AN APPLICATION OF THE MNEMONIC KEYWORD METHOD TO THE ACQUISITION OF A RUSSIAN VOCABULARY

by

Richard C. Atkinson and Michael R. Raugh

This research was supported jointly by:

Office of Naval Research
Psychological Sciences Division
Personnel and Training Research Programs (Code 458)
Contract Authority Number: NR 154-326
Scientific Officers: Dr. Marshall Farr and Dr. Joseph Young

and

Advanced Research Projects Agency
ARPA Order Number: 2284 dated 30 August 1972
Program Code Number: 3D20

Contract Number:

N00014-67-A-0012-0054
1 August 1972 - 31 July 1974

Principal Investigator:

Richard C. Atkinson
Professor of Psychology
Institute for Mathematical Studies in the Social Sciences
Stanford University
Stanford, California 94305
(415) 497-4117

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: Technical Report 237	2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE *(and Subtitle)*: An Application of the Mnemonic Keyword Method to the Acquisition of a Russian Vocabulary	5. TYPE OF REPORT & PERIOD COVERED: Technical Report
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Richard C. Atkinson and Michael R. Raugh	8. CONTRACT OR GRANT NUMBER(s): N00014-67-A-0012-0054
9. PERFORMING ORGANIZATION NAME AND ADDRESS: Institute for Mathematical Studies in the Social Sciences - Stanford University, Stanford, California 94305	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: 61153N; RR 042-0; RR 042-0-0; NR 154-326
11. CONTROLLING OFFICE NAME AND ADDRESS: Personnel & Training Research Programs, Office of Naval Research (Code 458), Arlington, VA 22217	12. REPORT DATE: October 4, 1974
	13. NUMBER OF PAGES: 27
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: Unclassified
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

mnemonics, second-language vocabulary learning, mental imagery, keyword, computer-assisted instruction

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

An experiment is reported evaluating the effectiveness of a mnemonic procedure, called the keyword method, for learning a foreign language vocabulary. The method divides the study of a vocabulary item into two stages. The first stage requires S to associate the spoken foreign word to an English word (the keyword) that sounds like some part of the foreign word; the second stage requires S to form a mental image or picture of the keyword "interacting" with the English translation. Thus, the keyword method can be

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-014-6601 |

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

described as a chain of two links connecting a foreign word to its English translation through the mediation of a keyword: the foreign word is linked to a keyword by a similarity in sound (acoustic link), and the keyword is linked to the English translation by a mental image (imagery link). The experiment reported here compared the keyword method with an unconstrained control procedure using Russian vocabulary. On all measures the keyword method proved to be highly effective, yielding for the most critical test a score of 72% correct for the keyword group compared to 46% for the control group.

SUMMARY

An experiment is reported evaluating the effectiveness of a mnemonic procedure, called the keyword method, for learning a foreign language vocabulary. The method divides the study of a vocabulary item into two stages. The first stage requires S to associate the spoken foreign word to an English word (the keyword) that sounds like some part of the foreign word; the second stage requires S to form a mental image or picture of the keyword "interacting" with the English translation. Thus, the keyword method can be described as a chain of two links connecting a foreign word to its English translation through the mediation of a keyword: the foreign word is linked to a keyword by a similarity in sound (acoustic link), and the keyword is linked to the English translation by a mental image (imagery link). The experiment reported here compared the keyword method with an unconstrained control procedure using Russian vocabulary. On all measures the keyword method proved to be highly effective, yielding for the most critical test a score of 72% correct for the keyword group compared to 46% for the control group.

AN APPLICATION OF THE MNEMONIC KEYWORD METHOD TO THE ACQUISITION OF A RUSSIAN VOCABULARY[1]

Richard C. Atkinson and Michael R. Raugh

Stanford University

Mental imagery has long been used as a means of memorizing information; Roman orators employed the technique when memorizing long speeches (Yates, 1972), and entertainers use mental imagery to perform impressive feats of memory. In recent years, mental imagery has been investigated in the psychological laboratory both for theoretical reasons (Paivio, 1971) and because it offers an effective means of memorizing certain kinds of information (Bower, 1972; Bugelski, 1968). Raugh and Atkinson (1974) developed an application of mental imagery to the acquisition of a second-language vocabulary and reported a series of experiments in which their keyword method proved to be effective for learning Spanish vocabulary items. The purpose of the work reported here was to test the effectiveness of the keyword method on a non-Romance language, namely Russian.

The keyword method divides the study of a vocabulary item into two stages. The first stage requires S to associate the spoken foreign word to an English word (the keyword) that sounds approximately like some part of the foreign word. The second stage requires S to form a mental image of the keyword "interacting" with the English translation. Thus, the keyword method can be described as a chain of two links connecting a foreign word to its English translation: the foreign word is linked to a keyword by a similarity in sound (acoustic link), and the keyword

is linked to the English translation by mental imagery (mnemonic or imagery link). As an example, consider the Russian word zvonók,[2] meaning bell. Its pronunciation is somewhat like "zvahn-oak," with emphasis on the last syllable, and it contains a sound that resembles the English word "oak." Employing the English word "oak" as the keyword, one could imagine something like an oak with little brass bells for acorns, or an oak in a belfry, or perhaps an oak growing beneath a giant bell jar. As another example, the Russian word for "building" (zdánie) is pronounced somewhat like "zdawn-yeh" with emphasis on the first syllable. Using "dawn" as the keyword, one could imagine the pink light of dawn reflected in the windows of a tall building.

The keyword method is applied by presenting S with a series of spoken foreign words. Each foreign word is pronounced; while the word is being pronounced, a keyword and the English translation are displayed. During the presentation of each item S must associate the sound of the foreign word to the given keyword and generate a mental image relating the keyword to the English translation.

The preselection of keywords by E is an important aspect of the method. In preparing a test vocabulary a keyword is considered eligible if it satisfies the following criteria: (1) The keyword sounds as much as possible like a part (not necessarily all) of the foreign word; (2) it is easy to form a memorable image linking the keyword and the English translation; and (3) the keyword is unique (different from the other keywords used in the test vocabulary). Criterion 1 allows flexibility in the choice of keywords, since any part of a foreign word could be used as the key sound. What this means for a polysyllabic foreign word

is that anything from a monosyllable to a longer word (or even a short phrase that "spans" the whole foreign word) might be used as a keyword. Criterion 2 must be satisfied to make the imagery link as easy to master as possible. Criterion 3 is used to avoid the ambiguities that could occur if a given keyword were associated with more than one foreign word. For a large vocabulary that is divided into subvocabularies to be presented in separate sessions, Criterion 3 might be applied only to each subvocabulary.

In applying the keyword method to the acquisition of Spanish vocabulary, Raugh and Atkinson (1974) found large differences between the keyword method and various control conditions. Two of the experiments used a within-subjects design, and the results were especially impressive because Ss often used the keyword method in the control condition, thus diminishing the true differences. Moreover, many Ss had studied at least one Romance language and were able to learn many words in the control condition by recognizing them as cognates. The results suggested that it would be useful to evaluate the keyword method, using a between-subjects design and a foreign language that was less obviously related to languages previously studied by Ss.

