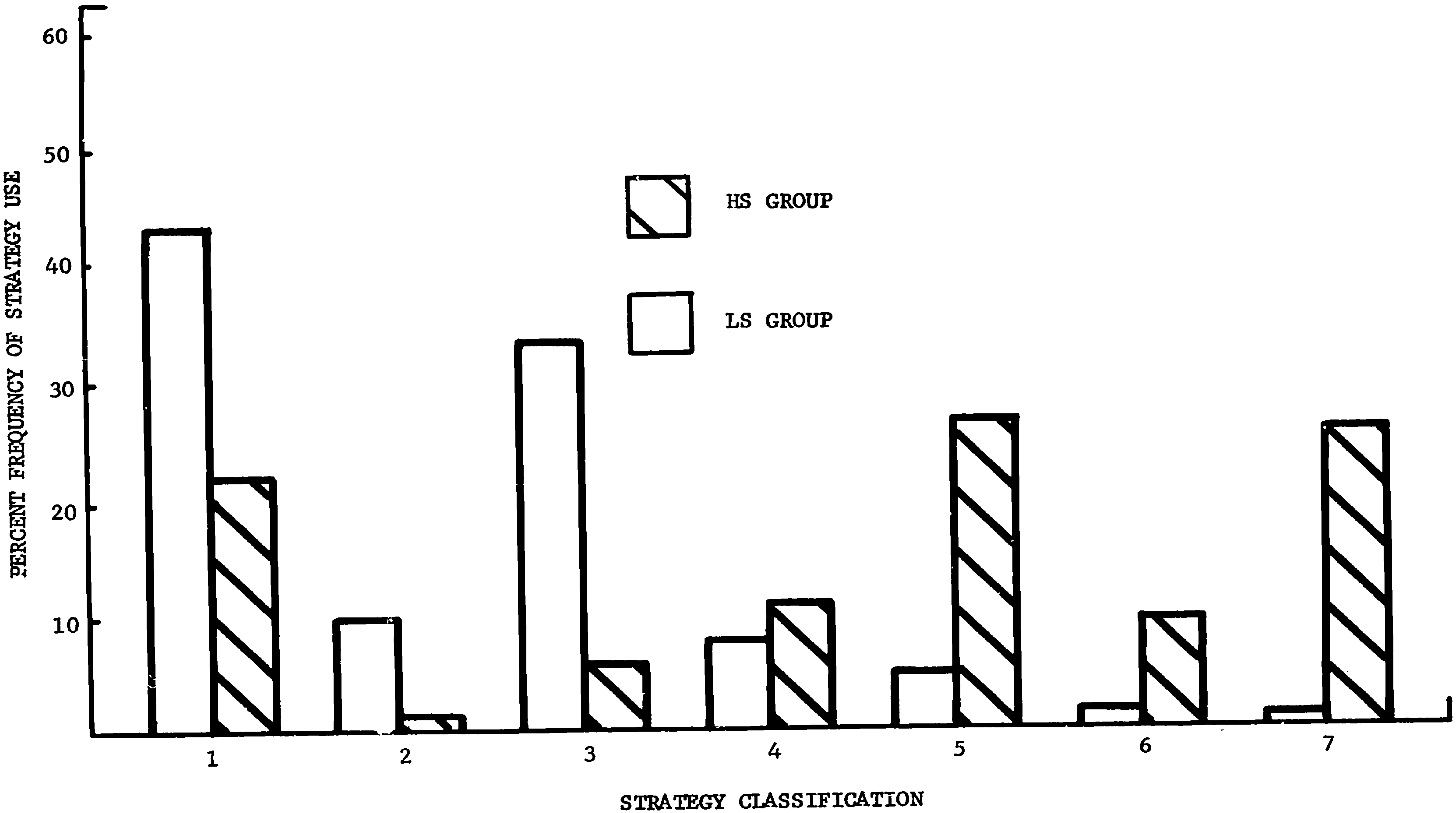

Fig. 6.3 Percentage of verbal reports by LS and HS groups in the seven different categories on the associative strategy task.

In order to determine whether there was a relationship between the total strategy scores reported by Ss on the conditioning task and the number of correct responses on the criterion task, Spearman rank correlations between these measures were computed for the two groups. The correlation coefficients for the LS and HS groups were .12 and .47 respectively. Again, only the latter coefficient was found to be significant ($p < .01$), indicating that, within the HS group, those Ss who gave the higher level strategies on the conditioning task also tended to do better on the criterion task.

Finally, to determine whether there was a relationship between performance in searching for strategies on the conditioning task and strategies Ss reported using on the criterion task, Spearman rank correlations between total strategy scores on the conditioning task and corresponding total strategy scores on the associative strategy task were computed. The correlation coefficients were .22 and .66 for the LS and HS groups respectively, showing a significant relationship ($p < .01$) between these measures for the HS group only.

The significant correlations for the HS group on these tasks indicate that Ss' performances on them were related. It appears that those who were better able to search for high level strategies on the conditioning task tended to perform better on the criterion task. Moreover, Ss who did well on the latter task generally reported using high level strategies to connect the criterion paired associates. Of particular interest, however, is the significant relationship ($r_s = .66$, $p < .01$) found between S's performance on the conditioning task and his performance on the associative strategy task. It appears that if a set to search for high level strategies had been effectively induced on the conditioning task, the S tended to later report using high level strategies on the criterion task. This result provides evidence for the notion that a general set to search for certain types of strategies can be conditioned so that there is transfer to other tasks as well as other pairs. In other words, strategies are not, as the results of Experiment II indicated, specific to particular paired associates.

On the other hand, no relationships were found between the tasks for the LS group. One possible explanation for these results is that the range of scores on all tasks for the LS group was quite limited. When the LS groups' strategy scores on the conditioning task were compared with those of the HS group in variability, it was found that the former had a much smaller semi-interquartile range (Q = 3.57 and Q = 13.50 for the groups respectively). Similarly, the semi-interquartile ranges for the associative strategy task scores were 2.39 and 8.50 for the LS and HS groups respectively. Consequently, it appears that measures for the LS group show limited dispersion which may account for the low correlation coefficients obtained.

A second analysis of variance (Type I Design, Lindquist, 1953) was performed on the data (number correct) from the criterion task for all four groups as shown in Figure 6.2. The main effect of Treatments and Trials and the interaction term, Treatments x Trials were all significant beyond the .01 level ($\underline{F}$ = 17.65, $\underline{df}$ = 3/112; $\underline{F}$ = 64.98, $\underline{df}$ = 4/448; $\underline{F}$ = 3.92, $\underline{df}$ = 12/448 respectively). It appears that, although all groups showed general improvement, some learned at a faster rate than others. Since it was assumed that the effect of the induced sets would be more evident on later trials (i.e., after Ss had searched for and found the high level strategies), individual comparisons between groups were made by means of the Tukey (a) Test for each of the five trials separately. On the first trial, the Aided group was significantly superior to the Unaided and LS groups only. On trials two and three, the Aided group was found significantly superior to the other three groups. On trial four, the Aided group was again superior to the other groups, but the HS group was also superior to the LS groups. On trial five, the Aided group was significantly superior to the Unaided and LS groups but not to the HS group. Again, the HS group was superior to the LS group.

The superiority of the Aided group, may be a result of the elimination of the searching-for-cues process; Ss had only to apply the experimenter-supplied strategies to learn. On the other hand, the other groups had to begin by searching for strategies. The LS group, given a set to search mainly for low strategies, improved very little from trial 1 through trial 5. The Unaided group, who had no induced set, showed a moderate amount of improvement. The HS group, having an induced set to search for high level strategies, at first remained near the Unaided group, but later appeared to pull away from it. It appears that, if more trials had been given, the performance of the HS group would have become more like the Aided group. Though there is some evidence that child-produced mediators may be as effective as investigator-supplied ones with progressive trials, hypothesis three is not supported. Certainly there is no evidence that child-supplied mediators are more effective than experimenter-supplied ones as Bruner (1961) suggests. The above results indicate that this would be true only if the child is allowed a longer period of time to search for strategies. Obviously, experimenter-supplied strategies eliminate the searching period.

In summary, the results of this study indicate that it is possible to condition a set to search for high or low level strategies. These conditioned sets, which can be thought of as sets to recode or organize materials efficiently (HS set), or inefficiently (LS set), appear to affect later learning of a PA task. Child-produced strategies, however, are not as effective as investigator-supplied ones, probably because the latter eliminates the searching-for-strategies period.

Experiment VII

Verbalization of Associative Strategies by Blind Children

ABSTRACT. The present study was designed to examine whether associative strategies reported by blind Ss could be classified according to the scheme developed in Experiment I. A second purpose was to determine whether syntactical strategy aids facilitate the paired-associate learning of the Ss. The experimental group received high level strategy aids during the learning task, whereas the control group was not provided with any aids. Performance of the aided group was superior to that of the unaided group. Two judges were able to classify the verbal reports according to the seven-category classification scheme and showed high agreement in their assignment of these reports to the various categories. The results of this study generally paralled those obtained in the previous experiments employing retarded and normal children.

Problem

Experiments II and III have examined the types of associative strategies reported by normal and retarded children in associative learning. It was not known what types of strategies other populations, such as blind Ss, would use. Therefore, the present study was carried out in order to examine whether the associative strategies reported by blind Ss could be classified in the classification scheme developed in Experiment I. A second purpose of this study was to determine whether syntactical strategy aids, which have been shown to facilitate the associative learning of normal and retarded Ss (Experiment II and Experiment IV respectively), also facilitate the associative learning of blind Ss.

Method

Subjects. The Ss were 39 visually handicapped children attending a summer program at a local residential school for the blind. The Ss were randomly assigned to two treatment conditions: the control group who received no aid and the aided group. Mean CAs were 13.67 (range 11-5 to 17-1) and 13.88 (range 11-7 to 16-5) for the control and aided groups respectively. IQ and reading achievement measures were available for only 15 of the 39 children. The mean IQ score for the six control Ss for whom data were available was 106 (range 90 to 122); mean IQ score for the nine aided Ss with available data was 105.2 (range 85 to 130). Mean reading achievement scores were 6.9 (range 5.8 to 9.0) and 7.1 (range 4.7 to 11.9) for the six control and nine aided Ss respectively. No significant differences were found between the Ss in these two groups for whom data were available.

Materials. Four dissyllabic pairs of low-high meaningfulness (m) were constructed for the practice task. The stimulus items were specifically devised for this task, and the response items were words selected from second grade text books. The four pairs were: Olpret-Balloon, Lenear-Garden, Binest-Outside, and Holbut-Farmer. These pairs are identical to those for the practice task of Experiment IV.

For the learning task, eight dissyllabic pairs of low-high m were constructed from Noble's (1952) list. The mean m values of the stimulus and response items were 1.54 (range 1.24 to 2.28) and 8.75 (range 6.57 to 9.61) respectively. The pairs for the learning task were: Lemür-Kitchen, Flotsam-Army, Bodkin-Wagon, Sagrole-Money, Zumap-Village, Gokem-Uncle, Tarop-Jelly, and Latuk-Dinner. These pairs were identical to those used for the criterion task in Experiment IV.

The individual stimulus-response pairs and test stimuli were brailled on 6" x 10" sheets which were punched and made into booklets. A Sony tape recorder was used to record Ss' verbal reports.

Procedure. All Ss participated individually in three tasks which were given successively in one session.

Practice task. The practice task was given in order to familiarize Ss with the concept of paired-associate learning. The Ss were told that they would be given a word task in which they were to learn four associations. They were given one learning trial and one test trial. On the learning trial, E pronounced the stimulus and response items as S read the braille version. On the test trial, S had to recall the appropriate response when given only the stimulus item in braille and pronounced by E.

Criterion Task. Immediately following the practice task, the E administered the criterion task to each S. The procedure was identical to that of the practice task except that the eight criterion pairs were employed, and five learning and test trials were alternately given. A six second exposure rate was used for each learning trial, and no time limit was imposed on the test trials. The Ss' responses were recorded by E.

Subjects in the aided group were instructed that E would give them "tricks" (syntactical strategies) and that they should try to use these tricks to help them learn which words went together. Each S in this group was given high level associative strategies on the first three learning trials. The strategy aids are the same as those given in Experiment IV (see Table 4.1).

Unaided Ss were not provided with strategy aids. In all other respects, the same procedure was followed for both groups.

Associative strategy task. Immediately following the criterion task, each S was again shown the eight criterion pairs separately and was asked to describe how he learned each pair. Each pair of items was presented for a maximum of 18 seconds. If S did not respond within 12 seconds following the onset of a pair, the E again asked what tricks, if any, were used to learn that pair. The S was then given six more seconds in which to respond before the next pair was presented. This entire session was tape recorded.

Results and Discussion

The means and standard deviations of the total number of correct responses on the criterion task are presented in Table 7.1. The learning curves for the aided and unaided groups are shown in Figure 7.1. Analysis of these data revealed that the variances of the two groups were heterogeneous (F max test, $F = 31.25$, $p < .001$). Therefore, a Mann-Whitney U test was performed on these data. A significant difference was found ($U = 118.5$, $p < .05$), indicating that the aided group was superior to the unaided group on the criterion task. It appears that experimenter-supplied strategy aids have the effect of facilitating the associative learning of blind Ss, similar to that of normal and retarded Ss.

The unaided Ss' strategy reports in the associative strategy task were independently assigned by two judges to the seven levels in the classification scheme devised in Experiment I. The Spearman rank correlation coefficients for the eight criterion pairs ranged from .74 to .96. Classification of four of the eight pairs had correlation coefficients of .90 and above. It appears that the two judges agreed highly in their assignment of verbal reports to the seven categories and that reports by blind Ss were not more difficult to classify than those by other populations.

Table 7.2 shows the percentage of strategy classifications reported by each group. The aided Ss, of course, reported predominantly syntactical strategies since they were given syntactical strategy aids on the criterion

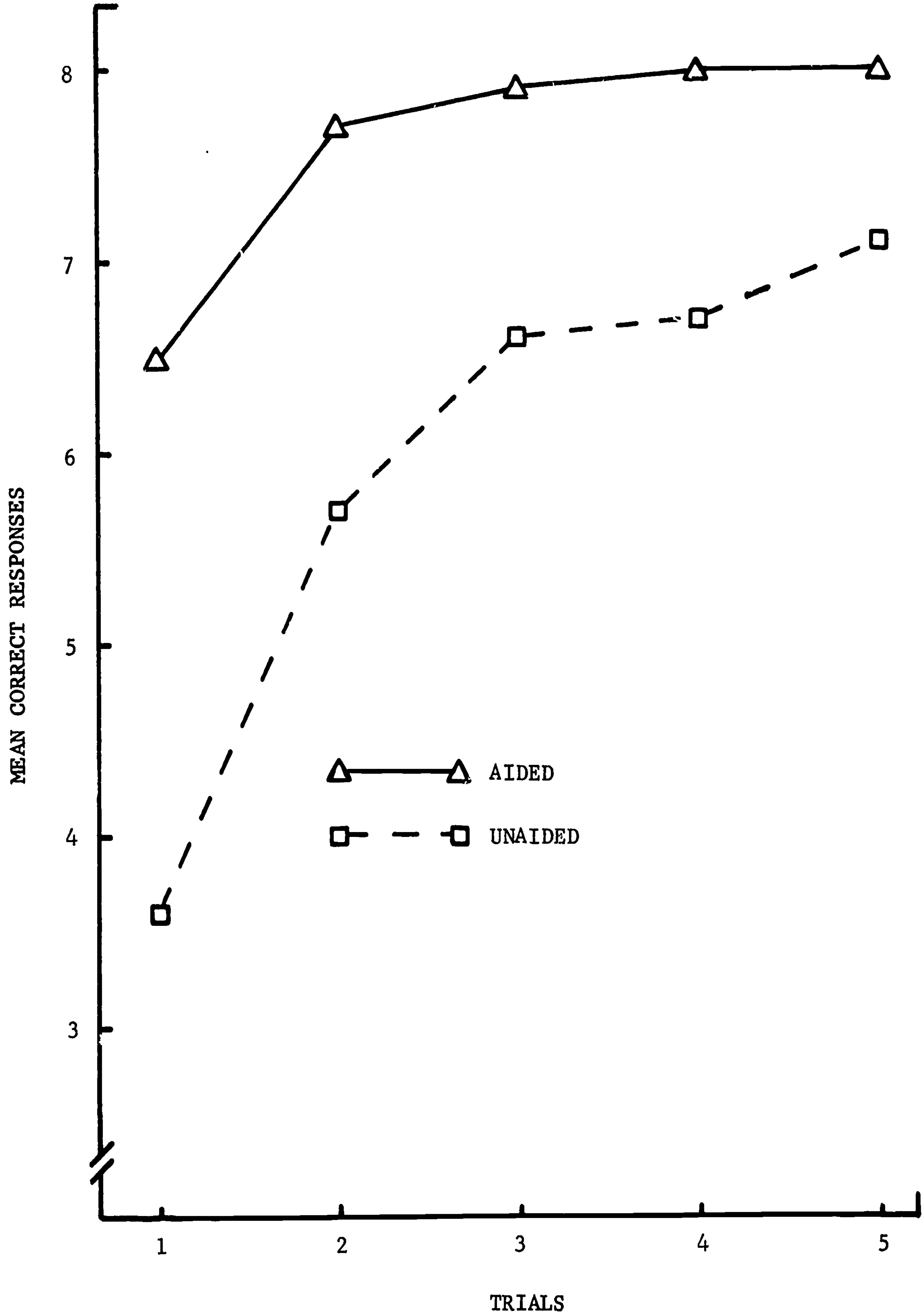

Fig. 7.1 Mean number correct responses on acquisition for aided and unaided groups.

