DOCUMENT RESUME

ED 096 816 FL 005 914

AUTHOR Raugh, Michael R.; Atkinson, Richard C.
TITLE A Mnemonic Method for the Acquisition of a Second-Language Vocabulary. Psychology and Education Series, Technical Report No. 224.
INSTITUTION Stanford Univ., Calif. Inst. for Mathematical Studies in Social Science.
SPONS AGENCY Advanced Research Projects Agency (DOD), Washington, D.C.; Office of Naval Research, Washington, D.C. Personnel and Training Research Programs Office.
PUB DATE 15 Mar 74
NOTE 84p.; For related document, see FL 006 488

EDRS PRICE MF-$0.75 HC-$4.20 PLUS POSTAGE
DESCRIPTORS *Associative Learning; Computer Assisted Instruction; Language Instruction; Memory; *Mnemonics; Retention; *Second Language Learning; *Spanish; *Vocabulary Development

ABSTRACT

Four experiments are 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 involves associating the spoken foreign word to an English word that sounds like some part of the foreign word; the second stage requires the subject to form a mental image or picture of the keyword "interacting" with the English translation. Thus, the keyword 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 a mental image (imagery link). The experiments compare the keyword method for learning a Spanish vocabulary with various control procedures. In all cases, the keyword method proved to be highly effective, yielding in one experiment a final test score of 88 percent correct for the keyword group compared to 28 percent for the control group. Several theoretical issues related to the keyword method are examined; practical aspects of incorporating the method into a foreign language curriculum also are discussed. (Author)

A MNEMONIC METHOD FOR THE ACQUISITION OF A SECOND-LANGUAGE VOCABULARY

by

Michael R. Raugh and Richard C. Atkinson

TECHNICAL REPORT NO. 224

March 15, 1974

PSYCHOLOGY & EDUCATION SERIES

This research was supported jointly by the Advanced Projects Research Agency of the Department of Defense and by the Office of Naval Research, Personnel and Training Research Programs, Psychological Sciences Division, under Contract No. N00014-67-A-0012-0054.

INSTITUTE FOR MATHEMATICAL STUDIES IN THE SOCIAL SCIENCES
STANFORD UNIVERSITY
STANFORD, CALIFORNIA

TECHNICAL REPORTS

PSYCHOLOGY SERIES

INSTITUTE FOR MATHEMATICAL STUDIES IN THE SOCIAL SCIENCES

(Place of publication shown in parentheses; if published title is different from title of Technical Report this is also shown in parentheses.)

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: 224

2. GOVT ACCESSION NO.:

3. RECIPIENT'S CATALOG NUMBER:

4. TITLE (and Subtitle): A MNEMONIC METHOD FOR THE ACQUISITION OF A SECOND-LANGUAGE VOCABULARY

5. TYPE OF REPORT & PERIOD COVERED: Technical Report

6. PERFORMING ORG. REPORT NUMBER:

7. AUTHOR(s): Michael R. Raugh and Richard C. Atkinson

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: NR 154-326

11. CONTROLLING OFFICE NAME AND ADDRESS: Personnel & Training Research Programs, Office of Naval Research, Arlington, VA 22217

12. REPORT DATE: March 15, 1974

13. NUMBER OF PAGES: 70

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office):

15. SECURITY CLASS. (of this report): none

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 acquisition
Mental Imagery
Keyword
Computer-assisted Instruction

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

Four experiments are 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 involves associating the spoken foreign word to an English word that sounds like some part of the foreign word; the second stage requires the subject to form a mental image or picture of the keyword "interacting" with the English translation. Thus, the keyword can be described as a chain of two

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)

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 a mental image (imagery link). The experiments compare the keyword method for learning a Spanish vocabulary with various control procedures. In all cases, the keyword method proved to be highly effective, yielding in one experiment a final test score of 88% correct for the keyword group compared to 28% for the control group. Several theoretical issues related to the keyword method are examined; practical aspects of incorporating the method into a foreign language curriculum also are discussed.

ARPA Order Number: 2284/8-30-72

Contract Number: N00014-67-A-0012-0054

Program Code Number: 3D20

ONR Project Number: NR 154-326

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Scientific Officer: Dr. Joseph Young
Assistant Director
Personnel and Training Research Programs
Office of Naval Research (Code 458)

Effective Date: 1 August 1970

Expiration Date: 31 July 1974

Sponsored by
Advanced Research Projects Agency
and
Office of Naval Research
ARPA Order No. 2284

TECHNICAL REPORT SUMMARY

A series of experiments are 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 involves associating the spoken foreign word to an English word that sounds like some part of the foreign word; the second stage requires the subject 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: 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). As an example, consider the Spanish word caballo, meaning horse. Its pronunciation is somewhat like "cob-eye-yo" and contains a sound that resembles the English word "eye." Using eye as the keyword the subject must form a mental image of an eye interacting in some way with a horse; e.g., a cyclopean eye winking in the forehead of a horse or a horse kicking a giant eye. With minimal training, the presentation of the Spanish word should elicit the keyword, which in turn will recall the mental image and the English translation.

Four experiments were designed to evaluate the effectiveness of the keyword method. In Experiment I all subjects were first taught the keyword for each word of a 60-word Spanish vocabulary. Afterwards, subjects were divided into two groups to learn the English translations; the experimental group learned by using mental imagery to associate each

keyword to the corresponding English translation, while the control group used a rehearsal method to associate each Spanish word directly to its English translation. Experiment II was similar to Experiment I, except that it did not involve the artificial prelearning of test vocabulary keywords. Instead, subjects in the experimental group learned the keywords at the same time that they formed the imagery links, whereas control subjects used the rehearsal method to make d t associations between the Spanish words and the English translations.

Experiment III, which used a within-subjects design, was conducted to test the keyword against a freer control condition. A larger and more varied test vocabulary was used and was presented to subjects over a period of many days. The experimental condition used the keyword method, and the control condition permitted the subject to use any learning strategy except the keyword method. Experiment IV was the same as Experiment III with the addition of a free-choice condition. The free-choice condition placed no constraint on how the subject learned; in this condition the subject could request a keyword whenever he wished. Experiments III and IV were run under computer control, employing equipment and a facility that is used for computer-assisted instruction. Thus, these two studies were conducted under conditions where instruction, rather than experimentation, was the focus of activity from the subjects' perspective.

Experiments I and II demonstrated that the keyword method was highly effective when compared with a rehearsal strategy. In Experiment I the keyword group yielded a final test score of 88% correct compared with 28% for the control group; in Experiment II the results

were 59% and 30% correct for the keyword and control groups, respectively. Experiment III demonstrated that the keyword method also is superior to a less restricted control that permitted subjects to use any learning strategy they desired except the keyword method; the keyword condition yielded a final test score of 54% correct versus 45% for the control condition. The result is all the more striking since a within-subjects design was used in this experiment, and many subjects reported using the keyword method for some of the control items even though instructed to the contrary. Experiment IV demonstrated that both the free-choice and keyword conditions were significantly better than the control condition, but not significantly different from each other; the final test scores were 59%, 57%, and 50% for the free-choice, keyword, and control conditions, respectively. In the free-choice condition, subjects requested a keyword at least once for 92% of the items, and the frequency of requests increased with the scaled difficulty of the items.

The results provide strong support for the use of the keyword method in learning a foreign language vocabulary. Several issues related to the keyword method are examined in the paper, and alternative versions of the method are described. Some of the practical considerations involved in adapting the method for inclusion in a foreign-language curriculum also are discussed.

INTRODUCTION

Mental imagery was employed by scholars of classical times as a means of memorizing complex arrays of information (Yates, 1972). Lately the technique has become a matter of research interest both because of its theoretical implications for memory (Paivio, 1971) and because it offers an effective means of remembering certain kinds of information (Bower, 1972; Bugelski, 1968). In the experiments reported here, we wanted to determine whether mental imagery could also be applied to the practical problem of learning a foreign language vocabulary, an area in which little systematic research has been done (Hughes, 1968).

For experimental purposes a procedure was devised that we have called the "keyword method" for associating a spoken foreign word with its English translation. This method divides the study of a word into two stages. The first stage involves associating the spoken foreign word to an English word that sounds approximately like some part of the foreign word. As an example, the Spanish word caballo (pronounced somewhat like "cob-eye-yo"), contains a sound that resembles the spoken English word "eye"; we call such a similar sounding English word a keyword. The second stage involves mental imagery in which a symbolic image of the keyword interacts in a graphic way with a symbolic image of the English translation. In the case of caballo (meaning horse), one could form a mental image of something like a cyclopean eye winking in the forehead of a horse or a horse kicking a giant eye. As another example, the Spanish word for duck is pato (pronounced somewhat like "pot-o"). Employing the English word "pot" as the keyword, one could

imagine a duck hiding under an overturned flower pot with its webbed feet and tufted tail sticking out below.

The keyword method is applied by presenting a subject 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 the subject must associate the sound of the foreign word to the given keyword and then generate a mental image relating the keyword to the English translation.

The preselection of keywords by the experimenter is an important aspect of the method. In preparing a test vocabulary a keyword is considered to be good 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 imagery link connecting the keyword and the English translation.

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. As examples of the two extremes, "log" could be used as a keyword for Spanish lagartija, and the keyword phrase "see you, dad" could be used for Spanish ciudad. Criterion 2 must be satisfied to make the imagery link as simple as possible. Often concrete nouns are good as keywords, because they are generally easy to image; abstract nouns for which symbolic imagery comes readily to mind also are

effective keywords. A good keyword is easily imaged in isolation; however, it must also be easily imaged in relationship to its paired English translation. Criterion 3 is used to avoid the ambiguities that could arise if a given keyword were associated with more than one foreign word. For a large vocabulary that is divided into subvocabularies to be presented on different days, Criterion 3 might be applied only to each subvocabulary; thus, a given keyword could be used for different words on different days, but not for different words on the same day. Criterion 3 does not impose a serious practical limitation on the presentation of a vocabulary, since it is usually an easy matter to distribute items over days in a way that avoids keyword repetition on any single day.

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 the keyword by a similarity in sound (the acoustic link); the keyword is in turn linked to the English translation by a learner-generated mental image (the mnemonic or imagery link). This method could be modified to produce a variety of related learning strategies by changing the ways in which the two links are formed. For example, instead of using an acoustic link, one could use an orthographic link by basing the selection of a keyword on a similarity of spelling rather than a similarity of sound (thus, "ball" might be used as a keyword for caballo). Or the mnemonic link could be based upon a verbal construct involving a sentence whose subject is the keyword and whose object is the English translation.

Furst (1949), a popular writer, proposed a variation of our method that employs an acoustic first link and a second link that is based upon

a similarity in meaning between the keyword and the English translation. An example from German is the word kurz, meaning short; "curt" might be used as a keyword since it is synonymous with one of the meanings of short. The problem with this method is that the vocabulary for which suitable keywords could be found is too restricted to be useful in most practical situations. In this respect our method is more accommodating than Furst's, since mental imagery permits the association of words that are not associated directly by similarities in meaning.

Lorayne (1957), another popular writer, proposed a method that resembles the keyword method. Lorayne used an acoustic link and a mental imagery link. As in the keyword method, Lorayne's mental imagery link is learner-generated. The two points that distinguish this method from the keyword method are: (1) Lorayne uses learner-generated keywords, and (2) he emphasizes spanning as much of the full sound of the foreign word as possible. In our method keywords are provided by the experimenter, and no emphasis is placed on spanning. Butler, Ott, and Blake (1973), using a German monosyllabic vocabulary, experimented with Lorayne's method and found no difference between a group using the experimental method and another equally timed group that was instructed to learn by any method. More will be said below about the differences between Lorayne's method and ours.

Four experiments were designed to evaluate the effectiveness of the keyword method. In Experiment I all subjects were first taught the keyword for each word of a 60-word Spanish vocabulary. Afterwards, subjects were divided into two groups to learn the English translations; the experimental group learned by using mental imagery to associate each

keyword to the corresponding English translation, while the control group used a rehearsal method to associate each Spanish word directly to its English translation. Experiment II was similar to Experiment I, except that it did not involve the artificial prelearning of test vocabulary keywords. Instead, subjects in the experimental group learned the keywords at the same time that they formed the imagery links, whereas control subjects used the rehearsal method to make direct associations between the Spanish words and the English translations.

Experiment III, which used a within-subjects design, was conducted to test the keyword method against a freer control condition. A larger and more varied test vocabulary was used and was presented to subjects over a period of many days. The experimental condition used the keyword method, and the control condition permitted the subject to use any learning strategy except the keyword method. Experiment IV was the same as Experiment III with the addition of a free-choice condition. The free-choice condition placed no constraint on how the subject learned; in this condition the subject could request a keyword whenever he wished.