Russian was selected for the work reported here. In addition to being a non-Romance language Russian posed a special challenge to the keyword method because Russian involves a number of frequently recurring phonemes that do not occur in English. Also, from a practial viewpoint, for many students the Russian vocabulary is more difficult to learn than is the vocabulary of, say, German, French, or Spanish; it would be useful if the keyword method proved to be an effective means of teaching Russian vocabulary.

A 120-word Russian test vocabulary was divided into three comparable 40-word subvocabularies for presentation on separate days. The Ss were run under computer control. The Ss received instructions from a cathode ray display scope, listened to recorded foreign language words through headphones, and typed responses into the computer by means of a console keyboard. The experiment began with an introductory session (Day 0) during the first part of which Ss were familiarized with the equipment; during the second part Ss were assigned to the keyword and control groups and given instructions on the appropriate learning method. On each of the three following days (Day 1, Day 2, and Day 3) one of the test subvocabularies was presented for study and testing. On each of these days three study/test trials were given. The study part of a study/test trial consisted of a run through the subvocabulary; each foreign word was pronounced and, depending upon the treatment group, either (i) the keyword and English translation were displayed (keyword group), or (ii) the English translation alone was displayed (control group). A test trial consisted of a run through the subvocabulary in which each foreign word was pronounced and 15 sec. were allowed for S to type the English translation. A comprehensive test covering all 120 items of the vocabulary was given the day after the presentation of the last subvocabulary (Day 4). A similar test was given approximately six weeks later.

Method

Subjects. Fifty-two Stanford University undergraduates were used (26 males and 26 females). Each spoke English as the native language, none had studied Russian, and none had participated in prior experiments using the keyword method with Spanish.

Stimulus material. A test vocabulary of 120 Russian nouns with associated keywords was selected (see Appendix). The test vocabulary represents a typical cross-section of vocabulary items presented in the first-year Russian curriculum at Stanford University. English translations of the Russian vocabulary were ranked according to imageability as determined both by judgment of E and the Paivio ("Imagery and familiarity ratings for 2448 words: Unpublished norms") image values for those English words for which values were available. The average Paivio value for the 15 most imageable words was 6.72, and the average for the 15 least imageable words was 2.51. The keywords were selected by a four-person committee whose members were familiar with the keyword method. For some items, the committee chose keyword phrases rather than single keywords; a total of 38 keyword phrases were used in the test vocabulary. The test vocabulary was divided into three subvocabularies of 40 words each, matched in abstractness and imageability.

Procedures. During the first session (Day 0) E showed each S how to start the computer program that conducted the experiment. The program itself explained all of the remaining procedures. After giving instructions on the use of the keyboard and audio headset, the program introduced keywords as a means of focusing attention on the sound of a Russian word. In order to provide all Ss with experience in the procedures, practice was given on a randomized list of 30 words (not included in the test vocabulary); a Russian word was spoken and its keyword was displayed in brackets for 5 sec. Afterwards, a test (randomized for each S) was given in which each Russian word was spoken, and 10 sec. were allowed to start typing the keyword. If a response was begun within 10 sec., the time

period was extended from 10 to 15 sec.; otherwise, the program advanced to the next item. A second randomized study of the 30 practice words was given, followed by a newly randomized test. Throughout the experiment, the same training and randomized presentation procedures were followed.

After the keyword practice, Ss were randomly assigned to the experimental and control groups with the contraint that both groups contain an equal number of males and females. The Ss were given the appropriate written instructions on the method for associating Russian words to English translations. The experimental instructions were like the keyword instructions for Experiment III presented in Raugh and Atkinson (1974). They explained that while a Russian word was being pronounced, a keyword (or keyword phrase) would be displayed in brackets at the left-hand margin of the screen and the English translation would appear to the right. Experimental Ss were instructed to learn the keyword first and then picture an imaginary interaction between the keyword and the English translation; the experimental instructions also stated that if no such image came to mind, they could generate a phrase or sentence incorporating the keyword and translation in some meaningful way. The control instructions explained that while each Russian word was pronounced, the English translation would be displayed near the center of the screen. Control Ss were told to learn in whatever manner they wished; control Ss were not given instructions on the use of keywords or mental imagery.

After the instructions were given, a practice series of ten Russian words was presented in which each Russian word was spoken while the

English translation was displayed; for Ss in the experimental group the appropriate keyword was also displayed with each English translation. Following this a test trial was given in which each Russian word was spoken and S attempted to type the English translation. A second study trial was given and was followed by a second test trial, concluding Day 0. The Ss were told that practice on the 10-word list was like the procedure for the remainder of the experiment.

The Ss returned the following day for the Day 1 session. For each S the computer program randomly selected one of the three 40-word subvocabularies for presentation. Day 1 consisted of three successive study-test trials. The study trial was exactly like the study trial at the end of Day 0: each Russian word was spoken while, depending upon the group, either the keyword and English translation, or the English translation alone, were displayed. For both groups, the presentation was timed for 10 sec. per item. The test trials were identical for both groups: each Russian word was spoken and S had 10 sec. to initiate a response. No feedback was given; an incomplete or misspelled response was scored as incorrect.

Day 1, Day 2, and Day 3 (which fell on consecutive days) followed identical formats. The only difference was that each day involved a different randomly assigned subvocabulary.

The Comprehensive Test followed on Day 4. The Comprehensive Test was exactly like a daily test trial, except that it covered the entire 120-word test vocabulary. For the sixth and final session (the Delayed Comprehensive Test), Ss were called back about 30 to 60 days (average 43 days) from Day 0 to take a randomized repeat of the Comprehensive

Test. The Ss had not been forewarned that they would be tested at a later date.

Results

The Day 0 keyword-practice phase of the experiment was identical for both the experimental and control groups. The results of the keyword tests averaged over trials were 51% for male keyword Ss and 53% for male control Ss; the comparable scores for females were 59% and 58%, respectively. The average overall score for keyword Ss was 55% and the corresponding average for control Ss was 56%. The results indicate that the keyword and control groups were evenly matched so far as performance on the pretest was concerned.

Table 1 presents results of the Comprehensive Test in which the probability of a correct response is given as a function of sex, treatment group, and day on which the word was studied; for example, the table shows that on the Comprehensive Test females in the keyword group responded correctly to 76% of the words that they had studied on Day 2, whereas males responded correctly to 63% of the words studied on Day 2. A sex by treatment analysis of the Comprehensive Test data was made wherein performance on the Day 1, Day 2, and Day 3 subvocabularies were viewed as repeated trials. It was found that keyword Ss were superior to the control Ss, $F(1,48) = 35.8$, $p < .001$; moreover, the female Ss performed significantly better than the male Ss, $F(1,48) = 5.9$, $p < .025$. No interactions between sex and treatment were found.[3] Because Ss were volunteers we cannot say whether the sex differences reflect a sampling error or an actual difference between males and females. In any case, the results suggest that for vocabulary-learning experiments

Table 1

Probability of a Correct Response on the Comprehensive Test as a Function of Treatment Group, Sex, and Study Day

	Keyword			Control		
	Male	Female	Mean	Male	Female	Mean
Day 1	.55	.73	.64	.27	.40	.33
Day 2	.63	.76	.70	.38	.47	.43
Day 3	.80	.82	.81	.60	.67	.63
Mean	.66	.77	.72	.42	.51	.46

of this sort, care should be taken to insure that males and females are evenly divided among treatment groups.

