DOCUMENT RESUME

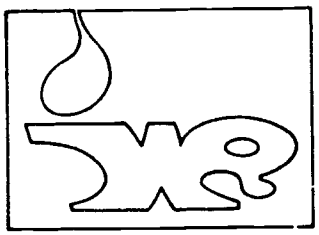
ED 269 725 CS 008 411

AUTHOR Shriberg, Linda K.
TITLE Comparison of Two Mnemonic Encoding Strategies on Children's Recognition and Recall of Abstract Prose Information.
INSTITUTION Wisconsin Center for Education Research, Madison.
SPONS AGENCY National Inst. of Education (ED), Washington, DC.
PUB DATE Nov 82
GRANT NIE-G-81-0009
NOTE 245p.; PhD. Dissertation, University of Wisconsin-Madison.
PUB TYPE Reports - Research/Technical (143) -- Dissertations/Theses - Doctoral Dissertations (041)

EDRS PRICE MF01/PC10 Plus Postage.
DESCRIPTORS Associative Learning; Comparative Analysis; Elementary Education; Grade 8; Junior High School Students; Learning Strategies; *Mnemonics; *Reading Comprehension; *Reading Processes; *Reading Research; *Recall (Psychology); *Recognition (Psychology); Vocabulary Development
IDENTIFIERS *Keyword Method (Language Learning)

ABSTRACT

As an extension of an earlier investigation that examined the effects of mnemonic strategy application on children's memory for abstract prose passages, a study compared the benefits accrued by students taught two different variations of the mnemonic keyword method for learning abstract prose information, via tasks of associative recognition and associative recall, both immediately after instruction and three days later. Subjects included 183 eighth-grade students assigned to one of four instructional conditions: (1) keyword-symbol picture, which provided semantically based representations and conventional symbols for encoding the relatively abstract attribute information and then integrated picture referents with a keyword referent; (2) keyword-keyword picture, which provided phonetically based concrete words for encoding the relatively abstract attribute information and then integrated the picture referents with a picture of another keyword referent; (3) control-passage, which provided students with a second opportunity to read the story passages and its associated attributes; and (4) control-list, which provided students with a list of each name with its associated attributes. Results supported the efficacy of semantically and phonetically based strategy applications for learning abstract prose information. (Appendixes include story passages, instructions, study passages, and test pages for all conditions.) (HOD)



COMPARISON OF TWO MNEMONIC ENCODING STRATEGIES ON CHILDREN'S RECOGNITION AND RECALL OF ABSTRACT PROSE INFORMATION

by Linda K. Shriberg

November 1982

Wisconsin Center for Education Research
an institute for the study of diversity in schooling

COMPARISON OF TWO MNEMONIC ENCODING STRATEGIES ON CHILDREN'S RECOGNITION AND RECALL OF ABSTRACT PROSE INFORMATION

BY

LINDA K. SHRIBERG

A thesis submitted in partial fulfillment of the
requirements for the degree of

DOCTOR OF PHILOSOPHY
(Curriculum & Instruction)

at the

UNIVERSITY OF WISCONSIN-MADISON

1982

This doctoral dissertation reports research supported by the Wisconsin Center for Education Research. Since it has been approved by a University Examining Committee, it has not been reviewed by the Center. It is published by the Center as a record of some of the Center's activities and as a service to the student. The bound original is in the University of Wisconsin Memorial Library.

The project reported herein was performed pursuant to a grant from the National Institute of Education (Grant No. NIE-G-81-0009). However, the opinions expressed herein do not necessarily reflect the position or policy of the National Institute of Education, and no official endorsement by the National Institute of Education should be inferred.

Acknowledgments

Dissertations may be single-authored, but they are definitely not the products of a single effort. This is especially true in the case of my dissertation, for I am indebted to many people for their contributions and support.

On the academic front, I wish to thank three members of my committee, Richard Smith, Steven Yussen, and Thomas Barrett, for providing helpful comments at the inception and culmination of this project. A very special debt of gratitude is due to both my major advisor, Dale Johnson, and to my minor advisor and dissertation chairperson, Joel Levin, who have guided me throughout my entire doctoral career. Dale Johnson's courses in psycholinguistics and reading were influential in my choice of Reading as a major area for graduate study, while Joel Levin's research in mnemonics and prose-learning steered me toward a minor area of Human Learning. Joel Levin also helped me to conceptualize the framework for the present study, and he has been tireless in discussing ideas, reviewing progress as the project developed, advising on the data analysis, and in providing a wealth of suggestions on earlier drafts of this report. Thanks are also extended to the Center for Education Research for funding this project, to the staff and students of

Van Hise Middle School in Madison, Wisconsin, for participating in the research, to Judy Ross for her assistance with the data collection, to Bob Cavey for his wonderful artwork, and to Lynn Sowle for typing the manuscript.

On the homefront, I wish to thank my family for their contributions to the project. First, I'd like to extend my deepest appreciation to my parents, who always expressed their faith in me--even when I "took the road less travelled by". Second, I owe a large thank you to my three daughters, Elizabeth, Kathryn, and Janet, who not only put up with my frequent absences and fast-food dinners, but who also were an inspiration for me to want to do my very best. And finally, most of all, I am indebted to my husband, Larry, for all his encouragement, and who, by example of his own unwavering dedication to research, has instilled in me a strong desire to seek truth through knowledge.

Table of Contents

List of Figures

List of Tables

Chapter 1

Introduction

Mnemonics

Throughout the centuries, humans have been concerned with the practical art of memory. The method of loci, for example, considered the oldest and most influential memory device, was described by the ancient Romans in their books on rhetoric (Yates, 1966). The ancient Greeks, too, also applied mnemonic devices (systematic techniques for organizing and/or encoding information to make it more memorable--see Bellezza, 1981; Levin, in press) to rhetoric as a technique by which orators could deliver long speeches from memory with unfailing accuracy (Norman, 1976).

Despite the fact that mnemonic devices have been in use for more than 2,000 years, the controlled study of mnemonic effects has been confined largely to the last 15 to 20 years (Higbee, 1979). According to Brown and Deffenbacher (1975), it was the rise in popularity in American psychology of the behaviorist notion--that behavior must be observable in order to be scientific--that resulted in a dearth of research on mnemonics during the first half of the twentieth century. Then, in the 1960's, the shift from behaviorism to cognitive psychology caused a revival of interest

in mnemonic strategies and other mental processes as legitimate avenues for investigation (Bellezza, 1981).

