6-1974

Age and sex differences, meaningfulness and formal similarity in a verbal discrimination task

Aleen Burke Dempster

AGE AND SEX DIFFERENCES, MEANINGFULNESS AND FORMAL SIMILARITY IN A VERBAL DISCRIMINATION TASK

by

Arleen Burke Dempster

A THESIS
SUBMITTED TO THE GRADUATE FACULTY
OF THE UNIVERSITY OF RICHMOND
IN CANDIDACY
FOR THE DEGREE OF
MASTER OF ARTS IN PSYCHOLOGY

June 1974

AGE AND SEX DIFFERENCES, MEANINGFULNESS AND FORMAL SIMILARITY IN A VERBAL DISCRIMINATION TASK

by

Arleen Burke Dempster

Approved:

L. James Tromater, Ph.D., Chairman

Kenneth A. Blick, Ph.D.

Frederick J. Kozub, Ph.D.

ACKNOWLEDGEMENTS

I wish to express my appreciation to those who made it possible for the older subjects to participate in this study by coordinating schedules and space: Mrs. Madelyn Gold, Director of the Senior Center of Richmond; Mrs. Edna Chelly Secretary for the Hermitage, the Methodist Home for the Aged; and Mrs. Louise Ryan, Social Secretary of Imperial Plaza. Special thanks must be extended to my thesis committee, for their continued guidance and encouragement; and of course, to all the subjects who participated in this study.

TABLE OF CONTENTS

Chapter		Page
I.	Introduction	1
II.	Background and Theory	3
III.	Method	14
IV.	Analysis and Results	18
V.	Discussion	29
VI.	Summary	40
Appendix A		41
Appendix B		42
Appendix C		43
Appendix D		44
Bibliography		46
Vita		49

TABLE OF TABLES

Table		Page
I.	The Verbal Discrimination Lists	16
II.	Cell Means and Standard Deviations	19
III.	Overall Analysis of Variance	20
IV.	Analysis of Simple Effects	24
V.	Frequency of Subjects who Omitted Responses	26

TABLE OF FIGURES

Figure		Page
I.	Age Difference in Performance	21
II.	Interaction of Meaningfulness and Formal Intrapair Similarity	23
III.	Performance of Older Subjects from Different Sources	27
IV.	Errors for Stimulus Pairs on High Similarity VD Lists	28

Chapter I

INTRODUCTION

A survey of the literature in two typically unassociated areas of research generated the present investigation. The two areas are verbal discrimination and aging.

Investigations of discrimination learning have produced a theoretical dichotomy (continuity--noncontinuity), sundry attempts to eliminate this dichotomy (MacKintosh, 1965), and other attempts to extend discrimination learning theory to explain all learning processes (Logan, 1971). The more circumscribed area of verbal discrimination learning, however, has been underrepresented in the literature, in terms of both theory and investigation. The frequency theory of Ekstrand, Wallace and Underwood (1966) stands unchallenged as an explanation of the verbal discrimination learning process. Its tenets have been only limitedly explored.

The verbal discrimination task is a complex one in which the subject (S) must learn several discriminations concurrently. Verbal discrimination, as a multiple discrimination task, is not unique, e.g. conditional discrimination learning; but its complexity makes it a ready analog to everyday learning. Further investigation is needed to fully understand its dynamics.

Ontogenetic investigations extending into middle and later adulthood are also underrepresented in the literature.

The concern of our culture has been with youth. It is distasteful to consider the physically catabolic process of aging and its behavioral correlates, particularly when we observe them in ourselves. We deny aging. Yet, as the character of our population continues to change, having left the point where the young predominate in number, our culture is confronted with aging and its concomitant problems, in ever greater proportions.

A survey of the developmental literature on aging reveals a preponderance of research on retention; it was one of the earliest problems of aging recognized and is among the most thoroughly investigated. It is also among the earliest signs of aging the individual recognizes. Ontogenetic studies of general intelligence have become popular, among the most thorough reviews being that of Fozard, Nuttall and Waugh (1972), using the GATB. Little research has been concerned with the problem of new learning in the aged, yet ready adaptation to new situations is expected of the elderly, e.g. widowhood, retirement, etc.

The Problem Stated. The present investigation is concerned with learning in the aged. The task is a verbal discrimination one, in which the dimensions of meaningfulness and formal intrapair similarity are examined. The study is ontogenetic in the limited sense that the older sample, over 60 years of age, is compared to a sample of college age youth.

Chapter II

BACKGROUND AND THEORY

Theories of Discrimination Learning. Continuity and noncontinuity theorists have attempted to account for discrimination learning in different ways. At issue have been several points of controversy: (a) the presence or absence of hypothesis behavior in the presolution period on the discrimination task, (b) the rate at which the discrimination is learned, (c) the nature of what is learned--whether S learns to respond to the relationship between the positive and negative discriminative stimuli, or whether S responds to each stimulus in terms of the absolute value of its individual characteristics.

Spence (1936), a notable continuity theorist, simply described discrimination as the end-product of a continuous, cumulative process of acquisition of excitatory and inhibitory tendencies by components of the stimulus situations. These components were assumed to have an initial excitatory strength dependent upon the previous experience of the organism.

> Discrimination learning does not consist . . . in the strengthening of one response relatively to another or others as in the case of problem-box learning, but involves, rather, the relative strengthening of the excitatory tendency of a certain component of the stimulus complex as compared with that of certain other elements until it attains sufficient strength to determine the response (p. 429-430).

Continuity theory, being notable for its parsimony, has

aided comprehension of such phenomena in discrimination learning as position responding, alternation responding, the transposition effect, and the reversal effect noted early in training (McCulloch and Pratt, 1934), without positing new descriptive terms for the processes involved.

. Krechevsky (1938) in a series of soluble and insoluble discrimination problems observed and described the systematic nature of the white rat's response. The animal appeared to be testing hypotheses (position responding, alternation responding, etc.) until the correct response was discovered. Once the correct response was hit upon, discrimination was achieved very rapidly. Noncontinuity theory has posited the presence of hypothesis behavior in the presolution period, leading to rapid learning, a learning of the relationship between positive and negative stimuli. Noncontinuity theory has received support from data which demonstrates the over-learning reversal effect (Reid, 1953), the absence of a clear-cut transposition effect following successive training (Baker and Lawrence, 1951), and relational responding (Lawrence and DeRivera, 1954).

MacKintosh (1965) noted the strict dichotomy between the continuity and noncontinuity positions, pointing out, however, that neither position had adequately accounted for all of the experimental data, nor have the theories been sufficiently rigorous. Of particular note was the neglect of the important concept of attention. A thorough examination

of relevant research led MacKintosh to espouse a modified noncontinuity position, focusing on the role of attention in the learning process. He proposed two stages to discrimination learning: during the first, attention stage, S learned to select from the stimulus configuration confronting him the dimension which was relevant to the solution of the problem; during the second stage, S learned to make the correct response--the correct stimulus was discriminated.

Logan (1971) questioned the need for the second stage proposed by MacKintosh--whether it is necessary to go beyond the receptor-orienting act in discussing discrimination. While restricting the definition of discrimination, Logan at the same time expanded the continuity position of Spence into a general learning theory, with discrimination as the basis of all learning. Discrimination is evident in both classical and instrumental conditioning: in the first, the conditioned stimulus (CS) is discriminated from its background; in the second, the relevant feedback stimuli associated with reward and punishment are discriminated. "Most generally, discrimination learning is the stimulus control of behavior resulting from the correlation of discriminative stimuli with emotionally significant events (p. 268)."

Verbal Discrimination Learning and the Frequency Theory. Investigators early demonstrated the formation of an association between the items in each pair (in temporal and spatial contiguity) on the verbal discrimination list (Battig, Williams

and Williams, 1962; Spear, Ekstrand and Underwood, 1964). Association by contiguity, however, hardly seemed an adequate explanation of what was occurring in verbal discrimination learning.