Figure 1 presents the probability of a correct response on each of the three test trials for Day 1, Day 2, and Day 3. The keyword group in all cases obtained superior scores; in fact, on each day the keyword group learned at least as many words in two study trials as the control group learned in three trials.

An analysis of performance on the test vocabulary was made with respect to imageability. The vocabulary had been ranked according to the image values of the English translations, and divided into four levels of imageability. Each level contained an equal number of words from each of the three subvocabularies. The 15 most highly imageable words (5 taken from each subvocabulary) were assigned to Level 1. The next ranking 45 words (15 from each subvocabulary) were assigned to Level 2, and the next 45 words were assigned to Level 3. The 15 least imageable words were assigned to Level 4. Table 2 presents the average probability that a word of a given level elicited a correct response on the Comprehensive Test for both the keyword and control groups. No significant difference was found across levels for the keyword group, whereas for the control group $\underline{F}(3,25) = 3.1$, $\underline{p} < .05$. Thus, image level did not affect performance in the keyword condition; on the other hand, it appears that high imageability facilitated learning in the control condition.

Figure 2 presents a scatter plot of the 120 words in the test vocabulary; each point represents performance for a particular word on the Comprehensive Test. The abscissa gives the probability of a correct

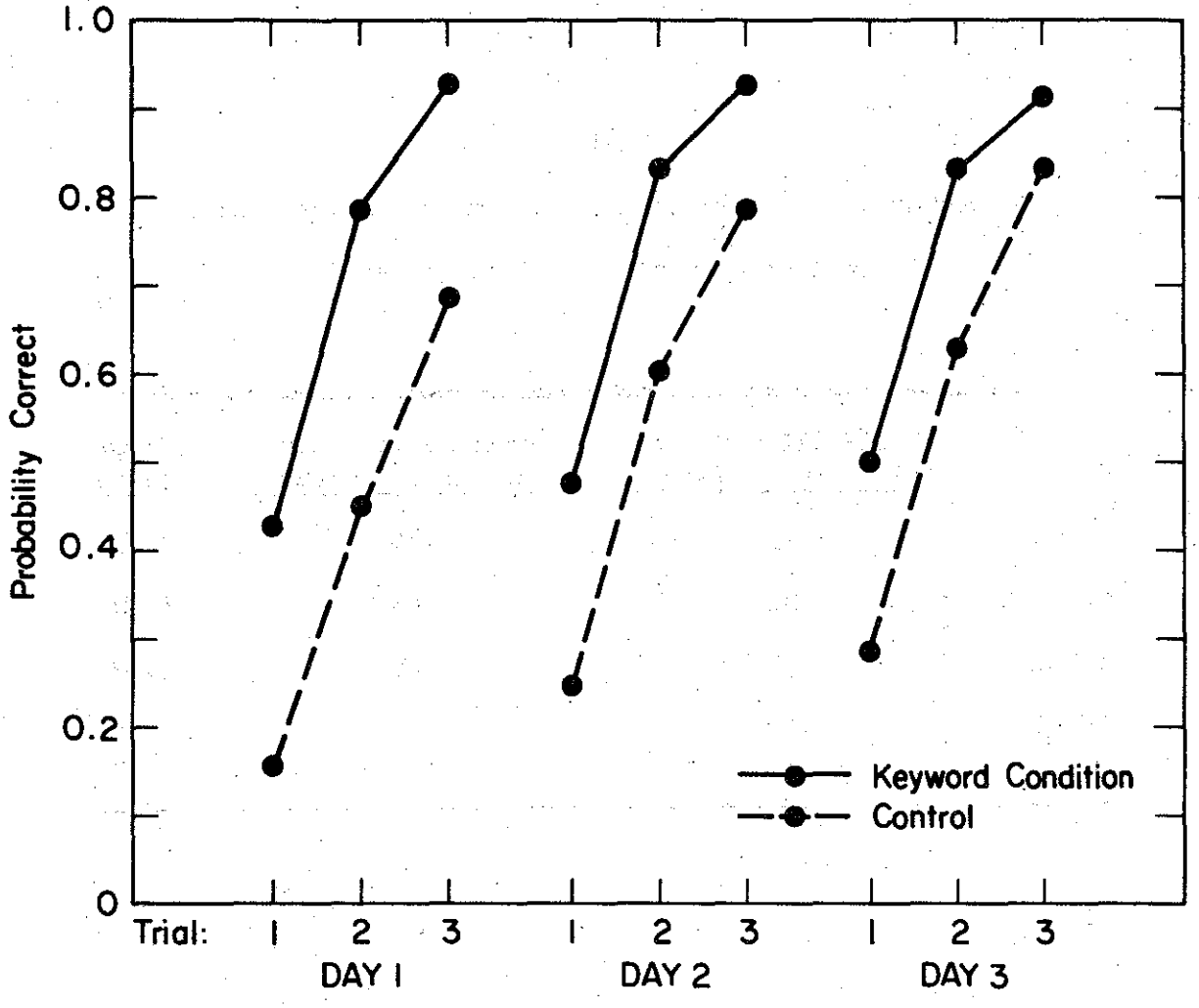

Figure 1. Probability of a correct response over test trials on Day 1, Day 2, and Day 3.

Table 2

Probability of a Correct Response on the Comprehensive Test as a Function of Imagery Level

	Probability Correct in Keyword Group	Probability Correct in Control Group	Image Value
Level 1	.75	.55	6.73
Level 2	.71	.45	6.31
Level 3	.71	.48	5.03
Level 4	.72	.38	2.46