Psychologists today have recognized a similarity between the mnemonic techniques used by the ancients and those used successfully in recent laboratory experiments, especially in regard to their organization and imagery features. Mnemonic devices, ancient and current, often try to relate the to-be-learned material to some previously learned organizational scheme, such as with rhymes, the method of loci, nd the pegword technique. Children often rely on a rhyme mnemonic for remembering certain classroom rules as, for example, "Place i before e, except after c," for sequencing the ie or ei in the spelling of words. The loci mnemonic is based on attaching pieces of the to-be-remembered information to different places along a familiar route, such as the rooms in one's house. The critical items are uncovered during an imaginary journey to each locus (room). The "one-bun" or pegword mnemonic involves selecting a rhyming word for each of the first ten numerals, and then associating pieces of the to-be-remembered information with each rhyming word via an interactive picture or visual image. The rhyming word for five, for example, is hive. Suppose that the fifth item to be learned were Maypole. One would construct an interaction involving both the pegword, hive, and the to-be-associated item, Maypole. This interaction could be in the form of a phrase or sentence, such as, "The hive of bees is stuck on top of the

Maypole", a provided illustration, or a visual image whereby the learner constructs a mental picture of a beehive on top of a Maypole. When asked to retrieve the fifth item on a list, then, the learner recalls that the pegword for five is hive, thinks back to the sentence or picture that contains hive, and remembers that a hive is interacting with a Maypole. Hence, the fifth item on the list is Maypole.

Organization for many mnemonic strategies, especially for the loci and pegword methods mentioned above, usually implicates a strong imagery component. Even in the days before the birth of Christ, Simonides and Cicero had relied on mental images for remembering information that they could not write down; this emphasis accorded visual imagery has continued throughout the centuries to the present day (Bugelski, 1970; Higbee, 1979; Norman, 1976). In its most common application, imagery represents the to-be-remembered verbal information by implying a sequence of symbolic transformations, which go from words to images, and then back to words (Paivio, 1971).

Most of the research on mnemonics and imagery to date has been based on artificial experimental tasks requiring the free recall, serial learning, and paired-associate learning of words (especially nouns) and, to some extent, sentence learning (Higbee, 1979). In 1975, however, Richard Atkinson of Stanford University demonstrated the benefits of an innovative mnemonic imagery strategy for the

real-world task of learning foreign language vocabulary. This technique, called the keyword method, is a two-stage process involving an auditory-perceptual link (henceforth referred to as an auditory link)[1] and an imagery link. To use the keyword method, one first derives a familiar English word that "sounds like" a salient part of the foreign word (auditory stage). This derived English word is the "keyword". For example, given the Spanish word, carta, a good keyword might be the familiar English word, cart. Next, a meaningful interaction must be constructed involving the keyword (cart) and the vocabulary word's definition (postal letter). This can be in the form of a phrase, a sentence, a provided interactive picture or, as is most often the case, the learner must generate an interactive visual image (imagery stage). For the Spanish word, carta, then, a reasonable picture/image would be of a postal letter inside a shopping cart (Pressley, Levin, & Delaney, 1982).

The keyword method has not only been strikingly facilitative for remembering foreign language vocabulary in tests of both immediate and delayed recall (Atkinson & Raugh, 1975), but has also been successfully adapted to the learning of native (English)

[1]This stage, originally termed acoustic by Atkinson, is termed auditory in this paper. Acoustic refers to a physical signal, and since keywords are not always uttered (they can be presented in written form, or subjects can generate their own keywords without necessarily saying them), the term, auditory, describes keyword derivation more appropriately.

vocabulary (e.g., Levin, McCormick, Miller, Berry, & Pressley, 1982; McGivern & Levin, in press; Pressley, Levin, & Miller, in press), as well as to the learning of other curricular content: technical terms and their definitions, and fictitious names and events (Jones & Hall, 1982); the states and their capitals (Levin, Shriberg, Miller, McCormick, & Levin, 1980), and the order of the United States Presidents (Levin, McCormick, & Dretzke, 1981). Recently, in a three-experiment study by Shriberg, Levin, McCormick, and Pressley (1982), eighth-grade students demonstrated that they could benefit from a keyword strategy for remembering central and incidental prose information about "famous" people and their accomplishments. Although limited to the use of short, concrete passages, this study was unique in that it was a first attempt to apply the keyword method to the learning of information presented within a prose format. The performance gains of keyword-taught subjects in all of these studies hold promise for continued keyword benefits in tasks investigating the application of mnemonic techniques for remembering information in a variety of prose-learning tasks.

The present study was designed as an extension of an earlier study by Levin, Shriberg, and Berry (in press), which investigated the effects of mnemonic strategy application on children's memory for abstract prose passages. Whereas the information contained in the Shriberg et al. (1982) stories was concrete and, therefore,

amenable to direct pictorial representation, the Levin et al. abstract passages contained information that was not as directly picturable (e.g., attributes and concepts). The major purpose of the present study was to compare the benefits accrued to students taught two different variations of the mnemonic keyword method for learning abstract prose information, via tasks of associative recognition and associative recall, both immediately after instruction and three days later. It was expected that the results would contribute to the relatively small, but steadily growing, body of knowledge exploring the efficacy of mnemonic strategy usage in prose-learning situations.

Chapter 2

Review of the Literature

Paired-Associate Learning of Unconnected Materials

Verbal and Pictorial Elaboration Strategies

The revival of interest in mnemonic strategies in the 1960's culminated in a number of research experiments concerned with the learning of unconnected materials. Unconnected materials refer to pair members that are not commonly associated in a "real world" sense (e.g., shoe - clock), but which are matched for the purposes of paired-associate learning. Paivio (1971) believes that most college students are innately strategic, and develop their own ways of mediating (i.e., associating) these unconnected pair members rather than learning them by rote. One such strategy is to incorporate the two semantically disparate members into a single context or sentence. Jensen and Rohwer (1963, 1965) investigated the effects of learning noun pairs via experimenter-provided sentence mediators (e.g., I threw the shoe at the clock) versus learning the pairs without mediation (e.g., shoe - clock), first with retarded adults, and then in a later experiment with subjects of seven different age levels (ages 5 to 17). For all groups, learning was markedly facilitated by sentence mediation.

Sentence mediation has been shown to enhance performance on tests of both immediate and delayed memory. The potency of a mediated strategy for immediate and delayed tests, according to Paivio (1971), probably can be explained in terms of classical notions of interference: for immediate learning, pairs originally learned by mediation are more resistant to retroactive inhibition than are nonmediated pairs; for retention, the use of mediators deters proactive interference of prior items.

In addition to benefiting tasks of paired-associate learning, mediational strategies have also been successfully applied to tasks of serial (i.e., ordered) learning. For example, in an experiment by Bower and Clark (1969), college students were presented with twelve 10-word lists, and were asked to recall each list when given the first word. During the learning phase, strategy subjects were asked to incorporate and sequence the words from each list into a meaningful narrative story. Control students were provided with an equal amount of time for studying the lists, but were not taught a special strategy for remembering the items. Results of the immediate recall test showed almost perfect recall for both strategy and control groups. On the test of delayed recall, however, the strategy students who had generated their own narrative sentences, recalled six to seven times as much as their yoked controls. Bower and Clark interpreted this effect as probably being due to thematic organization which, according to Paivio (1971), "increased learning, decreased interlist interference, and guided

reconstructive recall. The first-word cue presumably prompted recall of the theme, from which the person could reconstruct the sentences and retrieve the critical words" (p. 314-315).