In verbal discrimination (VD) learning, pairs of verbal items are presented to the subject whose task it is to discover which item in each pair has been arbitrarily designated correct. Ekstrand, Wallace and Underwood (1966) have advanced a theory to explain how the correct responses are acquired. Their theory is based on the frequency of occurrence of Ss implicit and explicit responses to the VD items. These responses include: representation responses, pronunciation responses and rehearsal-of-the-correct-alternative responses. The term frequency unit has been applied to each response. Ss perception of each pair of items adds one frequency unit to each item in the pair. The pronunciation of Ss guess of the correct item adds a frequency unit to that item. When the actual correct item appears on the memory drum, perception of it adds a frequency unit to the correct item. As VD learning proceeds, at least a 2:1 frequency difference in favor of the correct item is built up. The cue for discrimination is this difference in frequency of occurrence between the correct and incorrect items in each VD pair.

Several hypotheses stemming from the frequency theory have been supported by independent research. Paul (1971) manipulated the frequency of occurrence of correct alter-

natives in proportion to incorrect alternatives by constructing VD lists with correct:incorrect ratios of 4:1, 2:1 and 1:1. As predicted by the frequency theory, acquisition proceeded more rapidly on lists in which the correct alternatives appeared with greater frequency. Radtke, McHewitt and Jacoby (1970) manipulated the number of alternatives from which S had to choose the correct item. Acquisition of four-alternative lists occurred more rapidly than of two-alternative lists; again, as the frequency theory predicted. Underwood and his colleagues have also substantiated a number of hypotheses generated by the frequency theory (Ekstrand, Wallace and Underwood, 1966; Underwood, Shaughnessy and Zimmerman, 1972).

Stimulus Considerations. Among the many stimulus variables operating in the verbal discrimination task are meaningfulness and formal similarity. Meaningfulness has been defined by a number of surveys, most notable of those concerned with consonant-vowel-consonant (CVC) syllables being that of Noble (1961). Formal similarity has been defined by the number of letters of the alphabet the VD item-pairs have in common. A formally similar VD stimulus list, in general, has overall fewer different letters of the alphabet than a formally dissimilar list.

With respect to the meaningfulness of the VD items, the frequency theory has predicted that it should have no effect on the acquisition of the VD list (Ekstrand, Wallace and Underwood, 1966). Indeed, Keppel (1966) found no evidence

of a difference in trials to criterion between 12-pair VD lists of CVC syllables and lists of words. The frequency theorists speculated however that (1) greater difficulty with highly meaningful stimuli would result from the greater number of interfering associations to such stimuli, or (2) greater difficulty with low meaningful stimuli would result from lack of integration of the stimulus unit.

According to the frequency theory, increasing the similarity of VD items should interfere with acquisition of the VD list. Yelen (1969) using 10-set lists of CVC syllables found support for the frequency theory with formally similar lists requiring significantly more trials to criterion than formally dissimilar lists. Essentially the same result was found by Underwood and Archer (1955) with consonant syllables. Edwards (1966) using four-item displays of CVC syllables found that similarity between displays retarded task acquisition, while similarity within a display did not. Kausler and Olson (1969) using homonyms found that similarity between the items in a pair did not affect task acquisition. Recently, however, Schulz and Lovelace (1972) examined interpair acoustic and formal similarity in an eight trial VD task using 16-pair lists of words. The greatest number of errors occurred on the list with both acoustic and formal similarity. All lists with interpair similarity were more difficult than a control list; formal interpair similarity was more difficult than interpair acoustic similarity.

Aging. Ontogenetic studies extending into later adulthood are becoming increasingly prevalent. Fozard, Nuttall and Waugh (1972) incorporated research data of their own and others into a discussion of the effects of age and socioeconomic status on cognitive performance. Several of their observations are relevant to the present discussion. Age related decrements in performance were noted on all sub-tests of the General Aptitude Test Battery (GATB), and in a two-choice discrimination problem in which older Ss had difficulty initiating a response. When significant age differences were found, the greatest decrement in performance existed between those subjects 60 to 80 years of age and all younger subjects. The socioeconomic status effects, noted on GATB sub-tests, were present at all age levels, and were primarily determined by the large gap between middle class and lower class people. These effects were most evident on verbally weighted tasks.

In a study of the development of learning set in samples differing in chronological age, Levinson and Reese (1967) compared the performance of groups of elderly Ss from several institutions, a golden-age club and a group of retired college professors. The 77 Ss as a whole were inefficient in developing learning set. The performance of the small sample of retired college professors was superior; there was no difference in the performance of Ss from one institution compared to those residing in their homes and attending a golden-age

club; performance of Ss from a second institution was significantly inferior to that of the other samples, possibly due in part to the nonstimulating institutional environment. All of the response patterns were characterized by perseveration of position responses through prolonged periods of training.

Canestrari (1963, 1968) has been examining differences in verbal learning ontogenetically, using variations of the paired associates task. He has consistently found a deficit in the performance of his older subjects (especially in those Ss over 60 years of age). His comparison of elderly Ss using paced or self-paced conditions revealed an improvement in performance under the self-paced condition with a decrease in omission errors. Elderly Ss exhibited a differentially greater deficit than young Ss when the interval between presentation of the paired associates was short. And, in an examination of the use of mnemonics in the paired associates task, elderly Ss committed more errors to criterion (both commission and omission errors) despite verbal or graphic aids. The findings of Monge and Hultsch (1971) confirmed the early study of Canestrari (1963) in that longer anticipation intervals improved the performance of aged subjects. The anticipation interval was defined as the length of time available for S to orally produce the response item.

Nehrke and Coppinger (1971) studied discrimination learning and transfer among elderly males as a function of

number of stimulus dimensions determining positive response. Subjects used in the study were Veterans Administration Domiciliary residents. When given a discrimination task with one relevant dimension, Ss made fewer errors to criterion than on a task where two dimensions were relevant. When the transfer task was also two dimensional, Ss made significantly more errors if the initial task was also two dimensional, or if the shift was intradimensional.

In a subsequent study, Nehrke (1973) compared a college age sample and a middle-aged sample to his sample over 55 years of age. In this study his older subjects were all residing in the community. He was again studying transfer to see if there were any age or sex differences in the use of mediators. His overall analysis of errors to criterion on the second task showed mediational effects, regardless of age, on a reversal task and on an intradimensional shift task. There was no difference among his older Ss in their performance on the reversal task and the extradimensional shift task, which Nehrke construed as evidence that older Ss are mediationally deficient, performing like preschool children on these tasks.

Restatement of the Problem. The preceding discussion covered many aspects of the dual area under investigation, highlighting theory and current research.

It has been observed that the aging process is a physically catabolic one. It is the author's contention that

performance concomitantly deteriorates with the physical deterioration of aging. This is supported most pervasively by the data reviewed by Fozard et al. (1972), particularly for the subject over 60 years of age (Canestrari, 1971). The regression effects of aging on cognitive behavior are hastened by institutionalization (Nehrke, 1973; Levinson and Reese, 1967); and these effects are differentially experienced over time by men and women (Nehrke, 1973).

Of primary concern in constructing the verbal discrimination task was the frequency theory advanced by Ekstrand, Wallace and Underwood (1966), augmented by current verbal discrimination research data. Meaningfulness has been widely studied in the field of verbal learning using the paired associates task. The principal tenet advanced by the frequency theorists with respect to meaningfulness is that it has no effect on verbal discrimination learning. Formal similarity, however, is presumed to increase the difficulty of the verbal discrimination task. This latter hypothesis has been corroborated for interpair (Schulz and Lovelace, 1972) and intralist similarity (Yelen, 1969).

The present author chose to study age and sex differences in acquisition performance on a verbal discrimination task. Widely divergent age groups were studied with the older sample restricted to subjects over 60 years of age. Socioeconomic level was restricted to the middle classes, and all subjects in the study were functioning actively in the community. The

stimulus dimensions of formal intrapair similarity and meaningfulness were varied, across two levels, using consonant-vowel-consonant syllables as the stimulus material.