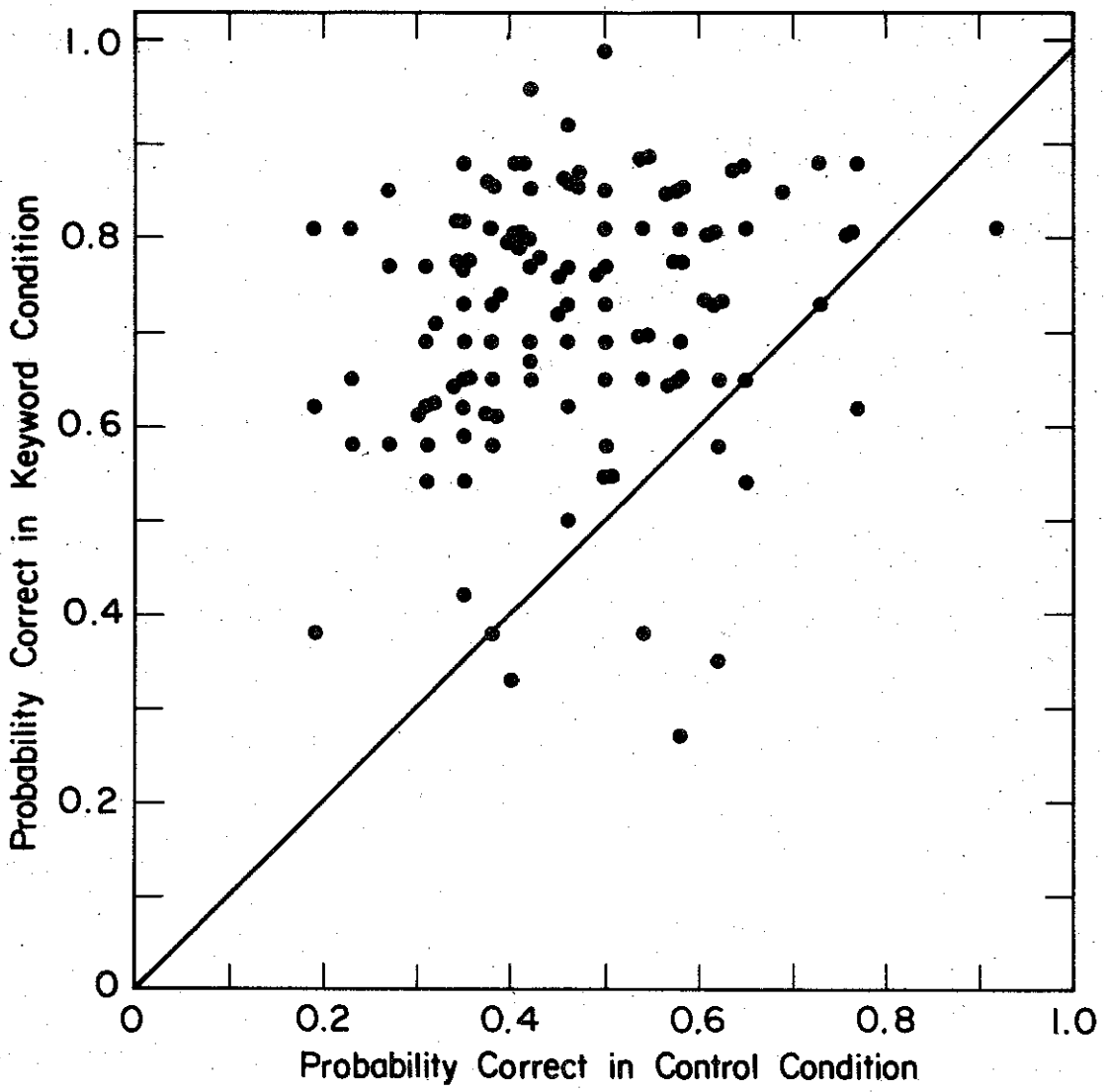

Figure 2. Scatter plot of performance levels on the Comprehensive Test. Each point corresponds to an item; the ordinate gives the performance level when the item was studied in the keyword condition, and the abscissa its value when studied in the control condition.

response in the control group and the ordinate gives the same probability in the keyword group. For example, the word at (.35,.81) is gálstuk (where the keyword is "gallstone" and the English translation is "necktie"); its probability of being correct on the Comprehensive Test was .35 for control Ss, and .81 for keyword Ss. Points above the diagonal in Figure 2 refer to words that were learned more effectively in the keyword condition, whereas points below are for words that were learned more effectively in the control condition. The word at (.19,.81), dvor (keyword: divorce; translation: yard), did especially well in the keyword condition relative to its performance in the control condition, whereas the word at (.58,.27), lápa (keyword: laughter; translation: paw) did especially poorly. A reason for the poor performance could be that either the keyword link was difficult to learn or the imagery link was difficult to form, resulting in an ineffective memory chain between the Russian word and the English translation. We will return to this point later.

The results of the Delayed Comprehensive Test are displayed in Table 3. The keyword group outperformed the control group in all male-male and female-female comparisons. Note that keyword Ss recalled more words from the Day 1 study list than from the Day 3 list, whereas the opposite relation held on the Comprehensive Test (see Table 1). Thus, a recency effect over days was exhibited on the first Comprehensive Test, whereas a primacy effect over days prevails on the delayed test. This result is somewhat surprising, although Schnorr and Atkinson (1970) obtained a similar finding in an experiment in which Ss used a mental imagery strategy to learn English paired-associates; recency was observed

Table 3

Probability of a Correct Response on the Delayed Comprehensive Test as a Function of Treatment Group, Sex, and Study Day

	Keyword			Control		
	Male	Female	Mean	Male	Female	Mean
Day 1	.38	.58	.48	.15	.34	.25
Day 2	.36	.51	.44	.19	.40	.30
Day 3	.30	.41	.36	.21	.36	.29
Mean	.35	.50	.43	.18	.37	.28

on an immediate recall test, whereas primacy was observed on a delayed test one week later. Table 3 indicates no serial position effect for the control group.

A question of some interest is whether keyword phrases facilitate learning as much as single keywords do. Our data cannot answer the question because we did not systematically vary the number of keywords used for each Russian item. Nevertheless, the data are suggestive. In the experimental condition 38 items involved the use of keyword phrases instead of a single keyword. For example, the keyword phrase "narrow road" was associated with the word naród, and "tell pa" was associated with tolpá. The average performance of the keyword-phrase items on the Comprehensive Test was .74 in the keyword condition and .44 in the control condition. The corresponding averages for single-keyword items were .71 and .45, respectively. Thus, the probability of learning a keyword-phrase item was about the same as the probability of learning a single-keyword item.

Discussion

Results using the keyword method raise a number of issues; some of these issues have been discussed elsewhere (Raugh & Atkinson, 1974) and will not be reviewed in this paper. Of special interest to the experiment reported here is the question: Should the experimenter supply the keyword, as we have done, or can the subject generate his own more effectively? The answer to this question is somewhat complicated. In an unpublished experiment similar to the one described here, all subjects were given instruction in the keyword method. During the actual experiment half of the items were presented for study with a keyword, whereas

no keyword was provided for the other items. The subjects were instructed to use the keyword method throughout. When a keyword was provided they were to use that word; when no keyword was provided they were to generate their own. On the Comprehensive Test the subjects were better on the keyword-supplied items than on the others, but the size of the difference was small in comparison to the difference between groups reported in this paper. Instruction in the keyword method was helpful, and somewhat more so if the experimenter also supplied the keywords.

It should be kept in mind that our results are for subjects who have not had previous training in Russian. It may well be that supplying the keywords is most helpful to the beginner, and becomes less useful as the subject gains familiarity with the language and the method. We have run an experiment using a Spanish vocabulary where subjects were instructed in the keyword method, but during study of an item received a keyword only if they requested it by pressing an appropriate key on their computer console (Raugh & Atkinson, 1974). We call this variant of the keyword method the free-choice procedure. When an item was initially presented for study a keyword was requested 89% of the time; on subsequent presentations of the item the subject's likelihood of requesting the keyword depended upon whether or not he missed the item on the preceding test trial. If he missed it, his likelihood of requesting the keyword was much higher than if he had been able to supply the correct translation. Otherwise, however, the likelihood of requesting a keyword was remarkably constant from one day of the experiment to the next; that is, there was no decrease in keyword requests over the three study days, where on each day the subject learned a new vocabulary. It

is interesting to note that performance on the Comprehensive Test for the free-choice group was virtually identical to the performance of a group that was automatically given a keyword on all trials. Not much of a difference would be expected between the two groups since the free-choice subjects had such a high likelihood of requesting keywords. Nevertheless, these findings suggest that the free-choice mode may be the preferred one. In the free-choice procedure subjects report that they generally wanted a keyword, but that there were occasional items that seemed to stand out and could be mastered immediately without the aid of a keyword. In summary, the answer to our question is that subjects appear to be somewhat less effective when they must generate their own keywords; but results from the free-choice procedure indicate that keywords need only be supplied when requested by the subject.