Table 7.1. Means and standard deviations of the number of correct responses on the criterion task.

Mean	38.00	29.79
S.D.	1.84	10.06

task. On the other hand, the unaided Ss gave mainly reports of no strategy (category one). This latter result is somewhat anomalous since, although 54 percent of the unaided Ss essentially reported using no strategy, the rate of learning was very high. When the verbal reports of the unaided Ss in category one were examined, it was found that these Ss mainly reported that they were not certain as to how they had learned the associations. It appears that a strategy may have been used, but Ss either could not verbalize it or were not aware that they had used any cue. This may be possible, particularly if Ss relied on very subtle proprioceptive cues which were present when the Ss read the brailled materials. Perhaps, more time and deeper probing by E should have been allowed during the associative strategy task.

A total strategy score was computed for each S by summing the strategy ratings assigned to the eight paired associates. Spearman rank correlations between total number of correct responses on the criterion task and total strategy score on the associative strategy task were computed for the two groups. The correlation coefficients were .50 ($p < .01$)and .37 ($p > .05$) for the unaided and aided groups respectively. The significant correlation for the unaided group, indicates that there is a relationship between strategies and performance,

Table 7.2. Percent frequency of strategy level reported for the two groups.

Group	Strategy Levels 1	2	3	4	5	6	7
Experimental	14	7	--	--	8	5	66
Control	54	7	5	6	3	11	14

i.e., the higher strategies tend to be associated with better performance on the criterion task. On the other hand, the correlation was not significant for the aided group, indicating that there was no relationship between strategies and performance. However, it must be noted that because the aided group reached ceiling in performance in the beginning trials (see Figure 7.1), their scores were quite similar on the criterion task. This is evidenced by the fact that the variance for the aided group was much smaller than that for the unaided one ($s^2 = 3.37$ and $s^2 = 101.79$ for the two groups respectively). This limitation in variance of the aided group's scores may have in effect reduced the correlation, thereby accounting for the lack of significance.

Since the associative strategy task had been recorded on tape, it was possible to estimate two time measures in the Ss' verbal reports of strategies. The first measure, strategy emission latency, was computed as the amount of time from presentation of the paired associate to the beginning of verbalization of a strategy for that pair. The second measure, verbalization time, was the amount of time that S used to describe the strategy. Spearman rank correlations were computed to determine whether there were relationships between these time measures and total strategy scores. For the aided group, there was a nonsignificant negative correlation between latency and strategy score as well as between verbalization time and strategy score ($r_s = -.11$, $p > .05$ and $r_s = -.27$, $p > .05$ respectively). For the unaided group, there was a nonsignificant negative correlation between latency and strategy score ($r_s = -.22$, $p > .05$) and a nonsignificant positive correlation between verbalization time and strategy score ($r_s = .38$, $p > .05$). From these results, no relationships were evident between any of these measures.

In summary, syntactical strategy aids appear to facilitate the associative learning of blind children. The use of syntactical strategies can be considered an effective means of recoding information in order to reduce memory limitations for blind as well as normal and retarded Ss. In addition, the strategies reported by blind Ss were about as easy to classify as those reported by other populations. There is, however, some question about the use of category one by blind Ss. Blind Ss whose reports fell into this category also performed well, although, as the correlation between strategy scores and learning indicates, not as well as the Ss who used the more complex strategies. Unlike the previous studies (Experiments II and IV) no relationships were found between time measures in strategy reports and the types of strategies reported.

Experiment VIII

Administration of Associative Strategies to Educable Retardates in Word Recognition Learning

ABSTRACT. The purpose of this study was to determine whether experimenter-supplied strategies can facilitate word recognition learning of retarded children. Three groups were formed: Syntactical, Word Formation, and Repetition. The Syntactical group was given cue word training and syntactical strategy training prior to the criterion task. The Word Formation group was also given cue word training, but not syntactical strategy training. The Repetition group did not receive syntactical strategy training and was given cue word training on only two of the eight criterion task words. A retention task was administered approximately 48 hours after the criterion task. This task included both a retention trial and two relearning and test trials. The results showed that there were no significant differences among the groups on the criterion task. Similarly, no significant differences among the groups were found on either the retention trial or on the two relearning test trials. However, an analysis of the data from the last relearning trial did reveal a significant difference among the groups. It was concluded that while there was some evidence concerning the effectiveness of the Syntactical condition during relearning, there was no differential effect upon acquisition as a function of the Syntactical, Word Formation, and Repetition treatment conditions.

Problem

Experiments I-VII have examined various aspects of associative strategies in the learning of verbal associations of the paired-associate type. In these experiments, the Ss' task has involved the learning of an association between two verbal units. One of the terms typically has been an unfamiliar verbal unit (S-term) while the other term has been a familiar word (R-term). When a number of these S-R pairs are presented to an S in a learning session, a number of trials are required to form the correct associations. On the basis of the results obtained in the previous experiments, it appears that much of the learning occurs as a result of transfer of learning. This seems especially true in the case of the higher level strategies. The learning which occurs as a result of employing these strategies appears to be due to the transfer or use of associations which have already been formed in the past. On the other hand, the lower level strategies appear to involve little, if any, previous learning.

The effectiveness of the high level strategies may be described in the following manner: Given the pair NEGLAN-LEADER, S must develop an association between these two verbal units. Rather than attempting to form a completely new association between these two units, S attempts to make use of previously established associations. During the early learning trials, he appears to be searching for some type of cue in the S-term which assists in the recall of the R-term. In the process of searching for such a cue, S may try recoding the unfamiliar S-term in several different ways. Because such recoding does not necessarily assist in making the association, new attempts at recoding are continued. Finally, S recodes the S-term in such a manner that a previously learned association can be employed. For example, S may recode the S-term (NEGLAN) to NEGRO. Since an association already exists between NEGRO-LEADER, the NEGLAN-LEADER association is mediated by the word NEGRO.

The beneficial effect of experimenter-supplied strategies in the previous experiments is due primarily to two major factors. One factor involves the nature of the supplied strategy. For most Ss, the strategy which has been provided is one which permits the S to recode the S-term in such a manner that a previously learned association can be employed. The second factor is related to the time at which the strategy is provided. In the preceding experiments, the strategies have been supplied on the first two or three learning trials. This eliminates unsuccessful recoding attempts in the early trials.

While a great deal of learning involves the formation of new associations, the exact nature of the association may vary from task to task or from material to material. A somewhat different type of association is involved in learning to recognize a new word. For the mature reader, word recognition occurs very rapidly and creates little imposition upon memory. However, this is usually not the case for the young child. Oftentimes a number of repetitions are required before the child can finally read the word when it is presented. The association which is being developed in this situation is between a printed S-term and an oral R-term. Although little experimental evidence is available concerning the strategies which children employ in learning such associations, the fact that various types of cues are employed is undeniable.

Carroll's (1964) description of the process involved in word recognition appears to be very similar to the process involved in paired-associate learning. He states,

> "When the beginning reader meets a word with which he is unfamiliar, that is, one that he cannot recognize instantly, the process of word recognition may be regarded as a case of problem-solving. Various cues are available to him; sometimes certain cues will very quickly allow him to arrive at a proper reconstruction of a word; at other times, cues must be used to suggest a series of possibilities. In this case, the learner must essentially go into a "search-routine," testing out each one of the possibilities until a satisfactory one is found. The case will vary, of course, depending upon whether the spoken word and its meaning happen to be in the child's speech repertoire. It will also vary depending upon what kind of information is available to allow the child to confirm his guess-whether, for example, there is sufficient context to test the correctness of a guess."

One of the first problems posed in the initial planning of this experiment was concerned with the manner in which associative strategies could be supplied in a word recognition task. It was assumed that since an association was being learned in both the paired-associate and word recognition tasks, the same basic problem confronted the S. That is, in order to make a correct response in the word recognition task, the visual presentation of the printed word must elicit the correct oral response (saying the word). The situation is quite similar in the paired-associate task; in order to make a correct response on the test trial, the S-term must elicit the R-term. One of the beneficial effects of experimenter-supplied strategies was the fact that the strategy incorporated an element of the S-term and also incorporated the R-term. For example, if S is presented the pair, Zumap-Village, and is provided the strategy, "map of the village," then, upon presentation of the S-term on the test trial, the embedded word, map, serves to elicit the strategy and hence the correct response.

A comparable situation was devised with a criterion list of eight words. On the learning trials, the eight words were presented visually while E pronounced each word. The test trial consisted of presenting the same words, but on this trial, E did not pronounce them and S was required to say the word if he remembered it. For the strategy group, it was first necessary to establish a cue in the criterion word upon which the experimenter-supplied strategy could be based. This was achieved by selecting only criterion words that contained small embedded words which the S already could read or be easily trained to read. Furthermore, only words which were in S's speech repertoire, but S could not read, were used for the criterion list.

The above conditions made it possible to supply Ss with associative strategies. In learning to recognize the word, BRACELET, pretraining on a cue word such as LET permitted the possibility of supplying the S with a strategy. During the learning trials, Ss receiving strategy training were instructed that they could use the little word LET to learn the larger word BRACELET by remembering, "Let me have the bracelet." It was assumed that, on the test trials, the cue words and the experimenter-supplied strategies would facilitate immediate recall of the criterion word.

The following hypotheses were tested in this experiment: 1) a syntactical strategy condition will result in significantly better performance than either a word formation or a repetition condition in a word recognition learning task, 2) a word formation condition involving cue-word training will result in significantly better performance than a repetition condition involving no cue-word training, and 3) retention of the criterion words will be facilitated as a result of syntactical and word formation conditions.

Method

Subjects. The Ss tested in this study were 54 educable retarded children, 37 males and 17 females, drawn from public school special education classes. Three groups were formed, each containing 18 Ss. The IQ and reading achievement measures were not available for all of the Ss; therefore, the following data are based upon the available information. The mean IQ (WISC) of each treatment group was as follows: Syntactical-74 (range 67 to 88, n=17), Word Formation-71 (range 56 to 88, n=17), Repetition-75 (range 56 to 90, n=11). The mean CA of each group was, respectively, 10-8 (range 8-3 to 12-11), 10-9 (range 7-9 to 12-9), and 11-3 (range 9-4 to 12-5). The mean reading achievement score of each group, was respectively, 1.35 (n=16), 1.52 (n=17), and 1.82 (n=11).

Materials. For the pretest, 12 large words, from which the 8 criterion words were chosen, and 12 cue words embedded in them were typed on individual 4 x 6 inch cards. The 12 cue word cards were later used for cue word training, and 4 from the 12 large word cards, not used on the criterion task, were employed for the strategy training session.

For the criterion and retention tasks, an MTA-100 Scholar teaching machine was used to present the eight criterion words. These large words and their embedded cue words, along with the strategies given to the Syntactical group on the criterion task, are presented in Table 8.1. The other four large words and their embedded cue words used for strategy training were as follows: antenna, caterpillar, legend, and toothpick.

Table 8.1. Criterion and cue words for the criterion list and corresponding syntactical strategies.

Criterion and Cue Words	Syntactical Strategies
Behavior	Be on your best behavior
Bracelet	Let me have the bracelet
Gladiator	Glad to be a gladiator
Gruesome	Some people are gruesome
Mansion	Man lives in a mansion
Mushroom	Room for the mushroom to grow
Particle	Part of the particle
Program	Am I in the program

Procedure. Three treatment groups were formed: Syntactical, Word Formation, and Repetition. The Syntactical group was given cue word training on all twelve cue words and syntactical strategy training on the four large strategy words prior to the criterion task. The Word Formation group was also given cue word training on all twelve embedded words and repetition strategy training on the four large strategy words. The Repetition group received cue training on only six of the twelve cue words (the four strategy cue words and two of the criterion cue words). After cue training, this group also received repetition strategy training.

Cue word training. Prior to cue word training, all Ss were given a pretest. Each S was first instructed to read as many of the 12 cue words as he could. Following this task, S was similarly tested on the 12 large words. Subjects who could read two or more of the criterion task words were not selected for the experiment. These pretest scores later served as a basis for matching Ss and assigning them to three treatment conditions.

After the pretest, subjects were presented with six of the cue words. Four of these were taken from the four words which were later presented during strategy training. The other two cue words were taken from two of the eight criterion task words. Alternate learning and test trials were given. On the learning trials the experimenter pronounced each word three times, and S repeated it each time E pronounced it. The exposure rate was six seconds per word. On the test trials, S had to read the words without prompting. The method of adjusted learning was used; that is, when an S gave three successively correct responses for a cue word, this word was removed from the list. Each word was removed when this criterion was met, until all words were learned. If

S did not reach criterion in approximately 15 minutes, he was given another training session the next day and the following day, if necessary, until he reached criterion.

Subjects were matched on the basis of the following criteria prior to assignment to the three treatment groups: 1) pretest scores on the cue words, 2) pretest scores on the twelve criterion words, and 3) number of trials required to learn the first six cue words. Whenever possible, Ss were matched solely on the number of cue words known. When Ss could not be matched on cue words alone, then the number of criterion words known and/or the number of trials required to learn the first six cue words were used as additional criteria. For cases in which the first two criteria were not completely adequate, it was necessary to employ the number of trials required to learn the first six cue words as the only criterion for matching. For Ss who could not read any of the cue words or criterion words on the pretest, this latter criterion served as the sole basis for matching. (See Appendix D for further description of matching). Approximately five minutes after completion of the cue word training, Ss who were assigned to the Syntactical and Word Formation groups were given six more cue words to learn. These words were taken from the remaining six criterion words which were later used in the criterion task. The procedure was the same as that used for the previous cue word training. After an S reached criterion, the two halves of the list of 12 cue words were combined, and he was run to a criterion of two complete successive trials without removing any of the words. The Repetition group Ss were not given training on the latter six cue words.

Strategy training. Four of the twelve large words were presented to all Ss. For the Syntactical group, on the learning trials, E presented the large word and pointed out the underlined cue word. The E then pronounced the cue word and gave the strategy which could be used to remember the large word. The large word was again pronounced by the E. Each S was required to repeat the above sequence. On the test trials, S was asked to identify the cue word, repeat the strategy, and say the large word. If S was able to repeat this sequence, the word was removed from the strategy training list.

Because the above procedure was similar to the procedure employed in the criterion task, the Word Formation and Repetition groups were given comparable exposure to the strategy training words and were also familiarized with the repetition type strategy procedure that they were given on the criterion task. For these two groups, the experimenter simply pronounced the four large words three times, without pronouncing or pointing out the cue words. The Ss then had to repeat each word after E pronounced it. On the test trials, Ss were requested to read each large word. Though both groups received repetition strategy training, the group who received cue training on the twelve embedded words and, consequently, were given all eight of the embedded criterion cue words was called the Word Formation group. This group could have used the embedded cue word as a word formation strategy, e.g., "let-bracelet."

Criterion task. All Ss received alternately five learning and five test trials. For the learning trials each word was presented automatically on the MTA Scholar at a 10 second rate. No time limit was imposed on the test trials. The cue word was underlined on all learning trials for the Syntactical group only. In addition E pronounced each cue word and the syntactical strategy, and S repeated these. The syntactical strategies are presented in Table 8.1. For the Word Formation and Repetition groups, E pronounced each criterion word three times without pronouncing or pointing out the cue words, and S repeated each word as E said it. On the test trials, Ss from all groups had to read the criterion words. Cue words were not underlined on the test trials for any group.