Visual, as well as verbal, processes have been shown to enhance learning. Following Levin (1976), maximizing what children learn can generally be accomplished through the use of techniques which "concretize" what is to be learned. Levin claims that pictures are more concrete than words in that they provide learners with a closer approximation to their environments. For children's and adults' learning of unconnected materials, pictures have been shown to be superior to words, in tasks involving both recognition and recall memory.

Pictures, as applied to most paired-associate tasks, can be either imposed (as in an experimenter-provided illustration) or induced (as in a subject-generated mental image). Just as with verbal mediators, illustrations and images must be organized into some kind of interactive scene in order to be rendered memorable. In an imagery study, Bower (1972) attempted to create a high memory load for his college-age subjects by presenting them with five 20-pair lists. Imagery subjects were instructed to generate interactions of the associated noun items, whereas control subjects were given an equivalent amount of time to study the lists. Results, based on the recall of the one-hundred pairs, showed that imagery subjects remembered

one-and-one-half times more information than did controls on both the immediate and delayed tests.

Rohwer (1973) claims that elaborative strategies enhance memory because the coupling together of pair members creates a shared context for initially disparate items. Thus, the learner is provided with a common event for the referents of the stimulus and response members of each pair. To determine the relative benefits of elaborated images versus unelaborated images, Bower (1972) compared two groups who were given imagery instructions for remembering concrete noun pairs. One group was asked to image the two objects for each pair separately, while the second group was instructed to image the two objects interacting in some way. A cued recall test showed that the interactive imagery subjects recalled 71 percent of the response terms, whereas the separated imagery subjects recalled only 46 percent. Bower concluded that imagery instructions are more effective when subjects are asked to imagine the pair members in some kind of interactive scene, rather than as separate objects. Thus, mediated pictures, as well as mediated sentences, have an organizational context that aids memory for associations of unconnected pairs.

Two factors appear to be especially salient for remembering associations of unrelated materials and, therefore, for influencing the degree of learning that takes place: 1) the concreteness of the stimulus member of the pair; and 2) the relationship created via the interaction.

Paivio's (1971) "conceptual peg hypothesis" states that the stimulus member of a pair functions as a "peg" to which its associate is hooked during learning, and from which it can be retrieved during recall. According to Paivio, the more concrete the stimulus, the more "solid" it is as a conceptual peg, and the better the recall. Concreteness can be defined in terms of its image-arousing value--that is, the speed and ease with which the word arouses some mental image (Bower, 1972). On recall trials, then, the image-arousing value of the stimulus is crucial, because it "redintegrates the compound image from which the response component can be retrieved and recoded as a word" (Paivio, 1971, p. 248).

When two unrelated nouns are paired, Bower (1972), Levin (1976), and Rohwer (1966) assert that verbal and imaginal elaborations that relate the two nouns in a meaningful episode are more potent than elaborations that maintain the separate characters of the two items. Thus, the most important factors in paired-associate learning do not relate to whether the elaboration is presented verbally or pictorially, but to the strength of the elaboration and the shared meaningfulness that it provides for the two members of the pair (Pressley, 1977; Rohwer, 1973).

Other Issues. Research has established that memory for unconnected pairs can be substantially facilitated through experimenter-provided verbal or pictorial elaborations. Because

of the greater concreteness of pictures, however, pictures make more substantive events than do words (Rohwer, 1973). Levin (1976) and Pressley (1977) have argued that this picture-word difference appears not to diminish with age (contrary to what had been previously believed). That is, subjects learn more from experimenter-provided pictorial presentations than from their verbal equivalents at all stages of development.

Age does appear to be a factor in children's ability to benefit from subject-generated images, however. Pressley claims that "the ability to increase learning by self-produced internal visual elaborations is a truly developmental phenomenon" (p. 614). Nursery school children are not able to spontaneously form imaginal elaborations with either pictures or words. Given the appropriate instructions, first and second graders can produce internal elaborations with pictures, but not with words. Third-grade children can employ elaborative strategies with both pictures and words, as well as with other complex tasks, such as prose learning. And by adolescence, a substantial number of children show the propensity to construct their own elaborative images with both pictures and words, without being specifically instructed to do so.

Individual differences are also a factor in how children benefit from visual and verbal strategies. For example, Levin, Divine-Hawkins, Kerst, and Guttmann (1974) found that although most fourth graders learned both pictures and words either well

("good" learners) or poorly ("poor" learners), for 20% of the students the nature of the materials presented was critical in classifying them. That is, they functioned like poor learners when words were presented, but like good learners when pictures were presented. According to Levin (1976), students at all age levels possess a wide range of cognitive-developmental abilities. He maintains that this results in great performance variability, because some students are capable of complying with the demands of a task and some are not. Age, therefore, appears to serve as a necessary, though not sufficient, variable for predicting performance. Learner characteristics, such as socioeconomic status, intelligence, and modality preferences, appear to interact with age in determining performance for the learning of unconnected pictorial and verbal paired associates.

Semantic and Phonetic Encoding Systems for Learning Unconnected Materials

Paivio's (1971) notion of "dual coding" implies the availability of both visual and verbal coding systems, and the relative contributions of each for the learning of various kinds of information. Following Paivio, the summative availability of both codes is highest for pictures, intermediate for concrete words, and lowest for abstract words. Through his "coding redundancy hypothesis", Paivio asserts that memory increases directly with the number of alternative memory codes for an item. Pictures, by definition, are already concretizations and, if a verbal label is not already attached, the

learner is often likely to provide one of his or her own spontaneously. Concrete words, according to Paivio (1971), Yuille and Paivio (1969), and Begg and Paivio (1969), may be stored via dual-coding, whereby the learner recalls the to-be-remembered information by generating verbal associations to the stored images. But abstract words are stored via a single-coding mechanism (i.e., as a verbal representation only), and during recall, the subject is unable to benefit from the addition of an auxiliary visual code. It is not surprising, therefore, that in tasks of both recognition (e.g., Levin, 1976; Shepard, 1967) and recall (e.g., Levin, 1976; Paivio & Csapo, 1969), pictures are remembered better than concrete words, and concrete words are remembered better than abstract words.