Let us now turn to a somewhat different issue. As Figure 2 indicates, some items are learned more readily than others. Poor performance on a given item in the keyword condition could be because the acoustic link, the imagery link, or both were difficult to master, thereby yielding an ineffective memory chain between the Russian word and its English translation. A test of this hypothesis involves having one group of subjects learn only the foreign word to keyword link and another independent group learn only the keyword to translation link. We have conducted such an experiment with the 120-word Russian vocabulary used in the study reported here. For each item an estimate was obtained for the probability of a correct response averaged over the first two test trials. We will denote that probability as $\underline{A}$ for the group learning the acoustic link, and as $\underline{I}$ for the group learning the imagery link. Finally, let $\underline{K}$ be the

probability of a correct response averaged over the first two test trials for an item in the keyword group in our original experiment. It is the case that the product of A × I (that is, the probability of knowing the acoustic link times the probability of knowing the imagery link) is a fairly good predictor of performance in the keyword condition. Table 4 displays the correlation matrix using rank-order data. Note that the correlation between A and I is near zero, indicating that the learning of the acoustic link is not related to the learning of the imagery link. Note also that the correlation between the product A × I and the variable K is .73; the product is a fair predictor of performance in the keyword condition. The C entry in the table is comparable to the K entry, except that it denotes performance for the control group in our original experiment. Note that C is not as good a predictor of K as is the product A × I.

A theoretical framework for interpreting these results is provided by Atkinson and Wescourt (1974). According to their theory, early in the learning process the memory structure for a given item involves only two independent links (what we have called the acoustic and imagery links). However, with continued practice a third link is formed directly associating the foreign word with its English translation. It is this direct link that sustains performance once an item is highly practiced; the subject may still be able to access the keyword but the retrieval process based on the direct association is so rapid that the subject only recalls the keyword under special circumstances, like when he is consciously trying to do so or has a retrieval failure in the primary process. But the less direct chain of the acoustic and imagery links

Table 4

Correlation Matrix for the Variables A × I, K, C, A, and I

	A×I	K	C	A	I
A × I	1.0	.73	.39	.68	.71
K		1.0	.38	.53	.49
C			1.0	.33	.19
A				1.0	.02
I					1.0

has the advantage that it is easily learned and provides a crutch for the subject as he learns the direct association; it facilitates the learning of the direct association by insuring that the subject is able to recall items early in the learning process.

There is some evidence to suggest that students use mediating strategies similar to the keyword method when learning a vocabulary, even if not instructed to do so. Ott, Butler, Blake, and Ball (1973), in a paper on the use of mental imagery in vocabulary learning, report that Ss not given special instructions when asked to learn a foreign vocabulary often resort to using English mediating words combined with imagery or other mnemonic aids. Their observation suggests that the keyword method is not essentially different from techniques commonly employed by students. The major difference, apart from the fact that E supplies the keywords, is the extent to which the method is applied.

Our experimental findings indicate that the keyword method should be evaluated in an actual teaching situation. Starting this fall, we will be running a computerized vocabulary-learning program designed to supplement a college course in Russian. The program will operate much like our experiments. When a word is presented for study it will be pronounced by the computer and simultaneously the English translation will be displayed on a CRT. The student will be free to study the item anyway he pleases, but he may request that a keyword be displayed by pressing an appropriate button on his console. Students will be exposed to about 800 words per quarter using the computer program, which in conjunction with their normal classroom work should enable them to develop a substantial vocabulary. We, in turn, will be able to answer

a number of questions about the keyword method when it is used over an extended period of time. Many foreign language instructors believe that the major obstacle to successful instruction is not learning the grammar of a language, but in acquiring a sufficient vocabulary so that the student can engage in spontaneous conversation and read materials other than the textbook.

If the instructional application proves successful, then the keyword method and variants thereof deserve a role in language-learning curricula. The keyword method may prove useful only in the early stages of learning a language and more so for some classes of words than others. The method may not be appropriate for all learners, but there is the possibility that some, especially those who have difficulty with foreign languages, will receive particular benefits.

APPENDIX

Russian Test Vocabulary, Related Keywords, and Performance Levels on the Comprehensive Test

Subvocabulary 1				Performance Level	
	Russian	Keyword	Translation	Keyword	Control
1.	DÉVUSHKA	[dear vooshka]	GIRL	1.00	.50
2.	LÓSHAD'	[sausage]	HORSE	.81	.58
3.	LES	[yes]	WOODS	.58	.31
4.	BLOXÁ	[block]	FLEA	.54	.50
5.	KROVÁT'	[cravat]	BED	.85	.58
6.	GÁLSTUK	[gallstone]	NECKTIE	.81	.35
7.	IZBÁ	[he's bad]	HUT	.65	.58
8.	KRÝSHA	[Kruschev]	ROOF	.69	.54
9.	STOL	[stole]	TABLE	.69	.58
10.	PÓLE	[pole]	FIELD	.54	.50
11.	MOST	[most]	BRIDGE	.50	.46
12.	PÓEZD	[poised]	TRAIN	.85	.46
13.	VRACH	[wretch]	PHYSICIAN	.58	.35
14.	KARANDÁSH	[car run dash]	PENCIL	.81	.38
15.	TARÉLKA	[daddy elk]	PLATE	.77	.31
16.	ROT	[rut]	MOUTH	.85	.46
17.	STAKÁN	[stuck on]	GLASS	.81	.62
18.	DED	[debt]	GRANDFATHER	.35	.62
19.	UZHIN	[engine]	SUPPER	.69	.35
20.	ÓVOSHCHI	[oversheet]	VEGETABLES	.81	.42

	Russian	Keyword	Translation	Performance Level	
				Keyword	Control
21.	CHELOVÉK	[chilly back]	PERSON	.85	.46
22.	RABÓTA	[rowboat]	WORK	.54	.65
23.	LÁPA	[laughter]	PAW	.27	.58
24.	VOJNÁ	[why not]	WAR	.77	.50
25.	ZHENÁ	[she gnaw]	WIFE	.58	.50
26.	RÓDINA	[regiment]	FATHERLAND	.69	.38
27.	DÓZHD'	[douche]	RAIN	.81	.65
28.	ERUNDÁ	[yer own doll]	RUBBISH	.62	.31
29.	LGUN	[lagoon]	LIAR	.77	.58
30.	DURÁK	[two rocks]	FOOL	.88	.42
31.	DEN'	[Jane]	DAY	.81	.77
32.	GÓLOD	[gullet]	HUNGER	.65	.23
33.	RECH'	[reach]	SPEECH	.65	.58
34.	LÁVKA	[Alaska]	SHOP	.33	.40
35.	VOPROS	[pros]	QUESTION	.62	.38
36.	GOD	[goat]	YEAR	.38	.38
37.	GLAGÓL	[gargle]	VERB	.69	.31
38.	CENÁ	[it's enough]	PRICE	.65	.35
39.	USLÓVIE	[Yugoslavia]	CONDITION	.92	.46
40.	KUSÓK	[blue sock]	PIECE	.85	.27
Subvocabulary 2					
41.	SLON	[so long]	ELEPHANT	.65	.65
42.	ISHÁK	[he's shocked]	DONKEY	.73	.46
43.	ZHÁBA	[jaw bone]	TOAD	.73	.38
44.	SOBÁKA	[tobacco]	DOG	.73	.73