As a direct outgrowth of the foregoing considerations and within the context of the present experimental task, the following hypotheses were advanced:

(1) it will be more difficult for older subjects to acquire the verbal discrimination lists to criterion;

(2) there will be a sex difference in acquisition, with the performance of female subjects being inferior to that of male subjects;

(3) performance of subjects on the high similarity stimulus lists will be inferior to performance of subjects on the low similarity stimulus lists;

(4) the performance of subjects on the high meaningful stimulus lists will not differ from that of subjects on the low meaningful stimulus lists.

Chapter III

METHOD

Subjects. Four groups of 16 subjects each participated in the study. They were an older male sample, age range 60 to 91 years, mean age 76.1 years, median age 75.0 years; an older female sample, age range 66 to 86 years, mean age 76.6 years, median age 77.5 years; a younger male sample, age range 17 to 25 years, mean age 20.2 years, median age 20 years; and a younger female sample, age range 18 to 24 years, mean age 20.2 years, median age 20 years. All subjects belonged to the middle classes as determined by occupation of the older sample (or their spouse's occupation) and occupation of the younger samples grandparents and parents. Middle classes were defined as levels 4, 3, and 2 (Warner, Meeker and Eells, 1960). All Ss were functioning actively in the community as determined by inquiry of the investigator about their activities. All Ss had no previous laboratory experience with a verbal discrimination task. Three Ss were eliminated from the study, since they refused to complete the experimental task. They evidenced frustration and an inability to comprehend that they were seeing the same stimulus material repeatedly. These subjects were an older male, an older female, and a younger male.

Lists. Five pairs of consonant-vowel-consonant syllables were selected to generate each list. Each pair was printed once horizontally in black 1/4 inch letters on white tape.

One member of each syllable pair was designated correct. The correct syllable was printed again, alone in the center of the tape as knowledge of results, according to the traditional anticipation method used in VD learning tasks.

Four lists were generated reflecting two levels of formal intrapair similarity and two levels of meaningfulness. The two levels of meaningfulness were selected using Noble's (1961) table of scaled meaningfulness: high meaningful stimuli with m' values between 3.20 and 3.29, low meaningful stimuli with m' values between 1.00 and 1.09,--no syllable chosen which was an actual word in Webster's New Collegiate Dictionary (1960). Formal intrapair similarity was determined by the number of letters the two CVC syllables had in common. Each high similarity pair had two letters in common; the different letters in each pair were not acoustically similar. Each low similarity pair had no letters in common. The four lists were designated high meaningfulness, high similarity (HM-HS); high meaningfulness, low similarity (HM-LS); low meaningfulness, high similarity (LM-HS); and low meaningfulness, low similarity (LM-LS). The lists are presented in Table I.

Each of the four experimental lists were presented in five different orders to minimize serial effects. The order of presentation was randomized in the same predetermined fashion for all four lists. Within each trial, correct items appeared equally often in the left and right positions, to minimize learning based on position cue. The orders of

TABLE I. The Verbal Discrimination Lists with correct syllable underlined

High Meaningfulness - High Similarity (HM-HS)	High Meaningfulness - Low Similarity (HM-LS)
SED - SEP	HAR - PUD
FAL - FAC	RAZ - LIK
HIC - LIC	GER - POS
NAV - NOV	SIG - FAL
SOR - WOR	WOR - NUM

Low Meaningfulness - High Similarity (LM-HS)	Low Meaningfulness - Low Similarity (LM-LS)
XAP - XAG	ZOK - TUJ
VUB - VUY	ZAV - QIG
RIW - CIW	CIJ - YEX
CIJ - CEJ	WOJ - XIR
QOF - ZOF	GEJ - VUY

presentation of the lists are available in Appendix A.

A three-pair list of CVC syllables of moderate values of meaningfulness and similarity was constructed for pretraining. This list is available in Appendix B.

Procedure. Following random assignment to one of the four experimental conditions--age and sex groupings matched across conditions--S was read conventional instructions for the VD task, anticipation method. A copy of these instructions appears in Appendix C. The stimulus material was presented on a memory drum constructed by Psychological Instruments, Inc., Richmond, Virginia. A presentation rate of two seconds was used together with a two-second intertrial interval, to cue the beginning of the next trial.

Reading of the instructions was followed by three trials on the two-pair pretraining list to familiarize S with the experimental procedure. Training with the anticipation method on the experimental list then proceeded until S reached a criterion of two perfect recitations or for 15 trials, whichever came first.

Chapter IV

ANALYSIS AND RESULTS

Two levels of each of four factors were investigated under the hypotheses advanced pertaining to the experimental task. These factors were age, sex, formal intrapair similarity of the VD lists and meaningfulness of these lists. Cell means and standard deviations of number of trials to criterion on the experimental task for this 2 X 2 X 2 X 2 factorial design are presented in Table II. Of note are the large and varying standard deviations across the cells. This was not unexpected, e.g. Underwood and Archer, 1955; Monge and Hultsch, 1971. Hartley's test for homogeneity of variance was performed on the experimental data. The hypothesis of homogeneous variability could not be rejected ($F_{max} = 70.22$, $p > 0.05$).* A summary table of the overall analysis of variance performed on the experimental data (after Winer, 1962) is presented in Table III.

Results of the overall analysis of variance as they relate to the hypotheses advanced earlier, include the following:

(1) The hypothesis of no age difference in performance was rejected. A significant difference in the performance of older subjects compared to younger subjects was found ($F = 4.23$, $p < 0.05$). The performance of the older subjects on the experimental task was inferior to that of the younger

* $F_{max}(3, 16) = 162$, $p < 0.05$

TABLE II. Cell Means and Standard Deviations for the 2 X 2 X 2 X 2 factorial design

		MALE		FEMALE	
		MEANINGFULNESS		MEANINGFULNESS	
	SIMILARITY	HIGH	LOW	HIGH	LOW
YOUNGER	HIGH	m=6.25 s=3.40	m=3.75 s=0.50	m=5.50 s=1.00	m=4.25 s=1.26
	LOW	m=3.75 s=1.50	m=5.25 s=2.98	m=3.75 s=1.26	m=7.25 s=4.19
	SIMILARITY				
OLDER	HIGH	m=7.50 s=2.64	m=5.75 s=3.10	m=6.50 s=2.38	m=7.25 s=2.02
	LOW	m=4.50 s=1.29	m=4.50 s=1.00	m=5.75 s=1.26	m=7.25 s=2.22

TABLE III. Overall Analysis of Variance

SOURCE	df	MS	F
Age (A)	1	21.391	4.237*
Sex (Sx)	1	9.766	1.943
Similarity (Si)	1	5.641	1.122
Meaningfulness (M)	1	0.766	0.152
A X Sx	1	1.891	0.376
A X Si	1	6.891	1.371
A X M	1	0.141	0.028
Sx X Si	1	8.266	1.644
Sx X M	1	13.141	2.614
Si X M	1	31.641	6.295*
A X Sx X Si	1	0.391	0.080
A X Sx X M	1	0.141	0.028
A X Si X M	1	9.766	1.943
Sx X Si X M	1	0.016	0.003
A X Sx X Si X M	1	0.764	0.152
Error	48	5.026	