Whereas concrete information can be directly pictorialized, abstract information must first be encoded into a more visualizable form. That is, the abstract information must be encoded into a concrete word or picture symbol, so that it can then be fit into some organizational scheme (Bellezza, 1981; Bugelski, 1970; Paivio, 1968). Bellezza discusses two such encoding operations, one based on semantic encoding, and the other on phonetic encoding. Consider one of Bellezza's examples, namely the relatively abstract word, "origin". The word, "origin", according to a dictionary definition (Webster, 1953), applies to the "source from which something is ultimately derived"; thus, a concrete word with a related meaning could be "egg" (semantic encoding). The word, "origin", also sounds like the concrete word, "orange" (phonetic encoding). According to Bellezza, either encoded

word, "egg" or "orange", could be integrated into an organized picture for attempting to remember "origin" along with its associated information.

Semantic Encoding Operations. Bellezza's (1981) semantic encoding operations render abstract information more concrete through meaning-related referents, such as symbols. According to Bower (1972), abstract words presumably evoke little or no imagery directly, but may do so indirectly through associated words, such as church or priest for "religion", or Cupid for "love". Semantic encoding operations have made abstract words and concepts more memorable in paired-associate learning tasks using unconnected materials. For example, in a paired-associate study using two ten-item lists of concrete nouns, Paivio (1968) investigated the effects of imagery or no-imagery instructions in the use of the pegword mnemonic. For List 1, subjects were not taught a mnemonic strategy, but were presented with the to-be-recalled nouns preceded by the numerals one to ten. The numerals were then presented in a random order, and subjects were asked to recall the corresponding items. For List 2, subjects were assigned to an imagery instruction or no-imagery instruction condition, and were taught either a concrete (e.g., one-bun, two-shoe; etc.) or an abstract (e.g., one-fun; two-true; etc.) pegword mnemonic. Numerals were again presented in a random order: Subjects in the imagery group were told to use mental images to relate the pegword rhymes with the

to-be-remembered items. That is, if the to-be-associated item with one were pencil, students in the concrete pegword group would be asked to construct an interactive mental picture involving the pegword, bun, and the to-be-associated item, pencil. A likely image would be that of a pencil inside a hot dog bun. Students in the abstract pegword group, on the other hand, would need to form a mental image of the pegword, fun, interacting with the pencil. Because the abstract term, fun, cannot be directly represented in a picture, the students might semantically encode fun into a concrete referent in order to render it picturable for an elaboration with pencil. An imaginal scene of a person juggling pencils, for example, would convey the idea of having fun with pencils. Subjects who were not given imagery instructions were told to recall the list by saying to themselves the rhyming words, along with the to-be-remembered item (e.g., "one-bun-pencil" or "one-fun-pencil").

Paivio found that recall was better for the list learned under mnemonic instructions (List 2) than for the control list (List 1), and under imagery instructions rather than no-imagery instructions. Whereas recall was comparable for all groups on the first no-mnemonic list, recall increased dramatically on the second list for subjects given mnemonic instructions, regardless of whether the rhyme was concrete or abstract. It is interesting to note that the method appeared to be equally facilitative for concrete and abstract pegwords. Because abstract words are generally low in imagery value, it is plausible to believe that imagery-instructed subjects

who were presented with abstract pegwords probably concretized the abstract pegs, as in the one-fun-pencil example above. By creating concrete representations or symbols for abstract information, subjects could then generate stable images of the newly-derived concrete word referents interacting with the to-be-associated items (Bellezza, 1981).

Wollen (1968) compared the effects of relevant pictures, irrelevant pictures, and no pictures on the learning of noun pairs that were either high (concrete) or low (abstract) in imagery value. Relevant pictures for high imagery nouns consisted of an integrated (elaborated) pictorialization for each member of the noun pair, accompanied by the corresponding noun labels. Relevant pictures for low imagery nouns consisted of integrated concretizations or symbols for each member of the noun pair, also accompanied by the corresponding noun labels. Irrelevant pictures for both high-imagery and low-imagery noun pairs were the identical integrated pictures used in the relevant picture condition, but "mismatched" with the noun pairs. Subjects in the no-picture control condition were asked to learn the noun pairs without accompanying illustrations. Results showed that subjects in the relevant picture condition recalled about twice as much as did subjects in the irrelevant and no picture conditions, for both high-imagery and low-imagery noun pairs. Wollen concluded that even though subjects who are given relevant accompanying pictures may have an extra decoding load as a result of concretizing the more abstract low-imagery

nouns (e.g., "strength" was represented by a dumbbell), they nevertheless realize the same performance gains as when they are learning concrete high-imagery nouns.

By representing vague and novel terms through conventional symbols or specific concretizations, Bellezza's (1981) semantic encoding operations fit popular notions of "schema theory" (see Anderson, Spiro, & Montague, 1977). When the learner is presented with abstract and sometimes new verbal information, semantic encoding operations transform this information into concrete, familiar illustrations or images.

Phonetic Encoding Operations. Although semantic encoding systems have already been proven effective in tasks involving the memory of abstract information, the success of phonetic encoding operations is speculative at this time. The mnemonic keyword method, which is a phonetically-based operation, has not yet been applied to abstract information, but to unfamiliar (i.e., foreign and native vocabulary) or difficult-to-remember (names of people and places) stimulus terms. The success of keyword studies using sound-based transformations for learning unfamiliar and difficult-to-remember information lends support to Bellezza's (1981) suggestion that phonetic encoding operations might also be successfully utilized for rendering abstract materials more concrete. It should be noted, however, that until the present study, all experiments involving phonetic recoding required transformations of the stimulus members

of pairs. The present study represents a departure from previously reported investigations, because phonetically-based transformations are applied to the to-be-remembered abstract information in the response members of pairs.

As mentioned above, an advantage of a phonetic encoding operation, such as the keyword method, is its applicability to comprehensible information containing unfamiliar terminology, or to information containing a great many facts (Levin, in press). Whereas the word "origin" might share a meaning base with egg, or the term "religion" might remind us of a church or a priest, unfamiliar words (foreign and native) and unfamiliar names (of people and places) are not likely to activate a schema for producing semantically related referents. A phonetic encoding system, on the other hand, can transform the unfamiliar information into a physically different text based on auditory cues. According to Levin (1981), mnemonic pictures are derived from phonetically encoded verbal information in that the to-be-learned verbal information is physically transformed into a semantically unrelated pictorial representation.

The keyword method described earlier is an example of how mnemonic pictures can be successfully utilized for foreign language vocabulary learning. If, for example, the learner were asked to remember that carta means letter, a sound-alike word (a keyword), such as cart, could be derived (transformed) from the Spanish word, carta. Next, an elaboration could be formed, with the keyword,

cart, interacting with the foreign word's definition, letter. Thus, if the elaboration were a picture, the subject might be presented with a drawing of a letter inside a shopping cart.

The keyword method has also been shown to facilitate fourth- and fifth-grade children's memory for native language vocabulary (Levin, Johnson, Pittelman, Hayes, Levin, & Shriberg, 1983). Subjects shown mnemonic keyword pictures (pictures wherein the keyword referent is shown to be interacting with a symbol for the vocabulary word's definition) remembered more vocabulary words on both immediate and delayed definition-recall measures, in comparison with subjects taught contextual analysis and semantic-mapping strategies.