EXPERIMENT I

A priori arguments in favor of the keyword method rest upon the effectiveness of mental imagery as a means of learning English paired-associates. Experiment I was designed to determine whether mental imagery could be used effectively to link foreign words to their English translations after subjects had prelearned the keywords. The prelearning of keywords was accomplished by using the words and keywords

of the test vocabulary as practice items in an introductory phase of the experiment. A slide projector was used for visual presentation of each Spanish word and keyword; as the experimenter pronounced each Spanish word, a slide was displayed showing the printed Spanish word and the keyword. After the presentation of the entire vocabulary, subjects were tested for recall of keywords and given feedback. A second slide study presentation identical to the first was given followed by a repeat of the test.

Following practice on keywords, subjects were assigned to either the experimental or control group. They were then given written instructions on methods of associating foreign words to their English translations.

For the next phase of the experiment (in which the English translations were learned) each subject received a list of all the items of the test vocabulary; on the list each keyword and English translation was printed next to the Spanish word. Experimental subjects were told to ignore the Spanish word (they had already learned the acoustic link in the introduction) and to concentrate on forming a mental image associating the keyword with the English translation; control subjects alternately subvocalized the Spanish word and the English translation. After the subjects completed study of the list they were then given three tests: the first tested the recall of the English translation given the spoken Spanish, the second tested the recall of the translation given the written Spanish, and the third tested the recall of the keyword given the spoken Spanish. Experiment I was the only experiment to be reported here in which subjects studied the written form of a foreign word.

Method

Subjects. Forty Stanford University undergraduates were used (24 males and 16 females); each was a native speaker of English and none had studied Spanish except possibly for a brief period in grammar school. None of the subjects participated in any of the other experiments reported in this paper. The rule of excluding a subject from all subsequent experiments was followed for all experiments.

Stimulus material. A test vocabulary of 60 Spanish words with associated keywords was used. An additional example vocabulary of six words with associated keywords was used in an introductory phase of the experiment. The English translations of all the Spanish words were judged, by the experimenters, to be easy to image. (See Appendix A for the test vocabulary and the example items.)

Procedures. Experimental and control subjects were run together in a single room. In the introductory phase of the experiment, subjects received training on the keywords of the test vocabulary. The first part of the introductory phase consisted of a slide presentation and practice on the example items and the test vocabulary. An individual slide was prepared for each item: the Spanish word appeared near the center and the keyword appeared between brackets beneath the Spanish word (the English translation was not displayed). At the start of the slide presentation subjects were told that they were going to be given practice on Spanish phonetics. The slides for the six example items were used to begin the presentation. Each of these was displayed for 20 seconds while the experimenter pronounced the Spanish word several times, and stated once for each of the six slides that the keyword was

to be learned by noting a resemblance in sound between it and the Spanish word. Following the six example items, a presentation of the items of the test vocabulary was begun immediately. Each slide of the test vocabulary was displayed for 10 seconds while the experimenter pronounced the associated Spanish word. When reference is made to a spoken Spanish word, it is to mean that the word was pronounced three times with a 1-second pause between pronunciations.

After concluding the first slide presentation, a test series was given in which the experimenter spoke each Spanish item in the same order as in the slide study presentation without displaying the corresponding slide. After allowing 5 seconds for subjects to write the keyword on a numbered test sheet, the corresponding slide was displayed for 5 seconds to allow subjects to note errors. Immediately following the test se ies a second slide presentation was given in which all items of the example vocabulary and the test vocabulary were pronounced and displayed for 10 seconds each; then a second test identical to the first was given.

Subjects were then randomly assigned to the experimental and control conditions with the constraint that both groups contain an equal number of males and females. Subjects were given written instructions on methods for associating Spanish words to English translations. The instructions are presented in Appendix B. The experimental instructions prescribed ignoring the Spanish word (since the link between the spoken Spanish and the keyword had already been learned) and asked the subject to image an interaction between the keyword and the English translation. (The term experimental condition is used interchangeably with keyword condition.) The control instructions stated that keywords could be used

to prompt pronunciation of the Spanish word and required the subjects to learn the English translation by alternately subvocalizing the Spanish word and the English translation. Two of the example items were used in the instructions to illustrate the appropriate method. After completing the instructions, subjects were allowed to study a practice list of the remaining four example items; each Spanish word was printed at the left-hand margin, the keyword was printed between brackets beneath the Spanish word, and the English translation was printed to the right of the Spanish word. Subjects studied the list for two minutes. Then a practice test was given in which the experimenter pronounced each Spanish word and allowed the subjects 10 seconds to write the translations (no feedback was given). After the practice all of the materials were collected, concluding the introductory phase.

In the second phase of the experiment, study lists (identical for all subjects) were distributed. Each list contained all of the triples of the test vocabulary listed in the order of presentation of the slide study. Each Spanish word was printed at the left margin of the page with its keyword printed between brackets beneath it and the English translation printed to its right. Six items were printed in this manner on each of ten pages. Study of the lists was paced by the experimenter at the rate of 1 minute per page. After completing the tenth page, subjects were instructed to turn back to the first page for a second study pass that was paced at the rate of 30 seconds per page (total study time 15 minutes). Spanish words were not spoken during this phase of the experiment.

Following study of the English translations, all of the study materials were collected and test materials for three tests were distributed. Each of these tests involved a randomized ordering of the test vocabulary. For the first test, Test S (spoken Spanish), each Spanish word of the test vocabulary was pronounced by the experimenter and 10 seconds were allowed to write the English translation on a numbered line. For the second test, Test P (printed Spanish), 10 minutes were allowed to write the English translations beside each Spanish word. For the third test, Test K (keyword), each Spanish word was pronounced by the experimenter, and 5 seconds were allowed to write the keyword on a numbered line. An experimental session took approximately 1 hour and 55 minutes.

Results

In the first phase of the experiment only keywords were learned. The results of the first keyword test during this phase were 64% and 67% correct for the experimental and control groups, respectively; the results of the second keyword test were 91% and 90%. There were no significant differences between groups on either test. Since subjects received identical treatment during the learning of keywords, no differences were expected.

In the second phase of the experiment, during which the English translations were learned, results of Test S (spoken Spanish to written English) were 88% and 28% correct for the experimental and control groups, respectively ($t = 14.74$, $p < .001$). The results of Test P (printed Spanish to written English) were 88% and 32% correct, respectively ($t = 11.56$, $p < .001$). Tests S and P show clearly that the imagery link

is quite effective. The results of Test K (spoken Spanish to written keyword) were 93% and 92% correct, respectively, with no significant difference between groups. This latter result may cause some surprise since the keyword subjects were instructed to ignore the sound (and spelling) of the Spanish word during study of the English translation, whereas control subjects were told to rehearse the sound. One might have expected that through the process of rehearsal the control group would increase its familiarity with the spoken Spanish words and thereby improve more than the experimental group in keyword recall. But such was not the case.

Figure 1 presents an item scatter plot of the test vocabulary. Each point represents the performance of a Spanish word on Test S: the abscissa gives the probability of being correct in the control condition, and the ordinate gives the same probability in the keyword condition. For example, the word at(0,.95) is bolsillo (keyword: [boll], English translation: pocket); the abscissa indicates that every subject in the control condition missed the word, and the ordinate indicates that 95% of the subjects in the keyword condition recalled the word correctly. The word at (.15,.45) is reloj ([rail], clock); subjects in both groups performed poorly on this word.

The ordinate of each point in Figure 1 provides a measure of how well subjects formed an imagery link between a keyword and the corresponding English translation: in other words, a measure of the strength of each imagery link. For example, lagartija ([log], lizard) is positioned at point (.35,1.0) and libelula ([bale], dragonfly) is at (.35,.75).

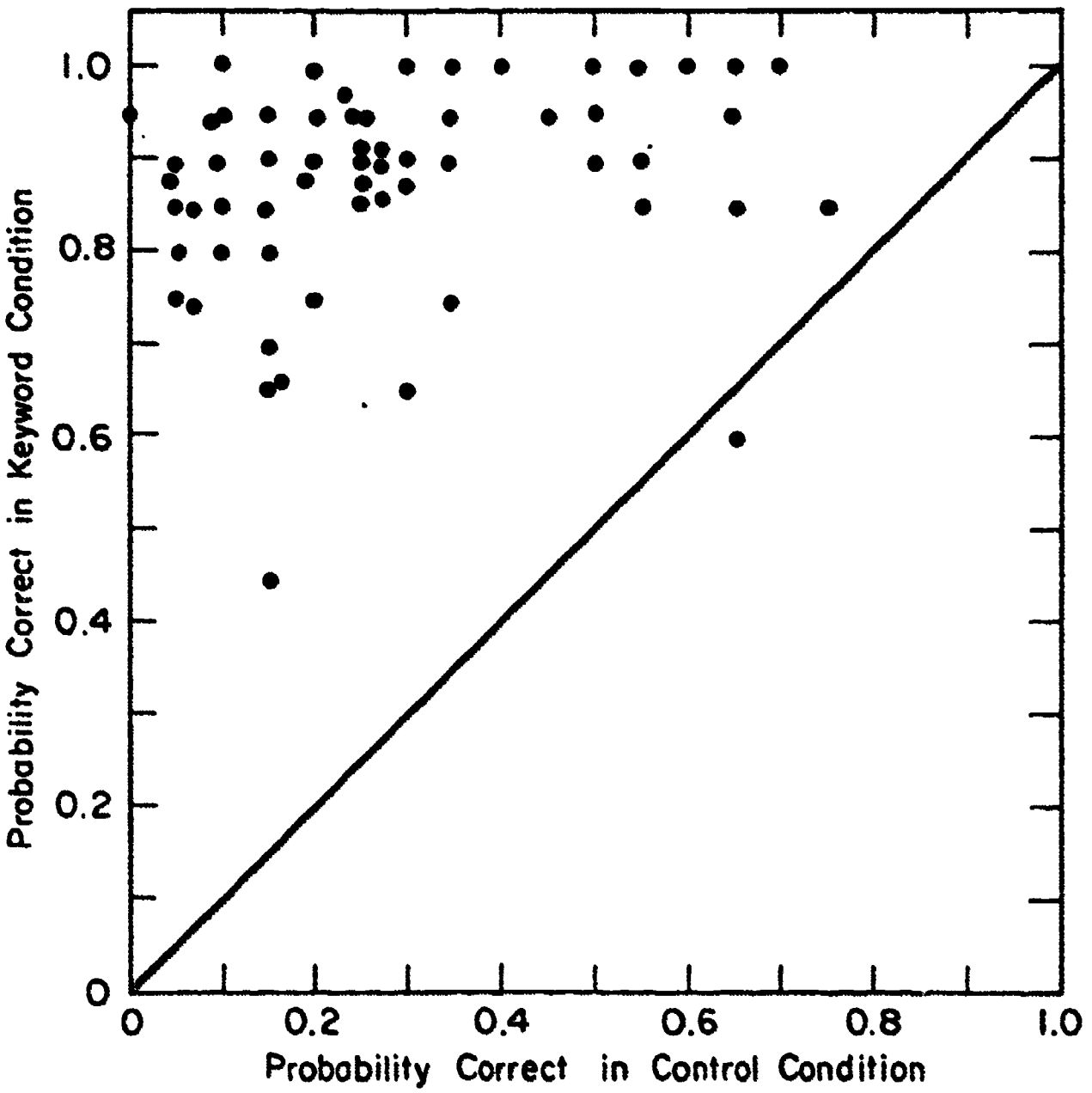

Figure 1. Scatter plot for the test vocabulary for Experiment I. Each point represents the performance levels on Test S of a word in the control and keyword conditions.

Comparing the ordinates of these words to other words on the plot, it can be seen that the imagery link between [log] and lizard is relatively strong compared with the link between [bale] and dragonfly.

EXPERIMENT II

Experiment I demonstrated that the imagery link was effective when not confounded with the learning of the acoustic link. It remained to be seen whether the acoustic link and the imagery link can be learned simultaneously.

Experiment II was designed to test the effect of the full keyword method. The test vocabulary used in Experiment I was used in Experiment II, but a second list (that had no words in common with the test vocabulary) was used for keyword practice in an introductory phase of the experiment. The purpose of keyword practice was twofold: (1) to introduce all subjects to the sounds of Spanish by means of contrasts between English and Spanish phonemes, and (2) to give experimental subjects practice on the learning of acoustic links. The slide projector was eliminated in Experiment II. Instead, subjects were given a printed list of numbered keywords; as the experimenter pronounced each Spanish word of the practice vocabulary, subjects noted the keyword on the list. After subjects had studied all items of the practice list, they turned back to the beginning of the list and repeated the study once again. Afterwards, subjects were tested for recall of keywords. Subjects were then randomly assigned to the experimental and control conditions and given written instructions on the method for associating Spanish words to English translations appropriate to the treatment condition.