Retention task. This task was administered approximately 48 hours after the criterion task. All Ss received one test trial, followed by two relearning and two test trials alternately (LTLT). The procedure for the retention task was the same as that of the criterion task.

Results and Discussion

In order to establish the initial comparability of the three groups on the pretest, two 1 x 3 analyses of variance for matched groups were performed on the total number of correct responses on the cue words and total number correct on the large words. Table 8.2 presents the means and standard deviations of the number of correct responses on the pretest for the cue words. Analysis of the data in Table 8.2 revealed no significant differences among the three groups ($F = 2.48$, $df = 2/34$, $p > .05$) on the number of cue words read correctly from the pretest.

Table 8.3 presents the means and standard deviations of the number of correct responses on the pretest for the large words. Again, a 1 x 3 analysis of variance for matched groups revealed no significant differences among the three groups ($F = .03$, $df = 2/34$, $p > .05$).

Table 8.4 presents the means and standard deviations of the number of correct responses for the three groups on the criterion task.

Table 8.2. Means and standard deviations of the number of correct responses on the pretest for the twelve cue words.

	Groups		
	Syntactical	Word Formation	Repetition
$\bar{X}$	5.94	5.61	5.83
S.D.	4.09	4.30	4.19

Table 8.3. Means and standard deviations of the number of correct responses on the pretest for the twelve large words.

	Groups		
	Syntactical	Word Formation	Repetition
$\bar{X}$	.72	.67	.67
S.D.	1.23	1.24	1.08

Table 8.4. Means and standard deviations of the number of correct responses for the three groups on the criterion task.

	Groups		
	Syntactical	Word Formation	Repetition
$\bar{X}$	21.83	22.61	21.06
S.D.	10.91	10.28	12.05

A 1 x 3 analysis of variance for matched groups was performed on these data. Contrary to the first two hypotheses, there was no significant difference among the three groups on the total number of correct responses made during the five test trials on the criterion task ($F = .29$, $df = 2/34$, $p > .05$). Figure 8.1 presents the learning curves for the three groups. Although the Repetition group's performance is slightly inferior to the performance of the other two groups, the general shape of the three learning curves is remarkably similar. Inspection of Figure 8.1 reveals that each of the three groups gained an average of one correct response per trial over the five trials.

Table 8.5 presents the means and standard deviations of the number of correct responses on the first retention trial which was administered 48 hrs. after the original criterion task. The results of the analysis of variance indicated no significant differences among the groups ($F = 2.00$, $df = 2/34$, $p > .05$). Thus, the third hypothesis concerning the predicted difference among the groups on the retention task was not supported. Since the groups were also administered two relearning test trials during the retention session, the number of correct responses were also analyzed. Table 8.6 presents the means and standard deviations of the number of correct responses on the two relearning test trials. The analysis of variance for these data also yielded no significant differences among the groups ($F = 3.05$, $df = 2/34$, $p > .05$). Although the groups did not differ significantly on this task, the F value for these data did approach significance at the .05 level (critical value = 3.28). The relearning data are also presented in

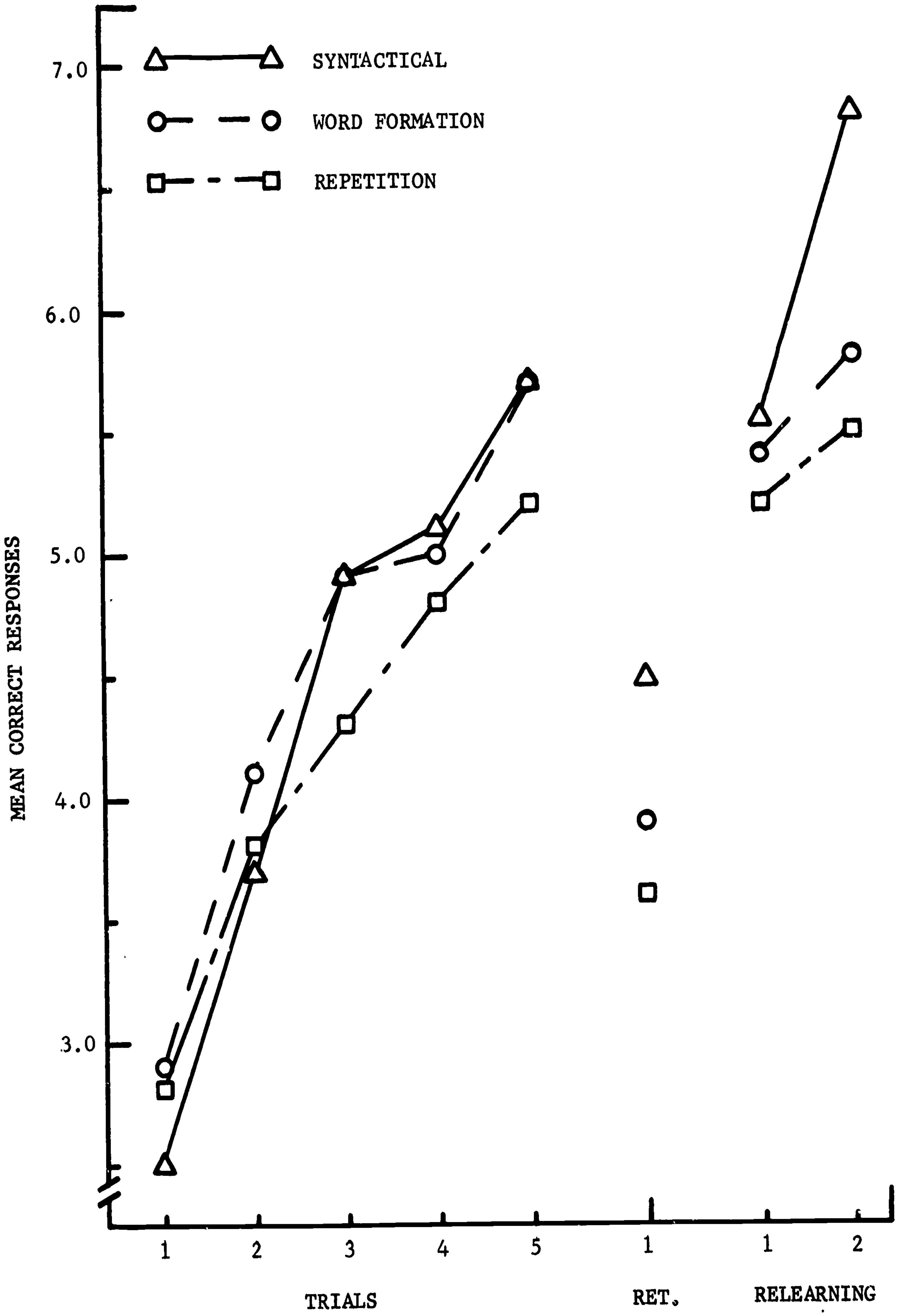

Fig. 8.1 Mean number correct responses for each group on acquisition, retention, and relearning.

Table 8.5. Means and standard deviations of the number of correct responses for the three groups on the first retention trial.

	Groups		
	Syntactical	Word Formation	Repetition
$\overline{X}$	4.50	3.89	3.56
S.D.	2.36	2.32	2.71

Table 8.6. Means and standard deviations of the number of correct responses for the three groups on the two relearning test trials.

	Groups		
	Syntactical	Word Formation	Repetition
$\overline{X}$	12.61	11.17	10.72
S.D.	3.38	4.87	4.56

Figure 8.1. Inspection of Figure 8.1 reveals a marked improvement in the performance of the syntactical group compared to the performance of the other two groups. A 1 x 3 analysis of variance for matched groups was performed on the number of correct responses on the second relearning trial. The resulting $\underline{F}$ value was significant at the .01 level ($\underline{F}$ 5.89, $\underline{df}$ = 2/34, $p < .01$).

Although there is some evidence that experimenter-supplied strategies had an effect upon the relearning scores, the acquisition and retention data indicated that such strategies had no effect upon performance in the word recognition task. These results are contrary to the findings obtained in Experiments III, IV, V, and VII with respect to the influence of experimenter-supplied strategies upon paired-associate learning. In spite of the associational nature of the word recognition task, it appears that the supplied strategies were no more effective than the repetition condition.

The negative results obtained in this study may be due to the nature of the word recognition strategies supplied to the Syntactical Ss. Examination of the types of strategies supplied to Ss in the previous experiments reveals such strategies as: "Map of the Village" for Zumap-Village, "Negro Leader" for Neglan-Leader, and "Late to Dinner" for Latuk-Dinner. Although the dominant responses to such words as Map, Negro, and Late are not Village, Leader and Dinner, respectively; the relatedness of a verbal string such as "Late to Dinner" is fairly high. This is in contrast to a verbal string such as "Let me have the bracelet" for the word Bracelet. In a situation where the verbal habits in the strategy are somewhat weaker, it becomes necessary for S to learn and remember the strategy as well as the required paired-associate or word. Another unfortunate aspect of the strategies employed in the word recognition task is length. The mere length of the verbal string is greater in this experiment than in the preceding experiments. The net result is that the Ss in the Syntactical condition are not only presented the criterion words, but they are also supplied with somewhat lengthy verbal phrases which may or may not have already been learned.

If it is assumed that a number of trials are required to learn the word recognition strategy itself, the marked increase in performance of the Syntactical group on the second relearning trial may be interpretable. The Ss in the Syntactical condition may indeed have been learning the strategies during criterion word training, but these strategies might not have been available for use until the relearning session. During the relearning session, Ss then had a strategy for recalling the word.

One other possible interpretation of the negative results has to do with understanding the concept of a word recognition strategy. Although Syntactical Ss were given a few minutes in a strategy training session prior to the criterion task, some Ss experienced difficulty in understanding the concept of an associative strategy. At times it appeared as though they failed to search for the cue word. Identification of the cue word was necessary in order for the strategy to produce the desired effect. This is especially true in view of the fact that none of the cue words were underlined for the Ss on the test trials.

While failure to understand the concept of a strategy and having to learn the rather lengthy verbal string are undoubtedly factors contributing to the negative results of this study, another very basic factor may be the rather contrived nature of the Syntactical strategies supplied in this experiment. There were no previous data which guided the selection of the word recognition strategies. This is in sharp contrast to the general procedure followed in the earlier experiments. The very first phase of this research project involved extensive analysis of the verbal reports of strategies employed during paired-associate learning. It was from this information that strategies were constructed for later experiments. No comparable data were available with respect to the types of strategies reported in a word recognition task. A fruitful attack on this problem might be to select beginning readers who are rather bright and verbal and require them to verbalize the types of strategies they employ in remembering words in a word recognition task. If the major objective is to facilitate word recognition ability, then it may be profitable to duplicate the general research strategy adopted in this project using word recognition, instead of paired associate tasks, as criterion tasks.

There are other alternatives to the study of word recognition strategies. In the development of effective associative strategies in word recognition learning, it is undoubtedly necessary to take phonological factors into consideration. Little attention was given to such factors in this experiment. Another important factor in the development of these strategies may be the nature of the within-word cue. Within-word cuesmay not necessarily be limited to the embedded word type. High association value consonant-vowel or consonant-vowel-consonant syllables may prove to be effective cue elements. Furthermore the amount of stress and position of the cue element within the word may be important variables influencing the effectiveness of word recognition strategies.

In summary, while there was slight evidence concerning the effectiveness of the Syntactical condition during relearning, there was no differential effect upon acquisition as a function of the Syntactical, Word Formation, and Repetition treatment conditions. These results suggest that caution must be exercised in the direct application of the results of the paired-associate studies to word recognition studies. However, this experiment has been extremely suggestive concerning the direction of future research designed to facilitate word recognition learning.

SUMMARY AND CONCLUSIONS

Objectives of the Present Project

The primary goal of this research has been to facilitate verbal associative learning among educable mentally retarded children. Consequently, the identification of the processes involved in the learning of verbal associations became the central research problem. The focus was associative learning because it was assumed that the learning of complex tasks is dependent upon the formation of more elementary associations (Gagné, 1964). Furthermore, many simpler tasks involve primarily the learning of an association. Consequently, it was believed that remediation must begin at the lower associative levels if proficiency is to be achieved at the higher levels. There were several objectives which this research project attempted to accomplish. One of the first objectives was the development of a classification scheme which would permit the categorization of Ss' reported associative strategies. Another aspect of this objective was the determination of the relationship between the types of strategies reported and the rate at which the material was learned and retained. The second objective involved an examination of the types of strategies employed by educable mentally retarded children. It was assumed that the inferior performance of these Ss in verbal associative learning was due to their preponderant use of the less efficient strategies. A third objective involved an investigation into the types of strategies reported by normal children at three developmental levels. Also of interest was the determination of those strategies which were most efficient at each developmental level. The final and most important objective concerned the degree to which learning and retention could be facilitated by providing slow learners with effective associative strategies.

Summary of Experiments I-VIII

Experiment I--Classification of Associative Strategies. The first experiment was undertaken to develop a systematic and reliable procedure for analyzing and classifying verbal reports obtained at the conclusion of a paired-associate learning task. It was believed that these reports would provide important data concerning the relationship between the types of associative strategies reported and rate of learning.

College students were presented an eight item paired-associate learning task consisting of unfamiliar dissyllables. Ten learning and ten test trials were alternately presented. A recognition procedure, in which each stimulus was presented along with all eight responses, was employed on the test trials. At the conclusion of the learning session, Ss were given 60 seconds to describe how they had attempted to form each association.

An examination of the verbal reports suggested seven different categories, differing with respect to an apparent underlying continuum of cue complexity. The percent frequency of the strategies in each category were: No Strategy 12%, Repetition Strategy 11%, Single Letter Strategy 14%, Multiple Letter Strategy 10%, Word Formation Strategy 6%, Superordinate Strategy 29%, and Syntactical Strategy 18%. Independent ratings by two judges indicated that verbal reports could be reliably classified.

A positive relationship between the complexity of the strategy level reported and performance on individual items was obtained. That is, Ss who reported using the higher strategy levels tended to do better on the PA learning task. A replication of the study also demonstrated that better performance was associated with the higher level strategies.

Experiment II--Verbalization of Associative Strategies at Three Developmental Levels. Experiment II incorporated the methods used in Experiment I in order to examine associative strategies of children and the developmental changes of these reported strategies with age. This experiment was also designed to investigate the effects of providing Ss with high-level strategy aids.

An eight item paired-associate list was presented to three groups of Ss within the fourth, sixth, and eighth grades. The stimulus items were unfamiliar dissyllables and the response items were familiar words. Experimenter-supplied strategies were administered for all the pairs, half of the pairs in the second group, and none of the pairs in the third group.

The results of this experiment provided convincing evidence that the formation of associative strategies is an important variable in verbal associative learning. The developmental analysis revealed that children were able to verbalize the specific cues which they regarded as having helped them make the association. Moreover, using the classification scheme developed in Experiment I, the cues reported by all Ss were easily ranked along a continuum of increasing complexity. Significant correlations between reported strategy level and performance scores were obtained in the control conditions at all three developmental levels. In addition, associative learning was significantly enhanced at all three developmental levels by the introduction of complex associative strategies. However, no differences in performance within any grade level were found between those groups receiving strategies on half the items and those groups receiving strategies on all the items. These results indicate that the concept of associative strategies may be a fruitful one to pursue in the study of individual and developmental differences in verbal learning.

Experiment III--Verbalization of Associative Strategies by Normal and Educable Retarded Children. The first purpose of Experiment III was to determine whether moderately retarded children could verbalize the types of associational cues employed during learning. A second purpose was the comparison between moderately retarded and normal children matched on CA in the types of associative strategies reported.

After a practice task, a six item paired-associate criterion list was presented to normal and educable mentally retarded junior high Ss. A total of ten learning and five test trials was administered to both groups. At the conclusion of the learning task, all Ss were asked to describe how they had learned or attempted to learn each association.

The results indicated that the retardates' performance on the criterion list was significantly poorer than that of the normals. In addition, the analysis of the Ss' verbal reports indicated that more retardates reported low level strategies, whereas more normal Ss reported high level ones. There was, however, no significant difference between the two groups in their reports of intermediate strategies. Rather marked similarities between the two groups were noted with respect to the rate of strategy emission as a function of strategy level and degree of learning. The results suggested that the inferior performance of the educable mentally retarded Ss was due to their preponderant use of the less effective strategies.