For keyword studies in both foreign and native language vocabulary learning, most experiments have compared mnemonic keyword picture conditions with no-picture control conditions. Thus, it was uncertain whether it was the specific use of the keyword pictures, or the utilization of pictures in general, that was responsible for the benefits accrued to all keyword picture groups. In a recent study by Levin, McCormick, Miller, Berry, and Pressley (1982), however, subjects presented with mnemonic keyword pictures significantly outperformed subjects shown nonmnemonic pictures. Fourth-grade students who were trying to learn difficult English vocabulary words, and who were provided with nonmnemonic pictures relating each word with its contextual definition, as in the picture for surplus in Figure 1, performed at the same level as no-picture

Figure 1. Contextually explicit nonkeyword illustration from Levin et al. (1982)

controls. In contrast, students provided with mnemonic pictures--such as the one in which the to-be-learned vocabulary word, surplus, was transformed into the keyword, syrup--and then shown a drawing relating the keyword to the vocabulary word's definition (see Figure 2), substantially outperformed students in the control condition. Mnemonic pictures, such as the one of syrup in Figure 2, display objects or events that are not even mentioned in the text, and that usually have little or no relation to the conceptual content of the material being learned (Bellezza, 1981; Levin, in press).

The examples for carta and surplus demonstrate how phonetically encoded mnemonic pictures can be successfully applied to the learning of foreign and native vocabulary words. The benefits of other types of mnemonic keyword pictures, such as those used to learn the names of fictitious people (Shriberg, Levin, McCormick, and Pressley, 1982) and places (Levin, Shriberg, & Berry, in press), and of abstract expository information (Levin et al., in press) will be discussed in detail in a later section on mnemonic strategy applications for prose.

Other Encoding Operations. In addition to the keyword method, Levin (in press) designates three strategies as examples of other truly mnemonic devices: the method of loci, the pegword method, and the digit/symbol method. As with the loci and pegword methods (described in the Introduction), the digit/symbol method also

SURPLUS (SYRUP) having some left over, having more than was needed

Figure 2. Contextually explicit keyword illustration from Levin et al. (1982)

calls for a restructuring of the to-be-learned content into some other form. According to Loisette (1896), "Numbers, as such, are abstractions and hard to be remembered. To make them hard to forget, we translate them into words or phrases" (p. 66-67). To accomplish this, each numeric figure, 1, 2, 3, 4, 5, 6, 7, 8, 9, and 0, is assigned one or more consonant sounds. Vowel sounds, which do not have numeric value, are inserted (as needed) among the consonant sounds in order to form words and phrases. Thus, to remember the date, 1609, the learner might come up with the term, "dish soap", based on the following arrangement of number-consonant pairings: 1 = d, 6 = sh, 0 = s, and 9 = p. "Dish soap" can be learned and remembered via words or pictures, and then transformed back into its original numeric value. Retrieval in a digit/symbol system, as in other mnemonic systems, is based on cues extrinsic to the information being recalled, rather than on cues which either are themselves part of, or are at least semantically related to, the information to be remembered (Bellezza, 1981).

Pictures and the Learning of Connected (Prose) Materials

Levin (1981) identified eight different functions of pictures in prose, four of which he classified as 'higher order' functions from a cognitive-psychological point of view: the representation function (when the illustrations accompanying a prose passage are redundant with the text information); the organization function (when a text's elemental structures are combined into

a single composite structure that enhances their relatedness); the interpretation function (when the text information is abstractly or complexly presented, and illustrations are used to increase the meaningfulness of the information); and the transformation function (when the text information is comprehensible but difficult to remember, and pictures serve to enhance the memorability of the text content).

Because representation, interpretation, and transformation relate to the nature of the correspondence between the information in the picture and the to-be-learned verbal information, these functions will be described in some detail. The organization function is less salient here, because it does not qualitatively describe a correspondence between pictorial and verbal information. Rather, it is an "organizing operation" (Bellezza, 1981), which relates formerly disparate representational, interpretational, and/or transformational units together within a single composite picture. Accordingly, the influence of the organizational function will be described only in relation to the three other higher order picture functions.

Nonmnemonic Pictures and Prose

According to Levin (1981), representational pictures "take information that [is] represented in one mode (verbal) and represent it in another (pictorial)" (p. 214). Representational pictures, therefore, contain information that directly overlaps

with the corresponding verbal content to help make that verbal information more specific or concrete. For unelaborated associations, the representation function is more effectively realized by illustrations than by images. Whereas representational illustrations tend to increase performance moderately, representational images per se appear to have little or no effect on performance. Levin explains that representational illustrations lay down a "memory trace" which is stronger than that for representational images, or for verbal information without accompanying pictures. This potent memory trace is assumed to benefit the learner during both storage and retrieval.

Although some investigators (e.g., Koenke, 1968; Miller, 1938; Samuels, 1967; and Weintraub, 1960) have found overlapping, representational pictures to be nonfacilitative, or even detrimental, to children's comprehension of text information, this view has not been upheld by the great majority of reading and education researchers. Levin and Lesgold (1978) and Schallert (1980) conducted literature reviews on picture effects for prose comprehension, and concluded that overlapping pictures are indeed facilitative. Overlapping, or representational, pictures are derived from concrete verbal information and provide the learner with the same content that is in the verbal information, but through a different modality. And, according to Levin (1981) and Schallert (1980), the benefits from such pictures

are attributed to the provision of a different access route to the verbal information, rather than from merely a repetition of it.

Levin and Lesgold (1978) and Schallert (1980) have examined the prose-learning literature to determine the effects of pictures on reading performance. Levin and Lesgold identified nearly twenty experiments in which children utilized experimenter-provided representational illustrations for the learning of fictional narrative prose information. The results of these experiments showed picture effects to be "positive, potent, and pervasive" (Levin, 1981, p. 204). That is, children who were shown illustrations that overlapped with the story's content, recalled at least 40 percent more story information than did no-picture controls. Based on their review, Levin and Lesgold were able to designate five important groundrules for research on pictures in prose. When all five conditions are met, the literature provides overwhelming support for positive picture effects--even over no-picture groups that receive a second exposure to the story passage. The five groundrules are: 1) prose passages are presented orally; 2) the subjects are elementary school-age children; 3) the passages are fictional narratives which are unfamiliar to the subjects; 4) the pictures overlap the story content (the story content must be concrete); and 5) learning is demonstrated by factual recall.

Levin and Lesgold claim that picture studies which adhere to these groundrules show benefits for picture subjects across the four main learner characteristics: age (within the elementary school grades), sex, social class, and intellectual ability. Subjects who were presented with such pictures also outperformed subjects who were not shown pictures, regardless of the length and complexity of the passages. This was true for both verbatim and paraphrase recall, on tests administered both immediately following learning and over time.