In the next phase of the experiment the test vocabulary was learned. Each subject studied the same list that was used in Experiment I except that the Spanish words were deleted; the list the subject saw contained a keyword and English translation for each Spanish word of the test vocabulary. Study was paced by the experimenter who pronounced each Spanish item and allowed a fixed time for subjects to observe the keyword and the English translation. Experimental subjects used the time both to learn the acoustic link and to form an imagery link. Control subjects learned by a rehearsal method in which they alternately subvocalized the Spanish word and the English translation. Subjects were then given two tests, one to test the recall of English translations and one to test the recall of keywords.

Method

Subjects. Thirty Stanford University students were used as subjects (14 males and 16 females); each was a native speaker of English, and none had studied Spanish except possibly for a brief period in grammar school.

Stimulus material. The test vocabulary and example items were the same as those used in Experiment I (presented in Appendix A). An additional vocabulary of 60 Spanish words and their keywords wereused for keyword practice in the introductory phase. The practice vocabulary had no words in common with the test vocabulary.

Procedures. In the introductory phase of the experiment all subjects were given practice on the learning of keywords. Each subject received a numbered list of 66 keywords, the first six of which corresponded to the example words and the remaining 60 corresponded to the Spanish words of the practice vocabulary. Subjects were told that they

were going to be given practice on Spanish phonetics. The first six example items were used to explain how to learn keywords. This was done by telling the subjects to look at an item (a keyword) as the experimenter pronounced the Spanish word; subjects were told that the keyword could be learned by noting the resemblance in sound between it and some part of the Spanish word. Each of the first six items was reviewed in this way at the rate of one item every 20 seconds. Immediately after completing the sixth item, learning of the remaining 60 keywords was begun; each Spanish word of the practice vocabulary was pronounced and 10 seconds were allowed for subjects to observe the keyword. After the list of 66 keywords had been studied in this way, the process was repeated, covering 66 items at the rate of one every 10 seconds. Afterwards a test series was given in which the experimenter pronounced each Spanish word (in random order) and allowed 10 seconds for subjects to write the keyword.

After the keyword practice, subjects were randomly assigned to the experimental (keyword) and control conditions with the constraint that both groups contain an equal number of males and females. Subjects were then given written instructions on methods for associating Spanish words to English translations. These instructions were the same as the instructions for Experiment I (see Appendix B) except that the Spanish words were not printed with the example items. The instructions stated that the experimenter would pronounce a Spanish word and allow a pause for study. Control subjects were told to note the keyword momentarily as an aid to hearing, and then learn the meaning by alternately subvocalizing the Spanish word and the English translation. Experimental

subjects were instructed to learn the keyword while the experimenter pronounced the Spanish word, and then during the following pause picture an imaginary interaction between the keyword and the English translation. Two of the example items were used in the instructions to illustrate the appropriate method. After completing the instructions, subjects studied a practice list of the four remaining example items; each keyword was printed between brackets at the left-hand margin and the English translation was printed to the right of the keyword. The study was paced by the experimenter who announced an item number, pronounced the Spanish word and allowed 10 seconds for subjects to observe the keyword and English translation. The study was repeated a second time; then a practice test was given in which the experimenter pronounced each Spanish word and allowed 10 seconds for the subjects to write the translations.

To begin the second phase of the experiment, each subject was given a list of the test vocabulary. The list was the same as the study list used in Experiment I, except that the printed Spanish words were deleted. Each item was numbered (1-60) at the left-hand margin of the page; the keyword was printed between brackets to the right of the item number, and the English translation was printed still farther to the right. Six items were printed in this manner on each of ten pages. Study was paced by the experimenter, who announced an item number, pronounced the corresponding Spanish word from the test vocabulary and allowed 10 seconds to study the keyword and English translation. Upon completing the 60th item, subjects were instructed to begin again with item 1, repeating the study process exactly as before.

Following study, the experimenter collected all materials and distributed two sets of test sheets, each with blank spaces numbered 1-60. Subjects were then given Test S (same as in Experiment I); the experimenter pronounced each Spanish word of the test vocabulary and allowed 10 seconds for subjects to write the English translation. Next, Test K (same as in Experiment I) was given; the experimenter pronounced each Spanish word and allowed 5 seconds to write the keyword. The experiment, which was two tests shorter than Experiment I, lasted one and one-half hours.

Results

In the introductory phase of the experiment, involving practice on the learning of keywords, the results of the keyword test were 68% and 70% correct for the experimental and control groups, respectively. Since all subjects received identicaltreatment in the keyword practice, no difference between the groups was expected.

In the second phase of the experiment, which involved learning the test vocabulary, the results of Test S (spoken Spanish to written English) were 59% and 30% correct for the experimental and control groups, respectively ($t = 3.2$, $p < .01$). The results of Test K were 69% and 53% correct, respectively ($t = 2.9$, $p < .02$). It was not surprising to obtain a difference between the two groups on Test K, since experimental subjects were expected to learn test vocabulary keywords, whereas control subjects were not.

Figure 2 shows an item scatter plot of the test vocabulary. Each point gives the subjects' recall of a Spanish word on Test S: the abscissa gives the probability of being correct in the control condition,

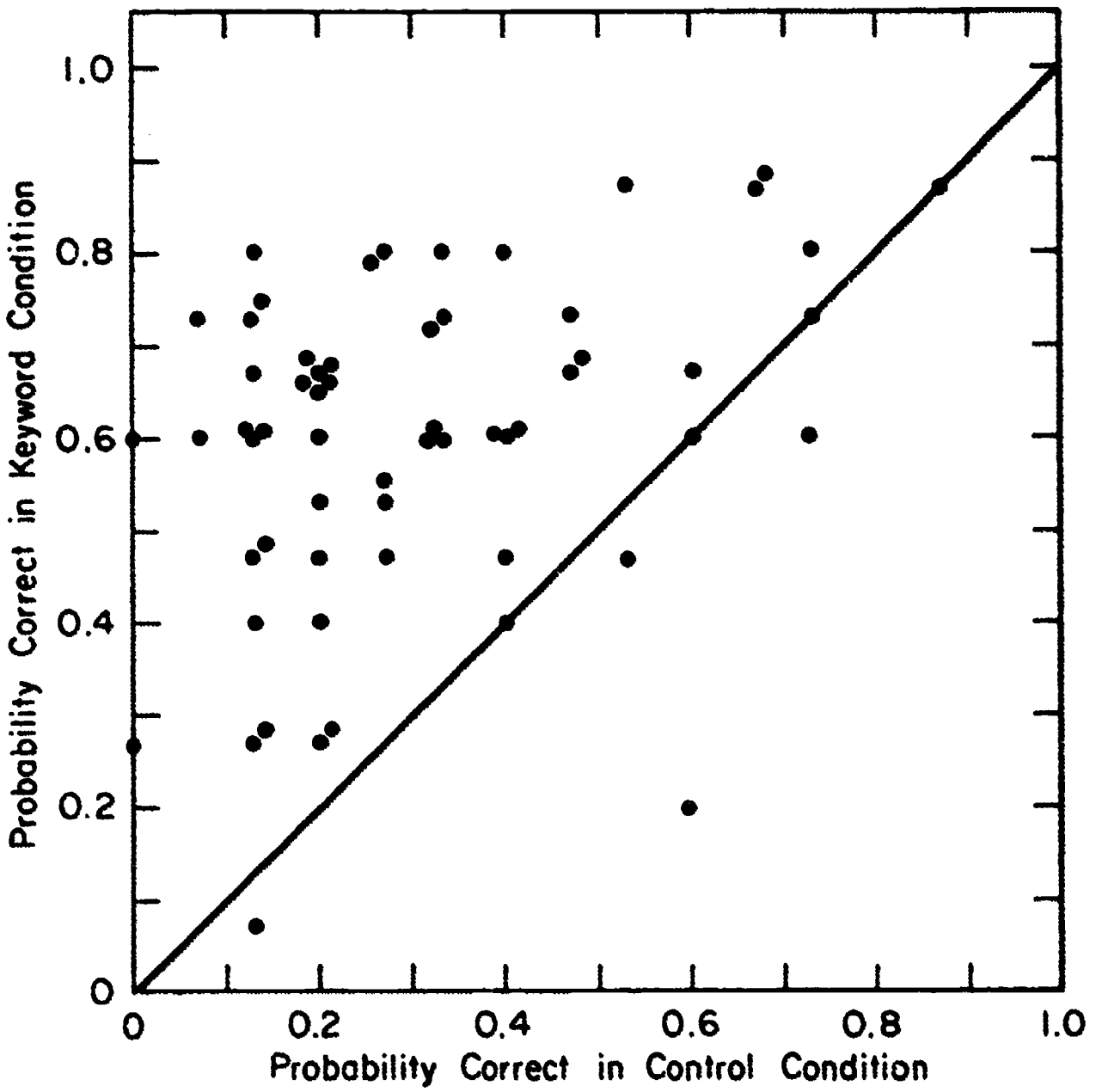

Figure 2. Scatter plot for the test vocabulary for Experiment II. Each point represents the performance levels on Test S of a word in the control and keyword conditions.

and the ordinate gives the same probability in the keyword condition. For example, the point (0,.60) represents the Spanish bolsillo ([bolll], pocket), which was learned by 0% of the control subjects and 60% of the experimental subjects. The point (.07,.60) represents the Spanish silbido ([sill], whistle). The maverick point (.60,.20) represents libelula ([bale], dragonfly). It is interesting to conjecture why this word did so poorly in the experimental condition. It could be that subjects, in hearing the Spanish word pronounced, were unable to perceive the keyword clearly; that is, there may be a weak acoustic link between libelula and [bale]. This is not an unreasonable assumption since the pronounced word breaks into the syllables li-be-lu-la; perhaps "bay" would have been a better keyword. In any case, the poor performance on libelula contradicted our intuition that [bale] would be a good keyword, and demonstrated that effective keywords often must be determined empirically. As a step toward such a determination, it would be useful to have independent measures of the strengths of both the acoustic and imagery links for each word of the test vocabulary.

EXPERIMENT III

The results of Experiment II were quite promising, but of limited generality because the control condition used a very special learning strategy (namely, rehearsal) and the test vocabulary involved only words that were judged easy to image. Experiment III was designed to test the keyword method against a freer control condition over a wider range of vocabulary items. A Spanish test vocabulary was selected that included words judged to be difficult to image, as well as words that were easy

to image. The test vocabulary was divided into three comparable subvocabularies for presentation on three separate days.

Another difference between Experiment III and the previous studies is that subjects were run under computer control, using equipment that also serves to provide computer-assisted instruction. Thus, this study and the next were conducted in a situation where instruction, rather than experimentation, was the focus of activity from the subject's viewpoint.

The experiment was run on a PDP-10 timeshare computer system and involved a within-subjects design. Subjects received instructions from a cathode ray display scope, listened to recorded Spanish words pronounced through headphones, and typed responses into the computer by means of a console keyboard. The experiment began with an introductory session (Day 0), during which subjects were familiarized with the equipment and given instructions on learning methods. 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 Spanish word was pronounced, and for 10 seconds either (1) the keyword and English translation were displayed, or (2) the English translation alone was displayed. In the first case, subjects learned by the keyword method; in the second case they could use any method they chose except the keyword method. A test trial consisted of a run through the subvocabulary in which each Spanish word was pronounced and 15 seconds were allowed to type the English translation.

A test covering all the items of the test vocabulary was given two days after the presentation of the last subvocabulary (Comprehensive Test), and a similar test was given approximately one month later (Delayed Comprehensive Test).

Method

Subjects. Thirty-two Stanford University undergraduates were used (20 females and 12 males). Each spoke English as the native language and none had studied Spanish except possibly for a brief period in grammar school.

Stimulus material. A test vocabulary of 120 Spanish nouns with associated keywords was selected (the test vocabulary is presented in Appendix C). Thirty of the Spanish words had English translations that were easy to image, and 30 had English translations that were difficult to image. Imageability was determined both by the judgment of the experimenters 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 words in the high image group was 6.4, and the average in the low image group was 3.6. The other 60 words had a mean value between these two extremes. The test vocabulary was divided into three comparable subvocabularies of 40 words each, matched (by judgment of the experimenters) in abstractness and imageability, for presentation on separate days.

Procedures. The purpose of the first session (Day 0) was to introduce each subject to the computer terminal and provide practice on the keyword method. The experimenter showed each subject how to start the program that conducted the experiment. The program itself explained

all of the remaining procedures of the experiment. The program, after giving instructions on the use of the keyboard and the audio headset, introduced keywords as a means of focusing attention on the sound of a Spanish word. Practice was given on a randomized list of 30 words (not included in the test vocabulary); a Spanish word was spoken and its bracketed keyword was displayed for 5 seconds. Afterwards, a test (randomized for each subject) was given in which each Spanish word was spoken, and 10 seconds were allowed to start typing the keyword. If a response was begun within 10 seconds, the time period was extended from 10 to 15 seconds; otherwise, the program advanced to the next item. All of the tests in both Experiments III and IV were timed in this way. A second randomized study of the 30 practice words was given, followed by a newly randomized test.

