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PREDICTION OF LEARNING BY GROUP RATED ASSOCIATION VALUES
VERSUS INDIVIDUAL RATED ASSOCIATION VALUES

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Philosophy in the Graduate
School of The Ohio State University

By

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INTRODUCTION

In the latter part of the nineteenth century, Ebbinghaus (8) invented the nonsense syllable by placing a vowel between two consonants. He used these consonant-vowel-consonant combinations to form the material that made up the tests that were used in his work on memory.

Ebbinghaus described the positive aspects of the nonsense syllable as follows:

The nonsense material just described offers many advantages, in part because of this very lack of meaning. First of all, it is relatively simple and relatively homogeneous. In the case of the material nearest at hand, namely poetry or prose, the content is now narrative in style, now descriptive, or now reflexive . . . associations which dart here and there, different degrees of interest . . . all this is avoided with our syllables. Among many thousand combinations there occur scarcely a few dozen that have a meaning and among these there are again only a few whose meaning was realized while they were being memorized (8, p. 23).

Ebbinghaus pointed to the limitation of the consonant-vowel-consonant combination by stating:

However, the simplicity and homogeneity of the materials must not be overestimated. It is far from ideal. . . . Again to particularize, the homogeneity of the series of syllables falls considerably short of what might be expected of it. These series exhibit very important and almost incomprehensible variations as to the ease or difficulty with which they are learned (8, p. 23).

The nonsense syllables, even with these limitations, were more suited to the experiments in memory than poetry and prose, thus they were used. No effort was made to study the difference in the degree of difficulty with which the nonsense syllables were learned.

Determining association value

It was not until almost 40 years later (1928) when Glaze conducted an experiment for the

. . . purpose of testing the association value of what is commonly known as nonsense syllables. It is well known that many of the so-called nonsense syllables lend themselves to some form of associations be the connections ever so distant and abstract. So far as the writer knows, no one has attempted to secure a list of which it can be truly said that they are comparatively free from ready-formed associations (1) or that they are equally easy (2) to all subjects (9, p. 255).

After Glaze constructed all of the consonant-vowel-consonant combinations and eliminated all the English words, 2019 syllables remained. (Ebbinghaus found about 2,300 syllables.) Glaze presented these syllables to 15 subjects, one subject at a time, by means of a tachistoscope. The experimenter spelled each syllable at the time it was shown, and the maximum exposure time per syllable was three seconds. If an association were made in less than three seconds, the next syllable was presented, but the exposure time was never less than two seconds.

When the nonsense syllable appeared, the subject was to indicate in one or two words what it meant to him, if anything. An experimenter, unknown to the subject, was writing down the responses of the subject. If the syllable meant something to the subject, but if the subject could not state it in the three seconds, he was to say "yes." If the syllable meant nothing, he was to remain silent.

The association value was determined for each syllable by the percentage of subjects who made an association with the syllable. If all the subjects made an association, the syllable was said to have 100 per cent association value. If no subject made an association, the syllable was said to have zero association value. Percentage values were computed between these two extremes.

In 1933, Hull (12), after inspecting the procedure used by Glaze, stated

An inspection of the latter list (Glaze) caused the writer to wonder whether Glaze's findings might not be, in part, the result of the particular technique employed in the investigation (12, p. 730).

To duplicate an actual memory experiment while making associations, Hull had his subject make associations while learning the nonsense syllables in a serial learning experiment. He used 20 subjects and determined association value by the Glaze procedure. His results agreed only in a general way with those of Glaze.

In 1934, Krueger (15) performed an experiment to determine the relative difficulty of 2,183 nonsense syllables, using a much larger group of subjects than did Glaze. A total of 586 college students participated in the experiment, but no subject responded to all the syllables. Here the subjects wrote their responses, the time per syllable was about seven seconds, and the association value was computed by the Glaze procedure. Aside from some procedural differences, the main difference in this experiment and the Glaze experiment was an increase in the number of subjects rating each syllable. Where Glaze had used 15 subjects, Krueger used over 200 subjects per syllable.

In 1935, Witmer (35) used three-place consonant syllables, rather than consonant-vowel-consonant syllables to determine association value. These syllables were presented on a memory drum to 24 subjects, one subject at a time. Association value was determined by the Glaze procedure. Witmer found that the total number of responses had no correlation with intelligence or size of vocabulary.

Noble (22) rated dissyllables by having his subjects write all the things the dissyllables elicited in a 60 second period. Mandler (18) used nonsense syllables and had his subjects write all the associations he could in 30 seconds.

Other methods of rating stimuli
which correlate with association
value

The following methods have all been used to rate stimuli and each method yields results which correlate highly with association values. Underwood and Schulz (34) used pronunciability of the verbal unit. Noble (23) had subjects rate the familiarity of the verbal unit. Richardson and Erlenbacker (27) had the subjects to rate the paired-associate learning material as to how fast they thought they could learn the response unit once the stimulus portion had been presented. Noble, Stockwell, and Pryer (25) had subjects rate nonsense syllables as to the number of different things or ideas the subject thought the syllable suggested.

Except for the Hull study mentioned above, all of these studies correlate highly with each other. Whether the subject has the material presented for three seconds or 60 seconds, whether he responds with a short verbal response or writes all the things he can think of in 60 seconds, whether he responds to pronunciability, familiarity, believed ease of learning, or the believed number of ideas suggested, the rank ordering of these verbal units is essentially the same. The verbal units that were used in these ratings were nonsense syllables, consonant syllables, and dissyllables.

Investigation of learning as a
function of association value

Glaze, in 1928, first attempted to order syllables along an association continuum and McGeoch (17), in 1930, was the first to investigate systematically learning as a function of the differences in association values.

McGeoch summarizes his results:

If we compare only lists of 0, 53 and 100 per cent association value, the data of the three experiments show unequivocally a steady increase in degree of learning with increase in association value. . . . It is equally evident that the data upon difficulty of learning confirm the general result that ease of learning varies directly with the meaningfulness of the material (17, p. 425-426).

This early work has been followed by Sauer (29), Davis (6), Noble (21), Kimble and Dufort (14), Mandler and Huttenlocher (19), Underwood and Richardson (33), Noble and McNelly (24) and Noble, Stockwell, and Pryer (25). All of these studies agree in showing that as association value increases, the rate of learning increases; and, as association value decreases, the rate of learning decreases. These studies also indicate that the learning does not produce a smooth curve, even though a large number of subjects are used. This is true for both serial and paired-associate learning.