In her review on pictures, Schallert (1980) cites several experiments which support positive effects of pictures for prose comprehension. For example, Denburg (1976-1977) found that carefully designed overlapping illustrations helped beginning readers to use their limited knowledge of print in a reading task, while Read and Barnsley (1977) discovered that the interaction of the text and its corresponding pictures aided new readers in processing and storing the passage information. And based upon an experiment by Rohwer and Harris (1975), Schallert proposes that "pictures can facilitate comprehension if they depict information which is central to the text and which is tapped in the comprehension measures" (ms. p. 9-10). Since verbal reiteration (e.g., reading-and-then-listening, or vice versa) of passage information did not improve performance, Schallert suggests that "differentiated access" (viz., pictures-with-reading or pictures-with-listening) via the visual and the

verbal, is responsible for the picture benefits on comprehension measures.

Another advantage of pictures is their effect on simplifying complex verbal materials. Pictures which correctly and specifically represent story information were found to be helpful even when the stories became longer and more complex (Lesgold, DeGood, & Levin, 1977). And Royer and Cable (1976) found that college students who read a first passage which was concrete, was abstract but included analogies, or was abstract but accompanied by pictures serving the interpretation function (Levin, 1981), performed equally well on a second abstract passage dealing with the closely related topic. Schallert (1980) says that all three of these conditions probably elicit in the reader "an internal representation of the way the concepts being learned are structurally related" (ms. p. 14).

For both reviews, Levin and Lesgold (1978) and Schallert (1980) found that it was difficult to compare the various experiments because of differences in the ages and ability levels of the subjects, the types of prose passages used, the variety of dependent variables, and the inadequacy of researchers' operationalizations of how pictures facilitate prose learning. Nevertheless, a strong case can be presented for the benefits of illustrations for prose, even though the case for imagery is considerably weaker. As opposed to illustrations, imagery effects are typically small in magnitude and limited in generality

(Levin & Lesgold, 1978). Levin (1981) suggests that this difference is due to the more sophisticated processing needed for the generation of visual mental images: "Visual perception and interpretation skills are required in internalizing an illustration, whereas cognitive constructions and elaborations are required in creating imaginal representations of verbal messages" (p. 207). Since children below the age of nine do not appear to benefit from imagery instructions, most of the imagery studies reviewed by Levin and Lesgold involved the participation of elementary school children who were nine years old or older (third grade and above).

In a dissertation study with prose, Dillingofski (1980) utilized Levin's (1981) representational and interpretational functions for both illustrations and imagery. Specifically, Dillingofski explored the effectiveness of experimenter-provided (imposed) illustrations versus subject-generated (induced) images with ninth-grade difference-poor readers, for remembering concrete and abstract social studies text passages. Difference-poor readers were defined as "readers who have adequate decoding or vocabulary skills, but who have difficulty comprehending what they read" (p. 7). In the case where illustrations were provided for concrete prose, the pictures served a representation function (Levin, 1981), in that they overlapped or were redundant with the text information.

For example, a concrete practice paragraph was: "The great white shark was only inches away from the boy's foot. Its huge teeth gleamed in the swirling water." The accompanying picture showed a shark in swirling water, with its large teeth very near to a boy's foot (see Figure 3). When illustrations were provided for relatively abstract passages, however, the pictures served the interpretation function (Levin, 1981); that is, they increased the meaningfulness of the text content through symbols or concretizations. An example of an abstract statement was: "One of the principles of American democracy is freedom of religion." The accompanying picture 'symbolized' freedom of religion by showing people on a path that branched out to several different houses of worship (see Figure 4). Imagery-induced subjects were instructed to "make up pictures in [their] heads" of the story information as they read the concrete or abstract passages.

Results showed that both imposed and induced pictures improved subjects' literal comprehension of both concrete and abstract prose information, as compared with no-picture control subjects. But, whereas imposed and induced pictures were equally beneficial for comprehending the concrete passages, imposed pictures were more facilitative than induced pictures for comprehending abstract passages. One might speculate that the difference-poor readers in this study did not optimally concretize the abstract text information in order to render