After the keyword practice, written instructions (reproduced in Appendix D) were given on learning methods. The instructions explained that two approaches were to be used in learning the meanings of Spanish words: in one case, while a Spanish word was being spoken, a bracketed keyword would be displayed at the left-hand margin of the screen and the English translation would appear to its right. In this condition, the keyword condition, the subject was instructed to learn the keyword first and then picture an imaginary interaction between the keyword and the English translation. In the other condition, while the Spanish word was being spoken, only the English translation would be displayed. In this condition, the control condition, subjects were told to learn by any method other than by using a keyword with mental imagery.

After the instructions were given, a practice study trial of ten Spanish words was given in which each Spanish word was spoken and either the keyword with the English translation, or the English translation alone, was displayed. Following this a test trial was given in which each Spanish word was spoken and the subject attempted to type the English translation. A second study trial was given and was followed by a second test trial, concluding Day 0.

Subjects returned the following day for the Day 1 session of the experiment. For each subject the computer program randomly selected one of the three 40-word subvocabularies for study, and randomly assigned half of the words to the keyword condition and the other half to the control condition. Day 1 consisted of three successive study-test trials. The study trial was exactly like the practice study trial at the end of Day 0: each Spanish word was spoken while either the keyword and English translation, or the English translation alone, were displayed. For both conditions, the presentation was timed for 10 seconds. On a test trial, a Spanish word was spoken and the subject was given 10 seconds 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 two days after Day 3. The Comprehensive Test was exactly like a daily test trial, except that it covered the entire 120-word test vocabulary. Immediately following the Comprehensive Test a self-paced on-line questionnaire was given to gather

testimony on the method of study used for each word. Each word of the test vocabulary was spoken and the subject was asked to indicate which one of seven modes he used to study the given word. The choices were as follows:

1. I used the GIVEN keyword to study this word, and I can recall the image/verbiage.
2. I used the GIVEN keyword to study this word, but I cannot recall the image/verbiage.
3. I used MY OWN keyword to study this word, and I can recall the image/verbiage.
4. I used MY OWN keyword to study this word, but I cannot recall the image/verbiage.
5. I learned this word because it sounds like a word I know in another foreign language.
6. I used some other method than the ones listed above.
7. I can't remember how I studied this word.

Whenever the subject selected a number between 1 and 4, the program required him to indicate (by typing I or V) whether he had used imagery or a verbal construct (verbiage) to link the keyword to the English translation. An example was given to help clarify the distinction: pollo, pronounced somewhat like poi-yo, might use "oil" as a keyword. If the English translation of pollo (chicken) were studied by memorizing the phrase "chicken oil," then a verbal construct was used. On the other hand, if an imaginary picture were formed of a chicken being squirted by an oil can, then mental imagery was used. Five learning modes were defined for later analysis of the questionnaire: (a) Image Mode referred to an instance in which a subject selected 1-4 on the questionnaire and specified that he had used mental imagery to associate the keyword to the

English translation, (b) Verbiage Mode referred to an instance in which 1-4 was selected and a verbal construct was used to associate the keyword to the English translation, (c) Cognate Mode referred to an instance in which 5 was indicated, (d) Other Mode meant that a subject selected 6, and (e) Don't Remember meant that the subject selected 7.

For the sixth and final session (the Delayed Comprehensive Test), subjects were called back about 25 to 35 days (average 30 days) from Day 0 to take a randomized repeat of the Comprehensive Test. Subjects had not been forewarned that they would be tested at a later date.

Results

The results of the Comprehensive Test were 54% and 45% correct for words in the keyword and control conditions, respectively (paired $t = 4.1$, $p < .001$). Although the differences were not as great as in Experiment II, they were substantial and were still evident on the Delayed Comprehensive Test. The results of the Delayed Comprehensive Test were 43% and 35% correct, respectively (paired $t = 3.5$, $p < .01$).

Figure 3 gives the performance levels of words learned in each condition for the three test trials on Day 1, Day 2, and Day 3. The keyword method is superior in all cases. Table 1 shows a breakdown of the Comprehensive Test and the Delayed Comprehensive Test into the performance levels of words that had been studied on Day 1, Day 2, and Day 3.

The questionnaire data were analyzed to determine the types of learning strategies subjects used in studying the test vocabulary. Only words that were correct on the Comprehensive Test were analyzed. Table 2 shows the percentages of words learned in the three principal modes (Image, Verbiage, and Cognate) and the remaining alternatives (Other

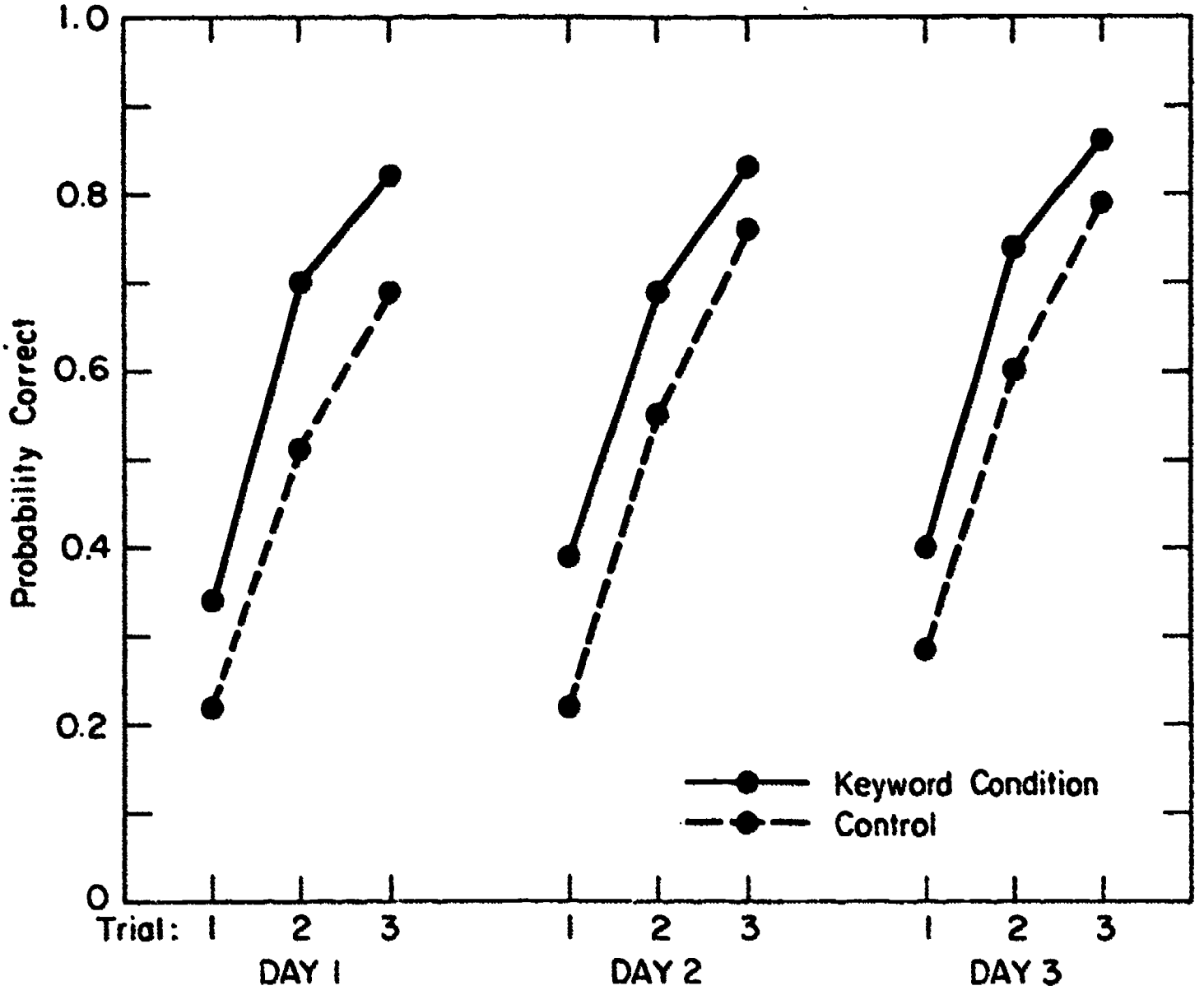

Figure 3. The performance levels in Experiment III for each condition on Day 1, Day 2, and Day 3.

Table 1

Probability That a Word was Correct on the Comprehensive Test as a Function of the Treatment Condition and the Day on Which it Was Studied

	Comprehensive Test		Delayed Comprehensive Test	
	Keyword	Control	Keyword	Control
Day 1	.44	.35	.41	.32
Day 2	.52	.44	.42	.33
Day 3	.65	.57	.46	.41
Average	.54	.45	.43	.35

Table 2

Likelihood of Selecting a Given Learning Mode as a Function of the Experimental Condition

	Cognate	Image	Verbiage	Other	Don't Remember	Total
Keyword	13	56	20	6	5	100%
Control	23	19	24	26	8	100%

and Don't Remember) described in the Methods Section. Note that the Image Mode was selected more frequently for words in the keyword condition, whereas the Cognate and Other Modes were selected more frequently in the control condition. This probably occurred because the control condition permitted the subject more freedom than the keyword condition to discover and use cognate relationships, and other means of remembering words. It was surprising to see the frequency with which the Image Mode was indicated in the control condition (19%), particularly since subjects were told not to use the keyword method in the control condition. Since a keyword is involved in both the Image and Verbiage Modes, an estimate of the extent to which keywords were used can be extracted from Table 2; by adding the percentages for Image and Verbiage (and not counting keywords that might have been used in the Other and Don't Remember Modes), we find that keywords were used for at least 43% of the words in the control condition. Although this percentage may be influenced by the keyword condition, it suggests that effective learning of a second-language vocabulary necessarily involves the use of native language mediators (such as keywords).

The high and low imageability words of the test vocabulary were analyzed to determine the effects of treatment upon image values. Table 3 gives the performance levels for these words, categorized by the keyword and control conditions. The keyword method is superior at both levels of imageability, but a greater relative advantage is obtained for words of high image value. Image value did not make a difference within the control condition, even though according to Table 2 a substantial number (19%) of the words in the control condition were learned by the image-keyword method.

Table 3

Probability of Being Correct on Test S for Words of High and Low Imageability

	High Imageability	Low Imageability
Keyword	.56	.50
Control	.44	.45

Figure 4 gives an item correlation plot of the words in the test vocabulary; each point gives performance on a word averaged over the Comprehensive Test and the Delayed Comprehensive Test. The abscissa gives the probability of getting the word correct in the control condition, and the ordinate gives the same probability in the keyword condition. For example, the word at (.09,.42) is provecho ([pro-baseball], profit); its probability of being correct on the comprehensive tests was .09 if the word had been presented in the control condition, and .42 if it had been presented in the keyword condition. The word at (.73,.20), mes ([mace], month), did especially poorly in the keyword condition; the word mace was probably too obscure, providing another example of the need for an empirical check when selecting keywords. Figure 4 indicates that, while most words were effectively learned in the keyword condition, many were not. It would be useful to know what factors account for the differences among words. To deal with this question, each test word was ranked by the signed difference between its probability of being correct on the comprehensive tests when in the keyword condition and its probability when in the control condition. The top and bottom 20 words in the ranking were examined with regard to the questionnaire data. The Top20 words are those that were best learned under the keyword condition, and the Bottom20 are those best learned under the control condition. Table 4 presents the study mode percentages for the Top20 and Bottom20 words. These results suggest that the Bottom20 contains more cognates, whereas the Top20 contains more words learned by the keyword method.