Experiment IV--Facilitation of Associative Learning Among Educable Retardates. Since fewer educable mentally retarded children reported high level strategies and more reported low level ones than normal Ss in Experiment III, it was assumed that their inferior performance in verbal learning tasks was the result of excessive use of these less efficient strategies. Experiment IV was designed to determine whether the performance of educable mentally retarded Ss could be facilitated by supplying them with high level associative strategies.

An eight item list was presented to elementary and junior high educable retardates and a control group of sixth grade normal Ss. The stimuli were unfamiliar dissyllables, and the responses were familiar words selected from Noble's (1952) list. The retarded Ss in aided groups were supplied with high level associative strategies on the first three learning trials. The normal Ss and the unaided retardates were not given strategies. Retention was examined one week after original learning.

The results indicated that the retarded groups with experimenter-supplied strategies made significantly more correct responses than the retarded groups not supplied with strategies. Furthermore, when normal Ss were compared with aided retarded Ss, there was no difference in rate of learning. The same results were obtained on the retention task.

These results suggest that the ability to develop effective associative strategies rather than the capacity to recall the associations from memory distinguish the educable mentally retarded Ss from the normal Ss in verbal learning tasks.

Experiment V--Effectiveness of Familiarization and Differentiation Training on the Successful Employment of Associative Strategies Among Educable Retardates. In Experiment IV it was found that retarded Ss did not make optimal use of the strategy aids provided them. Experiment V was designed to determine if retarded children given pretraining with relevant stimulus cues could make maximally effective use of strategy aids in an associative learning task. One group received relevant differentiation training on the criterion task stimuli. Four other groups were formed, each receiving one of the following treatments: differentiation of elements from irrelevant stimulus items (irrelevant differentiation), familiarization with the entire relevant stimulus items (relevant familiarization), familiarization with the entire irrelevant stimulus items (irrelevant familiarization), and no familiarization or differentiation (control).

After differentiation or familiarization training for the experimental groups, the same verbal association task was presented to the five groups. All Ss were provided with strategy aids on one-half of the items. At the conclusion of this task, verbal reports were collected.

The results demonstrated that aid was effective for all groups. The combined differentiation groups performed significantly better than the combined familiarization groups on the learning task. Although none of the combined groups differed significantly from the control group, the differentiation groups were superior and the familiarization groups were inferior to the control. The latter finding indicated that differentiation training facilitated learning whereas familiarization training with the entire stimulus inhibited learning. This finding suggests that training in selecting embedded elements from unfamiliar stimulus items results in significantly better performance on associative learning tasks than whole word training.

Experiment VI--Conditionability of Associative Strategies Among Educable Retardates. The performance of educable mentally retarded children on an associative learning task was facilitated by providing them with experimenter-supplied strategies for specific items in Experiments IV and V. However, results obtained from Experiment II indicated that providing Ss with such strategies for one-half of the pairs was not effective in inducing subject-generated high level strategies for the remaining pairs. The present study investigated the possibility of conditioning a set to search for various types of strategies and the extent to which such a set is effective in inducing subject-generated strategies on a transfer task.

A total of 62 later elementary educable mentally retarded Ss were randomly assigned to either a low strategy (LS) conditioning task or a high strategy (HS) conditioning task. The conditioning task list consisted of 25 paired-associate items. Subjects assigned to the LS treatment were verbally reinforced for reporting low level strategies (categories 1, 2, 3, or 4). Likewise, Ss in the HS group were reinforced for reporting high level strategies (categories 5, 6, or 7). After the conditioning session, all Ss were administered the same transfer list which they had to learn without benefit of experimenter aid.

The results indicated that Ss in the HS condition made significantly more correct responses on the transfer task than Ss in the LS condition. Furthermore, Ss in the HS group reported more high level strategies on the conditioning and transfer lists than Ss in the LS group. This study indicated that it was possible to condition a set to search for either high or low strategies and that such sets have predictable effects upon the learning of a transfer list.

Experiment VII--Verbalization of Associative Strategies by Blind Children. The purposes of this study were to determine whether the associative strategies used by blind subjects could be classified according to the scheme developed in Experiment I and also to determine whether syntactical strategy aids facilitate the associative learning of blind children.

The verbal learning task used in this study was identical to that employed in Experiment IV with the exception that the material was in braille. Subjects in the aided group were given experimenter-supplied syntactical strategies, as in Experiment IV, to help them learn the associations. The control Ss were not provided with strategy aids. Immediately following the learning task, verbal reports were collected.

The results showed that the aided group performed significantly better than the unaided group on the learning task. For Ss in the aided group, 66% of the strategies reported were syntactical strategies, whereas 54% of the verbal reports obtained from the unaided Ss were classified as "no strategy" (category one). The correlation between performance on the learning task and total strategy score was significant for the unaided group, indicating that better performance on the learning task tended to be associated with the reported use of higher strategies. However, the correlation for the aided group was not significant.

It was concluded that strategy aids facilitate the associative learning of blind children, and the classification of their verbal reports is possible within the classification scheme developed in Experiment I.

Experiment VIII--Administration of Associative Strategies to Educable Retardates in Word Recognition Learning. It was assumed that in learning to recognize a word, an association is developed between a printed stimulus and an oral response. However, in order to use a syntactical strategy in learning to recognize a word, presumably a cue from the printed stimulus term must be present. Thus, for this study, criterion words which Ss could not read but which contained small embedded words were selected. The Ss were then trained to recognize the small words. These cue words served as a basis for experimenter-supplied strategies. This study was designed to determine the effect of experimenter-supplied strategies in a word recognition task.

Three groups of educable mentally retarded Ss were tested. The Syntactical group was given cue word training and syntactical strategy training prior to the criterion task. The Word Formation group was also given cue word training, but no syntactical strategy training. The Repetition group did not receive syntactical strategy training and was given cue word training on only two of the eight criterion task words. A retention task was administered approximately 48 hours after the criterion task. This task included both a retention trial and two relearning trials.

The results showed that there were no significant differences among the groups on the criterion task. Similarly, no significant differences among the groups were found on either the retention trial or on the two relearning trials. However, an analysis of the data from the last relearning trial did reveal a significant difference in favor of the syntactical group.

A possible explanation for the negative results of this study was the rather low relatedness of each cue word to the syntactical strategy. Because of the artificial nature of the experimenter-supplied strategies, it may have been necessary for the S to learn and remember the strategy as well as the criterion word. Another factor which may have contributed to the negative results was the length of the strategies; the length of the verbal strings was greater in this experiment than in the previous ones. The marked increase in performance of the Syntactical group on the second relearning trial provided evidence that the Ss were learning the strategies during criterion word training, and that these strategies were probably not available for use until the relearning session. Another possible interpretation of the results was that the Ss may not have understood the concept of an associate strategy. Although the Syntactical Ss were given a few minutes in a strategy training session prior to the criterion task, some Ss experienced difficulty in understanding this concept. Moreover, in contrast to the earlier experiments, there were no previous data which guided the selection of these strategies. Suggestions were given as to what modifications in strategies might be made in future studies.

It was concluded that while there was some slight evidence concerning the effectiveness of the Syntactical condition during relearning, there was no differential effect upon acquisition as a function of the three treatment conditions.

Conclusions and Implications

Although there are limitations in one's ability to store information in memory, this research has demonstrated that the storage process can be greatly facilitated. It appears that Ss engage in recoding activity whereby unfamiliar incoming material is reorganized into more familiar units. Even though the particular strategies that people employ in attempting to store the verbal associations in memory are idiosyncratic, the facilitation treatments employed in this research have indicated that strategies can be devised which will facilitate the learning of many, if not all, Ss. With the exception of the word recognition experiment, all facilitation treatments have resulted in a significant increase in the learning of verbal associations. This has been true for normal children at three developmental levels, educable mentally retarded children, and visually handicapped children.

On the basis of the results obtained from this project, it appears that the inferior performance of the educable mentally retarded child is due to the preponderant use of less efficient strategies. The fact that experimenter-supplied strategies significantly facilitated learning of verbal associations for the EMR Ss suggests that such Ss do not normally employ these strategies thereby accounting for their inferior performance. These results also tend to support the Flavell et al. (1966) "mediational-deficiency hypothesis." The verbal reports of the EMR Ss indicate that they are mediating, but the mediators are much less complex than those of faster learners. This hypothesis is in contrast to the "production-deficiency hypothesis" which states that some Ss tend not to mediate at all in a specific task. Production deficiency is viewed as an all-or-none matter. The latter hypothesis seems not to be as tenable as the former in view of the relatively large percentage of the simpler strategies reported by the EMR Ss.

It is also evident that experimenter-supplied strategies facilitated retention. When the degree of original learning was the same for normal and EMR Ss, there was no difference in the amount of forgetting. The implication of this finding is that the retarded S does not possess a memory deficit per se. Rather, he appears to possess a strategy or recoding deficit; he is not able to recode the incoming information into more familiar units. However, when such units are provided, no difference in learning or retention was observed between the EMR Ss and the CA matched normal Ss.

Successful performance in the tasks employed in this project was dependent upon the identification of efficient learning strategies appropriate to the tasks in question. This fact adds a further dimension to Gagné's taxonomy of learning tasks presented in Table 1. Performance is not only dependent upon the acquisition of certain subtasks, but it is also dependent upon the employment of appropriate learning strategies for these subtasks. The task analysis approach and inquiry into efficient ways of learning the subtasks should provide a fruitful approach for the diagnosis and remediation of specific learning disabilities among any group of problem learners. Diagnosis as used in this context involves not only the learner but also the learning task. This approach places as much emphasis upon the identification and analysis of the subtasks in school subjects as it does upon the analysis of the individual learner.

The systematic analysis of school learning tasks has been a much neglected area. The value of Gagné's taxonomy is that it provides a basis for the analysis of such learning tasks.

Finally, this research has demonstrated that the learning of verbal associations can be greatly facilitated. Remediation of associative learning is possible. This fact has implications for the remediation of more complex learning tasks.

REFERENCES

Akutagawa, D., & Benoit, E. P. The effect of age and relative brightness on associative learning in children. Child Developm., 1959, 30, 229-238.

Berkson, G., & Cantor, G. N. A study of mediation in mentally retarded and normal school children. J. educ. Psychol., 1960, 51, 82-86.

Bruner, J. S. The act of discovery. Harvard Educ. Rev., 1961, 31, 21-32.

Bugelski, B. R. Presentation time, total time, and mediation in paired-associate learning. J. exp. Psychol., 1962, 63, 409-412.

Cantor, G. N., & Ryan, T. J. Retention of verbal paired-associates in normals and retardates. Amer. J. ment. Defic., 1962, 66, 861-865.

Carroll, J. B. The analysis of reading instruction: perspectives from psychology and linguistics. In E. R. Hilgard (Ed.), Theories of Learning and Instruction. Chicago: National Society for the Study of Education, 1964. Pp. 336-353.

Cieutat, V. J. Association indices for 446 randomly selected English monosyllables, bisyllables and trisyllables. J. verb. Learn. verb. Behav., 1963, 2, 176-185.

Denny, M. R. Research in learning and performance. In H. Stevens, & R. Heber, (Eds.), Mental retardation: A Review of Research. Chicago: Univ. of Chicago Press, 1964. Pp. 100-142.

Eagle, M. & Leiter, E. Recall and recognition in intentional and incidental learning. J. exp. Psychol., 1964, 68, 58-63.

Eisman, Bernice S. Paired associate learning, generalization, and retention as a function of intelligence. Amer. J. ment. Defic., 1958, 63, 481-489.

Farber, I. E. The things people say to themselves. Amer. Psychologist., 1963, 18, 185-197.

Flavell, J. H., Beach, D. R., & Chinsky, J. M. Spontaneous verbal rehearsal in a memory task as a function of age. Child Developm. 1966, 37, 283-299.

Gagné, R. The acquisition of knowledge. Psychol. Rev., 1962, 69, 355-365.

Gagné, R. M. Problem solving. In A. W. Melton, (Ed.), Categories of Human Learning. New York: Academic Press, 1964. Pp. 293-317.

Gagné, R. M. The Conditions of Learning. New York: Holt, Rinehart & Winston Inc., 1965.

Iscoe, I., & Semler, I. Paired-associate learning in normal and mentally retarded children as a function of four experimental conditions. J. comp. phys. Psychol., 1964, 57, 387-392.

Jensen, A. R. Rote learning in retarded adults and normal children. Amer. J. ment. Defic., 1965, 69, 828-834.

Jensen, A. R., & Rohwer, W. D. Jr. Verbal mediation in paired-associate and serial learning. J. verb. Learn. verb. Behav., 1963a, 1, 346-352.

Jensen, A. R., & Rohwer, W. D. Jr. The effect of verbal mediation on the learning and retention of paired associates by retarded adults. Amer. J. ment. Defic., 1963b, 68, 80-84.

Johnson, G. O., & Blake, K. A. Learning Performance of Retarded and Normal Children. Ithaca: Syracuse University Press, 1960.

Lindguist, E. F. Design and analysis of experiments in psychology in psychology and education. Cambridge: Riverside Press, 1953.

Martin, C. J., Boersma, F J., & Cox, D. L. A classification of associative strategies in paired-associate learning. Psychon. Sci., 1965, 3, 455-456.

McPherson, Marion W. A survey of experimental studies of learning in individuals who achieve subnormal ratings on standardized psychometric measures. Amer. J. ment. Defic., 1948, 52, 232-254.

McPherson, Marion W. Learning and mental deficiency. Amer. J. ment. Defic., 1958, 62, 870-877.

Miller, G. A. The magical number seven; plus or minus two: Some limits on our capacity for processing information. Psychol. Rev., 1956, 63, 81-97.

Miller, G. A. Psychology: The Science of Mental Life. New York: Harper & Row, 1962.

Miller, G. A., Galanter, E., & Pribram, K. H. Plans and the structure of behavior. New York: Henry Holt and Co., 1960.

Montague, W. E., Adams, J. A., & Keiss, H. O. Forgetting and natural language mediation. J. exp. Psychol., 1966, 72, 829-833.

Noble, C. E. An analysis of meaning. Psychol. Rev., 1952, 59, 421-430.

Ring, Elizabeth M., & Palermo, D. S. Paired associate learning of retarded and normal children. Amer. J. ment. Defic., 1961, 66, 100-107.

Siegel, S. Nonparametric Statistics for the Behavioral Sciences. New York: McGraw-Hill, 1956.

Spiker, C. C. Associative transfer in verbal paired-associate learning. Child Developm., 1960, 31, 73-87.

Spitz, H. H. The role of input organization in the learning and memory of mental retardates. In N. R. Ellis, (Ed.), International Review of Research in Mental Retardation. Vol. 2. New York: Academic Press, 1966. Pp. 29-56.

Tate, M. W., & Clelland, R. C. Nonparametric and Short cut Statistics in the Social, Biological and Medical Sciences. Danville, Ill.: Interstate Printers and Publishers Inc., 1957.

Thurstone, L. L., & Thurstone, Thelma F. S.R.A. Primary Mental Abilities: Manual. Chicago: Science Research Associates, 1958.

Underwood, B. J., & Schulz, R. W. Meaningfulness and Verbal Learning. New York: Lippincott, 1960.

Winer, B. J. Statistical Principles in Experimental Design. New York: McGraw-Hill, 1962

Young, R. K. Tests of three hypotheses about the effective stimulus in serial learning. J. exp. Psychol., 1962, 63, 307-313.

Appendix A

The Role of Associative Strategies in the Acquisition of P-A material: An Alternate Approach to Meaningfulness[1]

ABSTRACT. This study examined the effects of stimulus and response m on paired-associate learning when responses were equally available. A recognition procedure was used for equating response availability. The findings concerning relative performance on the four lists and the greater influence of m on the response side are consistent with previous studies. Associative strategies employed by Ss during the learning task were also collected and analyzed. Contrary to the acquisition data, the strategy data revealed that m exerts a greater effect on the stimulus side. The results were discussed in terms of Underwood and Schulz's two-stage of associative learning.

Problem

Studies in verbal learning reveal that performance on paired-associate tasks is a function of the meaningfulness (m) of the stimulus and response, and that variations in m of the response side have a greater effect on rate of acquisition than do those on the stimulus side (e.g., Cieutat, Stockwell, & Noble, 1958). Underwood & Schulz (1960, pp. 84-127) state: "Without exception, all definitions of m can be translated into frequency terms," and "... that the frequency with which verbal units have been experienced directly determines their availability as responses in new association connections." In addition, they postulate that verbal learning occurs in two stages, namely, a response-learning stage and an association-hook-up stage. More specifically, Underwood and Schulz posit that variation in m on the response side has its primary effect upon response availability. If the problem of availability were eliminated, the effect due to variation in m on the response side should be minimized.