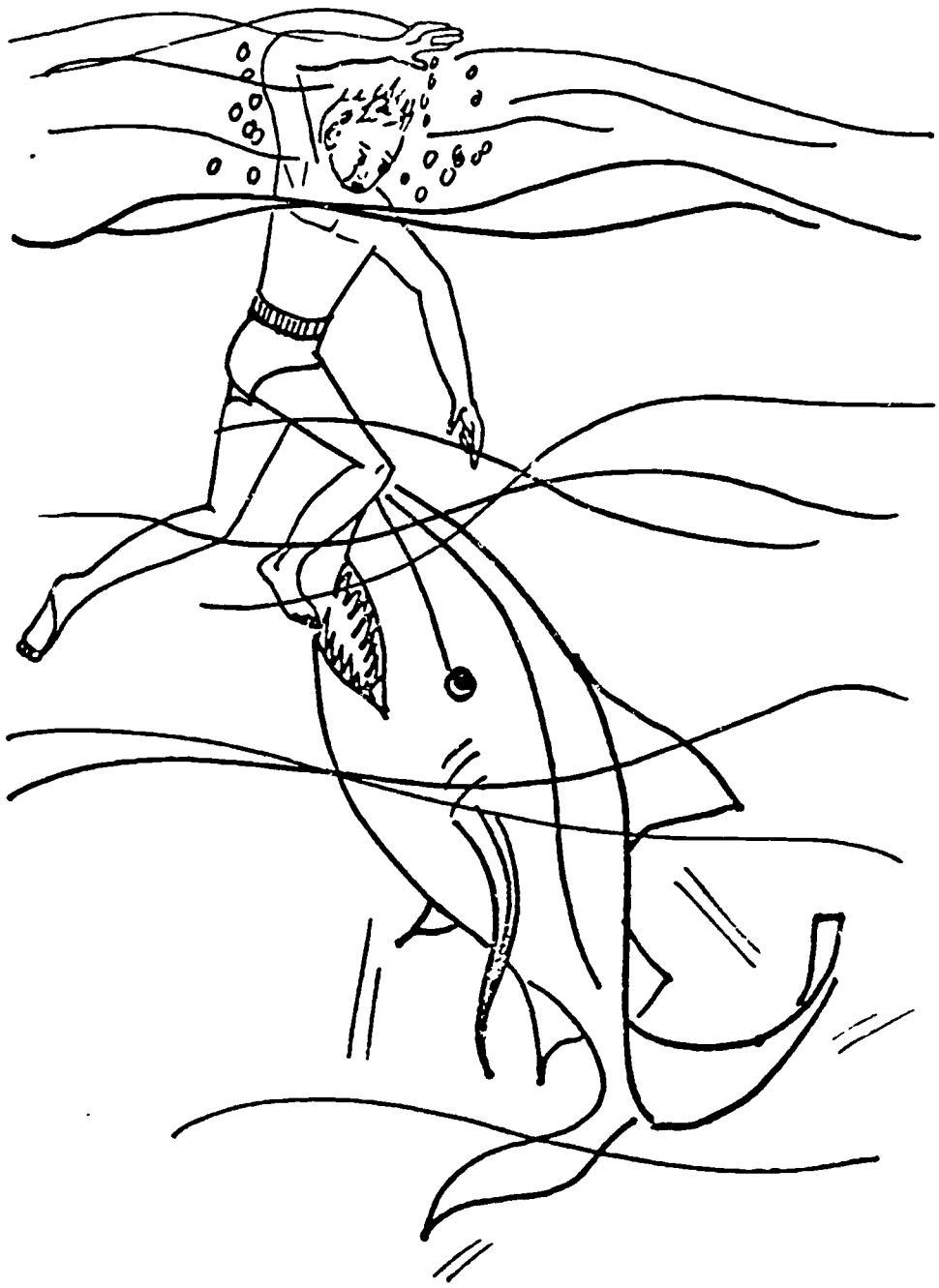


Figure 3. Sample illustration for a concrete text passage from Dillingofski (1980)

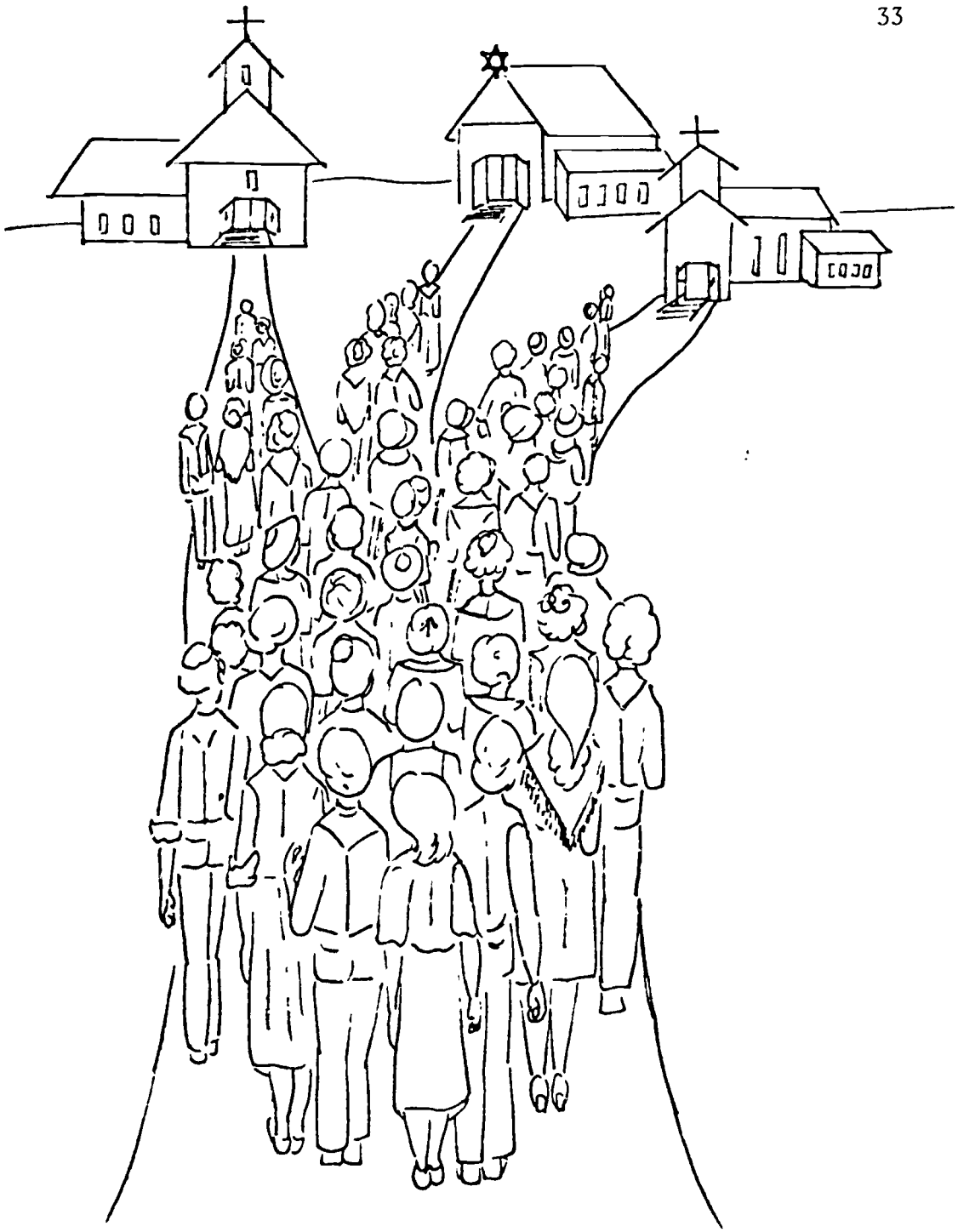


Figure 4. Sample illustration for an abstract text passage from Dillingofski (1980)

it more picturable for mental images. The performance gains obtained by Dillingofski's subjects in the imposed picture condition, however, exemplify the success of Bellezza's (1981) semantic encoding operation, and of Levin's (1981) interpretation function of pictures, on students' memory for abstract expository prose information.

In sum, illustrations have been shown to be a consistent and potent facilitator for children's learning of prose information. The effects of imagery, however, are much less clearcut. Imagery facilitation is smaller in magnitude and less consistent than picture facilitation. It should be noted, however, that these conclusions are based on reviews of studies using representational and interpretational pictures (both illustrations and images) with prose. Representational pictures have already been described as pictures which are redundant with, or which overlap with, the information in concrete prose passages. Schallert (1980) refers to the role of such pictures as providing a different access route (modality) to the verbal information.

According to Levin (in press), the representation, organization, and interpretation functions of pictures merely reiterate, consolidate, and symbolize, respectively, the information presented in the prose text and, therefore, they cannot properly be labelled "mnemonic". A truly mnemonic picture represents

a physical recoding of the textual information and must implicate the transformation function. In the same way, Bellezza (1981) distinguishes between mnemonics that primarily involve organizing operations and those that involve phonetic encoding operations. An organizing operation associates or relates in memory units of information that at first appear to be unrelated (Levin's, 1981, organization function), whereas a phonetic encoding operation transforms a unit of information into some other form (Levin's, 1981, transformation function). Hence, the representational pictures described in the Levin and Lesgold (1978) and Schallert (1980) reviews would be designated as nonmnemonic, because representational illustrations or images provide information that is identical to that in the accompanying text. Interpretational pictures help make abstract and vague information more understandable by rendering that information more familiar by means of conventional symbols or concretizations. Since the text information is not recoded or changed in meaning, but is instead 'paraphrased' via illustrations or images, interpretational pictures must also be designated nonmnemonic. Mnemonic pictures, however, contain different information from that in the text, because the illustrations or images provide a physical recoding of the to-be-remembered prose information.