Influence of association value in stimulus versus association value in the response

The studies of Stoddard (31), Kimble and Doufort (14), Cleutat, Stockwell, and Noble (4), L'Abate (16), Hunt (13), and Morikawa (20) all agree in showing that when the stimulus and the response are varied independently, both are related to learning; but the magnitude of the effect is greater for association value in the response unit, rather than for association value in the stimulus unit.

Determining association value for numbers

Of all the verbal units used to determine relative association values up to 1962, none of these has included numbers; yet, numbers have been used in verbal learning experiments (1) (28).

In 1962, Battig and Spera did scale the numbers from 0 to 100 and their particular technique and results are reported elsewhere in this report.

Purpose of this study

It is a consistent finding that various stimulus items can be scaled for association value and, even though a wide variety of scaling techniques have been used, the rank ordering of these items is highly reliable. Glaze (9); Krueger (15); Hull (12); Witmer (35); Mandler (18);

Noble (22); Underwood and Schulz (34); Noble (23); Richardson and Erlenbacker (27); and Noble, Stockwell, and Pryer (25). Making use of these two knowns, this study proposes to rate numbers for association value, obtaining both group norms for association value (all the studies to date have reported only group norms) and individual evaluation for association value, and investigate whether the group or individual values are better predictors of rate of learning in a paired-associate learning task. This has rather broad implications for all of psychology in that there is considerable theoretical interest in the idiographic versus the nomothetic approach in psychology. The associative-probability theory would suggest that faster learning rates would be predicted from the individual ratings, rather than the group norms.

METHOD

Phase one: rating numbers

Two hundred seventy-one students enrolled in an elementary psychology course were each given a test booklet (Appendix I) containing 50 numbers to be rated, plus instructions.

Instructions

The instructions were adapted from Noble, Stockwell and Pryer (25), and stated, in part, "This is a test to find out how many associations you have to certain numbers. You will be given a list of selected numbers between 1 and 100, and you are to rate each number relative to the number of things or ideas it makes you think of." The ratings were to be made by placing a check mark on a five-inch line to the right of each number. Under the line was printed from left to right the words none, below average, average, above average, and very many. The instructions contained two examples. "Take the number 1776. Pronounce it, look and think about the number for several seconds. This number probably makes you think of many things. 1776, Declaration of Independence, George Washington, Liberty Bell, Philadelphia, Revolutionary War, Birthday,

Flags, Holiday, Pioneers, History. You have a very large number of associations to 1776. For this reason, 1776 would be rated in the highest category (very many)." The other example was 3110. "Very likely this number is meaningless to you. That is, 3110 does not make you think of anything. For this reason 3110 would be rated in the lowest category (none)."

Numbers rated

The numbers to be rated were 1, 6, 7, 9, 11, 15, 16, 17, 18, 20, 25, 26, 27, 28, 35, 36, 37, 38, 39, 43, 44, 45, 48, 49, 50, 52, 55, 59, 63, 66, 67, 70, 72, 75, 79, 80, 81, 83, 84, 85, 87, 89, 90, 91, 92, 93, 94, 98, 99, 100. These numbers were selected from the Battig and Spera (2) list and cover the entire range of the mean association value scale (Appendix II).

Placing numbers in test booklet

The order in which the numbers appeared in the test booklet was determined as follows. First, the 50 numbers were randomly assigned a sequential order. Four different randomly assigned sequential orders were determined. A given sequential order was presented in the test booklet by placing 12 numbers on each of two pages and 13 numbers on each of two pages. These pages were counterbalanced to insure that each page appeared in

positions 1, 2, 3 or 4 an equal number of times. This same procedure was used for each of the four randomly assigned sequential orders. The use of this procedure insured that each number was relatively unbiased with respect to ordinal position within the test booklet and immediate context of other numbers which preceded or followed it.

It was possible to compute the rated association value for each number by converting the line on which the subject made his rating into a 1-2-3-4-5 scale corresponding it to none, below average, average, above average, and very many, respectively (2).

From seven to ten days later, 207 of these subjects rated these same numbers using the method described above. This gave a test-retest rating for each of these subjects.

Phase two: selection of subjects

Rated association value

Two rated association values were computed for each number. One association value for each number was computed, using the rating of every subject who took the test. This is referred to as the "group rated association value." Another association value was computed for each individual, using his test-retest ratings. This is referred to as the "individual rated association value."

Each of the 50 numbers now had two rated association values, one for the group and one for the individual.

Group rank order of rated association value

The rated association values of the group were placed in rank order according to mean association values and divided into three groups representing "low rated association values," "intermediate rated association values" and "high rated association values." The numbers included in the group low rated associated values were 26, 27, 37, 38, 43, 52, 59, 63, 67, 70, 72, 79, 80, 81, 83, 84, 85, 87, 89, 91, 92, 93, and 94. The numbers included in the group high rated association values were 1, 6, 7, 9, 11, 15, 16, 17, 18, 20, 25, 45, 49, 50, 75, 98, 99 and 100.

Individual rank order of rated association value

The next step was to place each of the numbers in a low, intermediate, or high category according to the individual rated association values. It will be recalled that the individual made his original ratings on a line that was converted into a 1-2-3-4-5 scale. His test-retest ratings were simply added. Examples: If the subject rated a given number "none" on the first test, this was converted into the scale value 1. If the subject gave the same rating to the number on the second test, the two

ones were added to give a value of two. Using this method of computation, values on the test-retest of 2, 3, or 4 were assigned to the individual low association value. A subject rating a number on the test-retest as follows would have the number assigned to the low category: 1-1; 1-2; 2-2; or 1-3. A subject rating the numbers on test-retest as follows would have numbers assigned to the high category 4-4; 4-5; 3-5; or 5-5. Values of 8, 9 or 10 were assigned to the individual high category. The test-retest values of 5, 6 or 7 were assigned the intermediate category.

Rank orders of numbers--group and individual

At this point each number for each subject was in a low, intermediate, or high category according to the group rated association value and the same number was placed in a low, intermediate, or high category according to the individual rated association value. The placement of a given number in a specific category according to the group rated association value or the individual rated association value may or may not agree.