Epstein (1963) attempted to eliminate differences in response availability by having Ss learn the response items to a criterion of complete free recall before presenting them with the paired-associate task. Because his results did not support Underwood and Schulz's interpretation of m with respect to response availability, he suggested that his procedure might not have eliminated differences in response availability. It is possible, however, that factors other than just availability are associated with differences in the m value of the response. For example, the types of cues employed by Ss may be different when there are variations in m on either, or both, the stimulus and response side(s).

[1]This study was published in Psychon. Sci., 1965, 3, 463-464 under the senior authorship of the principal investigator.

One purpose of the recent study was to make all responses equally available by using a recognition method instead of the traditional anticipation method. This procedure should eliminate response learning and guarantee availability of response items regardless of m values. A second purpose was to study verbal reports obtained from Ss. Such information might provide valuable data concerning the types of cues (strategies) employed by Ss in learning paired-associates at different m levels. In addition, these data might suggest an alternative approach to the study of meaningfulness.

Material

Sixteen low (L) and 16 high (H) items were selected from Noble's (1952) list. The mean values for the L and H m items were 1.31 and 7.54 respectively. Four lists of eight pairs each were formed from these items. The L_1-L_2 list consisted of pairs combined from L m items--the mean difference in m between the stimulus and response sides was .005. List L_1-H_2 contained the same stimuli paired with H m responses--the mean difference in m between the stimulus and responses for this list was 6.18. The H_1-L_2 list contained the responses used in the L_1-L_2 list paired with H m stimuli. The mean difference in m between the stimulus and response sides for these items was 6.29. List H_1-H_2 comprised the stimuli used in the H_1-L_2 list paired with the other 8 H m items. The mean difference in m between the stimulus and response sides here was .12.

Subjects

One-hundred and sixty Michigan State University undergraduates, 92 males and 68 females, served as Ss for this study. A group testing procedure was used and each group was randomly assigned to one of the four list conditions. Since classes were of unequal size, Ss were randomly eliminated so that each group contained 40 Ss.

Procedure

The items were placed on Thermofax transparencies and presented on an overhead projector in different random orders, for both learning and test trials. Ten learning and 10 test trials were presented alternately. A 3 sec. presentation rate was used for learning trials, and a 4 sec. rate for test trials. A recognition procedure was employed for test trials with each stimulus being paired with all eight responses. The responses on the test transparencies were randomized to avoid any serial position effect. Ss were provided with test booklets to record their answers. At the conclusion of the learning task each pair was presented for 60 sec. and Ss were instructed to describe how they attempted to form each association. These verbal reports were then classified according to the system developed by Martin, Boersma, & Cox (1965).

In a brief, Martin et al. classified verbal reports into seven categories: (1) No association, (2) Repetition, (3) Single letter cue, (4) Multiple letter cue, (5) Word formation, (6) Superordinate and (7) Syntactical. These categories are rank-ordered along an apparent

Table A.1. Means and variances of associative strategy level scores for the four lists.

M Value of S term		M Value of R Term L=1.31	H=7.48	Row Effects	S Diff
L=1.30	$\bar{X}$	30.4	35.6	33.0	
	s^2	140.7	120.4	130.6	$\bar{X}$=12.8
H=7.60	$\bar{X}$	41.2	50.3	45.8	s^2=91.9
	s^2	48.9	28.5	38.7	
Column Effects	$\bar{X}$	35.8	43.0		
	s^2	94.8	74.5		
R-Diff		$\bar{X}$=7.2			
		s^2=20.3			

continuum of cue complexity. A total strategy level score was obtained by summing strategy ratings over the eight pairs. Martin, Boersma, and Cox obtained a statistically significant Spearman correlation coefficient (r_s=.62, df=38, $p < .01$) between total strategy scores and number of correct responses on ten trials. The reliability of the classification scheme was checked by having two judges independently rate verbal reports of 86 Ss on an eight item L-L list. The Pearson correlation coefficients between the two judges' ratings of total strategy scores was .95.

Results and Discussion

Total number of correct responses in 10 trials was determined for each S. A 2 by 2 by 10 Lindquist (1953) Type III analysis revealed that all main and interaction effects were statistically significant ($p < .01$). The order of difficulty with respect to treatment means was L-L(36.4) < H-L(62.8) < L-H(68.7) < H-H(73.4). The difference between main effects as a function of m was 15.55 for the stimulus, and 21.45 for the response. The greater effect of m on the response side is similar to that obtained by Epstein (1963), and Cieutat, Stockwell & Noble (1958).

In short, although the experimental procedure attempted to control for equal response availability, a statistically significant response m effect was obtained. Consequently, it appears that m on the response side may be attributed to factors other than response availability.

A total strategy level score was obtained for each S by assigning to each pair the appropriate category level and then summing over pairs. For example, if the S reported using a Repetition strategy on three pairs (3 pairs learned by a 2 level strategy) and a Syntactical strategy on five pairs (5 pairs learned by a 7 level strategy) his total score would be 41. The means and variances for the four groups are presented in Table A.1. The rank order of mean strategy scores was L-L $<$ L-H $<$ H-L $<$ H-H. A 2 by 2 factorial analysis was performed to assess the independent effects of stimulus and response m. The main effects were statistically significant beyond the .001 level and the interaction was negligible. For both stimulus and response effects, highest strategy scores were associated with H m items and greatest variance with L m items. The difference between main effects as a function of m was 12.75 for the stimulus and 7.18 for the response. A post-hoc comparison using Scheffé's (1959) method of simultaneous confidence intervals revealed ($p < .05$) that the H-H group had significantly higher strategy level scores than the other three groups, and that the H-L group had significantly higher strategy level scores than the L-L group. In short, the data indicate that strategy level is more a function of stimulus m than response m, that high m items elicit higher level strategies than low m items, and that variability in strategy scores increases as m decreases.

To summarize, if the recognition procedure employed in this study produced equal response availability, then it can be argued that changes in response m influence factors other than response availability. The findings concerning relative performance on the four lists and the greater influence of m on the response side are consistent with previous studies. The associative strategy data, however, indicate that m also exerts an influence on the types of mediational cues employed by Ss during the learning task. More specifically, the analysis of strategy data revealed that m has a greater effect on the stimulus than the response side. This finding provides some support to Underwood and Schulz's suggestion that stimulus m exerts an influence during the associative learning stage. Moreover, it appears that the classification and analysis of the associative strategies may provide an alternative approach to the study of m.

References

Cieutat, V. J., Stockwell, F. E., and Noble, C. E. The interaction of ability and amount of practice with stimulus and response meaningfulness (m,m') in paired associate learning. J. exp. Psychol., 1958, 56, 193-202.

Epstein, W. The effect of stimulus and response meaningfulness when response availability is equated. J. verbal Learn. verbal Behav., 1963, 2, 242-249.

Lindquist, E. F. Design and analysis of experiments in psychology and education. Boston: Houghton-Mifflin, 1953.

Martin, C. J., Boersma, F. J. and Cox, D. L. Associative strategies in paired-associate learning. Paper read at meeting of Mid-western Psychological Association, 1965.

Noble, C. E. An analysis of meaning. Psychol. Rev., 1952, 59, 421-430.

Scheffé, H. The analysis of variance. New York: Wiley, 1959.

Underwood, B. J. and Schulz, R. W. Meaningfulness and verbal learning. Philadelphia: Lippincott, 1960.

Appendix B

Analysis of Variance Summary Tables for Experiments II-VIII

Experiment II.1. Summary of analysis of variance of the total number of correct responses for the three control groups on the criterion task.

Source	df	MS	F
Grade	2	504.29	7.84**
Error	80	64.32	
Total	82		

**p $<$ .01

Experiment II.2. Summary of analysis of variance of the total number of correct responses for the three control groups on the retention task.

Source	df	MS	F
Grade	2	39.54	7.21**
Error	80	5.48	
Total	82		

**p $<$ .01

Experiment II.3. Summary of analysis of variance of the total number of correct responses on the practice task.

	Source	df	MS	F
A:	Grade	2	831.49	19.55**
B:	Treatment (Strategy Aid)	2	76.31	1.79
A x B:	Grade x Treatment	4	119.57	2.81*
	Error	233	42.53	
	Total	241		

**p < .01
*p < .05

Experiment II.4. Summary of analysis of variance of the total number of correct responses for each group on the criterion task.

	Source	df	MS	F
A:	Grade	2	286.03	7.90**
B:	Treatment (Strategy Aid)	2	3049.48	84.26**
A x B:	Grade x Treatment	4	181.91	5.03**
	Error	233	36.19	
	Total	241		

**p < .01

Experiment II.5. Summary of analysis of variance of the total number of correct responses on the B pairs for the control and E-4 groups over all grade levels.

	Source	df	MS	F
A:	Grade	2	80.56	4.71*
B:	Treatment (Strategy Aid)	1	443.18	25.93**
A x B:	Grade x Treatment	2	63.52	3.72*
	Error	149	17.09	
	Total	154		

**p < .01
*p < .05

Experiment II.6. Summary of analysis of variance of the total number of correct responses on the B pairs for the control and E-4 groups of the 6th and 8th grades.

	Source	df	MS	F
A:	Grade	1	109.81	7.04**
B:	Treatment (Strategy Aid)	1	177.43	11.37**
A x B:	Grade x Treatment	1	17.12	1.10
	Error	100	15.60	
	Total	103		

**p < .01

Experiment II.7. Summary of analysis of variance of the total number of correct responses for each group on the retention task.

	Source	df	MS	F
A:	Grade	2	50.82	12.55**
B:	Treatment (Strategy Aid)	2	84.71	20.92**
A x B:	Grade x Treatment	4	7.35	1.81
	Error	230	4.05	
	Total	238		

**p < .01

Experiment II.8. Summary of analysis of variance of the total number of correct responses on the practice task for fast and slow learners over all grade levels and treatment groups.

	Source	df	MS	F
A:	Grade	2	613.40	72.50**
B:	Treatment (Strategy Aid)	2	77.66	9.18**
C:	Type of Learner	1	7423.35	877.46**
A x B:	Grade x Treatment	4	93.26	11.02**
A x C:	Grade x Type of Learner	2	67.32	7.96**
B x C:	Treatment x Type of Learner	2	16.24	1.91
A x B x C:	Grade x Treatment x Type of Learner	4	12.60	1.49
	Error	140	8.46	
	Total	157		

**p < .01

Experiment II.9. Summary of analysis of variance of the total number of correct responses on the criterion task for fast and slow learners over all grade levels and treatment groups.

	Source	df	MS	F
A:	Grade	2	95.81	3.28*
B:	Treatment (Strategy Aid)	2	2009.51	68.72**
C:	Type of Learner	1	1845.47	63.11**
A x B:	Grade x Treatment	4	138.52	4.74*
A x C:	Grade x Type of Learner	2	5.01	.17
B x C:	Treatment x Type of Learner	2	335.52	11.47**
A x B x C:	Grade x Treatment x Type of Learner	4	33.34	1.14
	Error	140	29.24	
	Total	157		

$^{**}p < .01$
$^{*}p < .05$

Experiment III.1. Summary of Lindquist Type I analysis of variance of the total number of correct responses on the criterion task.

	Source	df	MS	F
A:	Groups (IQ Level)	1	516.63	91.60***
	Error (a)	53	5.64	
B:	Trials	4	17.16	14.92***
A x B:	Groups x Trials	4	.70	.61
	Error (b)	212	1.15	
	Total	274		

$^{***}p < .001$

Experiment IV.1. Summary of analysis of variance of the total number of correct responses on the practice task.

	Source	df	MS	F
A:	Treatment (Strategy Aid)	1	20.46	2.78
B:	Grade	1	30.09	4.08*
A x B:	Treatment x Grade	1	2.08	.28
	Within Treatments	104	7.37	
	Total	107		

*p < .05

Experiment IV.2. Summary of Lindquist Type III analysis of variance of the total number of correct responses on the criterion task.

	Source	df	MS	F
A:	Treatment (Strategy Aid)	1	811.560	41.68**
B:	Grade	1	.360	.02
A x B:	Treatment x Grade	1	.270	.01
	Error (a)	104	19.472	
C:	Trials	4	135.960	85.83**
A x C:	Treatment x Trials	4	4.800	3.03*
B x C:	Grade x Trials	4	.442	.28
A x B x C:	Treatment x Grade x Trials	4	.907	.57
	Error (b)	416	1.584	
	Total	539		

**p < .01
*p < .05

Experiment IV.3. Summary of Lindquist Type I analysis of variance of the total number of correct responses on the criterion task for the normal and LE aided groups.

	Source	df	MS	F
A:	Groups (IQ Level)	1	10.29	.59
	Error (a)	60	17.22	
B:	Trials	4	117.84	89.95***
A x B:	Group x Trials	4	2.24	1.71
	Error (b)	240	1.31	
	Total	309		

***p < .001

Experiment IV.4. Summary of analysis of variance of the total number of correct responses on the retention task.

	Source	df	MS	F
A:	Strategy Aid	1	7.68	42.50***
B:	Grade	1	4.48	.25
A x B:	Strategy Aid x Grade	1	3.69	.20
	Within Treatments	104	18.07	
	Total	107		

***p < .001

Experiment V.1. Summary of analysis of variance of the total number of correct responses on the practice task.

Source	df	MS	F
Between groups	4	1.18	.23
Within groups	75	5.05	
Total	79		

Experiment V.2. Summary of analysis of variance of the total number of correct responses on the criterion task.

	Source	df	MS	F
A:	Stimulus	1	6.25	.09
B:	Type of Familiarization	1	451.57	6.62*
C:	Aided pairs	1	105.07	1.54
A x B:	Stim. x Type Famil.	1	56.25	.82
A x C:	Stim. x Aided pairs	1	240.25	3.52
B x C:	Type Famil. x Aided pairs	1	1.56	.02
A x B x C:	Stim. x Type Famil. x Aided pairs	1	20.24	.30
Error:	Within treatments	56	68.21	
	Total	63		

*Significant beyond the .05 level

Experiment V.3. Summary of analysis of variance of the number of correct responses on the aided pairs.

	Source	df	MS	F
A:	Stimulus	1	.25	.01
B:	Type of Familiarization	1	105.07	5.38*
C:	Aided pairs	1	56.25	2.88
A x B:	Stim. x Type Famil.	1	30.25	1.55
A x C:	Stim. x Aided pairs	1	39.06	2.00
B x C:	Type Famil. x Aided pairs	1	.77	.04
A x B x C:	Stim. x Type Famil. x Aided pairs	1	2.54	.13
Error:	Within treatments	56	19.25	
	Total	63		

*Significant beyond the .05 level

Experiment V.4. Summary of analysis of variance of the number of correct responses on the unaided pairs.

	Source	df	MS	F
A:	Stimulus	1	9.00	.42
B:	Type of Familiarization	1	121.00	5.66*
C:	Aided pairs	1	7.56	.35
A x B:	Stim. x Type Famil.	1	4.00	.19
A x C:	Stim. x Aided pairs	1	85.56	4.00
B x C:	Type Famil. x Aided pairs	1	3.06	.14
A x B x C:	Stim. x Type Famil. x Aided pairs	1	7.57	.35
Error:	Within treatments	56	21.39	
	Total	63		

*Significant behond the .05 level

Experiment V.5. Summary of analysis of variance of the number of correct responses on the aided pairs of the criterion task.

Source	df	MS	F
Between groups	4	36.52	1.91
Within groups	75	19.11	
Total	79		

Experiment V.6. Summary of analysis of variance of the number of correct responses on the unaided pairs of the criterion task.

Source	df	MS	F
Between groups	4	34.75	1.73
Within groups	75	20.1	
Total	79		

Experiment V.7. Summary of analysis of variance of the total number of correct responses on the criterion task.

Source	df	MS	F
Between groups	4	128.77	2.05
Within groups	75	62.81	
Total	79		

Experiment V.8. Summary of Lindquist Type I analysis of variance of the total number of correct responses on the criterion task for the five groups.

	Source	df	MS	F
A:	Groups	4	25.76	2.05
	Error (a)	75	12.56	
B:	Trials	4	126.48	1149.82***
A x B:	Groups x Trials	16	32.36	294.18***
	Error (b)	300	.11	
	Total	399		

***Significant beyond the .001 level

Experiment V.9. Summary of Lindquist Type I analysis of variance of the total number of correct responses on the first three trials of the criterion task.