*$F = 4.04$, $p < 0.05$

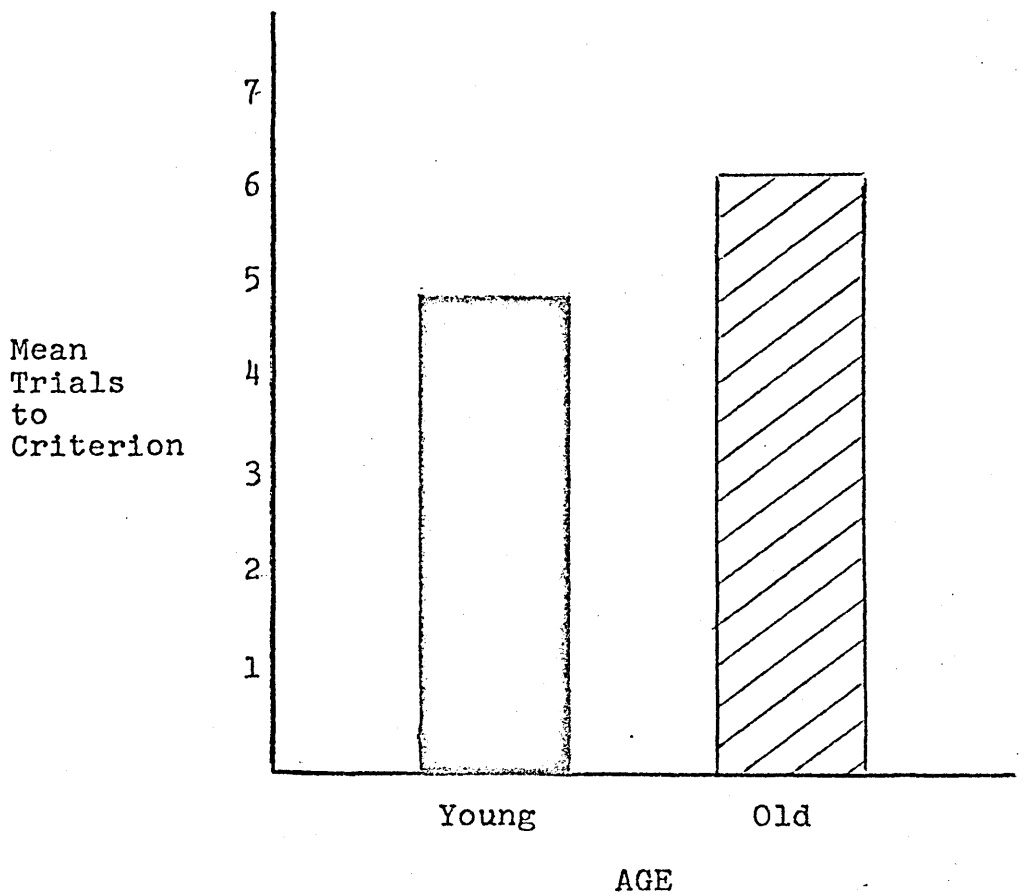


FIGURE I. Age Difference in Performance

subjects: this supports the contention of the investigator. The performance difference is represented graphically in Figure I.

(2) The hypothesis of no sex difference in performance could not be rejected on the strength of the experimental data. No sex difference in performance was indicated.

(3) The hypothesis of no performance difference due to the differential similarity of the VD lists could not be rejected on the strength of the experimental data.

(4) The hypothesis of no performance difference due to the differential meaningfulness of the VD lists could not be rejected on the strength of the experimental data: this supports the contention of the investigator.

Despite the lack of significance in the main effects due to formal intrapair similarity or meaningfulness of the VD lists; the interaction between similarity and meaningfulness was significant ($F = 6.30$, $p < 0.05$). Figure II presents this interaction graphically. A summary table of the analysis of the simple effects of meaningfulness and formal similarity is presented in Table IV. Two of these tests for simple effects reached significant levels: with high meaningful stimuli, a significant difference was found between high and low similarity lists ($F = 6.37$, $p < 0.05$); with low similarity stimulus lists, a significant difference was found between high and low meaningful stimuli ($F = 4.20$,

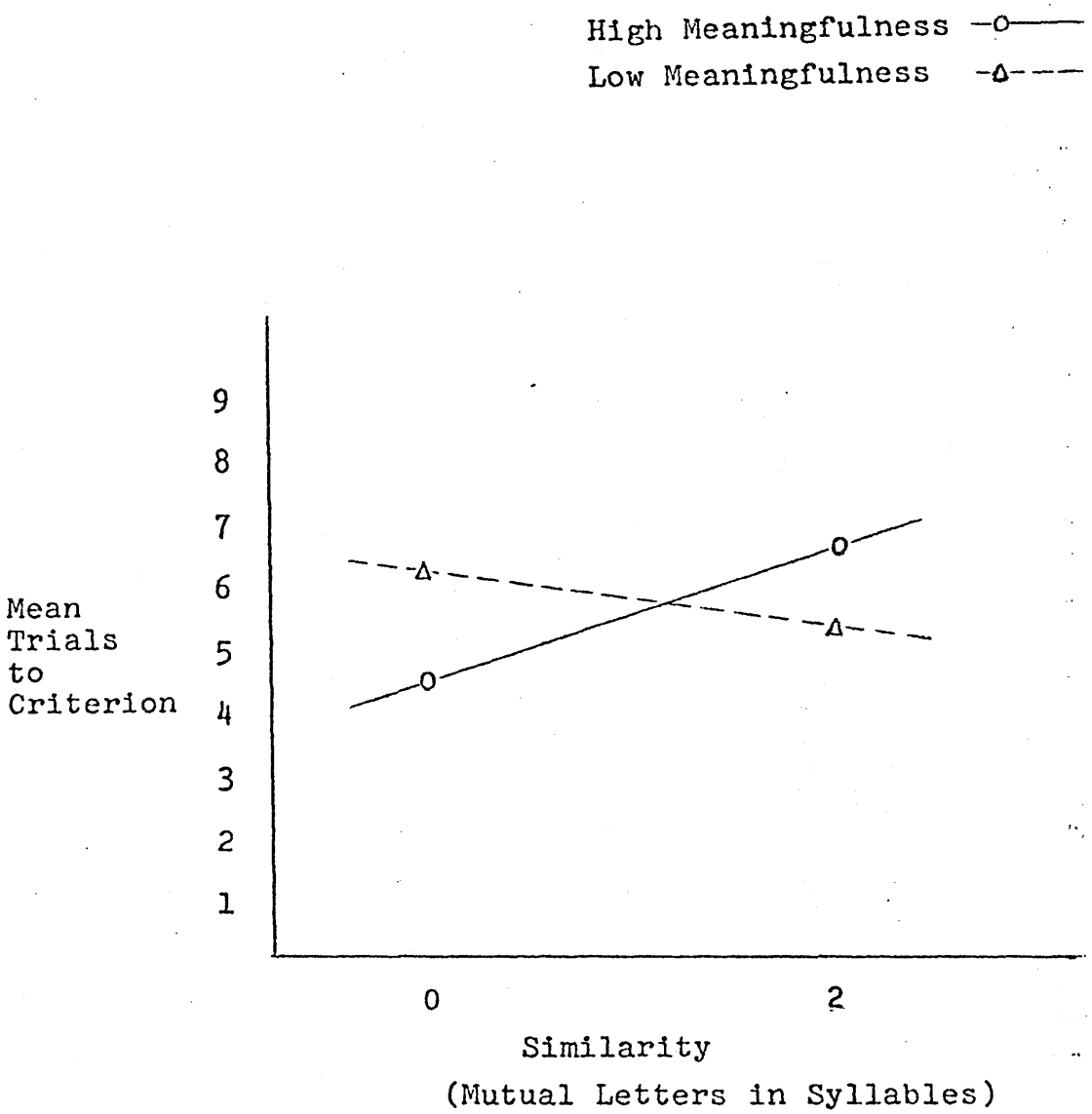


FIGURE II. Interaction of Meaningfulness and Formal Intrapair Similarity

TABLE IV. Analysis of Simple Effects

SOURCE	df	MS	F
Similarity			
at High Meaningfulness	1	32.000	6.367*
at Low Meaningfulness	1	5.281	1.051
Meaningfulness			
at High Similarity	1	11.281	2.244
at Low Similarity	1	21.125	4.203*
Error	48	5.026	

*$F = 4.04$, $p < 0.05$

$p < 0.05$). None of the other interactions of the data in the present analysis reached significant levels.

It was observed during administration of the experimental task that many older Ss omitted responses to the verbal stimuli despite the clear instructions to respond. A chi-square test of the frequency of older subjects who did and did not omit responses compared to the respective performance of younger subjects was significant ($X^2 = 22.74$, $p < 0.001$). Frequencies for the cells are given in Table V. More older Ss omitted responses.