A tentative explanation of why Top20 and Bottom20 words diverge in performance under the two conditions can be developed along the following

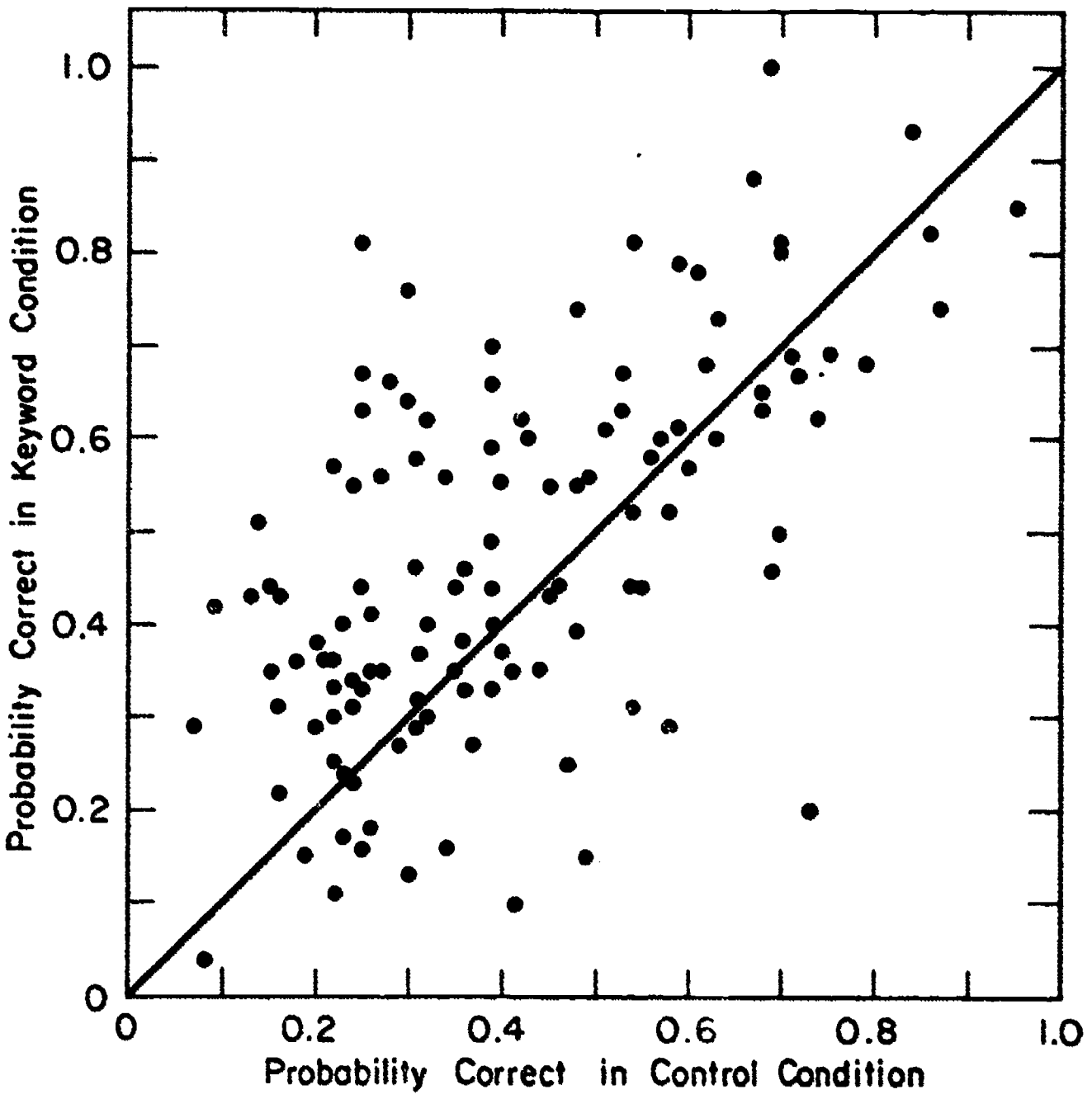

Figure 4. Scatter plot for the test vocabulary of Experiment III. Each point represents the performance levels of a word averaged over the Comprehensive Test and the Delayed Comprehensive Test.

Table 4

Likelihood of Selecting a Given Learning Mode for
Top20 and Bottom20 Word Groupings

	Cognate	Image	Verbiage	Other	Don't Remember	Total
Top20	6	40	16	7	31	100%
Bottom20	17	26	18	11	28	100%

lines: it seems likely that neither the Top20 nor Bottom20 contains words for which obvious cognates exist. An example of a word from the test vocabulary that has an obvious cognate is guerra (.95,.85), which has the same meaning as the French word guerre (war). Many of the subjects had studied French. The reason that such a word would not be found in the Bottom20 or the Top20 is that it would be learned in the obvious way and receive high scores in both conditions. Thus, the cognate relationships found in the Bottom20 and the Top20 must be of a more covert kind, such as exist between the test word viajero (.13,.43) and the Italian via (meaning traveler and road, respectively). Also, neither set of words should contain items that suggest obvious keywords and imagery, such as cama ([comma], bed) at (.84,.93), since these, too, would yield high scores under both experimental conditions. Therefore, it seems reasonable to assume that a characteristic of many Bottom20 words is that they are covert cognates that cannot be learned easily using the keyword method. When these words are presented in the keyword condition, subjects try to learn them by the keyword method; since no obvious alternative means of learning comes to mind, they are not learned very effectively. However, when these words are presented in the control condition, subjects engage in a search for memory aids until the cognate relationships are discovered, and thereby learn effectively. As noted in the discussion of Table 2, cognate relationships are more frequently discovered in the control condition than in the keyword condition.

The same type of argument would explain the divergent effects on the Top20 words of the keyword and control conditions. The argument assumes that in the Top20 group there are relatively few cognates but

many words that can be learned by nonobvious application of the keyword method. Therefore, these words will be learned effectively in the keyword condition, since keywords are provided and subjects are trying to use the keyword method. But in the control condition (where subjects are trying to avoid the keyword method) no obvious keyword and imagery spring to mind. Moreover, the cognate relationships are scarce and obscure, leaving no alternative but to learn by rote rehearsal.

The explanation outlined above, while speculative, has some support in the data. Further, it suggests that the keyword method would be particularly effective for languages that have few cognates in English, such as Russian and Japanese.

EXPERIMENT IV

Experiment IV was like Experiment III, except that a free-choice condition was added. The free-choice condition permitted the subjects to use whatever learning strategy they preferred, including requesting a keyword when desired. As a word was being pronounced in the free-choice condition, empty brackets were displayed to the left of the English translation. A subject could cause the keyword to appear by pressing an appropriate key on the console.

Method

Subjects. Twenty-five Stanford University undergraduates were used (16 males and 9 females). All were native speakers of English and none had studied Spanish except possibly for a brief period in grammar school.

Apparatus and stimulus material. The same as in Experiment III.

Procedure. A third condition, the free-choice condition, was added to the keyword and control conditions of Experiment III. In this condition, when a Spanish word was pronounced, empty brackets were displayed at the left-hand margin of the display screen and the English translation was displayed to the right. If the subject pressed the RETURN key, then the computer filled the empty brackets with a keyword.

The printed instructions for Day 0 were modified to include a statement saying that when a word was presented with empty brackets, "You may study the word using any technique you prefer; if you want the computer to suggest a keyword, press the RETURN key and a keyword will appear in the brackets." The practice vocabulary (employed on the study-test trials of Day 0) was augmented to include two more words that were presented in the free-choice condition.

The algorithm that randomly assigned test words to the keyword and control conditions on Day 1, Day 2, and Day 3 of Experiment III was modified to assign (for each sublist) 10 words to the keyword condition, 10 words to the control condition, and 20 words to the free-choice condition. The Comprehensive Test was given on the day following Day 3; the Delayed Comprehensive Test was omitted.

Results

The percentages of correct responses on the Comprehensive Test were 59%, 57%, and 50% correct, respectively, for words in the free-choice, keyword, and control conditions, $F(2,48) = 6.94$, $p < .005$. Tukey's test was employed to make pairwise comparisons; the free-choice and keyword conditions were both significantly different from the control condition

at the .05 level, but they were not significantly different from each other.

The results of the three daily test trials (averaged over days) can be seen in Figure 5; the learning curves are similar to those in Figure 3. The relationship between treatment conditions and imageability is given in Table 5; note that the keyword condition is the only condition affected by imageability. We will have more to say about Table 5 later.

Table 6 presents results from the questionnaire dealing with learning modes; only data for words that were correct on the Comprehensive Test are included. Note that more cognate relationships were exploited in the control condition than in the keyword condition; also, the Image and Verbiage modes were used quite frequently in the control condition. The same effects were reported in Experiment III. Cognate and Verbiage percentages were higher in the free-choice condition than in the keyword condition, indicating that subjects used the freedom of the free-choice condition to employ techniques other than the keyword method. The use of keywords in each of the treatment conditions can be estimated by noting that keywords were involved in both the Image and the Verbiage Modes; adding the entries for these two modes given in Table 6 yields 83%, 79%, and 44% for the keyword, free-choice, and control condition, respectively. It appears that keywords were used almost as often in the free-choice condition as in the keyword condition; keywords also were used for nearly half of the items in the control condition.

Figure 6 presents the probability of a keyword request as a function of study trials. An item analysis revealed that keyword requests were

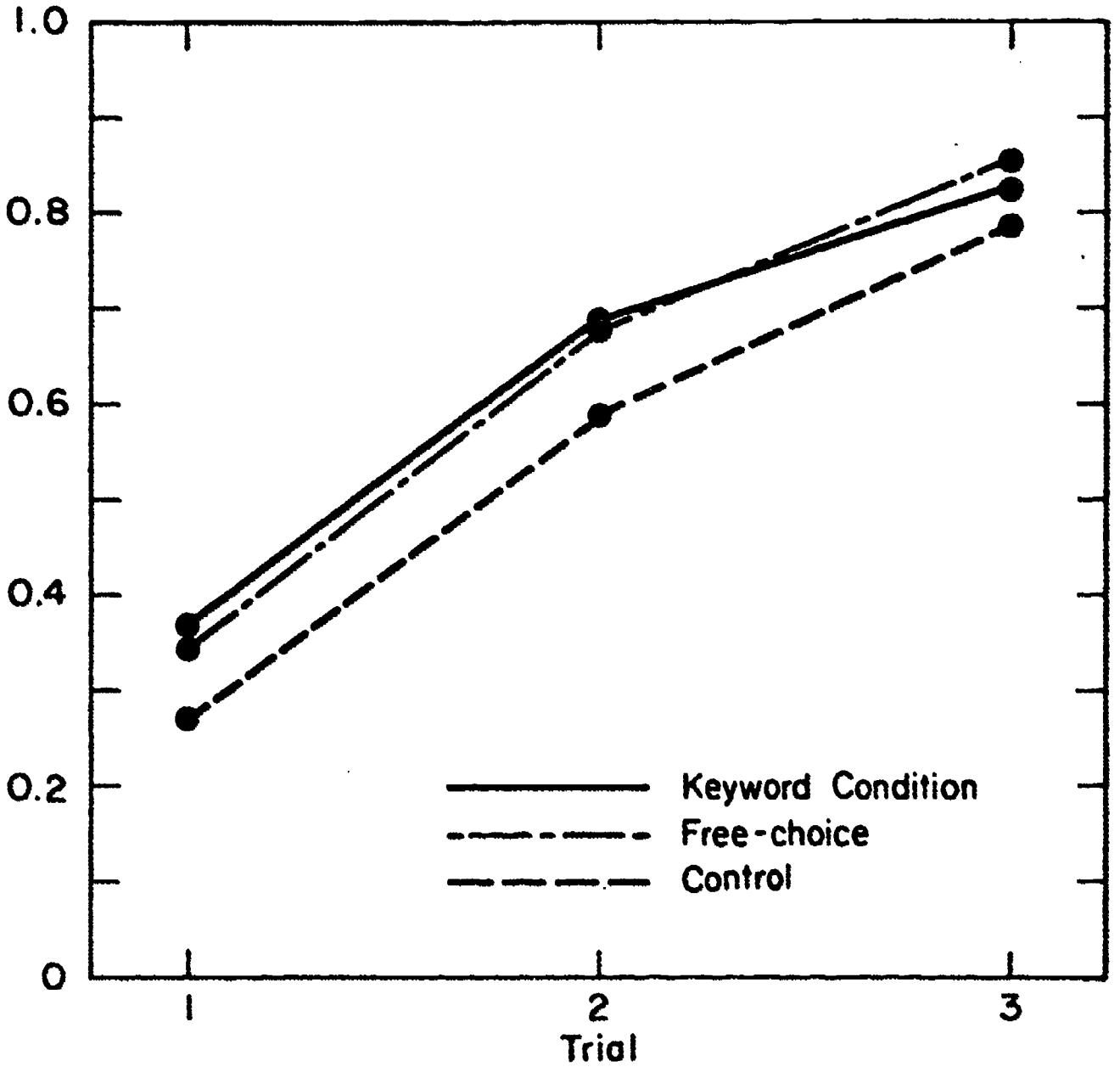

Figure 5. Probability of a correct response as a function of the trial number in Experiment IV; results averaged over days.