	Source	df	MS	F
A:	Groups	4	19.52	2.46
	Error (a)	75	7.93	
B:	Trials	22	136.4	909.33***
A x B:	Groups x Trials	8	35.05	233.67***
	Error (b)	150	.15	
	Total	239		

***$p < .001$

Experiment V.10. Summary of Lindquist Type I analysis of variance of the number of correct responses on the aided and unaided pairs for the five groups.

	Source	df	MS	F
A:	Groups	4	72.20	2.33
	Error (a)	75	30.99	
B:	Pairs	1	230.39	44.74***
A x B:	Groups x Pairs	4	56.67	11.00***
	Error (b)	75	5.15	
	Total	159		

***Significant beyond the .001 level

Experiment V.11. Summary of analysis of variance of the total number of correct responses on the criterion task for the three groups.

Source	df	MS	F
Between Groups	2	226.29	3.65*
Within Groups	77	61.99	
Total	79		

$*p < .05$

Experiment V.12. Summary of analysis of variance of the number of correct responses on the unaided pairs of the criterion task for the three groups.

Source	df	MS	F
Between Groups	2	63.00	3.198*
Within Groups	77	19.74	
Total	79		

$*p < .05$

Experiment V.13. Summary of analysis of variance of the number of correct responses on the aided pairs of the criterion task for the three groups.

Source	df	MS	F
Between Groups	2	57.55	3.04
Within Groups	77	19.01	
Total	79		

Experiment V.14. Summary of analysis of variance of the total number of correct responses on the differentiation task.

Source		df	MS	F
A:	Stimulus	1	3.06	.36
B:	Type of Familiarization	1	.06	.01
C:	Aidėd Pairs	1	1.00	.12
A x B:	Stim. x Type Famil.	1	16.00	1.92
A x C:	Stim. x Aided pairs	1	1.56	.19
B x C:	Type Famil. x Aided pairs	1	18.06	2.17
A x B x C:	Stim. x Type Famil. x Aided pairs	1	.01	.001
Error:	Within Treatments	56	8.32	
	Total	63		

Experiment V.15. Summary of analysis of variance of the number of correct responses on the unaided pairs of the differentiation task.

Source		df	MS	F
A:	Stimulus	1	5.63	1.64
B:	Type of Familiarization	1	1.26	.37
C:	Aided pairs	1	.14	.04
A x B:	Stim. x Type Famil.	1	9.77	2.84
A x C:	Stim. x Aided pairs	1	2.64	.77
B x C:	Type Famil. x Aided pairs	1	11.39	3.31
A x B x C:	Stim. x Type Famil. x Aided pairs	1	.03	.01
Error:	Within Treatments	56	3.44	
	Total	63		

Experiment VI.1. Summary of Lindquist Type I analysis of variance of the total number of correct responses on the criterion task for the LS and HS groups.

Source		df	MS	F
A:	Groups (Conditioned Strategy)	1	132.93	11.77**
	Error (a)	60	11.29	
B:	Trials	4	42.54	25.02**
A x B:	Groups x Trials	4	8.38	4.93**
	Error (b)	240	1.70	
	Total	309		

**p $<$ .01

Experiment VI.2. Summary of Lindquist Type I analysis of variance of the total number of correct responses on the criterion task for the four groups.

	Source	df	MS	F
A:	Treatments (Conditioned Strategy & Strategy Aid)	3	258.07	17.65**
	Error (a)	112	14.62	
B:	Trials	4	108.134	64.98**
A x B:	Treatments x Trials	12	6.516	3.92**
	Error (b)	448	1.664	
	Total	579		

**p $<$ .01

Experiment VIII.1. Summary of analysis of variance of the total number of cue words known on the pretest.

	Source	df	MS	F
A:	Strategy Aid	2	.52	2.48
B:	Blocks	17	52.40	
	Residual	34	.21	
	Total	53		

Experiment VIII.2. Summary of analysis of variance of the total number of criterion words known on the pretest.

	Source	df	MS	F
A:	Strategy Aid	2	.02	.03
B:	Blocks	17	2.76	
	Residual	34	.72	
	Total	53		

Experiment VIII.3. Summary of analysis of variance of the total number of correct responses on the criterion task.

Source	df	MS	F
A: Strategy Aid	2	10.89	.29
B: Blocks	17	294.36	
Residual	34	37.69	
Total	53		

Experiment VIII.4. Summary of analysis of variance of the number of correct responses on the retention task.

Source	df	MS	F
A: Strategy Aid	2	4.13	2.00
B: Blocks	17	14.14	
Residual	34	2.07	
Total	53		

Experiment VIII.5. Summary of analysis of variance of the total number of correct responses on the relearning task.

Source	df	MS	F
A: Strategy Aid	2	17.55	3.05
B: Blocks	17	44.40	
Residual	34	5.75	
Total	53		

Experiment VIII.6. Summary of analysis of variance of the number of correct responses on the last trial of the relearning task.

Source	df	MS	F
A: Strategy Aid	2	8.13	5.89**
B: Blocks	17	10.92	
Residual	34	1.38	
Total	53		

**$p < .01$

Appendix C

Description of Ss from Experiment V

Experiment V.1. Means and standard deviations of CA for the five groups.

	Groups				
	RD	ID	RF	IF	C
Mean	13.5	13.9	13.5	13.6	13.7
S.D.	.95	.68	1.06	.83	.90

Experiment V.2. Means and standard deviations of IQ for the five groups from the Detroit Tests of Learning Aptitudes.

	Groups				
	RD	ID	RF	IF	C
Mean	67	70	73	72	70
S.D.	4.20	6.22	5.12	4.44	6.34
N	10	11	12	10	13

Experiment V.3. Means and standard deviations of IQ for the five groups from the Stanford-Binet Scale.

	Groups				
	RD	ID	RF	IF	C
Mean	69	75	77	73	53
S.D.	5.62	4.51	7.32	5.34	—
N	6	5	4	5	1

Experiment V.4. Means and standard deviations of reading achievement grade equivalents for the five groups from the Metropolitan Achievement Tests.

	Groups				
	RD	ID	RF	IF	C
Mean	3.4	3.3	3.1	3.3	3.2
S.D.	.72	.58	.44	.72	.45
N	15	14	15	14	15

Experiment V.5. Means and standard deviations of reading achievement grade equivalents for the five groups from the Iowa Tests of Basic Skills.

	Groups				
	RD	ID	RF	IF	C
Mean	4.1	3.2	—	3.3	5.0
S.D.	—	.92	—	1.06	—
N	1	2	—	2	1

Appendix D--Original Data for Experiments I-VIII

Experiment I--Classification of Associative Strategies

Exp. Ia

S# (1)	SEX (2)	CRITERION TASK (3)	STRATEGY SCORE (4)
1	F	13	10
2	F	25	39
3	F	24	16
4	M	29	35
5	M	8	8
6	M	25	26
7	M	58	21
8	F	36	22
9	F	25	33
10	M	50	38
11	M	22	31
12	F	64	43
13	F	49	40
14	F	40	47
15	F	40	34
16	M	71	54
17	M	32	46
18	F	34	22
19	F	22	32
20	M	19	14
21	M	43	25
22		64	46
23	M	45	41
24	F	31	25
25		29	27
26	M	42	32
27	F	79	37
28	F	55	33
29	M	23	30
30	F	59	44
31	F	12	18
32	F	24	25
33	M	26	45
34	F	16	33
35		11	9

continued

(1)	(2)	(3)	(4)
36		20	17
37	F	77	38
38	M	46	32
39	M	41	39

Experiment I cont.

Exp. Ib

(1)	(2)	(3)	(4)
1	F	75	44
2	M	56	42
3	M	55	52
4	M	72	37
5	F	62	36
6	F	56	40
7	F	71	46
8	F	68	37
9	F	39	43
10	F	59	46
11	F	29	31
12	M	63	45
13	F	65	35
14	F	78	42
15	F	11	24
16	F	56	40
17	F	67	51
18	F	52	38
19	M	72	54
20	F	47	29
21	M	63	39
22	F	47	33
23	F	65	35
24	F	56	44
25	F	28	33
26	M	13	18
27	F	44	37
28	F	62	45
29	F	63	43
30	F	60	42
31	F	38	27
32	F	50	35
33	F	46	38
34	F	78	55
35	F	46	38
36	M	66	49
37	F	63	42
38	F	53	33
39	M	54	44
40	F	57	44
41	F	47	35
42	F	57	29
43	F	67	51
44	F	65	35
45	F	32	30
46	M	57	39
47	F	28	23

Experiment II--Verbalization of Associative Strategies at Three Developmental Levels

4 C

S# (1)	SEX (2)	SLOW FAST (3)	PRACTICE TASK (4)	B CRITERION (5)	A STRATEGY (6)	A CRITERION (7)	B STRATEGY (8)	TOTAL CRITERION (9)	TOTAL STRATEGY (10)	RETENTION (11)
1	M		20	8	14	16	14	24	28	4
2	M	S	9	2	4	6	4	8	8	0
3	M	S	13	6	6	9	6	15	12	3
4	M	S	11	7	16	8	10	15	26	4
5	F	F	20	13	27	18	17	31	44	8
6	M		15	10	5	5	8	15	13	2
7	F	F	20	14	23	12	28	26	51	8
8	F	F	25	13	5	9	18	22	23	3
9	F	S	6	5	6	2	5	7	11	1
10	F		18	11	15	8	17	19	32	6
11	F	F	30	20	8	19	8	39	16	8
12	M	S	13	9	25	6	26	15	51	2
13	M		14	6	13	5	4	11	17	4
14	M	F	22	15	24	13	20	28	44	8
15	M	F	23	15	12	6	15	21	27	5
16	M		15	5	12	8	12	13	24	0
17	M		17	10	10	8	17	18	27	1
18	M		18	9	21	13	12	22	33	5
19	F		14	16	15	12	14	28	29	5
20	F	S	9	11	17	9	15	20	32	1
21	F	F	21	15	18	16	24	31	42	8
22	M	S	14	9	19	12	11	21	30	5
23	M	S	7	2	6	13	6	5	12	0
24	M	S	11	11	14	6	13	17	27	3
25	M		16	15	8	13	8	28	16	3
26	F	F	22	16	25	16	21	32	46	4
27	F	F	23	17	28	17	20	34	48	5

Experiment II cont.

4 E-4

(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(11)
1	M		19	9	16	13	25	3
2	F	S	17	13	19	26	32	7
3	M	S	15	9	18	24	27	0
4	M		24	17	19	9	36	7
5	F	S	16	19	19	15	38	7
6	F		26	20	20	27	40	6
7	F	S	15	18	16	21	34	3
8	F	F	32	20	20	21	40	8
9	M	S	15	11	10	7	21	4
10	F		19	13	19	15	32	3
11	F	S	10	15	17	18	32	4
12	M	F	31	20	20	10	40	6
13	F		25	17	20	26	37	8
14	M	S	16	16	19	12	35	6
15	M	F	31	19	20	22	39	8
16	F	S	16	19	20	26	39	7
17	M	F	28	20	19	17	39	7
18	F	F	26	16	19	25	35	7
19	F	F	32	17	20	18	37	8
20	F		26	18	18	19	36	8
21	M		25	18	19	16	37	7
22	M	F	27	13	16	8	29	0
23	M		19	4	19	27	23	2
24	M	F	28	20	20	22	40	6

4 E-8

(1)	(2)	(3)	(4)	(5)	(7)	(9)	(11)
1	M		17	19	18	37	6
2	M	F	22	20	20	40	8
3	F	F	22	16	19	35	8
4	M	S	2	18	18	36	8
5	M	S	12	19	19	38	8
6	M		24	20	16	36	6
7	F	F	20	18	18	36	8
8	F	S	13	19	18	37	8
9	M	F	21	20	19	39	8
10	F	F	20	20	18	38	8
11	F	F	20	20	20	40	7
12	M		18	20	16	36	5
13	M	S	10	20	20	40	5
14	F	F	23	19	19	38	8
15	M		13	19	20	39	7
16	M	F	20	19	19	38	7
17	M	S	8	18	19	37	8
18	M	S	7	20	20	40	6
19	M		19	20	20	40	8
20	F		30	19	17	36	8

Experiment II cont.

4 E-8 cont.

(1)	(2)	(3)	(4)	(5)	(7)	(9)	(11)
21	F		18	20	20	40	8
22	M	S	11	20	12	32	8
23	F	F	20	20	20	40	8
24	M		16	19	18	37	8
25	M	S	11	20	17	37	4
26	F		27	18	17	35	5
27	M	F	20	19	19	38	6
28	F	F	23	20	19	39	8
29	F	S	12	18	19	37	8
30	F		30	19	20	39	8
31	M		16	18	18	36	7
32	M		15	19	20	39	6
33	M	S	7	18	18	36	6
34	M	S	3	16	18	34	8

6 C

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	F	F	24	15	26	17	21	32	47	8
2	M	S	15	12	21	9	17	21	38	5
3	F	S	11	11	18	14	18	25	36	5
4	F	S	18	13	27	15	18	28	45	5
5	M		21	10	25	11	19	21	44	6
6	F	S	11	4	11	7	23	11	34	1
7	M		23	16	27	18	23	34	50	8
8	F		20	16	22	18	17	34	39	8
9	M	S	12	5	17	13	12	18	29	3
10	M	S	13	6	15	10	10	16	25	2
11	M	S	3	4	15	4	21	8	36	1
12	F	F	24	17	26	19	21	36	47	8
13	F	F	28	18	27	18	21	36	48	8
14	F	F	29	18	20	20	12	38	32	8
15	F	F	28	18	21	18	21	36	42	7
16	M	S	17	18	24	15	23	33	47	7
17	F	F	29	11	18	13	13	24	31	3
18	F		21	9	13	14	19	23	32	5
19	M		20	19	27	20	18	39	45	6
20	M		24	16	24	16	14	32	38	6
21	F		21	14	22	14	12	28	34	7
22	F	S	12	16	28	17	27	33	55	5
23	M		24	12	26	14	17	26	43	4
24	F		22	15	20	16	21	31	41	6
25	F	F	30	18	28	19	21	37	49	8
26	M	F	25	12	19	11	23	23	42	6
27	M		23	9	13	12	21	21	34	5
28	F	F	25	13	14	11	22	24	36	3

Experiment II cont.

6 E-4

(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(11)
1	M		21	8	18	20	26	5
2	F	F	27	20	19	27	39	8
3	F	F	27	18	19	17	37	8
4	F		20	15	19	28	34	7
5	M	S	9	8	8	21	16	1
6	M	F	26	14	19	27	33	7
7	M	F	30	14	20	13	34	5
8	F	S	18	16	18	25	34	8
9	M	S	14	15	18	28	33	7
10	M	S	11	8	11	15	19	4
11	F	F	29	20	20	22	40	8
12	M		22	17	18	21	35	6
13	F		22	20	20	23	40	8
14	M	F	26	20	19	28	39	8
15	M	S	13	10	16	8	26	6
16	M	S	16	19	19	22	38	8
17	F		23	11	19	27	30	8
18	F	S	14	15	20	12	35	7
19	F		25	14	19	4	33	7
20	M	F	26	11	17	15	28	8
21	F	F	29	18	20	22	38	8
22	M	S	5	18	16	22	34	5
23	F		22	18	18	23	36	7
24	M	F	27	17	17	15	34	7
25	M		24	18	19	26	37	8
26	M	S	7	4	5	12	9	1

6 E-8

(1)	(2)	(3)	(4)	(5)	(7)	(9)	(11)
1	F	S	13	19	17	36	8
2	F		26	20	20	40	6
3	F		27	19	20	39	8
4	F	S	12	20	20	40	7
5	M	F	28	18	20	38	8
6	M	S	9	17	20	37	8
7	M		23	20	20	40	8
8	M		19	17	18	35	8
9	F	F	32	19	20	39	7
10	M	F	32	17	20	37	8
11	F		25	20	20	40	8
12	M		20	20	20	40	8
13	M	S	16	20	20	40	8
14	M		24	20	20	40	8
15	M	S	12	17	19	36	5
16	F	S	18	20	19	39	8

Experiment II cont.