The older sample for this study was drawn from groups of people still functioning actively in the community, referred for participation in the study by three different sources. It is interesting to observe a comparison of the performance of the older subjects from each source. A schematic representation of the frequency of subjects from each source whose performance was above the mean for his particular cell is given in Figure III, together with the frequency of subjects from the same source whose performance was below the mean for his particular cell.

A consideration of the difficulty of each of the formally similar stimulus pairs was deemed of interest to the present investigation. Bar graphs showing total number of errors across all subjects on the high similarity, high meaningfulness list and on the high similarity, low meaningfulness list are given in Figure IV.

TABLE V. Frequency of Subjects who Omitted Responses
2 X 2 Chi Square Frequency Table

	OMITTED RESPONSES	DID NOT OMIT RESPONSES
	17.5	14.5
OLDER	27	5
	17.5	14.5
YOUNGER	8	24

$X^2 = 22.74$

$p < 0.001$, $X^2_{(df=1)} = 10.83$

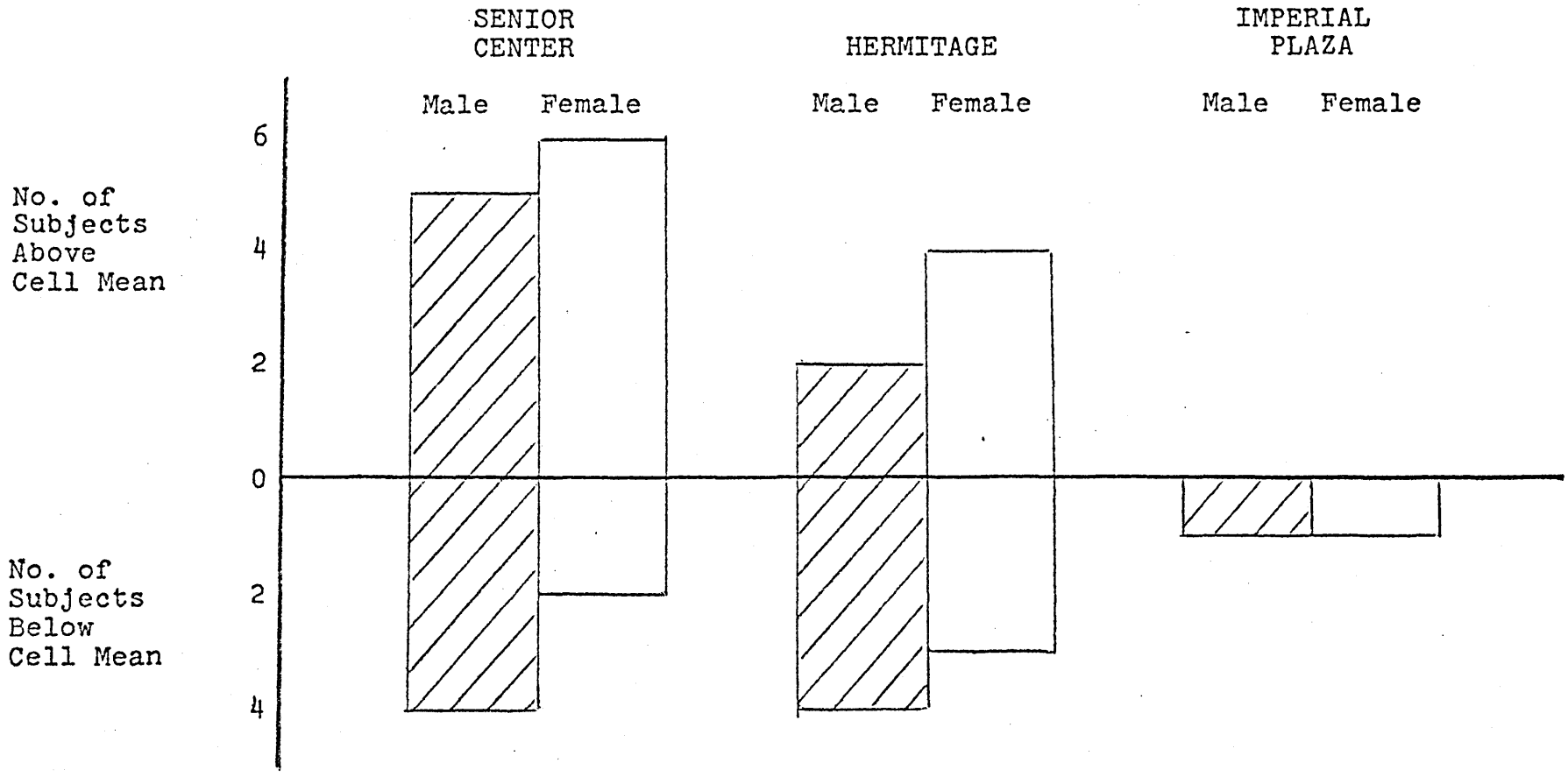


FIGURE III. Performance of Older Subjects from Different Sources

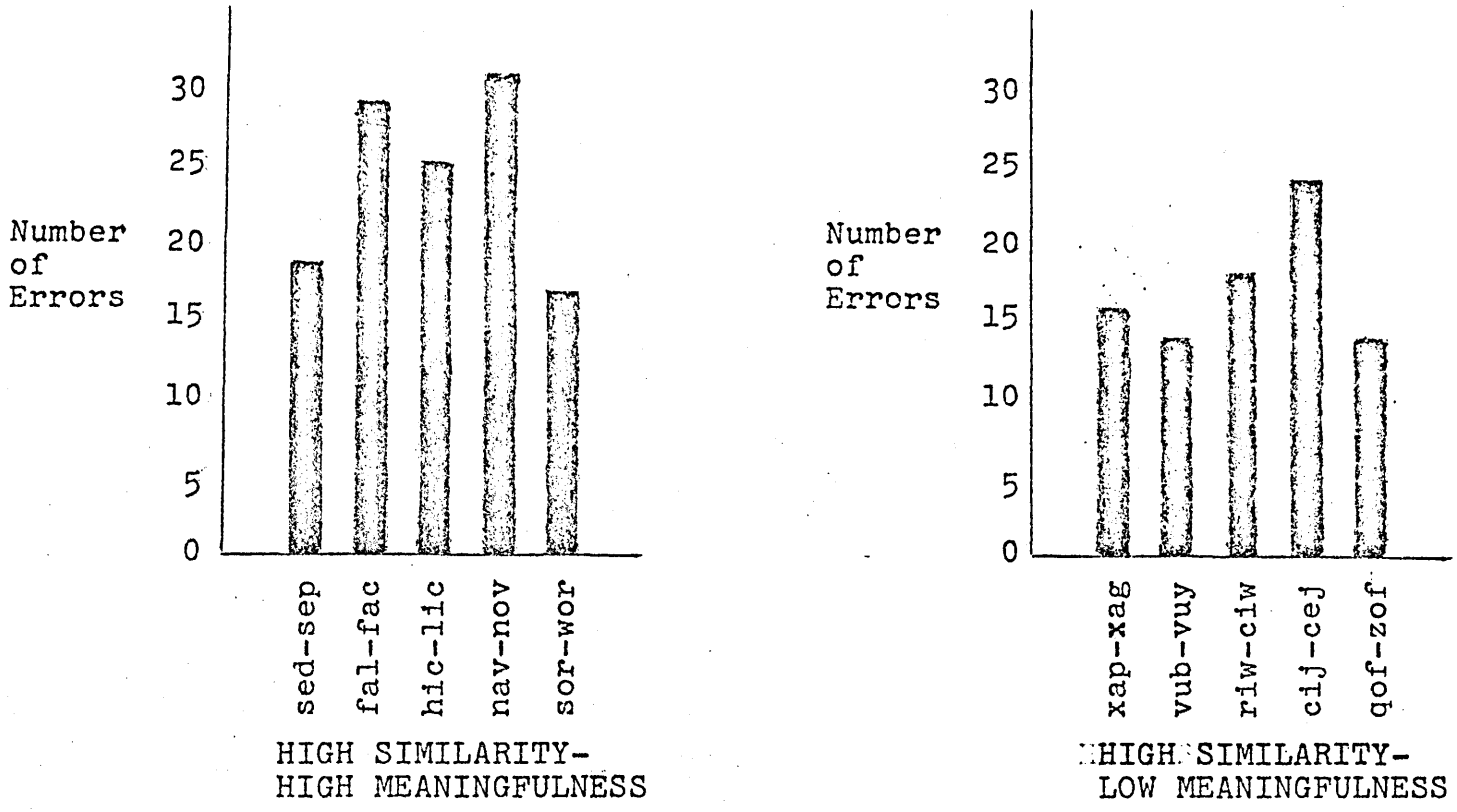


FIGURE IV. Total Number of Errors for Stimulus Pairs on High Similarity Verbal Discrimination Lists