Table 5

Probability Correct of the High and Low Imageability Words on the Comprehensive Test

	High Imageability	Low Imageability
Keyword	.63	.55
Free-choice	.58	.59
Control	.48	.50

Table 6

Likelihood of Selecting a Given Learning Mode as a Function of the Experimental Condition

	Cognate	Image	Verbiage	Other	Don't Remember	Total
Keyword	7	62	21	5	5	100%
Free-choice	10	53	26	8	3	100%
Control	18	25	19	32	6	100%

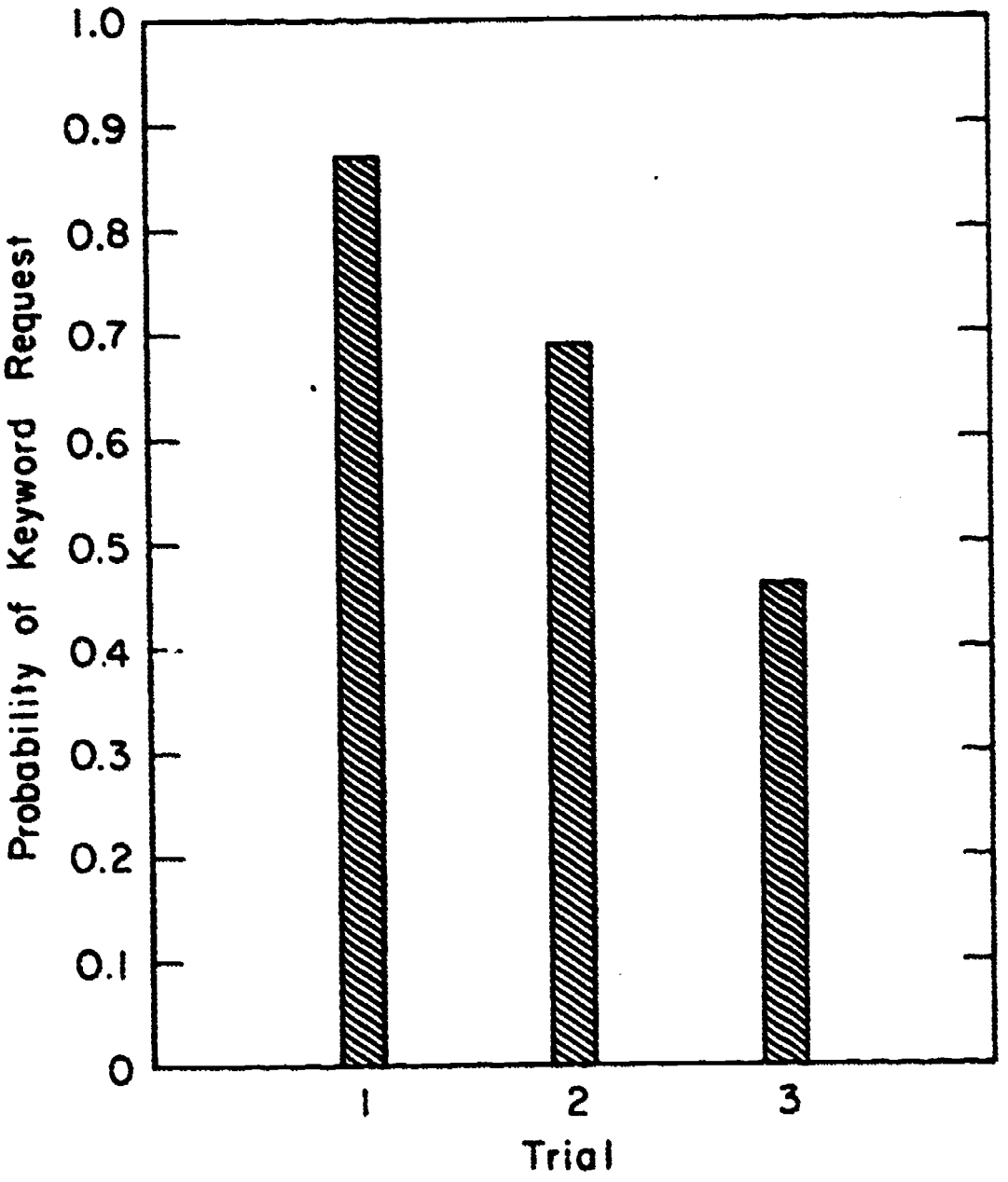

Figure 6. Probability of a keyword request as a function of the trial number in the free-choice condition of Experiment IV; results averaged over days.

more probable if the subject missed the word on the preceding test trial than if he was correct. If a subject responded incorrectly (correctly) to a word on test trial 1, then with probability .77 (.54) he requested a keyword for that item on study trial 2. Likewise, the corresponding probability was .60 (.39) for a keyword request on study trial 3, given an incorrect (correct) response on test trial 2.

The results cited above suggest that keyword requests are more likely for difficult items. To examine this issue from a different perspective, we analyzed each free-choice word with respect to (a) the number of keyword requests the subject made for that word, (b) the subject's recall of the word on the Comprehensive Test, and (c) the "difficulty" of the word. Difficulty was defined as the probability of an error in Experiment III, where the probability was averaged over both treatments and both the Comprehensive and Delayed Comprehensive Tests. The free-choice words were then divided into four categories depending upon the number of keyword requests made for that word on its three study trials.

Table 7 presents results from the analysis, categorized by the number of keyword requests. For 8% of the words the subject made no keyword requests; for 92% of the words at least one or more requests were made during the course of the three study trials. Note that the number of keyword requests is negatively correlated with performance on the Comprehensive Test; the more keyword requests a subject made, the poorer was his recall for that item. But this is not a cause-and-effect relationship as is indicated by the difficulty measure given in the last column of Table 7. Difficulty level is based on data from Experiment III and provides an independent estimate of how difficult an item is to learn.

Table 7

Information about the Free-choice Words as a Function of the Number of Keyword Requests

	Number of keyword requests			
	0	1	2	3
Percentage of free-choice words	8	23	27	42
Probability correct on Comprehensive Test	.82	.67	.59	.51
Difficulty level	.47	.53	.56	.57

For this measure, we see that number of keyword requests increases as difficulty increases. Thus, the number of keyword requests is positively related to the actual difficulty of an item, but negatively related to a subject's recall of the item. Items with zero requests were most easily learned, and the questionnaire data indicates that many were mastered using cognates. For the more difficult items there are no obvious learning strategies other than the keyword method, thus accounting for the frequency of keyword requests.

DISCUSSION

Experiments I and II demonstrate that the keyword method produces better recall than a rehearsal strategy. Experiment III demonstrates that recall with the keyword method is also superior to recall under a control condition where subjects were asked to learn by any means except the keyword method. The latter result is all the more striking, since subjects reported (in spite of instructions to the contrary) that they often employed the keyword method to learn words in this condition. Experiment IV added a free-choice condition to Experiment III that allowed subjects to learn by any strategy and, in addition, permitted them to request keywords whenever desired. Both the free-choice and keyword conditions were superior to the control condition, but not significantly different from one another. An item analysis of the free-choice condition revealed that subjects requested a keyword at least once for 92% of the test words; further, the number of requests per item was positively correlated with word difficulty. In the work reported here the keyword method proved to be an effective means of learning a

foreign language vocabulary. Although the test vocabularies were restricted to nouns, the method is equally applicable to verbs, adjectives, and adverbs.

It was evident from pilot studies preceding these experiments that several variations of the keyword method were possible. Our earlier experiences led us to make the following procedural decisions for the experiments reported here:

1. It is better to have the experimenter provide keywords than to have the subject generate his own. This is particularly true for subjects who are unfamiliar with the phonetics of the foreign language: the keywords, by offering contrasting sounds, help the beginner to distinguish the phonemes of the foreign language.

2. With regard to the imagery link, the opposite appears to be the case: it is better to have the subject generate his own image than to provide a written suggestion. This observation corresponds to results reported by Bower (1972), indicating that natural language mediators are more effective in the learning of paired-associates if they have been generated by the subject rather than provided by the experimenter.

3. The guiding principle of keyword selection is to approximate enough of the sound of each foreign word to distinguish it from other words of the list; it is not necessary to approximate the full sound of the foreign word. In pilot work, we employed a procedure in which a keyword or keyword phrase was used to span the full sound of the foreign word. For example, "pie saw hay" was used for paisaje, and "race free auto" was used for resfriado. This procedure did not work well, possibly because subjects had too much difficulty in forming an image complex

enough to meaningfully relate all of the keywords and the English translation. The keywords in the present experiments are almost all monosyllables, whereas most of the Spanish words are polysyllables.

4. We did not evaluate the keyword method with regard to the recall of a Spanish word given its English translation. Such an evaluation (requiring that subjects be taught to pronounce or spell Spanish words) was judged to be too complicated at this stage of research. Pilot work, however, indicated that the keyword method would be highly effective in the recall of Spanish words when used by subjects somewhat familiar with Spanish. Our experience suggests that when a mediating keyword is used for retrieving a foreign word, the keyword should (when all other factors are equal) emphasize the initial syllable of the foreign word; for example, "cob" rather than "eye" might be used as the keyword for caballo.

Data on individual items indicate that some of the keywords used in the experiments were poor choices. Whenever possible keywords should be determined by empirical means, or at least by a committee familiar with the method, rather than by a single individual. An empirical procedure for evaluating keywords could be based upon measures of "link strength," for both the acoustic and mnemonic links. The acoustic link could be measured by training a group of subjects on only the keywords of a test vocabulary, as was done in the first phase of Experiment I. Forward link strength can be defined as the percentage of subjects who recall the keyword from the spoken word, and backward link strength by the percentage of subjects who recall the Spanish word given the keyword. The mnemonic link can be measured in a similar way, using different subjects. Subjects would be given a list of keyword-translation pairs and instructed

to learn them using imagery. Forward and backward link strengths could then be estimated using the keyword or English translation, respectively, as test stimuli. Link strengths might provide a means of ascribing keyword failings to acoustic or mnemonic factors, and contribute to an understanding of variables underlying word difficulty. It would be interesting to determine the extent to which estimates of link strengths could be used to predict performance in the keyword condition.

The experimental results reported here suggest that the keyword method might be improved by generalizing our conception of a mnemonic link. Some subjects indicated in interviews that the imagery procedure proved on occasion to be too restrictive, and cited instances where a verbal construct would have been preferable. The word pulgada ([god], inch) is an example; it is easier to think of a phrase like "pull god an inch," or "god won't budge an inch," than to try to form an image relating god and inch. In fact, Table 6 indicates that subjects employed more verbal constructs and fewer imagery links in the free-choice condition than in the keyword condition; Table 5 suggests that the free-choice condition is superior to the keyword condition for low image words (like pulgada), but inferior for high image words. It appears that verbal constructs are more effective than imagery for words of low image value.

There are other techniques, besides imagery and verbal constructs, for associating keywords to English translations: for example, rhyme, alliteration, cadence, or synonymy. And there are other links besides the acoustic link for associating the foreign word to the keyword (the orthographic link, for example). When used by a skilled learner, these additional variations may improve the keyword method; however, they are

fine points of the method, and it is doubtful that beginners would profit from instruction in their use.

It is interesting to speculate on the potential applications of the keyword method in a foreign language curriculum. One possibility is that the keyword method could be used in a special computerized "vocabulary program," supplementing an introductory language course. The purpose of the program would be to provide the student with an individualized procedure for rapidly expanding his vocabulary, using optimal sequencing schemes of the sort investigated by Atkinson (1972). The best arrangement would coordinate the vocabulary program with other components of the curriculum; in such an arrangement, the idiomatic usage of words acquired in the vocabulary program could be developed in the regular curriculum using pattern drills and various forms of context practice.

In deciding whether to use the keyword method, several problems need to be considered. One problem is that keywords might interfere with correct pronunciation. Our experiments do not deal with this issue, but we have discussed it with a number of experts on language instruction. Although opinions vary, most believed that the keyword method might well facilitate, rather than interfere with, pronunciation. The keyword method has features in common with the method of "contrasting minimal pairs"--a standard technique for teaching phonetics by contrasting words that differ slightly in pronunciation. Further, if the practical use of a language is the principal goal, then effective vocabulary-acquisition methods should be used even if they do interfere with pronunciation. Another problem to be considered in using the keyword method is whether items learned in this way will be retrieved more

slowly, particularly once the item has been thoroughly mastered. Again we have no direct evidence on this point, but our experience with the method suggests that it should not be a problem. Once an item has been thoroughly learned, it comes to mind immediately, and rarely is the learner aware of the related keyword unless he makes a conscious effort to recall it. Experiments need to be done on this point, but introspective reports suggest that the keyword will not interfere with retrieval once an item has been mastered.

In conclusion, we should note that many of our subjects had studied at least one Romance language; consequently, they were able to learn some of the Spanish words by using cognates as memory aids. It would be interesting to evaluate the keyword method on a language, such as Russian or Japanese, that has few cognates. We plan to conduct a series of studies applying the keyword method to Russian; these studies will be like those reported here, but more of an effort will be made to explore the problems of adapting the method to classroom use.