6 E-8 cont.

(1)	(2)	(3)	(4)	(5)	(7)	(9)	(11)
17	M	S	6	18	9	27	3
18	M	S	12	14	16	30	4
19	M	F	27	20	20	40	8
20	F		22	18	20	38	8
21	F	F	29	20	20	40	8
22	F	F	32	17	17	34	8
23	F	F	28	20	20	40	8
24	M	S	3	17	18	35	0
25	M	F	28	20	18	38	6
26	F		27	19	19	38	8
27	F		27	20	18	38	7
28	F	F	32	20	19	39	8

8 C

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	M		28	10	27	16	28	26	55	8
2	F	S	22	15	27	17	20	32	47	6
3	M	S	15	9	13	9	12	18	25	3
4	M	S	14	5	17	5	24	10	41	0
5	M	S	19	14	26	8	22	22	48	5
6	F	F	30	18	22	20	26	38	48	8
7	M		25	17	21	17	27	34	48	7
8	M	F	30	15	17	14	19	29	36	8
9	M		25	13	16	12	21	25	37	7
10	F	F	31	20	27	18	23	38	50	8
11	M	S	15	11	26	9	20	20	46	2
12	M	F	29	17	18	17	19	34	37	8
13	M	S	22	14	27	13	21	27	48	7
14	M		24	15	25	10	10	25	35	8
15	F	F	32	20	21	19	26	39	47	5
16	M		25	14	27	14	16	28	43	7
17	M	S	22	15	19	12	19	27	38	7
18	M	S	24	14	27	16	28	30	55	8
19	M		27	20	22	19	26	39	48	8
20	F	F	30	14	27	17	24	31	51	7
21	F		28	17	24	18	24	35	48	8
22	F		28	19	22	14	20	33	42	7
23	M		25	8	18	10	19	18	37	3
24	M	F	29	15	19	14	13	29	32	2
25	M	F	29	16	22	16	21	32	43	8
26	M	S	20	12	16	12	21	24	37	7
27	F	F	29	18	27	17	22	35	49	7
28	F		28	18	19	17	24	35	43	7

Experiment II cont.

8 E-4

(1)	(2)	(3)	(4)	(5)	(7)	(8)	(9)	(11)
1	M	S	14	20	12	21	32	7
2	F	F	31	20	20	8	40	5
3	F	F	32	18	18	24	36	8
4	F	F	32	20	20	20	40	8
5	F	F	32	17	19	24	36	8
6	M	F	32	20	20	24	40	8
7	F		25	20	14	23	34	8
8	F		28	19	16	24	35	8
9	M	F	31	20	20	28	40	8
10	M	S	13	20	18	19	38	7
11	F	S	16	18	17	23	35	7
12	M	S	19	19	15	8	34	6
13	F		26	20	20	28	40	8
14	F		27	20	18	22	38	8
15	M	S	17	18	14	23	32	7
16	F		25	20	19	23	39	6
17	F		26	17	15	13	32	6
18	F	F	29	20	20	26	40	8
19	M		24	19	18	28	37	8
20	M	S	20	19	18	19	37	8
21	F	S	20	20	19	27	39	8
22	F		26	19	20	24	39	8

8 E-8

(1)	(2)	(3)	(4)	(5)	(7)	(9)	(11)
1	M	S	23	20	20	40	
2	F	F	28	20	20	40	8
3	M		26	20	20	40	7
4	F		26	20	20	40	8
5	F	S	16	9	7	16	
6	M	S	20	19	20	39	8
7	M	F	28	20	19	39	
8	F	S	23	20	20	40	7
9	M	S	18	17	20	37	8
10	F	F	32	20	20	40	8
11	M	F	30	20	19	39	8
12	M	S	17	20	17	37	7
13	F	S	16	20	20	40	7
14	M	S	18	18	20	38	8
15	F		26	20	19	39	8
16	M	F	30	20	20	40	8
17	M	F	28	18	18	36	8
18	F		27	19	19	38	8
19	F		24	20	20	40	8
20	M		27	18	19	37	7

Experiment II cont.

8 E-8 cont.

(1)	(2)	(3)	(4)	(5)	(7)	(9)	(11)
21	F		26	20	19	39	6
22	F	F	32	19	19	38	8
23	M		25	19	18	37	8
24	F	F	30	20	20	40	8
25	M		24	20	20	40	8

Experiment III--Verbalization of Associative Strategies by Normal and Educable Retarded Children

RETARDATES

S# (1)	AGE (2)	IQ (3)	SEX (4)	PRACTICE TASK (5)	CRITERION TASK (6)	STRATEGY JUDGE 1 (7)	STRATEGY JUDGE 2 (8)	EMISSION LATENCY (9)	STRATEGY VERBALIZATION (10)
1	13-2	81	M		6	15	18	48	336
2	15-9	66	F	2	6	10	9	96	199
3	13-0	75	M	14	15	18	16	35	145
4	14-7	82	F	12	19	30	27	77	115
5	14-9	63	M	9	5	30	18	81	170
6	13-5	83	M	21	10	18	18	37	56
7	13-7	73	M	11	10	8	6	110	40
8	14-0	77	F	10	10	29	27	52	179
9	13-9	76	M	21	7	31	25	60	165
10	13-7	70	M	9	11	10	8		
11	15-5	73	M		8	9	6	66	35
12	13-1	72	M	19	24	37	25	29	292
13	14-8	67	F	21	23	17	16		
14	14-9	70	F	3	4	24	16	52	280
15	15-8	80	M	2	11	21	17	58	113
16	13-7	64	F	13	8	11	8	81	77
17	14-4	59	F	9	8	12	12		
18	13-11	75	F	12	8	12	12	106	99
19	13-5	73	M		11	24	30	40	151
20	13-2	77	M		12	8	8	111	111
21	15-0	59	F	14	14	23	18	29	63
22	14-0	80	F		7	13	8	56	89
23	14-9	58	F	5	5	15	15	72	55
24	13-7	64	F	21	4	18	19	71	63
25	14-0	80	F	15	11	24	22	41	148
26	15-7	75	M	10	11	14	14	149	38

Experiment III cont.

NORMALS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	13-9	110	F	17	26	38	33	29	139
2	14-1	121	M	19	27	35	31	41	107
3	13-5	113	M	17	27	29	29	27	223
4	13-3	117	F	13	22	34	30	57	215
5	13-4	103	M	17	27	16	17	88	207
6	15-2	93	M	15	18	18	23	86	414
7	13-5	95	F	21	23	29	29	110	108
8	14-2	97	M	18	22	32	34	29	129
9	13-2	108	M	16	21	34	37	61	92
10	13-3	118	M	21	28	29	32	22	80
11	14-9	91	F	2	21	29	29	127	107
12	14-0	91	M	12	20	29	29	33	113
13	13-7	123	F	21	29	33	30	39	134
14	14-8	102	M	19	15	26	30	40	95
15	13-3	119	M	17	30	32	32	40	210
16	13-2	119	M	18	30	32	31	22	96
17	16-1	82	M	4	12	37	38	63	133
18	15-0	84	F	17	29	38	40	53	129
19	13-5	121	M	21	30	24	26	62	145
20	15-2	83	F	21	22	31	32	56	136
21	13-9	107	F	21	29	32	29	61	274
22	14-10	93	M	11	11	22	21	142	130
23	13-9	120	F	21	30	36	40	30	111
24	13-9	104	F	17	25	25	23	63	194
25	14-6	88	F	18	18	32	33	34	105
26	13-8	107	F	10	24	31	27	26	190
27	13-6	117	F	21	28	27	26	44	213
28	14-3	103	F	17	25	32	29	33	183
29	13-7	113	F	21	28	35	35	19	65

Experiment IV--Facilitation of Associative Learning Among Educable Retardates

(Later Elementary Aided N=27)

S# (1)	SEX (2)	AGE (3)	IQ (4)	READ ACHIEVEMENT (5)	ACHIEVEMENT (6)	PRACTICE TASK (7)	CRITERION TASK (8)	CRITERION STRATEGY (9)	EMISSION LATENCY (10)	VERBALIZATION TIME (11)	RETENTION (12)	RETENTION STRATEGY (13)	DIFFERENTIATION (14)	GENERALIZATION (15)
2	F	12-2	72	3.7	3.3	3	13	23	169	35	10	42	7	27
4	F	11-10		1.8	1.3	3	23	43	67	8	16	47	5	21
6	M	10-11	83	3.3	3.1	4	37	56	36	21	16	56	8	28
8	F	11-8		1.6	1.1	6	16	47	54	11	11	44	3	16
10	M	10-6	96	2.3	3.0	7	35	44	55	173	15	39	7	28
12	M	12-6		3.8	3.1	8	37	56	31	9	16	56	8	28
14	F	11-0		2.8	2.1	8	36	56	28	20	16	56	8	28
201	F	12-3	72	4.2	4.5	5	32	43	102	10	11	50	7	22
203	M	14-0	55	3.2	2.8	3	35	55	49	12	15	54	7	28
205	M	10-6	88	3.2	3.5	4	35	54	82	60	16	55	7	28
207	F	12-7				6	18	29	272	37	16	38	5	13
209	F	10-10	82	2.0	2.2	3	30	28	122	146	15	48	5	27
211	M	12-4	75	2.5	2.6	3	15	22	107	57	8	18	3	11
402	M	10-9	76	1.9	1.7	5	29	13	149	83	15	9	4	6
404	M	12-3	85	2.8	2.4	4	30	38	84	48	14	44	6	28
406	F	12-6	64	1.5	1.2	3	4	8	144	70	2	25	4	17
408	M	12-1	77	2.5	2.2	4	28		54	20	16	50	8	28
410	M	11-9	67			2	4	16	350	25				
412	F	11-5	67	1.5	1.6	6	14	18	211	7	9	14	3	10
414	F	12-8	78	2.7	2.2	3	30	54	32	7	14	40	7	20
501	M	12-1	75	3.4	3.6	0	32	56	52	18	16	50	8	28
503	M	10-10	72	4.0	3.8	3	23	20	132	118	10	17	7	4
505	M	12-5	77	4.2	4.0	11	28	53	55	40	14		8	
507	M	12-5	86	2.2	1.9	3	34	42	53	10	16	44	7	28
509	M	11-9	82	2.8	2.6	0	35	56	45	13	15	56	8	28
511	M	11-0	69	2.6	2.3	8	31	14	234	16	14	20	5	11
513	M	12-5	84	2.8	2.9	10	37	48	37	23	16	47	7	27

Experiment IV cont.

(Later Elementary Unaided N=27)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1	F	11-9	78	3.3	3.5	3	6	16	122	51	6	23	5	21
3	F	11-9		3.8	3.2	4	8	21	159	95	7	23	0	9
5	M	11-8		1.6	2.2	4	8	15	69	21	4	9	0	9
7	M	12-4	80	1.3	2.0	4	4	8	98	39	5	11	2	8
9	F	11-2		2.7	3.0	6	26	14	167	99	14	19	5	10
11	F	10-8		2.3	2.6	10	27	28	161	96	16	29	7	12
13	M	12-3				6	18	39	96	68	7	30	6	25
15	F	10-5		1.6	1.4	7	18	8	28	10	10	8	5	4
202	F	13-3	75	4.5	4.4	6	35	14	218	19	16	8	6	12
204	M	10-8	83	4.9	3.9	5	28	18	77	43	14	35	6	19
208	M	12-6	90	5.0	4.7	2	22	24	95	151	7	22	3	10
210	F	10-4	85	2.0	2.0	1	3	8	44	8	3	8	6	6
212	M	9-7	75	3.1	2.7	2	11	8	117	13	1	12	6	4
214	F	11-5	62	2.4	2.4	0	10	17	62	23	7	21	5	20
401	F	11-6	.7	0.5	0.8	6	13	25	114	32	9	15	1	8
403	F	12-0	70	2.9	3.2	3	18	56	107	46	10	55	7	26
405	F	11-10	62	1.5	1.6	4	4	12	104	66	3	24	5	19
407	F	11-4	66	2.8	2.8	1	8	19	88	53	2	22	6	9
409	F	11-5	75	3.5	3.3	1	6	11	142	91	5	32	4	11
411	M	12-4	78	2.6	3.1	6	31	18	55	36	13	14	5	14
413	F	12-3	78	4.0	3.6	3	19	27	118	32	14	33	4	6
502	M	11-11	54	1.9	2.3	2	6	20	103	23	1	8	3	4
504	F	12-4	79	2.1	3.2	2	13	22	122	51	6	17	4	11
506	M	12-5	70	2 3	2.6	7	13	12	204	11	10	16	1	8
508	M	12-0	77	1.8	2.2	5	12	17	99	41	3	16	5	12
510	M	11-10	79	1.8	2.2	6	23	12	75	12	10	10	2	4
512	M	12-11	81	1.8	3.4	3	8	17	71	48	6	21	2	12

JR. HIGH AIDED

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
102	M	15-1	78	3.0	2.8	2	11	41	71	21	11	35		
104	M	13-11	73	2.0	2.1	1	27	50	70	16	13	51		
106	M	14-9	64	2.9	2.5	3	20	41	63	23	11	41		
108	M	14-4	81	5.0	4.6	9	38	56	41	9	15	56		
110	M	14-7	62	1.6	1.3	2	19	41	163	83	5	56		
112	M	13-9	64	4.0	4.2	6	32	56	103	10	16	56		
113	M	13-1	71	3.8	3.3	5	11	33	228	12	6	35		
302	F	15-11	58	2.7	2.4	5	28	42	106	8	12	38	3	26
304	M	15-6	67			3	16	17	53	111	10	22	2	4
306	M	14-5	76	4.0	4.2	12	16	32	70	16	9	36	6	16
308	M	13-11	75	1.5	1.1	2	5	44	66	85	3	50	2	14
310	M	13-4	82	3.0	3.2	5	33	22	229	36	14	27	4	16
312	M	15-7	67	4.0	4.2	8	39	55	39	7	15	53	8	22

Experiment IV cont. (Jr. High Aided)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
314	M	14-11	69	3.5	3.2	11	38	49	72	46	16	55	8	28
316	F	15-11		2.2	2.0	8	30	56	34	7	15	56	8	28
318	M	14-5	75	3.8	3.3	10	38	49	42	37	16	39	6	22
319	M	13-7	78			8	31	54	34	38	14		7	
321	F	15-4	63	2.8	2.4	2	19		44	8	13		7	
322	F	15-0	67	6.3	6.0	3	36	56	42	17	16		8	
326	F	14-3	59	2.0	1.6	6	5	14	139	57	3		4	
327	F	14-7	85	1.9	2.1	4	37	51	35	8	16	56	8	28
330	M	14-10	73			4	32	66	27	13	16		8	
331	F	13-6	81	3.8	4.1	3	40				16	56	8	28
336	M	13-7	74			5	13		108	8				
338	F	14-5	81	3.7	3.8	8	37	56	41	7	16		8	
340	F	13-4	80	3.7	3.4	12	35	56	26	23	16	56	8	28
342	M	15-4	75	4.4	4.1	9	19	51	47	17	13	55	7	25
324	F	14-9	76	3.7	2.9	9	30	56	23	6	16		8	

JR. HIGH UNAIDED

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
101	M	13-4	75	1.6	1.8	2	5	21	96	98	5	29		
103	M	13-8	67	2.7	2.9	5	23	18	125	97	14	18		
105	F	14-9	72	4.3	4.5	7	16	38	55	69	7	32		
107	M	12-6				6	13	16	52	63	10	18		
109	F	13-6	76	3.5	3.3	11	10	13	76	22	6	10		
111	F	15-1	72	4.0	4.2	4	15	22	91	158	9	15		
301	F	14-1	73	4.4	4.7	7	26	13	78	78	12		4	
303	F	14-9	59	2.8	2.8	3	29	26	113	30	14	26	5	16
305	M	14-4	80	2.7	2.8	2	4	14	129	21	1	12	4	7
307	F	14-1	75	3.7	4.1	4	12	22	82	12	6	21	6	11
309	M	13-10	69	1.0	2.0	4	17	23	81	93	9	32	3	26
311	F	15-2	66	6.3	5.4	4	12	31	69	55	7	26	7	22
313	M	14-8	80	2.0	1.9	4	6	31	39	53	2	36	3	17
315	M	14-8	80	1.5	2.6	8	6	23	53	45	2		5	
317	F	15-0		2.3	2.6	4	12	14	85	12	6	11	3	7
320	M	14-3	75	4.9	4.4	5	10	20	72	28	3			
323	M	14-3	77	3.2	2.8	2	11	13	41	32	3		2	
325	M	14-3	56	4.2	3.2	4	11	16	64	99	14		5	
328	M	14-7		5.1	4.2	6	27	10	132	50	16		6	
329	M	14-0	73	3.0	3.1	4	9	11	36	16	5		3	
332	M	14-9	81	2.2	2.8	4	8	12	140	7	3		5	
333	F	14-6	80	3.7	3.8	6	29	25	69	96	13	17	6	14
334	M	13-0	78	3.4	3.8	8	9	8	185	8	8	8	4	4
335	M	13-2	62	0.1	0.5	2	4	8	28	4	1		5	
337	M	14-4		3.4	3.2	6	37	14	67	53	15	14	6	8
339	F	15-5	70	3.8	4.0	0	15	24			7	21	7	19
341	F	15-3	77	9.9	8.4	8	23	18	56	41	13		6	26

Experiment IV cont.