Chapter V

DISCUSSION

The age difference in performance found in acquisition of the present verbal discrimination task--older subjects requiring more trials to reach criterion--is consistent with other ontogenetic findings related to task acquisition: paired associate learning (Monge and Hultsch, 1971; Canestrari, 1963), problem-solving (Fozard et al., 1972), etc. Possible factors contributing to this age difference in performance, not directly related to the aging process need elucidation. Given the cross-sectional nature of this design (and many of those cited), the age difference in performance could be attributed in part at least to sociocultural changes that have taken place between the generations of subjects studied. In the present study, the dimension of meaningfulness of the verbal stimuli is particularly vulnerable to this type of contamination. Of note is the lack of significance in the contribution of the age by meaningfulness interaction to the overall variance in the experimental data.

Several characteristics of the present study were designed to maximize this age difference in performance. These include the age of the older sample, the paced nature of the task and the younger sample of students. All of the subjects in the older sample were at least 60 years of age. As noted by Fozard et al. (1972) in a review of data encompassing a much wider age range, an age difference in

performance became evident only in comparison of people in their sixties and seventies to the younger samples. Canestrari (1968) also noted a greater performance deficiency in Ss over 60 years. Hence, selection of an older sample over 60 years of age for the present study was intended to maximize any age difference observed. Maximization of the age difference in performance was further enhanced by the paced nature of the verbal discrimination task. A two second presentation rate was used. As noted by Goulet (1972), in a consideration of task variables affected by aging, performance proficiency of the aged is generally reduced by pacing. The available response time in many cases determines the performance of elderly subjects on a given task. Goulet also considered the influence of nonspecific transfer on performance proficiency. This is of relevance in a comparison between the two age samples for the frequency of use of written material, verbal comparisons and/or participation in testing situations. Despite the lack of specific experience with the memory drum and the verbal discrimination task, the student status of the younger sample may be considered a source of positive nonspecific transfer to the experimental task. Goulet considered pretraining as a sort of equalizer for nonspecific transfer. And pretraining was employed in the present study. Nevertheless, the nonspecific transfer resulting from the ongoing scholastic activity of the younger

sample must be considered another factor maximizing the age difference in performance.

In another way, the age difference in performance sought in the present investigation was minimized. The older sample was selected from a population still active in the community. The Nehrke studies (1971, 1973) and those of Levinson and Reese (1967) indicated that greater regression in cognitive behavior was observed in aged subjects who were institutionalized. Consequently, it was anticipated that the general performance decrement found in the present sample of aged subjects would be minimal. Within the present sample, it was anticipated that the greatest performance decrement would be found among those subjects living at the Hermitage, the Methodist Home for the Aged. This differential performance decrement among the older sample was not observed as illustrated in Figure III. The residents of the Hermitage did well on the VD task.

Levinson and Reese (1967) in particular, noted a lack of cooperation from their elderly subjects when confronted with the experimental task. Taking this cue from them, the present task was designed to be soluble. The length of the task was shortened deliberately to avoid the onset of frustration and the consequent refusal to continue with the task.

Despite this precaution, the investigator did encounter some initial resistance to the task from the older subjects. They responded well to encouragement, however, and once

pretraining had begun, they were cooperating fully with the investigator. They invariably verbalized great satisfaction when they reached criterion, and curiosity. The investigator spent from five to 30 minutes with each older S after the experimental task had been completed, explaining the purpose of the study and discussing the present sociocultural position of an older person.

Although in general cooperation was evident among the older subjects, the investigator early noted that a number of them omitted responses to some of the verbal stimuli. In the present study, a greater frequency of older subjects than younger subjects omitted responses during task acquisition. This difference in frequency was significant ($X^2 = 22.74$, $p < 0.001$). Canestrari (1968), cited earlier, found it necessary to separate errors of omission from errors of commission on the paired associates task. His 60 year old sample made significantly more errors of omission than his younger sample. Canestrari had manipulated this type of error in an earlier study (1963), finding omissions reduced by a self-paced presentation schedule. Several hypotheses have been advanced to account for both the greater number of omissions in the performance of older subjects and their greater difficulty in responding during a paced task. Goulet (1972) noted the inability of the aged to respond in short intervals of time,--implying some deficit in response availability. This interpretation was likewise broached by Monge

and Hultsch (1971). Canestrari suggested a deficit in the short-term storage mechanism of the elderly, where maintenance of an ongoing pattern of stimulation is impossible in the face of fresh stimulus input. Both he and Nehrke (1973) have also explored the possibility of a deficit in the ability of the aged to employ mnemonic devices. A differential test of these hypotheses has yet to be accomplished.

It was observed in the present investigation that the older subjects generally were capable of processing the information received in the two-second presentation interval. Only two aged male subjects omitted all five responses on their first trial. Where response to a given stimulus pair was omitted in one trial, on succeeding trials it could be present and correct. (The statistical probability of this occurrence, however, was not tested.) Consequently, it is felt that response inavailability played a generally greater role in determining the number of omits observed in the present study. No consistent observations with regard to the use of mnemonics by either aged sample were made. Subsequent investigations may concern themselves with differentiating the relative contributions of response inavailability, short-term storage deficits, and use of mnemonic devices to the performance inefficiency of the aged.

Current studies in the field of verbal learning have employed number of errors to criterion as their data for analysis. Consideration of the foregoing discussion supports

the use in the present study of trials to criterion. Errors to criterion appears to be a difficult to interpret, albeit inappropriate, measure for use in an ontogenetic study of later adulthood, unless after Canestrari, errors of commission are separated from errors of omission. Then the question still remains of what consideration should be given to errors of omission.

Some interesting behaviors were observed during task performance. As mentioned previously, three subjects were eliminated from the study: one older man, one older woman, and one younger man. All three of these Ss performed well on the pretraining list. None of these subjects completed the experimental task; all evidenced marked frustration. The cause of this, inasmuch as it can be ascertained by the experimenter, was an inability of the subjects to comprehend that they were seeing the same list repeatedly, and that for each pair of syllables, one was always correct. Technically, the frequency theory would suggest that awareness of these task cues should not have been necessary to acquisition of the VD lists. It must remain an unanswered question whether, were it not for the onset of frustration, these three Ss would have acquired the VD lists to criterion.

As mentioned previously the stimuli appeared to be coming too fast for two older men on the first trial of the VD task: they omitted all five responses the first time through the list. The very same phenomenon was observed in

one young woman subject. This could be construed as inattention, although all three subjects were oriented toward the memory drum and appeared to be attending. Again, either a dysfunction of the short-term storage mechanism, or a lack of response availability may account for this series of omissions.

Consideration of hypothesis behavior is difficult given the verbal discrimination paradigm. Since the task is complex--in this instance, five discriminations were being learned simultaneously--determination of the presolution period is difficult: it could include all the trials before criterion is reached, or only those trials for each pair of items when those items are incorrectly given. Another question that arises is the number of responses that must be considered to determine whether an hypothesis is being used. The present experimental situation was structured so that performance on the list would be perfect during the first trial if S adopted an alternation hypothesis. Five of the 64 subjects in this study did this: three young men, one young woman, and one older woman. Interestingly enough, only three of these five subjects (one young woman, two young men) were able to gain the information they needed from this first perfect recitation to choose the correct alternatives on the second trial when the alternation hypothesis no longer worked.