Selection of subjects to continue in study

Subjects were selected to continue in the experiment if the low, intermediate or high category in which they placed a number agreed with or differed from the group

low, intermediate, or high category in specific ways. The desired category pattern was for three numbers to have group and individual agreement in the high category (H-H) and another three numbers to have group and individual agreement in the low category (L-L). Another six numbers were placed in group or individual categories as follows. Three of the numbers must be in the low category for the group and the high category for the individual (L-H); and another three numbers must be in the high category for the group and the low category for the individual (H-L) (see Table 1). Of the 207 test-retest subjects, 29 conformed to this configuration.

Phase three: paired-associate learning

At this point, each of the 29 subjects had his own list of rated numbers which conformed to the specifications given above. These numbers were used as the stimulus or the response term, as applicable, to construct a paired-associate learning task for each subject. The paired-associate learning task was conducted from three to four weeks after the second scaling of the numbers.

TABLE 1

ASSIGNMENT OF NUMBERS TO PAIRED-ASSOCIATE LEARNING
TASK ACCORDING TO GROUP MEAN ASSOCIATION VALUE
VERSUS INDIVIDUAL RATED ASSOCIATION VALUE

3 Numbers (H-H)	3 Numbers (H-L)
Group (H) high rated association value	Group (H) high rated association value
Individual (H) high rated association value	Individual (L) low rated association value
3 Numbers (L-H)	3 Numbers (L-L)
Group (L) low rated association value	Group (L) low rated association value
Individual (H) high rated association value	Individual (L) low rated association value

Experiment 1

Experiment 1, composed of 14 subjects, six males and eight females, had a rated number as the stimulus term and a word as the response term. The words selected for the response term were selected because of their close similarity in ease of learning as determined by an unpublished experiment performed by Mr. Arno F. Wittig under the direction of Dr. D. D. Wickens at The Ohio State University. These words were originally selected from the most frequent 1,000 words in the Thorndike-Lorge Word List (32) and represent the most frequently recalled words in a free recall task varying in length of time from one to 24 hours. The twelve words were SHOULDER, PARTY, VALLEY, MONEY, HEAVEN, BROTHER, LADY, CAPTAIN, PROBLEM, KITCHEN, CITY, and FLOWER.

Experiment 2

Experiment 2, composed of 15 subjects, five males and ten females, had a word, selected by the procedure described above, as the stimulus term and a rated number selected by the procedure described above for the response term.

Assignment of subjects to experiments

Subjects were randomly assigned to Experiment 1 or Experiment 2.

Equipment

A Lafayette Memory Drum was used to present the paired-associate learning task. The subject pronounced both the stimulus and the response the first time through the list and on subsequent presentation attempted to anticipate the response.

Presentation rate

The stimulus member was exposed alone for two seconds followed by a two-second exposure for the stimulus unit and response unit together. The intertrial interval was eight seconds.

Order of presentation

To prevent serial learning, each list was arranged in four different orders. The orders were counterbalanced to insure that the numbers in the high rated association value for the group and the high rated association value for the individual (H-H); the numbers in the low rated association value group and the low rated association value for the individual (L-L); the numbers in the high rated association value for the group and the low rated association value for the individual (H-L); and the numbers in the low rated association value for the group and the high rated association value for the individual (L-H), appeared in first, middle, and last positions in

the list an equal number of times. The four different orders were also arranged to insure that no number preceded or followed a number if it had done so in a different order. This arrangement of orders was constant for each of the 29 subjects.

Assignment of words

The words used in the paired-associate learning task were assigned to insure that each word appeared in both Experiments 1 and 2 in the H-H; L-L; H-L; L-H positions an equal number of times. This procedure was employed to insure that each word would have equal weight throughout the experiments. After the number-word pairings were completed, three competent judges independently studied each of the 29 lists of paired-associates to insure there were no obvious associations, such as "7 - HEAVEN." Where such patterns were found, corrections were made.

Criterion

The trial on which the subject first correctly anticipated the response was used as the criterion for learning. Dowling and Braun (7) carried learning to a criterion of two successive perfect trials, while many other studies used one perfect trial as criterion. Using the two successive perfect trials, the absolute number of

trials was increased; but the relative rate of learning remained the same in learning the extremes of meaningfulness.

Instructions

The experimenter read standard paired-associate learning instructions to each subject (Appendix III). The subject was given an opportunity to ask questions.

Control group

By constructing the paired-associate list for each subject to learn of equal number of H-H; L-L; L-H and H-L association value numbers, each subject acted as his own control. Peters (26) points out that certain interactions can be expected when there is intralist variability rather than interlist variability. This interaction, if it does occur, will tend to minimize differences between variables. This study uses intralist variability and, if differences are found between the variables using this configuration, it can be expected that the differences would be even more pronounced were interlist variability used.

After paired-associate learning task

After the paired-associate learning task was completed, the subject was asked to rate the numbers he had

used in the experiment relative to the number of things or ideas it made the subject think of. These were the same instructions, the same numbers, and the same format that the subjects had used in rating these numbers two times previously. This gave a third and independent rating to the numbers. Throughout this study all numbers were written as numbers rather than spelled as words.

RESULTS

The majority of the evidence points to the fact that words, consonant-vowel-consonant combinations, or nonsense syllables are learned faster if the rated association value is high and that these are learned slower if the rated association value is low. In this study, both a group rated association value and an individual rated association were computed for each of 50 numbers. These numbers were placed in a paired-associate learning task and the problem under consideration was to determine whether the individual would learn according to his individual association value or according to the group rated association value. Traditionally, the group rated association values have been used in experiments conducted in this area.

Computing group mean rated association values

In 1962, Battig and Spera published the rated association values of numbers from 0 to 100 and reported individual differences in rating numbers of considerable magnitude as indicated by the relatively large standard deviations for each number (2, p. 201). Cochran and

Wickens experiment was in the instructions given the subject. Two examples were given in the Cochran and Wickens experiment (Appendix I). A significant difference in the absolute value of the numbers for the two populations suggests that the computed values are valid only within the context of the particular experiment. It seems probable that the example 1776 as the high frequency association number suppressed the values assigned to other numbers. Battig and Spera did not use an example for their association items. Cochran and Wickens also found a relatively large standard deviation for each number. The rank order correlation of the mean association values of the two studies was .91 and the product-moment correlation ($\underline{r}$) was .92. Fifty of these numbers were scaled again for this experiment. The $\underline{r}$ between the mean association values of the test-retest in this study ($N = 207$) was .96. The $\underline{r}$ between the Battig and Spera study and the retest portion of this study was .91 (Appendix II). All of these correlations indicate high agreement between the group mean rated association values using the rating procedures employed in this study.