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APPENDIX A

The Example and Test Vocabularies of Experiments I and II*

Example Vocabulary

Spanish	Keyword	Translation
JAULA	[howl]	CAGE
REGAZO	[ray]	LAP
INVIERNO	[inferno]	WINTER
SABANA	[sob]	SHEET
CABALLO	[eye]	HORSE
MORSA	[morsel]	WALRUS

Test Vocabulary

			Performance	
Spanish	Keyword	Translation	Keyword	Control
CORDERO	[cord]	LAMB	.67	.13
GUAJALOTE	[hall]	TURKEY	.27	.13
HUEVO	[wave]	EGG	.67	.60
TIJERAS	[t-hairs]	SCISSORS	.67	.47
SILBIDO	[sill]	WHISTLE	.60	.07
PISO	[pea]	FLOOR	.60	.33
RELOJ	[rail]	CLOCK	.07	.13
CHARCO	[charcoal]	PUDDLE	.80	.27
CABRA	[cob]	GOAT	.47	.27
BOMBERO	[bomb]	FIREMAN	.87	.53
TOALLA	[toe-eyed]	TOWEL	.80	.27
CUBETA	[cube]	PAIL	.47	.20
BOLSILLO	[boll]	POCKET	.60	.00
PALANCA	[pall]	CROWBAR	.27	.00
AZULEJO	[zoo]	TILE	.40	.13
CLAVO	[claw]	NAIL	.53	.27
ARENA	[rain]	SAND	.67	.47
MUNECA	[moon]	DOLL	.67	.20

*Performance on Test S of Experiment II is given for both the keyword and control conditions.

			Performance	
Spanish	Keyword	Translation	Keyword	Control
HELADO	[ale]	ICE CREAM	.27	.13
GUSANO	[goose]	WORM	.60	.13
PARABRISAS	[breezes]	WINDSHIELD	.60	.60
TENEDOR	[ten-door]	FORK	.60	.20
ARROZ	[a rose]	RICE	.80	.73
BARRO	[bar]	MUD	.67	.20
TALLARIN	[tie]	NOODLE	.53	.27
POLVO	[pole]	DUST	.47	.40
LAGARTIJA	[log]	LIZARD	.60	.20
MALETA	[mallet]	SUITCASE	.73	.33
CARACOL	[car]	SNAIL	.47	.13
PATO	[pot]	DUCK	.73	.07
CIERVO	[sierra]	DEER	.47	.53
RODILLA	[road]	KNEE	.60	.13
PRADO	[prod]	MEADOW	.60	.40
OBRERO	[brer]	WORKER	.73	.73
CEBOLLA	[boy]	ONION	.60	.40
MEDANO	[maid]	DUNE	.40	.40
NABO	[knob]	TURNIP	.60	.33
SAPO	[sop]	TOAD	.47	.13
PAYASO	[pie]	CLOWN	.67	.20
AJEDREZ	[head-dress]	CHESS	.87	.67
HILO	[eel]	THREAD	.80	.40
LATA	[lot]	TIN CAN	.67	.20
TRIGO	[tree]	WHEAT	.73	.13
POSTRE	[post]	DESSERT	.60	.40
MOSCA	[moscow]	FLY	.87	.87
CAMA	[comma]	BED	.87	.67
CHISPA	[cheese]	SPARK	.73	.47
BUTACA	[boot]	ARMCHAIR	.53	.20
ZARAGUELLES	[czar]	OVERALLS	.67	.20
ESPALDAS	[bald]	BACK	.27	.20
MULETA	[mule]	CRUTCH	.67	.20
PESTANA	[pest]	EYELASH	.73	.13
COMEDOR	[comb]	DINING ROOM	.60	.73
CARDO	[card]	THISTLE	.60	.13
SALTAMONTES	[salt]	GRASSHOPPER	.27	.20
TENAZA	[tennis]	PLIARS	.40	.20
PULGADO	[pool]	INCH	.80	.13
JABON	[bone]	SOAP	.80	.33
LIBELULA	[bale]	DRAGONFLY	.20	.60
CARPA	[carp]	TENT	.73	.33

APPENDIX B

Instructions to the Experimental and Control Groups for Experiment I

Instructions to the Experimental Group in Experiment I

Please read these instructions quietly to yourself. Different subjects have different instructions. PLEASE DO NOT ASK QUESTIONS.

On the following pages you will find the Spanish words that you studied earlier. To the right of each Spanish word is its English translation. Directly beneath each Spanish word is the bracketed keyword that you learned in the first half of the experiment. Remember this English keyword is only a clue to the pronunciation of the Spanish word and has nothing to do with its meaning.

REMEMBER, THE TRANSLATION IS TO THE RIGHT OF THE SPANISH WORD AND THE KEYWORD IS IN BRACKETS DIRECTLY BENEATH THE SPANISH WORD.

Your task now will be to learn the translations of the Spanish words USING THE KEYWORD METHOD. This method can be explained best by examples:

1. CABALLO HORSE

   [eye]

Item 1 above states that the Spanish word CABALLO means horse, and the keyword provides a partial reminder that the Spanish word is pronounced "cob-eye-yo." You should already know this keyword from your previous practice. A simple way to recall that the word CABALLO means HORSE would be to imagine an interaction between an eye and a horse. For example, you might imagine any one of the following:

1. Your own eye being flicked by the tail of a horse,

2. One cyclopean eye winking in the forehead of a horse,

3. A giant eye being kicked by a horse.

Any of these images could help you to recall that CABALLO means horse. Or you could easily create other images to suit your taste. The point is that it is EASY to create them, and, NO MATTER HOW ILLOGICAL THE IMAGES MAY SEEM TO YOU, THEY ARE POWERFUL MEMORY AIDS.

THE STRATEGY YOU SHOULD EMPLOY FOR LEARNING THE MEANING OF A SPANISH WORD, THEN, IS TO

FIRST: IGNORE THE SPANISH WORD; YOU HAVE ALREADY STUDIED IT SUFFICIENTLY IN THE INTRODUCTORY PHASE OF THE EXPERIMENT.

SECOND: USE YOUR TIME CREATIVELY BY MAKING DISTINCTIVE MENTAL IMAGES FOR THE KEYWORD AND TRANSLATION, THEN MAKE THEM INTERACT IN A GRAPHIC WAY. FOR THIS INTERACTION STICK TO ONE GOOD PICTURE--DO NOT CONFUSE YOURSELF BY IMAGINING MORE THAN ONE INTERACTION.

This strategy forces you to ignore the Spanish word in order to focus entirely on its keyword and translation. Since you have already learned to recognize the keyword in the Spanish word, the keyword will provide a link from the Spanish word when you need it. DO NOT WASTE YOUR TIME PRACTICING THE SPANISH-KEYWORD ASSOCIATIONS ANY MORE. USE YOUR TIME IN THIS STAGE CREATIVELY. THE PURPOSE OF THIS STAGE OF THE EXPERIMENT IS TO CREATE THE INTERACTIVE IMAGES RELATING KEYWORDS TO TRANSLATIONS.

As a second example consider the Spanish word MORSA:

2. MORSA WALRUS
[morsel]

To connect the keyword "morsel" to WALRUS, you could imagine yourself eating a gigantic morsel on a walrus-tusk toothpick, or you could

picture a whale spitting up morsels of walrus. VISUALIZE THE SCENE AS VIVIDLY AS POSSIBLE. MAKE THE IMAGE GRAPHIC. Then when you hear the word MORSA, you should recognize the sound of MORSEL within it and use the remembered image to recall that MORSA means WALRUS.

REMEMBER, KEYWORDS ARE CLUES TO PRONUNCIATION. DO NOT CONFUSE THEM WITH TRANSLATIONS. In a moment you will have an opportunity to practice the image method on five words that you have already studied. But first, go back and review the capitalized statements, then read the advice on the following page.

LAST MINUTE ADVICE:

1. IGNORE THE SPANISH WORD. Cover it with your thumb, if that will help. Instead,

2. Concentrate entirely on making INTERACTIVE IMAGES to connect the keywords to the English translations.

Instructions to the Control Group in Experiment I

Please read these instructions quietly to yourself. Different subjects have different instructions. PLEASE DO NOT ASK QUESTIONS.

On the following pages you will find the Spanish words that you studied earlier. To the right of each Spanish word is its English translation. Directly beneath each Spanish word is the bracketed keyword that you learned in the first half of the experiment. Remember, this English keyword is only a clue to the pronunciation of the Spanish word and has nothing to do with its meaning.

REMEMBER, THE TRANSLATION IS TO THE RIGHT OF THE SPANISH WORD AND THE KEYWORD IS IN BRACKETS DIRECTLY BENEATH THE SPANISH WORD.

Your task now will be to learn the translations of the Spanish words USING THE METHOD OF REPETITION. This method can be explained best by examples:

1. CABALLO HORSE

   [eye]

Item 1 above states that the Spanish word CABALLO means horse, and the keyword provides a partial reminder that the Spanish word is pronounced "cob-eye-yo." You should already know this keyword from your previous practice. Use this keyword to remind yourself of the pronunciation of the Spanish word, but do not waste time relating the Spanish word to its keyword. Instead, once you have learned the pronunciation, practice saying the Spanish word to yourself followed by its English equivalent. Alternate back and forth between the Spanish and the English several times, then move on to the next item.

For example, in the case of CABALLO above, use the keyword to remind yourself that the second syllable of the word sounds like the English word "eye." That will help you to recall that the word is pronounced "cob-eye-yo." Now subvocalize the series "caballo - horse - caballo - horse - caballo - horse."

THE STRATEGY YOU SHOULD EMPLOY FOR LEARNING THE TRANSLATION OF A SPANISH WORD, THEN, IS TO

FIRST: OBSERVE THE KEYWORD ONCE TO GET THE CLUE TO THE PRONUNCIATION OF THE SPANISH WORD. THEN IGNORE THE KEYWORD IN ORDER TO DEVOTE AS MUCH TIME AS POSSIBLE TO THE MAIN TASK, WHICH IS TO,

SECOND: PRONOUNCE THE SPANISH WORD AND ENGLISH TRANSLATION QUIETLY TO YOURSELF. DO NOT SPEAK OUT LOUD. ALTERNATE BETWEEN THE SPANISH WORD AND ENGLISH TRANSLATION SEVERAL TIMES, THEN MOVE ON TO THE NEXT ITEM. YOU MAY DEVOTE EXTRA TIME TO RECYCLING OVER PREVIOUS ITEMS.

This strategy exploits your knowledge of the keywords in order to practice associating the SOUND of a Spanish word with its English translation. DO NOT WASTE YOUR TIME ON THE SPANISH SPELLING; INSTEAD, CONCENTRATE ON PRONOUNCING THE SPANISH AND ENGLISH WORDS REPETITIVELY TO YOURSELF.

As a second example, consider the Spanish word MORSA:

2. MORSA WALRUS

[morsel]

The keyword "morsel" provides a reminder of the sound and rhythm of the Spanish word. Practice quietly repeating the Spanish word and English equivalent to fix them together in your memory: "morsa - walrus - morsa - walrus - morsa - walrus."

REMEMBER, KEYWORDS ARE PRONUNCIATION CLUES. DO NOT CONFUSE THEM WITH TRANSLATIONS. In a moment you will have an opportunity to practice the repetition method on five words that you have already studied. But first, go back and review the capitalized statements, then read the advice on the following page.

LAST MINUTE ADVICE:

1. Do not waste time reviewing the Spanish spelling. INSTEAD, USE THE KEYWORD FIRST TO RECALL THE SOUND OF THE SPANISH WORD (then cover the keyword with your thumb if that will help to avoid distraction), THEN

2. CONCENTRATE ENTIRELY ON REPEATING QUIETLY TO YOURSELF THE PRONUNCIATION OF THE SPANISH WORD AND ITS ENGLISH TRANSLATION. Use the time to fix in your memory the SOUND of the Spanish word and its English translation.