No significant difference in performance on the experimental task was found between the sexes. This was consonant

with the findings of Nehrke (1973) with respect to performance on a discrimination learning and transfer task. Performance of younger men, particularly on complex tasks, has been observed to be superior to that of women. While the present data do not support this contention to a significant extent, it must be noted that both groups of men performed slightly better on the task than their female counterparts.

The frequency theory (Ekstrand, Wallace and Underwood, 1966) makes independent predictions with respect to the effects of meaningfulness and similarity of the stimulus pairs on acquisition of the VD list. Similarity of stimulus pairs is supposed to increase the difficulty of the VD list. Meaningfulness is predicted to have no effect upon acquisition of the VD list: however, greater difficulty with highly meaningful stimuli could result from the greater number of interfering associations to such stimuli, or greater difficulty with low meaningful stimuli could result from lack of integration of the stimulus unit.

In the present investigation, neither the main effects of meaningfulness nor formal similarity reached significant levels; however, the interaction between meaningfulness and formal similarity was significant. Analysis of the simple effects of meaningfulness and formal similarity revealed two significant findings: when the CVC stimulus pairs were highly meaningful, the difference between high and low similarity stimulus lists was significant; when the CVC stimulus

pairs were of low similarity, the difference between high and low meaningful stimulus lists was significant.

With respect to the meaningfulness of the VD stimulus lists, the results of the present investigation revealed that with low similarity stimulus lists, the dimension of meaningfulness can operate significantly: low similarity-low meaningfulness lists are more difficult to learn than low similarity-high meaningfulness lists. Thus it appears that with distinctly different stimuli comprising VD pairs, the dimension of meaningfulness will operate to make the VD task more or less difficult.

Regarding the effect of similarity on the VD task, past research while tending to support the prediction of the frequency theory, nevertheless confounded intrapair similarity with intralist similarity (Underwood and Archer, 1955; Yelen, 1969). Those investigators who did separate the two found support for the frequency theory only from intralist similarity (Edwards, 1966; Kausler and Olson, 1969). The present research findings indicate that support for the position of the frequency theorists with respect to the similarity of stimulus pairs can best be gotten from, and may be restricted to the use of highly meaningful stimuli.

Runquist (1973) has been exploring the different types of formal similarity possible, using the paired associates paradigm. He has found that the location of the similar letters can either facilitate or hinder stimulus selection.

Consideration of the position of the different letter in the formally similar stimulus pairs in the present investigation was confounded by the position of the stimulus pairs in the list and the number of stimulus pairs with the different letter in the same position. Within this context, however, there was some indication of greater difficulty on the stimulus pairs when the vowel, the middle letter, was the different letter, particularly when this occurred in a low meaningful stimulus list (re Figure IV). This indication remains to be verified experimentally,--what structure must the similar stimuli take to either facilitate or hinder performance with varying formal intrapair similarity.

Reiteration: Considerations and Implications. The inefficiency noted so pervasively in the performance of persons over 60 years of age on cognitive tasks can be extended to include their performance on verbal discrimination tasks. Relative importance of factors contributing to this performance inefficiency, whether they be response inavailability, short term storage deficits, or inefficient use of mnemonic devices, could not be ascertained from the given datum. Male subjects functioned slightly (but not significantly) more efficiently on the given paradigm than female subjects across both age groups.

The tenet advanced by the frequency theorists relative to the stimulus dimension of similarity in a verbal discrimination task received support from the present investigation,

restricted to the use of highly meaningful stimuli. It was also evident from the present investigation that the stimulus dimension of meaningfulness is operable in the verbal discrimination task when the stimuli are of low similarity or are distinctly different.

Chapter VI

SUMMARY

With a verbal discrimination task, subject variables of age and sex, and stimulus variables of meaningfulness and formal intrapair similarity were investigated. Overall analysis of variance of the 2 X 2 X 2 X 2 factorial design yielded a significant age difference in performance, on trials to criterion, between the samples of mean age 76.4 years and mean age 20.2 years. Such a difference in favor of the younger sample, is consistent with and extends existing ontogenetic research.

None of the other tests for the action of the main effects on the experimental task reached significance; however, the interaction between the consonant-vowel-consonant stimulus dimensions of meaningfulness and formal intrapair similarity did reach significance. Two significant results emerged from the analysis of the simple effects of meaningfulness and formal intrapair similarity: formal intrapair similarity operates to make the VD task more difficult only with highly meaningful stimuli; the dimension of meaningfulness operates only when the VD stimulus pairs are of low similarity.

APPENDIX A. Order of Presentation

HS-HM	LS-HM	HS-LM	LS-LM
SED - SEP	HAR - PUD	XAP - XAG	ZOK - TUJ
FAL - FAC	RAZ - LIK	VUB - VUY	ZAV - QIG
HIC - LIC	GER - POS	RIW - CIW	CIJ - YEX
NAV - NOV	SIG - FAL	CIJ - CEJ	WOJ - XIR
SOR - WOR	WOR - NUM	QOF - ZOF	GEJ - VUY
NAV - NOV	SIG - FAL	CIJ - CEJ	WOJ - XIR
FAC - FAL	LIK - RAZ	VUY - VUB	QIG - ZAV
LIC - HIC	POS - GER	CIW - RIW	YEX - CIJ
SEP - SED	PUD - HAR	XAG - XAP	TUJ - ZOK
SOR - WOR	WOR - NUM	QOF - ZOF	GEJ - VUY
FAL - FAC	RAZ - LIK	VUB - VUY	ZAV - QIG
SEP - SED	PUD - HAR	XAG - XAP	TUJ - ZOK
NOV - NAV	FAL - SIG	CEJ - CIJ	XIR - WOJ
WOR - SOR	NUM - WOR	ZOF - QOF	VUY - GEJ
LIC - HIC	POS - GER	CIW - RIW	YEX - CIJ
HIC - LIC	GER - POS	RIW - CIW	CIJ - YEX
WOR - SOR	NUM - WOR	ZOF - QOF	VUY - GEJ
SEP - SED	PUD - HAR	XAG - XAP	TUJ - ZOK
FAC - FAL	LIK - RAZ	VUY - VUB	QIG - ZAV
NOV - NAV	FAL - SIG	CEJ - CIJ	XIR - WOJ
FAC - FAL	LIK - RAZ	VUY - VUB	QIG - ZAV
SOR - WOR	WOR - NUM	QOF - ZOF	GEJ - VUY
NAV - NOV	SIG - FAL	CIJ - CEJ	WOJ - XIR
HIC - LIC	GER - POS	RIW - CIW	CIJ - YEX
SEP - SED	PUD - HAR	XAG - XAP	TUJ - ZOK

APPENDIX B. Pretraining List

Example:

DOW - VIP

VIP - DOW

Pretraining:

NAW - CAY

TAS - PIC

NAW - CAY

PIC - TAS

CAY - NAW

PIC - TAS

APPENDIX C. Instructions

This is a memory drum. In the window are two syllables. (Point to window) You will see several pairs of syllables like this pair. They are pronounced by pronouncing the three letters that make up the syllable. (Pronounce them: DOW - VIP)

For each pair of syllables, one syllable will be the correct syllable. It has been arbitrarily designated correct. Guess which one of these is correct.. (Pause for answer, roll to correct syllable)

After you see each pair of syllables, then you will see the correct syllable appear by itself.

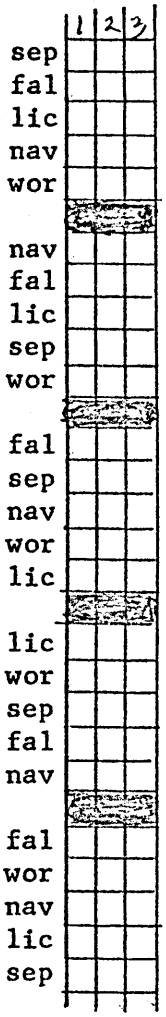
Here is the pair of syllables again. This time on opposite sides. Do you remember which one is correct?