TABLE 2

EXPERIMENT 1 (STIMULUS IS NUMBER, RESPONSE IS WORD) TRIALS
TO CRITERION FOR EVERY SUBJECT IN EACH CATEGORY

Subject	High group- High individual ^a	High group- Low individual ^a	Low group- High individual ^a	Low group- Low individual ^a
1	22	17	17	22
2	13	16	20	21
3	12	13	15	18
4	7	15	19	18
5	19	30	16	21
6	44	26	28	39
7	11	14	22	20
8	11	14	15	17
9	17	13	11	20
10	15	9	26	26
11	7	14	24	18
12	15	22	18	19
13	15	17	14	16
14	12	9	12	15
Total	220	229	257	290

^aEach number listed here represents the total trials required to learn the three paired-associates in this category to criterion. The criterion was established as the first trial on which the subject correctly anticipated the response to the stimulus.

TABLE 3

EXPERIMENT 2 (STIMULUS IS WORD, RESPONSE IS NUMBER) TRIALS
TO CRITERION FOR EVERY SUBJECT IN EACH CATEGORY

Subject	High group- High individual ^a	High group- Low individual ^a	Low group- High individual ^a	Low group- Low individual ^a
1	8	12	11	12
2	10	8	13	15
3	15	18	15	13
4	14	26	16	23
5	6	8	17	9
6	22	15	24	34
7	19	17	14	16
8	8	14	9	11
9	20	19	29	19
10	11	12	22	8
11	9	14	24	19
12	6	21	17	26
13	9	7	13	14
14	18	18	15	17
15	8	8	8	14
Total	183	217	247	250

^aEach number listed here represents the total trials required to learn the three paired-associates in this category to criterion. The criterion was established as the first trial on which the subject correctly anticipated the response to the stimulus.

Individual idiosyncratic rated association value

The relatively large standard deviation of the mean of each number used allowed the experimenters to expect the type idiosyncratic ratings referred to in this study. Twenty-nine subjects rated idiosyncratically and were consistent over test-retest, thus, they were used in this study.

Scores for experiments 1 and 2

When examining Tables 2 and 3 it should be remembered that the lower the number the fewer trials required to learn, thus a faster rate of learning. In both Experiments 1 and 2, it is observed that the numbers that had high rated association values for both the group and the individual were learned at the fastest rate, while the numbers with low rated association values for both the group and the individual were learned slowest. This result is the usual finding when group rated association values are used and gives overall support to the findings reported in this study. It can be observed that the total trials to learn are higher for Experiment 1 than for Experiment 2. An analysis of variance (Table 7) indicates that this difference is not significant.

TABLE 4
RESULTS OF t TESTS FOR EXPERIMENT 1^a

Condition	vs.	Condition	Diff.	df	<u>t</u>	Signif.
H1 Gp H1 Ind 220		H1 Gp Lo Ind 229	9	13	.03	--
H1 Gp H1 Ind 220		Lo Gp H1 Ind 257	37	13	1.13	.30
H1 Gp H1 Ind 220		Lo Gp Lo Ind 290	70	13	3.93	.01
H1 Gp Lo Ind 229		Lo Gp H1 Ind 257	28	13	1.04	.40
H1 Gp Lo Ind 229		Lo Gp Lo Ind 290	61	13	2.59	.05
Lo Gp H1 Ind 257		Lo Gp Lo Ind 290	33	13	2.06	.10

^aCriterion scores are presented in Table 2.

TABLE 5
RESULTS OF t TESTS FOR EXPERIMENT 2^a

Condition	vs.	Condition	Diff.	df	<u>t</u>	Signif.
H1 Gp H1 Ind 183		H1 Gp Lo Ind 217	34	14	1.56	.20
H1 Gp H1 Ind 183		Lo Gp H1 Ind 247	64	14	2.74	.02
H1 Gp H1 Ind 183		Lo Gp Lo Ind 250	67	14	2.71	.02
H1 Gp Lo Ind 217		Lo Gp H1 Ind 247	30	14	1.15	.30
H1 Gp Lo Ind 217		Lo Gp Lo Ind 250	33	14	1.38	.20
Lo Gp H1 Ind 247		Lo Gp Lo Ind 250	3	14	.11	--

^aCriterion scores are presented in Table 3.

TABLE 6
COMPARISON OF RESULTS OF t TEST FOR CRITERION DATA

vs		Experiment One	Experiment Two	Trends in favor of	
				Group	Individual
(b,c)		not signif.		x	
H1 Gp	H1 Gp				
H1 Ind	Lo Ind		not signif.	x	
(a,d)		not signif.			x
H1 Gp	Lo Gp				
H1 Ind	H1 Ind		signif. .02	x	
(a,b)		signif. .01			
H1 Gp	Lo Gp				
H1 Ind	Lo Ind		signif. .02		
(a,b)		not signif.			
H1 Gp	Lo Gp				
Lo Ind	H1 Ind		not signif.		
(a,d)		signif. .05		x	
H1 Gp	Lo Gp				
Lo Ind	Lo Ind		not signif.		x
(b,c)		not signif.		x	
Lo Gp	Lo Gp				
Lo Ind	H1 Ind		not signif.	x	

Experiment One				Experiment Two			
H1 Gp	H1 Gp	Lo Gp	Lo Gp	H1 Gp	H1 Gp	Lo Gp	Lo Gp
H1 Ind	Lo Ind	H1 Ind	Lo Ind	H1 Ind	Lo Ind	H1 Ind	Lo Ind
220	229	257	290	183	217	247	250

- (a) Group rated association values would predict a significant difference between these two categories.
 (b) Individual rated association values would predict a significant difference between these two categories.
 (c) Group rated association values would not predict a significant difference between these two categories.
 (d) Individual rated association values would not predict a significant difference between these two categories.

t tests

Since the F for groups in Table 7 was significant, twelve t tests for matched groups were computed for each of the possible category combinations in both Experiments 1 and 2. These results are presented in Tables 4, 5, and 6. Here it is seen that when trials to criterion are taken as the dependent variable and rated association value is taken as the independent variable, the trend is in favor of group mean rated association in predicting rate of learning of a given subject. Six of the t tests favor group mean rated association values for predicting rate of learning of the numbers in this experiment; two of the t tests favor individual rated association values for predicting rate of learning; two of the t tests (H-L) versus (L-H) favor neither group norms nor individual norms, but the direction of the difference is in favor of the group. Two of the tests confirm other studies in finding a significant difference between the means of the H-H versus L-L categories; here the norms of the individual agree with the norms of the group and, traditionally, words and syllables having high group rated association values are learned faster than words and syllables having low group rated association values. This trend was demonstrated with numbers in this experiment.