	Russian	Keyword	Translation	Performance Level	
				Keyword	Control
45.	MJÁSO	[yassuh]	MEAT	.73	.62
46.	PLÁT'E	[watch it]	DRESS	.73	.38
47.	BAGÓR	[bug]	HOOK	.77	.46
48.	POL	[pull]	FLOOR	.38	.54
49.	SELÓ	[seal law]	VILLAGE	.88	.54
50.	LUG	[luke]	MEADOW	.81	.42
51.	TRÚHKA	[troop car]	PIPE	.76	.42
52.	SKOT	[squat]	CATTLE	.77	.42
53.	PLÓSHCHAD'	[postage]	SQUARE	.81	.35
54.	MEL	[miaow]	CHALK	.65	.42
55.	NOZH	[mush]	KNIFE	.69	.50
56.	PÁLEC	[pies]	FINGER	.65	.35
57.	SYR	[sear]	CHEESE	.77	.58
58.	VNUK	[fluke]	GRANDSON	.38	.19
59.	OBÉD	[a bet]	DINNER	.65	.38
60.	SHKÁF	[scoff]	CUPBOARD	.77	.42
61.	SEM'JÁ	[see me yell]	FAMILY	.62	.77
62.	TRUD	[brute]	LABOR	.71	.32
63.	GOLOVÁ	[Gulliver]	HEAD	.88	.77
64.	AD	[bat]	HELL	.73	.50
65.	MUZH	[moose]	HUSBAND	.58	.62
66.	VDOVÁ	[David]	WIDOW	.65	.58
67.	KITÁJ	[he died]	CHINA	.42	.35
68.	ÓSTROV	[ostrich]	ISLAND	.73	.46

	Russian	Keyword	Translation	Performance Level	
				Keyword	Control
69.	VÝXOD	[boyhood]	EXIT	.77	.35
70.	DYM	[dim]	SMOKE	.88	.73
71.	KANÍKULY	[can equally]	VACATION	.85	.50
72.	ZHÁZHDA	[judge]	THIRST	.77	.35
73.	GÓLOS	[goal-less]	VOICE	.62	.38
74.	SÉVER	[saviour]	NORTH	.88	.65
75.	SPOR	[spore]	ARGUMENT	.69	.54
76.	ÓSEN'	[ocean]	AUTUMN	.88	.42
77.	STUL	[stool]	CHARITY	.58	.38
78.	PÁMJAT'	[palm itch]	MEMORY	.81	.50
79.	SHUM	[shoe 'em]	NOISE	.65	.62
80.	CHAST'	[trash]	PART	.77	.46
Subvocabulary 3					
81.	KORÓVA	[rover]	COW	.65	.54
82.	GORÁ	[garage]	MOUNTAIN	.85	.38
83.	PTÍCA	[pizza]	BIRD	.81	.62
84.	RÝBA	[rhubarb]	FISH	.73	.62
85.	MÁL'CHIK	[my cheek]	BOY	.81	.77
86.	SHLJÁPA	[slap]	HAT	.73	.35
87.	ZHREC	[Juliet's]	PRIEST	.81	.42
88.	POTOLÓK	[better lock]	CEILING	.69	.42
89.	SAD	[sat]	ORCHARD	.62	.46
90.	GÓROD	[go]	CITY	.65	.35
91.	EL'	[Yale]	FIR	.81	.42
92.	LINKÓR	[Lincoln]	BATTLESHIP	.85	.58

	Russian	Keyword	Translation	Performance Level	
				Keyword	Control
93.	XLEB	[hurry up]	BREAD	.54	.35
94.	TETRÁD'	[she tries]	NOTEBOOK	.81	.54
95.	LÓZHKA	[Moscow]	SPOON	.58	.27
96.	GLAZ	[glass]	EYE	.81	.92
97.	ÚGOL	[Hugo]	CORNER	.85	.69
98.	RODÍTELI	[Gigi]	PARENTS	.81	.42
99.	EDÁ	[ya die]	FOOD	.62	.19
100.	VÁNNA	[vomit]	BATH	.73	.62
101.	TOLPÁ	[tell pa]	CROWD	.85	.38
102.	NARÓD	[narrow road]	PEOPLE	.77	.27
103.	LICÓ	[it's soft]	FACE	.65	.50
104.	CHERT	[short]	DEVIL	.77	.50
105.	TJÓTJA	[Churchill]	AUNT	.85	.46
106.	BOG	[balk]	GOD	.85	.58
107.	STRANÁ	[strawman]	COUNTRY	.85	.42
108.	SON	[sun]	SLEEP	.69	.46
109.	VOZHD'	[wash]	LEADER	.62	.35
110.	DVOR	[divorce]	YARD	.81	.19
111.	PRÁZDNIK	[bras nicked]	HOLIDAY	.62	.31
112.	DOLG	[dog]	DEBT	.62	.31
113.	VÓZDUX	[fuzz duke]	AIR	.77	.35
114.	ZÁPAD	[zap it]	WEST	.88	.65
115.	DÉLO	[jello]	AFFAIR	.88	.54

	Russian	Keyword	Translation	Performance Level	
				Keyword	Control
116.	VTÓRNIK	[storm]	TUESDAY	.54	.31
117.	PRÁVILO	[pry your love]	RULE	.77	.42
118.	VNIMÁNIE	[pneumonia]	ATTENTION	.88	.35
119.	NACHÁLO	[not shallow]	BEGINNING	.81	.23
120.	ITÓG	[he talk]	SUM	.58	.23

REFERENCES

Atkinson, R. C., & Wescourt, K. T. Some remarks on a theory of memory. In P. Rabbitt and S. Dornic (Eds.), Attention and performance V. London: Academic Press, 1974, in press.

Bower, G. Mental imagery and associative learning. In L. Gregg (Ed.), Cognition in learning and memory. New York: Wiley, 1972.

Bugelski, B. R. Images as mediators in one-trial paired associate learning. II: Self-timing in successive lists. Journal of Experimental Psychology, 1968, 77, 328-334.

Ott, C. E., Butler, D. C., Blake, R. S., & Ball, J. P. The effect of interactive-image elaboration on the acquisition of foreign language vocabulary. Language Learning, 1973, 23, 197-206.

Paivio, A. Imagery and verbal processes. New York: Holt, Rinehart and Winston, 1971.

Raugh, M. R., & Atkinson, R. C. A mnemonic method for the learning of a second language vocabulary. Journal of Educational Psychology, 1974, in press.