When you see each pair of syllables you must tell me which one you think is correct, before the correct syllable shows up.

Let's try a couple. (Run through pretraining list)

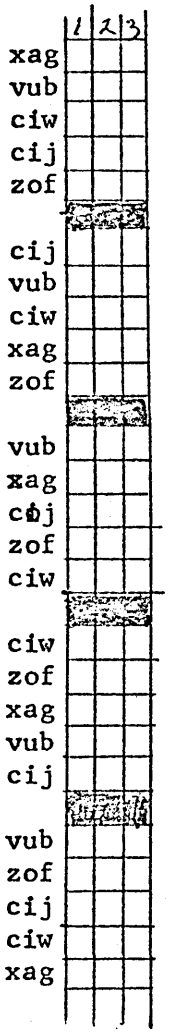
Now let's try a longer list.

HS-HM



NAME"
AGE
OCCUPATION
SEX

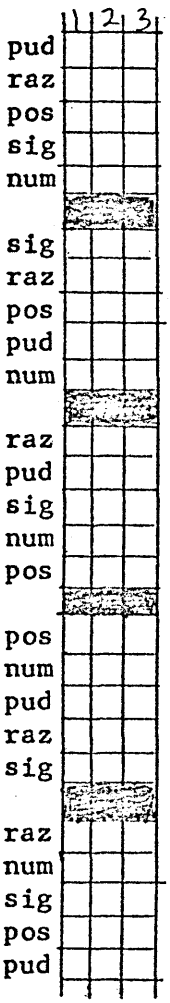
HS-LM



NAMR
AGE
OCCUPATION
SEX

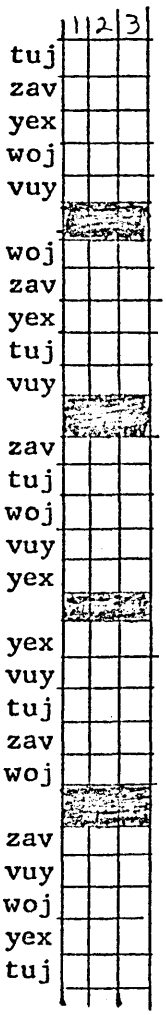
APPENDIX D. Scoring Sheets

LS-HM



NAME
AGE
OCCUPATION
SEX

LS-LM



NAME
AGE
OCCUPATION
SEX

BIBLIOGRAPHY

Baker, R. A., and Lawrence, D. H., The differential effects of simultaneous and successive stimuli presentation on transposition, Journal of Comparative and Physiological Psychology (1951), 44, p. 378-382.

Battig, W. F., Williams, J. M., and Williams, J. G., Transfer from verbal discrimination to paired-associate learning, Journal of Experimental Psychology (1962), 63, p. 258-268.

Canestrari, R. E., Paced and self-paced learning in young and elderly adults, Journal of Gerontology (1963), 18, p. 165-168.

Canestrari, R. E., Age changes in acquisition, In G. A. Talland (ed.), Human Aging and Behavior, Recent Advances in Research and Theory, New York: Academic Press, 1968.

Edwards, D. C., Similarity in verbal discrimination, Perceptual and Motor Skills (1966), 23, p. 815-820.

Ekstrand, B. R., Wallace, W. P., and Underwood, B. J., A frequency theory of verbal-discrimination learning, Psychological Review (1966), 73, p. 566-578.

Fozard, J. L., Nuttall, R. L., and Waugh, N. C., Age-related differences in mental performance, Aging and Human Development (1972), 3, p. 19-43.

Goulet, L. R., New directions for research on aging and retention, Journal of Gerontology (1972), 27, p. 52-60.

Kausler, D. H. and Olson, R. D., Homonyms as items in verbal discrimination learning and transfer, Journal of Experimental Psychology (1969), 82, p. 136-142.

Keppel, G., Association by contiguity: Role of response availability, Journal of Experimental Psychology (1966), 71, p. 624-628.

Krechevsky, I., A study of the continuity of the problem solving process, Psychological Review (1938), 45, p. 107-133.

Lawrence, D. H., and DeRivera, J., Evidence for relational discrimination, Journal of Comparative and Physiological Psychology (1954), 47, p. 465-471.

Levinson, B., and Reese, H. W., Patterns of discrimination learning set in preschool children, fifth-graders, college freshmen, and the aged, Monographs of the Society for Research in Child Development, Serial no. 115, 1967, 32(7).

Logan, F. A., Essentials of a theory of discrimination learning, In H. H. Kendler and J. T. Spence (eds.), Essays in neobehaviorism, New York: Appleton-Century-Crofts, 1971.

MacKintosh, N. J., Selective attention in animal discrimination learning, Psychological Bulletin (1965), 64, p. 124-150.

McCollogh, T. L., and Pratt, J. G., A study of the presolution period in weight discrimination, Journal of Comparative and Physiological Psychology (1934), 18, p. 271-290.

Monge, R. H., and Hultsch, D. F., Paired-associate learning as a function of adult age and the length of the anticipation and inspection intervals, Journal of Gerontology (1971), 26, p. 157-162.

Nehrke, M. F., Age and sex differences in discrimination learning and transfer of training, Journal of Gerontology (1973), 28, p. 320-327.

Nehrke, M. F., and Coppinger, N. W., The effect of task dimensionality on discrimination learning and transfer of training in the aged, Journal of Gerontology (1971), 26, p. 151-156.

Noble, C. D., Measurements of association value (a), rated associations (a'), and scaled meaningfulness (m') for the 2100 CVC combinations of the English alphabet, Psychological Reports (1961), 8, p. 487-521.

Paul, H., Ratio of correct to incorrect alternatives: A test of the frequency hypothesis of verbal discrimination learning, Journal of Experimental Psychology (1971), 88, p. 285-286.

Radtke, R. C., McHewitt, E., and Jacoby, L., Number of alternatives and rate of presentation in verbal discrimination learning, Journal of Experimental Psychology (1970), 83, p. 179-181.

Reid, L. S., The development of noncontinuity behavior through continuity learning, Journal of Experimental Psychology (1953), 46, p. 107-112.

Runquist, W. N., The interaction between meaningfulness and stimulus similarity, Journal of Verbal Learning and Verbal Behavior (1973), 12, p. 150-154.

Schulz, L. S., and Lovelace, E. A., Interpair acoustic and formal similarity in verbal discrimination learning, Journal of Experimental Psychology (1972), 94, p. 295-299.

Spear, N. E., Ekstrand, B. R., and Underwood, B. J., Association by contiguity, Journal of Experimental Psychology (1964), 67, p. 151-156.

Spence, K. W., The nature of discrimination learning in animals, Psychological Review (1936), 43, p. 427-449.

Underwood, B. J., and Archer, E. J., Studies in distributed practice: XIV. Intralist similarity and presentation rate in verbal discrimination learning of consonant syllables, Journal of Experimental Psychology (1955), 50, p. 120-124.

Underwood, B. J., Shaughnessy, J. J., and Zimmerman, J., Learning-to-learn verbal discrimination lists, Journal of Verbal Learning and Verbal Behavior (1962), 11, p. 96-104.

Warner, W. L., Meeker, M., and Eells, K., Social class in America: The evaluation of status, New York: Harper, 1960.

Winer, B. J., Statistical principles in experimental design, New York: McGraw-Hill, 1962.

Yelen, D., Verbal discrimination as a function of similarity and frequency of incorrect items, Journal of Verbal Learning and Verbal Behavior (1969), 8, p. 552-553.

VITA

Arleen Helen Burke was born on December 27, 1945 at Neptune, New Jersey. She was graduated from the George Washington University with distinction and special honors in psychology in June 1969. Her graduate studies at the University of Richmond began the following autumn under the auspices of a University Fellowship. Her marriage to Theodore Ross Dempster in January 1971, delayed the completion of her graduate work to the present time.