TABLE 7
RESULTS OF ANALYSIS OF VARIANCE OF EXPERIMENTS 1 AND 2

Source	SS	DF	MS	F
Between <u>S</u>	2869.45	28		
Experiments (E)	232.92	1	232.92	2.39
<u>S</u> /exp.	2636.53	27	97.65	
Within <u>S</u>	2097.75	87		
Group (A)	327.80	1	327.80	13.64 ^a
Individual (B)	53.80	1	53.80	3.34 ^b
A x B	.43	1	.43	.019
A x E	.52	1	.52	.022
B x E	.52	1	.52	.032
A x B x E	25.87	1	25.87	1.15
A x <u>S</u> /E	648.93	27	24.03	
B x <u>S</u> /E	434.91	27	16.11	
A x B x <u>S</u> /E	604.97	27	22.41	
Total	4967.20	115		

^aSignificant at .01 level.

^bSignificant at <.10 level and > .05 level.

Analysis of variance

Table 7 is the results of an analysis of variance of Experiments 1 and 2. The same trend is noted here as was evident in the results of the t tests, namely the group rated association values are more important in predicting learning rate than is the individual rated association values. The group influence is significant at .01 level while the individual influence is observed as a trend. No interactions are evident. While it is true that the individual influence is not significant at the .05 level, the data indicate the significance level is between .10 and .05. Correlations indicate the group rated association values account for about 3.5 times as much of the variance as does the individual rated association values.

Product-moment correlations (r)

To pursue this trend, product-moment correlations (r) were computed to determine more of the relative influence of the rated association values of the group and the rated association values of the individual. To compute these r's, the trials to criterion were converted to z scores because of the relatively great absolute differences in the rate of learning of the individual subjects. The relative rate of learning was the area of

investigation in this study and not the absolute number of trials to learn the numbers in any specific category (H-H; L-L; L-H; or H-L). Data were available on the rated association value of the group, the rated association value of the individual, and the trials to reach the criterion for each number used in the paired-associate learning task. Each subject had his unique list of twelve numbers used in his learning task. For any specific number the rated association value of the group would always be the same; however, the individual rated association values would be unique to the individual. His individual rated association value may or may not agree with the rated association value of the group. The subjects had also rated the numbers a third time at the conclusion of his paired-associate learning task. This meant that there were four measures for each number used in the paired-associate learning task: X_1 the mean of test-retest individual association values; X_2 , the rated association value given the number immediately after the subject had completed the paired-associate learning task; X_3 , the group rated association value for each number; and X_4 , the criterion score converted to z scores. All possible combinations of $\underline{r}$'s were computed and are presented in Table 8. The N of 348 represents 29 individuals with 12 measures each.

TABLE 8

RESULTS OF CORRELATIONS IDENTIFIED IN THIS TABLE. ALL
CATEGORIES H-H; L-L; H-L; AND L-H WERE COMBINED.
N = 348

	Individual rated association values (test-retest)	Individual rated association values (time of paired- associate learning)	Group rated association value
Criterion	-.13 ^a	-.12 ^a	-.26 ^b
Group rated association value	.16 ^b	.25 ^b	
Individual rated association values (time of paired- associate learning)	.55 ^b		

^aSignificant at .05 level.

^bSignificant at .01 level.

^cNot significant.

Table 8 indicates that the group-rated association values correlate with the criterion $-.26$. This negative correlation is in the expected direction as the higher the rated association value the fewer number trials to learn. The correlations between the individual association values for the test-retest, three weeks before the paired-associate learning task, and the individual rated association values at the time of testing are $-.13$ and $-.12$. The correlations are nearly the same for the rated association value of the individual and the criterion, whether the ratings for the individual were obtained three weeks before the paired-associate learning task as a test-retest measure or an individual rating at the time of the paired-associate learning task. There is a correlation of $.55$ between the individual rated association values (test-retest) and individual rated association values (time of paired-associate learning). This is a substantial correlation, especially in view of the fact that the test-retest ratings were made under carefully controlled experimental conditions and the rated association values at the time of paired-associate learning were made immediately after the subject had learned these twelve numbers in a paired-associate learning task. It is difficult to visualize what the correlation would be between the individual rated association values of the individual and the rated

association values of the group as these particular subjects were selected because they had certain rated association values that agreed with the rated association values of the group and certain rated values that were different from the group. The correlation is reported as .16. An important factor to notice here is the fact that the correlation of the rated association value of the individual at the time of the paired-associate learning task and the rated association value of the group is .24. This represents a tendency of the individual to regress toward the group mean.

What kinds of correlations would occur if the group and individual's mean rated association values were matched for both high and low values? This problem was studied by combining the H-H and L-L groups and correlating the same variables as were correlated in the overall analysis. These results are presented in Table 9.

Table 9 indicates that the individual rated association values (test-retest), individual rated association values (time of paired-associate learning), along with group rated association value, all have a greater degree of relationship with the criterion. The greatest percentage of improvement is shown in the individual rated association values (test-retest). This is probably the result of the individual agreeing with

TABLE 9
RESULTS OF CORRELATION IDENTIFIED IN THIS TABLE
CATEGORIES H-H AND L-L WERE COMBINED
N = 174

	Individual rated association values (test- retest)	Individual rated association values (time of paired-associate learning)	Group rated association value
Criterion	-.29 ^b	-.14 ^c	-.32 ^b
Group rated association value	.83 ^b	.56 ^b	
Individual rated association values (time of paired- associate learning)	.68 ^b		

^bSignificant at .01 level.

^cNot significant.

the group association value. The correlation of .83 between the individual rated association values (test-retest) and the group rated association values confirms the matching that was accomplished in selecting these 29 subjects. Again the correlation between individual rated association value of the individual (test-retest and test at time of paired associate learning) of .68 is considered high for the reasons listed above. The same trend of individual reliability is shown in the correlation of .56 between the group rated association value and individual-rated values (time of paired-associate learning).