APPENDIX C

The Test Vocabulary for Experiments III and IV*

Subvocabulary 1

Spanish	Keyword	Translation	Performance		
			Keyword	Control	Overall
CORDERO	[cord]	LAMB	.35	.26	.32
PAVO	[paw]	TURKEY	.04	.08	.07
CARACOL	[coal]	SNAIL	.38	.26	.32
MOSCA	[moscow]	FLY	1.00	.41	.72
RELOJ	[rail]	CLOCK	.16	.34	.27
LATA	[lot]	TIN CAN	.37	.40	.38
MUJER	[hair]	WOMAN	.86	.68	.77
BOLSILLO	[boll]	POCKET	.52	.14	.33
ZARAGUELLES	[czar]	OVERALLS	.15	.19	.17
PISO	[pea]	FLOOR	.41	.39	.40
POLVO	[volvo]	DUST	.64	.26	.47
PALANCA	[lawn]	CROWBAR	.33	.36	.35
RODILLA	[rodesia]	KNEE	.76	.26	.53
JABON	[bone]	SOAP	.44	.55	.50
MALETA	[mallet]	SUITCASE	.46	.69	.58
POSTRE	[post]	DESSERT	.38	.11	.25
PRADO	[prod]	MEADOW	.43	.16	.28
CEBOLLA	[boy]	ONION	.63	.25	.45
BUTACA	[boot]	ARMCHAIR	.44	.15	.32
PULGADA	[god]	INCH	.35	.26	.30
BUSCA	[booze]	SEARCH	.24	.23	.23
HERIDO	[reed]	WOUND	.31	.24	.27
VIENTRE	[vienna]	BELLY	.35	.41	.38
VIAJERO	[hero]	TRAVELER	.43	.13	.32
JEFE	[hay]	BOSS	.35	.43	.38
AVISO	[avis]	NOTICE	.57	.24	.37
GENTE	[hen]	PEOPLE	.17	.23	.73
ROJO	[row]	RED	.68	.79	.73
GUERRA	[garlic]	WAR	.85	.95	.88
MES	[mace]	MONTH	.20	.73	.55
MENESTER	[stair]	JOB	.63	.53	.57
PREGUNTA	[goon]	QUESTION	.67	.25	.50

*Performance, averaged over the Comprehensive Test and the Delayed Comprehensive Test of Experiment III, is given for (1) the keyword condition (2) the control condition, and (3) overall.

			Performance		
Spanish	Keyword	Translation	Keyword	Control	Overall
ORGULLO	[goo]	PRIDE	.46	.36	.40
DUDA	[dude]	DOUBT	.50	.71	.58
PORMENOR	[poor manure]	DETAIL	.55	.40	.50
EXITO	[exit]	SUCCESS	.55	.48	.50
PENSAMIENTO	[pen]	THOUGHT	.35	.15	.27
SALUD	[salad]	HEALTH	.69	.71	.70
TARDE	[tar]	AFTERNOON	.73	.63	.68
RUMBO	[room]	DIRECTION	.44	.39	.42
Subvocabulary 2					
CABRA	[cob]	GOAT	.39	.48	.43
POLLO	[polo]	CHICKEN	.33	.39	.37
SAPO	[sop]	TOAD	.33	.22	.28
SALTAMONTES	[salt]	GRASSHOPPER	.56	.48	.52
TIJERAS	[hair]	SCISSORS	.57	.22	.38
CARPA	[carp]	TENT	.78	.61	.70
BOMBERO	[bomb]	FIREMAN	.62	.74	.68
TOALLA	[eye]	TOWEL	.32	.31	.32
AJEDREZ	[head-dress]	CHESS	.68	.62	.65
CHARCO	[charcoal]	PUDDLE	.62	.32	.45
ARENA	[rain]	SAND	.66	.39	.53
CLAVO	[claw]	NAIL	.46	.31	.38
PESTANA	[pest]	EYELASH	.35	.35	.35
AZULEJO	[zoo]	TILE	.30	.22	.27
CHISPA	[cheese]	SPARK	.70	.39	.58
TALLARIN	[tie]	NOODLE	.57	.59	.58
MEDANO	[maid]	DUNE	.31	.16	.25
NABO	[knob]	TURNIP	.56	.34	.43
CAMA	[comma]	BED	.93	.84	.90
LARGO	[lark]	LENGTH	.58	.56	.57
CAZA	[causeway]	HUNT	.13	.30	.22
GOLPE	[gold]	HIT	.40	.23	.32
ALA	[allah]	WING	.79	.59	.68
VIUDA	[view]	WIDOW	.31	.54	.42
ALREDEDOR	[raid]	NEIGHBORHOOD	.34	.24	.30
FONDO	[phone]	BOTTOM	.44	.54	.50
MUNDO	[moon]	WORLD	.60	.63	.62
MILAGRO	[log-roll]	MIRACLE	.33	.25	.30
ASUNTO	[sun]	AFFAIR	.41	.26	.33
SIGLO	[sea-glow]	CENTURY	.74	.48	.62
MOCEDAD	[moses]	YOUTH	.49	.39	.45
DEBER	[bear]	DUTY	.22	.16	.18
DESCANSO	[desk]	REST	.43	.35	.38
TRISTEZA	[tryst]	SADNESS	.81	.70	.77

Spanish	Keyword	Translation	Performance: Keyword	Control	Overall
SEGUIDA	[guide]	SERIES	.36	.18	.25
MIEDO	[me]	FEAR	.29	.32	.30
RECUERDO	[rake]	MEMORY	.18	.26	.22
RIQUEZA	[case]	WEALTH	.15	.48	.33
DOMINGO	[ming]	SUNDAY	.76	.87	.80
AYUDA	[i you]	HELP	.61	.51	.55
Subvocabulary 3					
CIERVO	[sierra]	DEER	.58	.31	.45
PATO	[pot]	DUCK	.59	.39	.48
GUSANO	[goose]	WORM	.43	.45	.43
LAGARTIJA	[log]	LIZARD	.60	.43	.48
CUBETA	[cube]	PAIL	.23	.24	.23
TENEDOR	[door]	FORK	.62	.42	.53
PAYASO	[pie]	CLOWN	.66	.28	.50
MUNECA	[moon]	DOLL	.44	.46	.45
SILBIDO	[bee]	WHISTLE	.11	.22	.17
TRIGO	[tree]	WHEAT	.81	.25	.55
BARRO	[bar]	MUD	.52	.58	.55
TENAZA	[tennis]	PLIARS	.36	.22	.30
BRAZO	[bra]	ARM	.82	.86	.83
HELADO	[ale]	ICE CREAM	.27	.29	.28
HILO	[eel]	THREAD	.52	.54	.53
ARROZ	[rose]	RICE	.63	.68	.65
CAMPO	[camp]	FIELD	.65	.68	.67
CARDO	[card]	THISTLE	.56	.27	.43
MULETA	[mule]	CRUTCH	.27	.37	.32
TIEMPO	[tempo]	TIME	.80	.70	.75
ENSAYO	[sigh]	TRIAL	.25	.22	.23
HOGAR	[ogre]	HOME	.59	.57	.58
CORAZON	[core]	HEART	.16	.25	.20
SABIO	[sob]	SCHOLAR	.25	.47	.37
EJERCITO	[hair]	ARMY	.39	.32	.37
RETRATO	[trot]	PICTURE	.55	.45	.48
CIUDAD	[see you dad]	CITY	1.00	.69	.82
SABOR	[boar]	TASTE	.29	.20	.25
LUCHA	[lute]	FIGHT	.61	.59	.60
PORVENIR	[veneer]	FUTURE	.81	.54	.68
FAENA	[hyena]	TASK	.38	.35	.37
JUICIO	[whee]	JUDGMENT	.29	.07	.18
ESPERANZA	[pear]	HOPE	.69	.75	.72

Spanish	Keyword	Translation	Performance		
			Keyword	Control	Overall
ANHELO	[nail]	LONGING	.29	.31	.30
EJEMPLO	[hemp]	EXAMPLE	.67	.72	.70
TRAVES	[vase]	MISFORTUNE	.44	.25	.37
CONOCIMIENTO	[cone]	KNOWLEDGE	.29	.58	.42
PROVECHO	[pro-baseball]	PROFIT	.42	.09	.23
VENTA	[vent]	SALE	.67	.53	.58
DESAROLLO	[royal]	DEVELOPMENT	.36	.21	.30

APPENDIX D

Instructions to All Subjects for Experiment III

Please read carefully. It is imperative that you do not discuss the experiment with other students. We will discuss general results with you after you have completed your work at the end of the week. If after reading the instructions you still have questions, indicate this to the proctor, and he (or she) will arrange to answer you without disturbing the other subjects.

In the days that follow, you will have Spanish words presented to you, one at a time. Each word will be pronounced three times, while its English translation is displayed on the screen. In half of the cases, the keyword will be displayed in brackets to the left of the English translation; in the other half, the English translation will appear without the keyword. (Do not forget that keywords are derived from the SOUNDS of Spanish words and have nothing to do with their meanings.) After a word has been pronounced, the display will continue for a short time, then the program will advance to the next item.

REMEMBER, THE TRANSLATION WILL APPEAR ON THE RIGHT OF YOUR SCREEN, AND IN HALF THE CASES THE KEYWORD WILL APPEAR IN BRACKETS TO THE LEFT OF THE ENGLISH TRANSLATION.

Your task will be to learn the meanings of the Spanish words using two different methods, depending upon whether or not a keyword is displayed. The two methods, and when each is to be used, are described below.

METHOD I (TO BE USED WHEN A KEYWORD PRECEDES THE TRANSLATION)

When a keyword is displayed with the English translation, the computer will pronounce the appropriate Spanish word three times (the pronunciation phase), then allow a pause for quiet study (the quiet phase). DURING THE PRONUNCIATION PHASE, CONCENTRATE EXCLUSIVELY ON LEARNING THE KEYWORD.

DURING THE QUIET PHASE, ASSOCIATE THE KEYWORD WITH THE ENGLISH TRANSLATION BY USING MENTAL IMAGERY. Do this by visualizing an imaginary situation in which the keyword and the translation interact. The image can be as wild and absurd as you like; the point is to make it vivid.

For example, suppose that the following keyword and translation appeared on your screen:

[EYE] HORSE

The computer would first pronounce the Spanish word (which sounds somewhat like "cob-eye-yo"), then allow a pause for quiet study. During the quiet phase, you should imagine an interaction between an eye and a horse. Following are some examples of what you might imagine:

1. Your own eye being flicked by the tail of a horse,
2. One cyclopean eye winking in the forehead of a horse,
3. A giant eye being kicked by a horse.

Any of these images could help you to recall that [EYE] was paired with horse. Create your own image to suit your taste. You will find that it is EASY to create such images, and, NO MATTER HOW ILLOGICAL THEY MAY BE, IMAGES ARE POWERFUL MEMORY AIDS.

SO WHEN A KEYWORD IS DISPLAYED ON THE SCREEN, THE STRATEGY YOU SHOULD EMPLOY FOR LEARNING THE TRANSLATION IS TO

FIRST: (DURING THE PRONUNCIATION PHASE) LEARN THE KEYWORD.

SECOND: (DURING THE QUIET PHASE) CREATE A DISTINCTIVE MENTAL IMAGE IN WHICH THE KEYWORD AND THE TRANSLATION INTERACT IN A GRAPHIC WAY. FOR THIS INTERACTION, STICK TO ONE GOOD "PICTURE"--DO NOT CONFUSE YOURSELF BY IMAGINING MORE THAN ONE INTERACTION.

As a second example, consider the Spanish word for WALRUS; it sounds somewhat like "more-sa" (accent on the first syllable). Suppose the following appeared on your screen:

[MORSEL] WALRUS

While the computer is pronouncing "more-sa" three times, you should concentrate entirely on learning the keyword. After the computer has completed the pronunciation, you should then create an image relating morsel to WALRUS. For example, imagine yourself eating a gigantic morsel of meat on a walrus-tusk toothpick, or image a whale spitting up morsels of walrus. VISUALIZE THE SCENE AS VIVIDLY AS POSSIBLE. MAKE THE IMAGE DYNAMIC.

Here are a few more tips on imagery that may be useful. If a keyword or the English translation is abstract, and not easy to picture directly, it is still easy to make up a symbolic image to assist your memory. For example, to visualize "thought" you might imagine some thoughtful person you know, scratching his head. If a phrase or exclamation, such as "gee whizz," is used in place of a single keyword, imagine a situation in which the phrase or exclamation is appropriate.

If an occasional keyword sounds a little out of key to your ear, and a more "natural" keyword occurs to you, use your own. But remember, the keyword you choose must be easy to remember and easy to visualize.

METHOD II (TO BE USED WHEN NO KEYWORD IS GIVEN)

WHEN NO KEYWORD IS GIVEN, YOU MAY USE ANY LEARNING METHOD YOU LIKE, EXCEPT METHOD I. In other words, do anything you like, but avoid using a keyword with mental imagery.

In a moment you will have an opportunity to practice Methods I and II on 10 Spanish words. But first, go back and review the capitalized statements, then read the advice on the following page.

LAST MINUTE ADVICE:

ALWAYS DO YOUR BEST TO LEARN EACH WORD. BE SURE TO USE THE APPROPRIATE METHOD:

IF THERE IS A KEYWORD, then

1. (During the pronunciation phase) LEARN THE KEYWORD, then
2. (After the pronunciation phase) CONCENTRATE ENTIRELY ON MAKING AN INTERACTIVE IMAGE connecting the keyword to the meaning.

IF THERE IS NOT A KEYWORD, then

1. Do your own thing.

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