Schnorr, J. A., & Atkinson, R. C. Study position and item differences in the short- and long-term retention of paired associates learned by imagery. Journal of Verbal Learning and Verbal Behavior, 1970, 9, 614-622.

Yates, F. The art of memory. Chicago: University of Chicago Press, 1972.

FOOTNOTES

[1]This research was supported by the Office of Naval Research, Contract No. N00014-67-A-0012-0054, and by Grant MH-21747 from the National Institute of Mental Health. The authors wish to thank Professors Richard D. Schupbach and Joseph A. Van Campen of the Department of Slavic Languages and Literature at Stanford University for assistance in preparing the vocabulary used in the work reported here and for advice on problems of vocabulary acquisition in second-language learning.

[2]Printed Russian words are presented in a standard transliteration of the Cyrillic alphabet into the Roman alphabet; stress is marked.

[3]An inspection of frequency histograms indicated unimodal distributions for both the keyword and control groups. There was no evidence to suggest that some subjects in the keyword group performed unusually well, whereas the others were comparable to control subjects.

DISTRIBUTION LIST

Navy

4 Dr. Marshall J. Farr, Director
Personnel & Training Research Programs
Office of Naval Research (Code 458)
Arlington, VA 22217

1 ONR Branch Office
495 Summer Street
Boston, MA 02210
Attn: Research Psychologist

1 ONR Branch Office
1030 East Green Street
Pasadena, CA 91101
Attn: E. E. Gloye

1 ONR Branch Office
536 South Clark Street
Chicago, IL 60605
Attn: M. A. Bertin

1 Office of Naval Research
Area Office
207 West 24th Street
New York, NY 10011

6 Director
Naval Research Laboratory
Code 2627
Washington, DC 20390

12 Defense Documentation Center
Cameron Station, Building 5
5010 Duke Street
Alexandria, VA 22314

1 Special Assistant for Manpower
OASN (M&RA)
Pentagon, Room 4E794
Washington, DC 20350

1 LCDR Charles J. Theisen, Jr., MSC, USN
4024
Naval Air Development Center
Warminster, PA 18974

1 Chief of Naval Reserve
Code 3055
New Orleans, LA 70146

1 Dr. Harold R. Booher
Naval Air Systems Command
NAVAIR 04A4
Washington, DC 20361

1 Commander
Naval Air Systems Command
Department of the Navy
AIR-413C
Washington, DC 20361

1 Dr. Lee Miller
Naval Air Systems Command
AIR-413E
Washington, DC 20361

1 CAPT John F. Riley, USN
Commanding Officer
U.S. Naval Amphibious School
Coronado, CA 92155

1 CAPT Ouida C. Upchurch, USN
Program Coordinator
Bureau of Medicine & Surgery (Code 71G)
Washington, DC 20372

1 Chairman
Behavioral Science Department
Naval Command & Management Division
U.S. Naval Academy
Luce Hall
Annapolis, MD 21402

1 Chief of Naval Education & Training
Naval Air Station
Pensacola, FL 32508
Attn: CAPT Bruce Stone, USN

1 Mr. Arnold Rubinstein
Naval Material Command (NAVMAT 03424)
Room 820, Crystal Plaza No. 6
Washington, DC 20360

1 Commanding Officer
Naval Medical Neuropsychiatric
Research Unit
San Diego, CA 92152

1 Director, Navy Occupational Task
Analysis Program (NOTAP)
Navy Personnel Program Support
Activity
Building 1304, Bolling AFB
Washington, DC 20336

1 Dr. Richard J. Niehaus
Office of Civilian Manpower Management
Code 06A
Washington, DC 20390

1 Department of the Navy
Office of Civilian Manpower Management
Code 263
Washington, DC 20390

1 Superintendent
Naval Postgraduate School
Monterey, CA 93940
Attn: Library (Code 2124)

1 Commander, Navy Recruiting Command
4015 Wilson Boulevard
Arlington, VA 22203
Attn: Code 015

1 Mr. George N. Graine
Naval Ship Systems Command
SHIPS 047C12
Washington, DC 20362

1 Chief of Naval Technical Training
Naval Air Station Memphis (75)
Millington, TN 38054
Attn: Dr. Norman J. Kerr

1 Commanding Officer
Service School Command
U.S. Naval Training Center
San Diego, CA 92133
Attn: Code 3030

1 Dr. William L. Maloy
Principal Civilian Advisor for
Education & Training
Naval Training Command, Code 01A
Pensacola, FL 32508

1 Dr. Alfred F. Smode, Staff Consultant
Training Analysis & Evaluation Group
Naval Training Equipment Center
Code N-00T
Orlando, FL 32813

1 Dr. Hanns H. Wolff
Technical Director (Code N-2)
Naval Training Equipment Center
Orlando, FL 32813

1 Chief of Naval Training Support
Code N-21
Building 45
Naval Air Station
Pensacola, FL 32508

1 Dr. Robert French
Naval Undersea Center
San Diego, CA 92132

1 CDR Richard L. Martin, USN
Fighter Squadron 124
NAS Miramar, CA 92145

1 Navy Personnel R&D Center
San Diego, CA 92152

5 Navy Personnel R&D Center
San Diego, CA 92152
Attn: Code 10

Army

1 Headquarters
U.S. Army Administration Center
Personnel Administration Combat
Development Activity
ATCP-HRO
Ft. Benjamin Harrison, IN 46249