The next analysis was conducted to determine the correlations when the H-L and L-H categories were combined. The results of this should give further evidence as to whether high or low association values of the group or the individual are better predictors of rate of learning.

Again the $-.79$ correlation between the individual rated association values (test-retest) and the group rated association value confirms the original matching procedure. The $-.21$ correlation between the individual rated association values (time of paired-associate learning) and rated association values of the group indicates a regression of the individual rated association to the group rated association value. Again, the rated association values group are better predictors of learning rate

TABLE 10
 RESULTS OF CORRELATIONS IDENTIFIED IN THIS TABLE
 CATEGORIES H-L AND L-H WERE COMBINED
 N = 174

	Individual rated association values (test- retest)	Individual rated association values (time of paired- associate learning)	Group rated association value
Criterion	.05 ^c	-.09 ^c	-.19 ^a
Group rated association value	-.79 ^b	-.21 ^b	
Individual rated association values (time of paired- associate learning)	.36 ^b		

^aSignificant at .05 level

^bSignificant at .01 level

^cNot significant

r $-.19$ as compared to r $-.09$ and $.05$ of the individual. All of these trends have been established before. This particular analysis is the most direct approach of determining the relative influence of the rated association values of the group versus the rated association values of the individual. In each instance, if the group mean was high the individual mean was low and visa versa. Here the trend is clearly in favor of the group means with a correlation of $-.19$. When the individual rated association value (test-retest) is observed, the $.05$ is for all practical purposes 0, but under these conditions the trend is toward individual norms predicting in the opposite direction.

Graphic presentation

To round out this analysis, learning curves are presented by plotting trials to criterion against rated association values. Again, no new trends are noted; this is merely a graphic way of showing that group rated association values are more closely related to trials to criterion than are individual rated association values.

Figure 1.--Comparison of group and individual rated association value

Summary of results

1. Group rated association values are more reliable than are individual rated association values. (Group rated values indicate the product-moment correlation ($\underline{r}$) between two populations is .92, Battig and Spera (2) correlated with Cochran and Wickens (5); $\underline{r}$ between Battig and Spera (2) and second rating conducted for this study is .91; test-retest for this study, same population $\underline{r}$.96. Individual rated association values correlate ($\underline{r}$) with each other from .36, .55, to .68, according to the particular ratings computed.)

2. High group rated association values predict a faster rate of learning than low group rated association values. ($\underline{t}$ test for matched groups between H-H and L-L categories.)

3. Relative rates of learning can be predicted from both the group rated association values and the individual rated association values; however, the group rated association value is a better predictor of the individual rate of learning than is his own rated association value. (Of the 12 $\underline{t}$ tests computed for various combinations of Experiments 1 and 2 in comparing the H-H, L-L, H-L, and L-H categories, six showed trends in favor of the group rated association values, two showed trends in favor of the individual rated association values,

two demonstrated that when H-H's were tested against L-L's there was a difference in learning rate. Two results did not favor the individual or the group rated association values. An analysis of variance indicated that the group rated association values were significant at .01 level, while the individual rated association value was significant between the .10 and the .05 level. Correlations indicate the group rated association values account for about 3.5 times as much of the variance as does the individual rated association values. Correlations varied from -.19, -.26 to -.32 when predicting rate of learning from group rated association values to .05, -.09, -.12, -.13, -.14, -.29 when predicting rate of learning using individual rated association values according to the particular categories and conditions. The learning curves show a steeper slope when comparing rated association values against trials to criterion for the group association values as compared to the individual association values.)

4. There is a slightly higher predictive value for the individual norms taken on test-retest three weeks before the paired-associate learning task as compared to the individual norms obtained at the time of the paired-associate task. (Test-retest norms correlated with criterion range from an r of .05, -.13 to -.29 and the

individual norms taken at the time of learning correlation with the criterion from $-.09$, $-.12$ to $-.14$ according to categories correlated.)

5. When group rated association values are combined with like individual rated association values, the predictive value of both are increased (H-H and L-L combined the predictive value of the group changed from the $-.26$ to $-.32$ and the individual predictive value changed from $-.13$ to $-.29$).

6. When the group rated association values for the group and individual are opposed, the predictive value of both the group and individual are lowered with the predictive value of the individual being lowered more (group changed from $-.26$ to $-.19$, while the individual changed from $-.12$ and $-.13$ to $.05$ and $-.09$ according to groups correlated).

7. The results of t tests, analysis of variance, and correlations all agree in showing that the predictive value of the rated association value of the group is superior to the rated association value of the individual when predicting relative rate of learning of the individual.

DISCUSSION

When rate of learning is the dependent variable and rated association values of numbers between 1 and 100 is the independent variable, it is possible to predict more accurately the rate of learning of the individual using group rated association of the numbers rather than his own rated association values. This relationship holds whether the individual rated association values are the result of his average of a test-retest, seven to ten days apart, and three to four weeks before a paired-associate learning, or whether his individual rated association values are the result of his ratings of the numbers immediately after learning these numbers in paired-associate learning task. This finding would not have been predicted when reasoning from the general orientation of the associative-probability theory. It would be logical to conclude from the associative-probability theory that if an individual rated an item high in association value he would learn it faster than an item he rated low in association value. Meaningfulness can be equated with association value (34, p. 9); association values were used in this study, and the items to which associations were given were numbers.

Related study

Scheible (30) studied this same general problem using a different technique. In the Scheible study, 108 subjects gave association values to 27 syllables differing widely in Glaze values. It was hypothesized that the subjects who gave more associations would learn faster and the subjects who gave fewer associations would learn slower. Subjects made many ratings and were reliable in the number of ratings they made.

The subjects were then divided into three groups. One group was composed of subjects who had given many associations, another group composed of subjects who gave fewest associations, and the third group was composed of subjects who gave associations ranging between these two values. When the same syllables were used in a learning task, it was found that the three groups did not differ in learning rate, but the association value as determined by the Glaze scale was strongly related to learning. The results of the present study agree with those of the Scheible study.

Explanations for results of this study

There is no obvious explanation for the results of this study; however, some of the possibilities should be explored. For years engineering psychologists have made

use of population stereotypes in designing machines and equipment. This is because most of the people of a given population conform to predictable modes of behavior most of the time. The individual is also subject to variability. Quotidian refers to his variability from day to day and saccadic variability in his variability from moment to moment.