NORMAL UNAIDED

S# (1)	SEX (2)	AGE (3)	PRACTICE TASK (4)	CRITERION TASK (5)	CRITERION STRATEGY (6)	LATENCY (7)	VERBALIZATION (8)	RETENTION (9)	RETENTION STRATEGY (10)	DIFFERENTIATION (11)
601	F	12-3	7	36	47	27	99	16	44	6
602	M	11-1	11	34	30	64	98	16	31	4
603	F	11-8	7	18	39	33	47	11	37	7
604	F	12-4	11	27	38	43	64	16	46	6
605	F	10-10	4	38	29	36	31	16	37	5
606	F	12-2	12	34	33	49	51			
607	M	10-11	8	34	21	36	132	16	55	6
608	M	11-9	10	32	47	25	122	16	35	7
609	M	11-1	8	27	34	36	59	7	40	5
610	M	12-1	10	30	26	45	28	16	29	7
611	M	11-8	6	21	26	41	88	12	28	4
612	M	12-0	7	31	25	108	53	14	41	7
613	F	11-9	5	15	23	414	39	12	17	4
614	M	11-6	11	35	33	38	23	16	36	7
615	F	11-3	8	37	46	30	12	15	50	5
616	F	11-2	8	29	11	71	38	11	12	4
617	M	11-5	7	12	27	72	21	6	32	7
618	F	11-11	10	20	12	31	80	16	17	5
619	F	10-11	12	32	20	26	37	16	38	6
620	F	12-3	10	22		38	26	15	20	5
621	M	12-1	12	25	37	27	19	16	55	5
622	F	11-1	9	37	49	32	20	16	48	3
623	F	11-4	11	23	14	24	20	13	24	4
624	F	11-10	12	37	25	21	20	16	24	6
625	F	11-10	5	12	23	32	68	8	34	5
626	F	11-9	9	9	41	23	31	10	49	6
627	M	11-6	6	13				13	19	4
628	F	11-4	8	19				12	35	5
629	F	11-5	2	16				11	31	7
630	F	11-8	8	22				10	28	5
632	M	12-0	5	24				15	40	6
633	M	11-2	6	16				8	16	2
634	F	11-1	11	19				12	27	5
635	M	12-1	6	23				16	54	5

Experiment V--Effectiveness of Familiarization and Differentiation Training on the Successful Employment of Associative Strategies Among Educable Retardates

RELEVANT DIFFERENTIATION

S# (1)	AGE (2)	IQ (3)	SEX (4)	READ ACHIEVEMENT (5)	PRACTICE TASK (6)	CRITERION TASK TOTAL # CORRECT (7)	CRITERION TASK AIDED PAIRS (8)	CRITERION TASK UNAIDED PAIRS (9)	STRATEGY SCORES AIDED PAIRS (10)	STRATEGY SCORES UNAIDED PAIRS (11)	DIFFERENTIATION TASK (12)
1	13-8	68	M	3.3	5	27	14	13	28	10	9
2	13-1	61	M	2.7	5	19	10	9	8	4	4
3	12-5	67	M	3.3	4	21	16	5	27	21	8
4	13-2	60	F	3.7	2	31	16	15	4	4	7
5	12-7	74	F	2.7	4	38	20	18	4	4	6
6	14-6	66	M	4.2	3	36	19	17	26	27	16
7	15-2	72	M	2.5	7	32	18	14	10	10	12
8	14-2	70	F	4.1	5	35	18	17	26	25	9
9	15-3	61	F	2.8	10	34	18	16	6	16	13
10	13-3	66	M	3.8	6	36	18	18	26	25	8
11	14-1	70	F	3.4	4	22	8	14	15	13	9
12	12-9	73	F	4.9	5	32	17	15	28	14	8
13	13-1	73	M	3.1	11	33	19	14	28	9	8
14	12-1	63	M	2.5	5	23	17	6	9	4	6
15	12-5	73	F	3.0	10	39	20	19	26	24	9
16	14-0	68	F	4.4	8	22	15	7	28	16	7

RELEVANT FAMILIARIZATION

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
17	14-5	76	M	3.7	6	28	13	15	15	8	10
18	13-9	77	M	3.0	7	18	6	12	5	12	6
19	13-2	72	M	2.5	3	19	10	9	22	10	10
20	12-2	71	F	3.9	9	36	17	19	17	9	8
21	15-5	77	M	2.5	5	33	18	15	4	8	5
22	14-7	82	M	3.5	10	27	16	11	23	17	9

Experiment V cont.

RELEVANT
FAMILIARIZATION

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
23	14-1	76	M	3.0	5	6	4	2	13	11	2
24	13-3	74	M	2.6	4	34	19	15	28	8	14
25	12-4	87	M	3.5	7	19	8	11	16	10	4
26	13-4	74	M	3.4	7	27	17	10	28	12	7
27	15-1	67	F	3.1	5	35	20	15	21	17	8
28	12-9	76	M	2.7	3	32	17	15	26	16	12
29	11-4	72	F	3.0	5	8	5	3	12	15	4
30	12-10	72	F	3.4	1	15	10	5	22	15	6
31	12-10	63	F	3.1	7	10	8	2	4	4	5
32	13-10	68	M	2.6	6	18	12	6	14	10	12

IRRELEVANT
DIFFERENTIATION

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
33	14-10	70	M	3.8	8	26	15	11	22	14	9
34	14-5	76	M	4.9	8	35	20	15	28	12	7
35	15-5	65	M	2.5	5	16	9	7	14	10	6
36	13-5	79	F	2.8	7	35	18	17	22	6	10
37	13-11	69	F	2.5	3	23	13	10	17	15	6
3[illegible]	14-8	73	M	3.2	7	40	20	20	28	23	11
39	14-1	70	M	3.4	6	40	20	20	26	4	9
40	13-10	61	M	3.8	7	27	14	13	8	8	7
41	12-6	75	M	3.2	4	39	20	19	22	6	6
42	13-7	67	F	3.3	6	23	14	9	28	12	6
43	13-5	78	M	2.8	6	24	12	12	14	18	5
44	13-6	77	M	3.7	7	17	7	10	18	8	8
45	13-9	76	M	3.2	4	23	12	11	19	19	2
46	13-9	71	F	3.5	6	27	12	15	26	22	10
47	13-6	76	M	3.3	6	33	17	16	22	4	4
48	14-1	59	M	2.8	3	32	16	16	28	26	10

Experiment V cont.

IRRELEVANT FAMILIARIZATION

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
49	14-9	69	M	3.5	5	34	17	17	12	9	7
50	13-3	72	M	3.5	3	25	14	11	28	16	7
51	13-7	70	F	2.9	3	21	15	6	28	7	5
52	13-8	77	F	4.7	5	21	12	9	11	4	9
53	14-5	74	M	3.2	5	27	18	9	28	22	10
54	14-5	67	M	2.5	6	33	17	16	22	22	10
55	14-5	73	M	3.3	8	23	10	13	11	14	10
56	12-3	77	F	2.7	7	21	13	8	26	4	5
57	14-0	71	M	3.5	9	36	20	16	15	15	9
58	13-6	73	M	3.4	5	26	12	14	21	17	10
59	11-9	76	M	3.3	4	22	13	9	26	10	7
60	13-3	78	M	4.9	11	39	20	19	28	16	14
61	14-1	74	F	2.5	3	8	6	2	4	4	5
62	12-5	73	M	2.5	5	10	2	8	10	9	5
63	13-7	61	M	4.0	4	34	17	17	16	16	8
64	13-6	79	M	2.8	3	25	14	11	15	7	10

CONTROL

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
65	15-0	53	M	2.7	9	20	17	3	28	4	6
66	13-3	70	M	3.2	6	31	17	14	7	7	2
67	14-0	79	M	2.8	1	33	18	15	28	23	9
68	12-5	73	F	3.7	3	27	13	14	21	16	9
69	11-8	75	F	3.4	4	26	17	9	7	8	3
70	14-10	65	M	3.5	6	26	11	15	28	22	5
71	14-10	60	M	2.5	4	20	12	8	22	25	7
72	14-0	60	M	2.8	5	24	13	11	4	4	8
73	13-9	D	M	3.2	10	35	20	15	28	21	9
74	13-10	76	M	5.0	4	32	18	14	22	14	8
75	13-2	70	M	4.2	4	25	17	8	22	6	8
76	12-7	76	M	3.5	6	36	18	18	28	16	9
77	14-3	68	M	2.7	7	27	17	10	18	12	8
78	14-0	66	F	3.4	7	25	14	11	11	5	14
79	13-10	65	F	3.3	4	14	4	10	15	10	3
80	13-6	75	F	3.2	4	31	19	12	28	8	13

Experiment VI--Conditionability of Associative Strategies Among Educable Retardates

LS Group

S# (1)	CONDITIONING STRATEGY (2)	CRITERION TASK (3)	CRITERION STRATEGY (4)
1	94	13	22
2	92	5	20
3	93	7	18
4	92	9	11
5	93	6	9
6	99	18	20
7	85	11	16
8	88	5	20
9	88	6	35
10	88	22	13
11	92	24	14
12	90	9	20
13	75	7	20
14	97	17	20
15	86	3	20
16	92	9	23
17	90	15	20
18	90	10	28
19	112	5	22
20	89	9	8
21	86	21	8
22	89	21	23
23	84	7	12
24	77	8	18
25	89	8	12

HS Group

(1)	(2)	(3)	(4)
1	114	5	36
2	153	29	20
3	165	20	51
4	145	15	37
5	165	19	36
6	168	25	40
7	147	9	39
8	162	11	35
9	163	22	56
10	133	24	29
11	134	16	25
12	158	11	37
13	110	12	37
14	169	8	41
15	151	18	44
16	143	20	36
17	169	18	46
18	132	6	25
19	133	8	31
20	160	25	44
21	157	12	36
22	137	11	12
23	143	36	43
24	170	26	54
25	174	27	55
26	137	5	8
27	136	10	8

Experiment VII--Verbalization of Associative Strategies by Blind Children

EXPERIMENTALS

S# (1)	CRITERION TASK (2)	STRATEGY (3)	EMISSION LATENCY (4)	STRATEGY VERBALIZATION (5)
1	37	38	17	36
2	35			
3	39	38	17.5	5.5
4	36	21	41.5	46.5
5	40	56	10	8.5
6	40	30	17.5	31
7	34	44	52.5	11.5
8	38	56	74.5	10.5
9	40	53	14.5	18
10	36			
11	37	56	37.5	29.5
12	40			
13	39	33	36	64
14	39	56	18	37.5
15	38	32	33	28.5
16	40	56	22	34.5
17	38	52	24.5	24
18	39	52	14	8
19	36	31	12	9.5
20	39	56	9.5	55.5

CONTROLS

S# (1)	CRITERION TASK (2)	STRATEGY (3)	EMISSION LATENCY (4)	STRATEGY VERBALIZATION (5)
21	37	13	38.5	25.5
22	39	31	23	21.5
23	22	12	101	23
24	34	32	18	17
25	11	8	51	7.5
26	31			
27	39	32	41	36.5
28	37			

Experiment VII cont.

CONTROLS

(1)	(2)	(3)	(4)	(5)
29	23	14	10	6.5
30	38	43	12.5	39.5
31	20	29	16.5	11
32	16	8	23	11
33	39	26	8	16
34	39	27	13	37.5
35	36	29	11	15.5
36	33			
37	39	19	69.5	34
38	11	15	68	42
39	22	29	111.5	66.5

Experiment VIII--Administration of Associative Strategies to Educable Retardates in a Word Recognition Task.

S# (1)	SEX (2)	AGE (3)	IQ (4)	READ ACHIEVEMENT (5)	PRETEST CUE WORD (6)	PRETEST CRITERION WORD (7)	CRITERION TASK (8)	RETENTION TASK (9)	RELEARNING TASK (10)	NUMBER TRIALS FOR SIX WORDS (11)
SYNTACTICAL										
801	M	10-6	88	1.4	1	0	13	3	9	47
802	M	10-6	67	2.8	9	0	33	6	16	9
803	M	9-8	77	1.5	0	0	8	1	6	32
804	F	10-1	77	.6	10	4	31	7	15	6
805	M	8-5	76	1.1	7	0	22	4	14	13
806	M	8-4	78	.7	0	0	5	1	8	34
807	M	11-7	74	.3	0	0	5	2	6	30
808	M	10-8			6	0	34	3	14	18
809	F	12-4	75	1.9	7	1	11	3	11	12
810	M	8-3	71	.6	9	2	29	6	15	6
811	F	12-11	75	1.4	11	0	33	8	16	--*
812	M	12-9	67		4	0	22	7	11	6
813	F	10-4	74	2.1	11	3	36	7	16	3
814	M	10-5	76	1.5	11	2	33	7	16	3
815	F	11-3	71	1.9	10	1	19	7	14	3
816	M	9-10	74	1.3	4	0	9	3	14	21
817	M	12-2	73	.6	5	0	28	2	14	15
818	M	12-1	67	1.9	2	0	22	4	12	26
WORD FORMATION										
819	F	10-0	63	1.4	4	0	8	2	4	18
820	M	11-2	63	1.0	4	0	15	2	11	22
821	F	10-2	56	1.5	8	0	24	5	11	9
822	M	11-0	63	1.7	12	1	30	6	15	--*
823	M	9-6			7	2	26	6	15	9
824	M	8-6	69	.5	0	0	14	1	5	37
825	M	11-9	70	3.1	10	4	31	7	16	3
826	M	12-9	88	3.5	9	0	28	4	11	9

*Ss knew all six cue words on the pretest.

*Ss knew all six cue words on the pretest.

Experiment VIII cont.

WORD FORMATION

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
827	M	9-9	71	1.6	5	0	26	6	16	12
828	M	7-9	58	.8	1	0	11	3	10	21
829	M	12-9	74	.6	10	3	37	3	16	6
830	F	12-0	78	1.5	10	2	37	6	16	6
831	F	7-9	72	1.1	0	0	17	1	8	29
832	M	10-9	83	.5	0	0	4	0	10	41
833	F	11-5	70	1.1	6	0	31	6	12	12
834	F	12-7	62	1.7	2	0	14	1	6	36
835	F	10-7	74	2.0	1	0	18	4	13	23
836	M	13-5	85	2.2	12	0	36	7	16	--*

REPETITION

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
837	M	9-4	68	1.3	0	0	7	0	5	24
838	M	10-0			0	0	2	1	3	48
839	M	10-9			11	3	35	7	16	3
840	M	9-8			5	0	10	1	5	19
841	F	11-1			6	0	13	4	10	11
842	F	12-4	74	2.8	12	2	39	8	16	--*
843	F	11-11	67	.6	10	0	32	5	14	3
844	M	12-2	71	.4	4	0	18	3	11	18
845	F	12-1	75	2.9	11	1	27	6	14	--*
846	M	12-5			10	3	36	7	16	6
847	M	11-3			9	2	37	7	16	6
848	M	11-9	90	2.2	9	1	36	6	16	9
849	M	11-0	74	1.8	6	0	22	2	12	0
850	F	12-0	80	2.1	6	0	14	1	11	17
851	M	10-10	81	2.0	3	0	10	2	8	38
852	M	10-9	75	2.1	2	0	14	0	5	36
853	M	11-6	75	1.8	1	0	14	2	9	37
854	M	10-11			0	0	13	2	6	28

*Ss knew all six cue words on the pretest.

Experiment VIII cont.

Matched Subjects

Syntactical	Word Formation	Repetition
814	822	842
813	836	839
811	325	845
804	829	846
815	830	843
810	826	848
802	821	847
809	823	849
805	833	850
808	827	841
817	819	840
812	820	844
816	834	851
818	835	852
801	828	853
803	831	837
806	824	854
807	832	838