1 Armed Forces Staff College
Norfolk, VA 23511
Attn: Library

1 Director of Research
U.S. Army Armor Human Research Unit
Building 2422 Morade Street
Fort Knox, KY 40121
Attn: Library

1 Commandant
United States Army Infantry School
Fort Benning, GA 31905
Attn: ATSH-DET

1 Deputy Commander
U.S. Army Institute of Administration
Fort Benjamin Harrison, IN 46216
Attn: EA

1 Dr. Frank J. Harris
U.S. Army Research Institute
1300 Wilson Boulevard
Arlington, VA 22209

1 Dr. Ralph Dusek
U.S. Army Research Institute
1300 Wilson Boulevard
Arlington, VA 22209

1 Mr. Edmund F. Fuchs
U.S. Army Research Institute
1300 Wilson Boulevard
Arlington, VA 22209

1 Dr. Leon H. Nawrocki
U.S. Army Research Institute
1300 Wilson Boulevard
Arlington, VA 22209

1 Dr. J. E. Uhlaner, Technical Director
U.S. Army Research Institute
1300 Wilson Boulevard
Arlington, VA 22209

1 Dr. Joseph Ward
U.S. Army Research Institute
1300 Wilson Boulevard
Arlington, VA 22209

1 HQ USAREUR & 7th Army
ODCSOPS
USAREUR Director of GED
APO New York 09403

Air Force

1 Research Branch (AF/DPXYR)
Pentagon, Room 5C428
Washington, DC 20330

1 Dr. G. A. Eckstrand (AFHRL/AS)
Wright-Patterson AFB
Ohio 45433

1 Dr. Ross L. Morgan (AFHRL/AST)
Wright-Patterson AFB
Ohio 45433

1 AFHRL/DOJN
Stop No. 63
Lackland AFB, TX 78236

1 Dr. Martin Rockway (AFHRL/TT)
Lowry AFB
Colorado 80230

1 Major P. J. DeLeo
Instructional Technology Branch
AF Human Resources Laboratory
Lowry AFB, CO 80230

1 AFOSR/NL
1400 Wilson Boulevard
Arlington, VA 22209

1 Commandant
USAF School of Aerospace Medicine
Aeromedical Library (SUL-4)
Brooks AFB, TX 78235

1 Dr. Sylvia R. Mayer (MCIT)
Headquarters, Electronic Systems
Division
LG Hanscom Field
Bedford, MA 01730

1 CAPT Jack Thorpe, USAF
Flying Training Division (HRL)
Williams AFB, AZ 85224

Marine Corps

1 Dr. E. A. Dover
Manpower Measurement Unit (Code MPI)
Arlington Annex, Room 2413
Arlington, VA 20380

1 Commandant of the Marine Corps
Headquarters, U.S. Marine Corps
Code MPI-20
Washington, DC 20380

1 Director, Office of Manpower Utilization
Headquarters, Marine Corps (Code MPU)
MCB (Building 2009)
Quantico, VA 22134

1 Dr. A. L. Slafkosky
Scientific Advisor (Code RD-1)
Headquarters, U.S. Marine Corps
Washington, DC 20380

Coast Guard

1 Mr. Joseph J. Cowan, Chief
Psychological Research Branch (G-P-1/62)
U.S. Coast Guard Headquarters
Washington, DC 20590

Other DOD

1 Lt. Col. Henry L. Taylor, USAF
Military Assistant for Human Resources
OAD (E&LS) ODDR&E
Pentagon, Room 3D129
Washington, DC 20301

1 Mr. William J. Stormer
DOD Computer Institute
Washington Navy Yard, Building 175
Washington, DC 20374

1 Col. Austin W. Kibler
Advanced Research Projects Agency
Human Resources Research Office
1400 Wilson Boulevard
Arlington, VA 22209

1 Mr. Thomas C. O'Sullivan
Advanced Research Projects Agency
Human Resources Research Office
1400 Wilson Boulevard
Arlington, VA 22209

1 Helga L. Yeich
Advanced Research Projects Agency
Manpower Management Office
1400 Wilson Boulevard
Arlington, VA 22209

Other Government

1 Dr. Eric McWilliams, Program Manager
Technology and Systems, TIE
National Science Foundation
Washington, DC 20550

1 Dr. Andrew R. Molnar
Technological Innovations in
Education
National Science Foundation
Washington, DC 20550

Miscellaneous

1 Dr. Scarvia B. Anderson
Educational Testing Service
17 Executive Park Drive, N.E.
Atlanta, GA 30329

1 Dr. John Annett
The Open University
Milton Keynes
Buckinghamshire
ENGLAND

1 Dr. Gerald V. Barrett
University of Akron
Department of Psychology
Akron, OH 44325

1 Dr. Bernard M. Bass
University of Rochester
Management Research Center
Rochester, NY 14627

1 Dr. David G. Bowers
University of Michigan
Institute for Social Research
Ann Arbor, MI 48106

1 Mr. Kenneth M. Bromberg
Manager - Washington Operations
Information Concepts, Inc.
1701 North Fort Meyer Drive
Arlington, VA 22209

1 Dr. Ronald P. Carver
American Institutes for Research
Foxhall Square
3301 New Mexico Avenue, N.W.
Washington, DC 20016

1 Centry Research Corporation
4113 Lee Highway
Arlington, VA 22207

1 Dr. Allan M. Collins
Bolt Beranek and Newman, Inc.
50 Moulton Street
Cambridge, MA 02138

1 Dr. H. Peter Dachler
University of Maryland
Department of Psychology
College Park, MD 20742

1 Dr. René V. Dawis
University of Minnesota
Department of Psychology
Minneapolis, MN 55455

1 ERIC
Processing and Reference Facility
4833 Rugby Avenue
Bethesda, MD 20014

1 Dr. Victor Fields
Montgomery College
Department of Psychology
Rockville, MD 20850

1 Dr. Edwin A. Fleishman
American Institutes for Research
Foxhall Square
3301 New Mexico Avenue, N.W.
Washington, DC 20016

1 Dr. Dexter Fletcher
Navy Personnel Research &
Development Center
San Diego, CA 92152

1 Dr. Robert Glaser, Director
University of Pittsburgh
Learning Research & Development
Center
Pittsburgh, PA 15213

1 Dr. Henry J. Hamburger
University of California
School of Social Sciences
Irvine, CA 92664

1 Dr. M. D. Havron
Human Sciences Research, Inc.
7710 Old Spring House Road
West Gate Industrial Park
McLean, VA 22101

1 HumRRO
Division No. 3
P.O. Box 5787
Presidio of Monterey, CA 93940

1 HumRRO
Division No. 4, Infantry
P.O. Box 2086
Fort Benning, GA 31905

1 HumRRO
Division No. 5, Air Defense
P.O. Box 6057
Fort Bliss, TX

1 Dr. Lawrence B. Johnson
Lawrence Johnson & Associates, Inc.
200 S. Street, N.W., Suite 502
Washington, DC 20009

1 Dr. Milton S. Katz
MITRE Corporation
Westgate Research Center
McLean, VA 22101

1 Dr. Steven W. Keele
University of Oregon
Department of Psychology
Eugene, OR 97403

1 Dr. David Klahr
Carnegie-Mellon University
Department of Psychology
Pittsburgh, PA 15213

1 Dr. Alma E. Lantz
University of Denver
Denver Research Institute
Industrial Economics Division
Denver, CO 80210

1 Dr. Robert R. Mackie
Human Factors Research, Inc.
6780 Cortona Drive
Santa Barbara Research Park
Goleta, CA 93017

1 Dr. Donald A. Norman
University of California, San Diego
Center for Human Information Processing
La Jolla, CA 92037

1 Mr. A. J. Pesch, President
Eclectech Associates, Inc.
P.O. Box 178
North Stonington, CT 06359

1 Mr. Luigi Petrullo
2431 North Edgewood Street
Arlington, VA 22207

1 Dr. Joseph W. Rigney
University of Southern California
Behavioral Technology Laboratories
3717 South Grand
Los Angeles, CA 90007

1 Dr. Leonard L. Rosenbaum, Chairman
Montgomery College
Department of Psychology
Rockville, MD 20850

1 Dr. George E. Rowland
Rowland and Company, Inc.
P.O. Box 61
Haddonfield, NJ 08033

1 Dr. Arthur I. Siegel
Applied Psychological Services
404 East Lancaster Avenue
Wayne, PA 19087

1 Dr. C. Harold Stone
1428 Virginia Avenue
Glendale, CA 91202

1 Mr. Dennis J. Sullivan
725 Benson Way
Thousand Oaks, CA 91360

1 Dr. Benton J. Underwood
Northwestern University
Department of Psychology
Evanston, IL 60201

1 Dr. David J. Weiss
University of Minnesota
Department of Psychology
Minneapolis, MN 55455

1 Dr. Anita West
Denver Research Institute
University of Denver
Denver, CO 80210

1 Dr. Kenneth N. Wexler
University of California
School of Social Sciences
Irvine, CA 92664