It is possible that the variability of the individual makes it improbable to obtain an accurate sample of the behavior of the individual in one, two, or even three trials. These specific ratings, behavior samples, are taken from his own population of responses, but he is a part of a larger population. If many behavior samples were taken on a given individual and his mean were established, very likely his mean would be closer to the mean of the population from which he is selected than to only two or three of his own behavior samples.

The subjects used in this study were from a population that is specifically defined. All were high school graduates, most of them from schools in Ohio. All were about the same age--18-22; all were attending The Ohio State University; and all were enrolled in Elementary Psychology. It would be a rather straightforward task to define many of the parameters of this population and

describe in detail many of the population stereotypes. Consequently, if it is desired to use a measure of meaningfulness to predict learning rate, a person could make more accurate predictions using the means of the population from which the subject is selected, rather than a limited sample of his own reports.

This is not to imply that the reports of the individual play no part in predicting his own behavior, because it does (as is indicated by the increased predictive value when the group and individual rated association values agree and are combined to make predictions versus the decrease in predictive value when the group and individual rated association values do not agree). The question considered in this report is whether the group or the individual rated association values are more accurate in predicting rate of learning numbers. Clearly the group rated association values are more important and a smaller, but nevertheless influential, part is contributed by the individual-rated association values.

Implications

Hull's postulate number five, generalization gradient, is based on work done by Hovland (11) in testing 20 subjects for generalization of the conditioned galvanic

skin response to tones differing in frequency of the conditioned stimulus. When the data for each individual are examined, it can be observed that the modal response for the individual does not follow the generalization gradient obtained by combining the responses for all the subjects; yet, the generalization hypothesis has proven useful in perceptual and learning theory.

Something akin to this notion is implied in much psychological experimentation as many of the experiments in psychology are composed of more than one subject. The responses of these subjects are combined in some meaningful fashion and the results generalized to some specific population.

Idiographic versus nomothetic approach

This study was not designed to determine the relative merits of the idiographic or the nomothetic approach. Only three measures were taken on the individual compared to 207 measures included in the group score. Within the parameters imposed by this study the nomothetic approach is a better predictor of the behavior of the individual than the individual is in predicting his own behavior.

Limitations

Throughout this entire report one question has been the subject of inquiry. The question is whether learning rate of a specific individual can be predicted more accurately by referring to his own rated association values or to the association values of the group. This question has been answered, but it should be pointed out that other factors contribute to learning rate rather than rated association values. This is evident from the correlations presented above. When the various independent variables are correlated with the criterion, the most predictive correlation is only $-.32$. Almost 90 per cent of the variance can be attributed to something other than the rated association value of the number.

It would be possible to increase this correlation (r) by grouping the rating and reporting a single score for each category for the individual (H-H; L-L; H-L or L-H) rather than reporting each score obtained on the individual. The more stringent method was employed, that is, using each measure obtained on every individual, as the aim was to determine whether individual behavior could be predicted rather than blocks of behavior.

SUMMARY

This study was conducted to determine whether the learning rate of an individual could be predicted more accurately by his own rated association value or by the group mean rated association values. Two hundred seven subjects rated 50 numbers between one and 100 using the Noble, Stockwell, and Pryer technique and from seven to ten days later rated these same numbers again. Two rated association values were computed for each number. One association value for each number was computed using the rating of every subject who took the test. Another association value was computed for each individual, using his test-retest ratings. The rated association values of the group were placed in rank order according to mean association values and divided into three groups representing "low rated association values," "intermediate rated association values" and "high rated association values." This same procedure was accomplished for the individual rated association values. Subjects were selected to continue in the experiment if the low, intermediate, or high category in which they placed a number agreed with or differed from the group low, intermediate

or high category in specific ways. The desired category pattern was for three numbers to have group and individual agreement in the high category (H-H) and another three numbers to have group and individual agreement in the low category (L-L). Another six numbers were placed in group or individual categories as follows. Three of the numbers must be in the low category for the group and the high category for the individual (L-H); and another three numbers must be in the high category for the group and the low category for the individual (H-L). Of the 207 test-retest subjects, 29 conformed to this configuration. At this point, each of the 29 subjects had his own list of rated numbers which conformed to the previously mentioned specifications. These numbers were used as the stimulus or the response term, as applicable, to construct a paired-associate learning task for each subject.

The principal findings of the investigation are (1) High group rated association values for numbers predict a faster rate of learning than do low group rated association values, (2) When predicting the relative learning rate of the individual the predictive value of the rated association value of the group is superior to the rated association value of the individual.

A P P E N D I X I

BOOKLET CONTAINING INSTRUCTIONS
AND NUMBERS TO BE RATED

Name (Print) _____ Date _____

Local Address _____ Phone No. _____

(Circle one) Male Female

(Circle one) Freshman Sophomore Junior Senior

Instructions

This is a test to find out how many associations you have to certain numbers. You will be given a list of selected numbers between 1 and 100, and you are to rate each number as to the number of things or ideas it makes you think of. The ratings are made by simply placing a check mark (✓) in one of five spaces provided for your estimate. This is to be done for each of the numbers. The five possible ratings are described by the words none, below average, average, above average and very many. The way in which your estimations are to be made will be explained by two examples. Take the number 1776. Pronounce it, look and think about the number for several seconds. This number probably makes you think of many things. 1776, "Declaration of Independence," "George Washington," "Liberty Bell," "Philadelphia," "Revolutionary War," "Birthday," "Flags," "Holiday," "Pioneers," "History." You have a very large number of associations to 1776. For this reason, 1776 would be rated in the highest category (very many) as follows:

1776	.	.	.	.	.	✓	.
	none	below average	average	above average	very many		

Now, let us take the number 3110. Pronounce it, look and think about the number for several seconds. Very likely this number is meaningless to you. That is, 3110 does not make you think of anything. For this reason 3110 would be rated in the lowest category (none) as follows:

3110 .

 none below average above very
 average average many

Rate each number relative to the number of things or ideas with which you associate it. Be as accurate in your ratings as you can for the results will be used for research purposes. Pay no attention to those working near you. The items are in a mixed order and each student will be working on a different page. Are there any questions?

Remember these things:

1. Work independently of everyone else.
2. Work silently; ask no questions after the test begins.
3. Make only one rating for each number.
4. Make one rating for each number.
5. Look at each number carefully (for several seconds), pronounce it, think about the number of associations you have to the number, make your rating. Go on to the next number.
6. Be accurate.

A P P E N D I X I I

A COMPARISON OF MEAN RATED ASSOCIATION
VALUES OF NUMBERS USED IN THIS STUDY
(ALL NUMBERS CONVERTED TO 1-5 SCALE)

Battig and Spera (1962) (N = 95)		Cochran and Wickens (1962) (N = 100)		This Study First Test (N = 207)		This Study Second Test (N = 207)	
Number	Mean	Number	Mean	Number	Mean	Number	Mean
83	1.79	37	1.49	83	1.44	67	1.49
59	1.88	83	1.51	37	1.46	91	1.49
37	1.93	87	1.53	67	1.47	83	1.50
87	1.95	91	1.58	93	1.51	59	1.52
79	2.02	93	1.60	91	1.52	87	1.53
43	2.03	38	1.62	87	1.52	37	1.56
84	2.09	79	1.64	79	1.52	79	1.56
67	2.12	67	1.67	94	1.57	93	1.65
92	2.14	92	1.70	89	1.65	94	1.66
91	2.22	81	1.74	59	1.65	92	1.67
38	2.23	59	1.77	92	1.66	84	1.67
93	2.23	85	1.80	38	1.67	89	1.76
52	2.33	94	1.84	84	1.70	38	1.76
85	2.33	84	1.85	81	1.75	52	1.83
39	2.34	43	1.86	85	1.77	81	1.87
63	2.34	89	1.88	72	1.82	72	1.89
72	2.36	52	1.91	70	1.83	26	1.91
89	2.38	26	1.91	26	1.83	43	1.94
94	2.38	63	1.93	90	1.96	70	1.94
35	2.54	72	1.96	80	1.96	85	1.95

Battig and Spera (1962) (N = 95)		Cochran and Wickens (1962) (N = 100)		This Study First Test (N = 207)		This Study Second Test (N = 207)	
Number	Mean	Number	Mean	Number	Mean	Number	Mean
26	2.55	28	2.01	52	1.96	63	2.06
81	2.61	70	2.02	43	1.98	80	2.07
70	2.65	55	2.06	35	1.99	27	2.07
28	2.69	27	2.15	39	2.00	35	2.10
44	2.73	39	2.19	55	2.04	39	2.11
80	2.74	90	2.21	27	2.05	28	2.13
55	2.78	80	2.22	28	2.06	55	2.23
17	2.85	35	2.27	63	2.11	90	2.25
48	2.86	36	2.32	11	2.12	44	2.29
27	2.98	66	2.33	36	2.18	48	2.30
66	3.00	45	2.36	98	2.25	66	2.32
90	3.05	11	2.37	66	2.25	36	2.35
49	3.07	98	2.43	48	2.27	11	2.39
11	3.08	48	2.45	45	2.30	49	2.40
36	3.13	7	2.54	9	2.32	45	2.43
45	3.21	44	2.57	44	2.35	98	2.45
6	3.23	9	2.60	49	2.42	9	2.47
15	3.25	49	2.64	6	2.49	6	2.59
9	3.29	17	2.71	15	2.55	15	2.91

Battig and Spera (1962) (N = 95)		Cochran and Wickens (1962) (N = 100)		This Study First Test (N = 207)		This Study Second Test (N = 207)	
Number	Mean	Number	Mean	Number	Mean	Number	Mean
98	3.32	6	2.82	17	2.58	99	2.92
20	3.36	15	2.93	75	2.59	7	2.98
75	3.43	75	3.04	99	2.62	75	3.06
7	3.62	99	3.09	7	2.66	17	3.08
18	3.67	25	3.22	25	2.84	20	3.22
50	3.69	20	3.29	20	2.91	25	3.38
16	3.72	50	3.48	50	2.94	50	3.42
99	3.80	18	3.56	16	3.12	16	3.43
25	3.85	16	3.71	18	3.43	18	3.72
1	4.38	100	4.26	1	3.58	1	3.89
100	4.56	1	4.27	100	3.72	100	4.10

A P P E N D I X I I I

INSTRUCTIONS USED IN PAIRED-ASSOCIATE LEARNING TASK

(These instructions were used for Experiment 2)

(Experiment 1 had the same instructions
with the word-number order reversed)

Introduction

This is a paired-associate learning task. Soon after the experiment starts, you will see a word appear in this window (point to the window). Two seconds later a number will appear in this window (point to the window). Other word-number combinations will follow. The word-number combination will always remain the same, that is, a given word will always be paired with a given number. Your task is to learn all of the word-number combinations. There are twelve combinations to learn.

Procedure

The first time you go through the list you will see the word-number combination for the first time. For this reason I would like for you to pronounce (aloud) both the word and the number. In this way we can both be sure that you see the word and the number and that the equipment is operating properly. Try to remember these word-number combinations and recall them on future trials.

Criterion

When you see the word appear in the window you should say the number that you have learned to associate with the word. If you give the number before it appears in the window you will be scored correct. The experiment will continue until you can go through the list, without an error, two times in succession. Any questions?

Concluding Statement

Remember:

1. Pronounce the word and number the first time through the list.
2. Try to learn these word-number combinations as fast as possible.
3. Do not become discouraged if it takes you longer to learn these combinations than you think it should--most subjects feel some discouragement and frustration before the criterion is reached--but every subject has been able to learn the list.

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AUTOBIOGRAPHY

I, Samuel Warren Cochran, was born in Waynesboro, Mississippi, August 1, 1921. I received my secondary school education in the public schools of Wayne County, Mississippi, and my undergraduate training at Mississippi College which granted me the Bachelor of Arts degree in 1947. From George Peabody College for Teachers, in conjunction with Vanderbilt University, I received the Master of Arts degree in 1948. From 1949 until 1953 I was a member of the faculty at Mississippi College. In 1953, I was recalled into the United States Air Force. From 1957 to 1959 I was a graduate student at The Ohio State University; in 1960, I was a research psychologist at Edwards AFB, California. I was a member of the faculty, Department of Psychology, United States Air Force Academy, Colorado, for two years prior to re-entering The Ohio State University in June, 1962. While at The Ohio State University, I specialized in the Department of Psychology.

I am scheduled to return to the United States Air Force Academy where I will be a member of the faculty.