In an earlier subsection of this paper, it was demonstrated that mnemonic transformational pictures are highly potent

facilitators for the learning of unconnected (e.g., vocabulary) materials, as compared with nonmnemonic pictures (Levin et al., 1982). It would seem worthwhile, then, to determine whether mnemonic transformational pictures would have an equally powerful effect on the learning of connected (prose) materials. Since not all text information is concrete, familiar, or easy to remember, subjects learning prose passages containing information that is abstract, unfamiliar, or difficult to remember, might benefit from transformational pictures. The remainder of this chapter will therefore be devoted to mnemonic strategy application to prose-learning situations. All pictures in the experiments in this review involve experimenter-provided illustrations, subject-generated images, or experimenter-structured images (when the specific images to be generated are described by the experimenter) and concentrate on either the loci or keyword mnemonic.

Mnemonic Pictures and Prose

Although, by the mid-1960's, a sizeable number of research investigations had been undertaken to explore the efficacy of mnemonic strategy usage for the learning of unconnected pairs, there had been only a paucity of studies relating mnemonic techniques to the recognition or recall of information from prose materials. Yet, according to Meyer (1975), prose is the primary medium through which information is transmitted

in formal instructional settings, such as the classroom. Because mnemonic strategies tend to facilitate learning, because mnemonic strategies can be taught, and because most of what goes on in the classroom is communicated through prose, it seems reasonable to explore the effectiveness of mnemonic strategy application for children's memory of information from prose materials (Krebs, Snowman, & Smith, 1978).

In the past few years, a small corpus of research has emerged, with encouraging results, for the application of mnemonic strategies [in particular, loci (Krebs et al., 1978; Snowman, Krebs, & Kelly, 1980a; Snowman, Krebs, & Lockhart, 1980b), and the keyword method (Levin, Shriberg, & Berry, in press; McCormick & Levin, 1982; Shriberg, Levin, McCormick, & Pressley, 1982)] to prose-learning tasks.

In the Krebs et al. (1978) study, seven college students taught a text analysis strategy for scanning passages for central theme and information units, along with the method of loci for remembering supporting details, performed significantly higher for immediate, two-week delayed, and four-week delayed recall, than when they had used "typical study methods" prior to training. The absence of a control group, however, makes it difficult to draw valid conclusions from the results (McCormick, 1981).

Although the study by Snowman et al. (1980a) also lacked an appropriate control group, it utilized a larger sample size (n = 96) and manipulated type and sequence of strategy instruction. Subjects were trained in separate or combined conditions for visual imagery (using the loci mnemonic), and for prose analysis (using Meyer's, 1975, explanations of superordinate and subordinate relationships). Snowman and his colleagues found that for both immediate and delayed recall, the single most important component was the prose analysis training. Failure of the loci mnemonic to enhance performance was attributed to the notion that the method of loci is better adapted to list learning than to prose. Because the passages used in this study had many abstract terms, subjects had to rely heavily on the prose analysis training in order to reduce the complexity of the prose to a form amenable to the method of loci. As Levin (in press) suggests, a mnemonic strategy other than the method of loci, or the method of loci used in conjunction with an additional mnemonic strategy, might have been more appropriate for the Snowman et al. passages.

The second Snowman et al. (1980b) study involved the participation of 72 "high-risk" college freshmen, who were randomly assigned in equal numbers to experimental and control conditions. "High-risk" college freshmen in this experiment were described as lower-than average achieving students from

racial minorities and/or low socioeconomic groups. Students in the experimental condition were taught a coding scheme for identifying the basic organizational structure and idea units of prose passages (prose analysis) along with instructions for generating visual images of the idea units and, "where serial recall was necessary or desirable [for embedding] the images in the method of loci mnemonic" (p. 37). Students in the control group were taught note-taking, identification of main ideas, text-skimming, and context and word identification skills for increasing reading comprehension. All students were provided with practice tasks appropriate for their instructional condition during weekly 50-minute classes, spread out over a 10-week period. During the eleventh week, all students read the same expository prose passage that they had read prior to treatment. Recall protocols were scored for the percent of idea units correctly recalled. Whereas there had been no differences in performance between conditions on the precourse passage, students instructed in the prose analysis, imagery, and loci strategy procedures, significantly outperformed controls by 50 percent on the post-course passage.

Although facilitation was substantial for subjects taught the combined procedure of prose analysis, imagery, and the method of loci, the relative contribution of each component

was not determined. Perhaps it was only the prose analysis training (as in the Snowman et al., 1980a, study), and not the imagery and loci method components, that was responsible for the overall benefits.

Probably the most encouraging experiments on mnemonic strategy application for prose learning have come from the laboratory of Levin and his associates at the University of Wisconsin-Madison. In a three-experiment study by Shriberg, Levin, McCormick, and Pressley (1982), eighth graders were presented with short passages describing the names and accomplishments of fictitious people. The first sentence of each passage provided the name of the person and his or her accomplishment (central information), while each of the remaining sentences contained information elaborating on the central idea (incidental details). Consider, for example, the following passage:

> Animal owners all over the world are impressed that Charlene McKune has taught her pet cat how to count. The cat can count to 20 without making any mistakes. Moreover, the remarkable cat can do some simple addition.

In Experiment 1, students in two keyword conditions--Pictures and Pictures Plus--first learned an appropriate keyword for each of the twelve fictitious names, while control students were given a comparable amount of time to become familiar

with the names. (The last names for all twelve "famous" persons were randomly drawn from a local telephone directory in order to avoid the creation of names that might be especially amenable to keyword use.) Students in the Pictures condition were shown a colored line drawing depicting an interactive scene between the picture for the keyword referent and a representation of that person's accomplishment. Students in the Pictures Plus condition were additionally shown pictorial representations for the two pieces of incidental information. All passages were read aloud by the experimenter.

When the passages were presented to the keyword subjects for learning, the first six passages were accompanied by the appropriate pictures. For the Charlene McKune passage, then, in which Ms. McKune (keyword = raccoon) taught her pet cat to count, both groups of keyword subjects were shown a picture of a cat using a tally board for counting raccoons, to represent the central information. The illustration for the Pictures Plus students, however, additionally included twenty tallies and a "2 + 2 = 4" equation, which represented the two pieces of incidental information--namely, that "the cat can count to 20", and "the cat can do some simple addition" (see Figure 5). For the second six passages, the keyword subjects were not shown pictures, but instead, were provided with the keywords and instructed to make up pictures in their heads (i.e., to construct visual images) modeled after those that they had

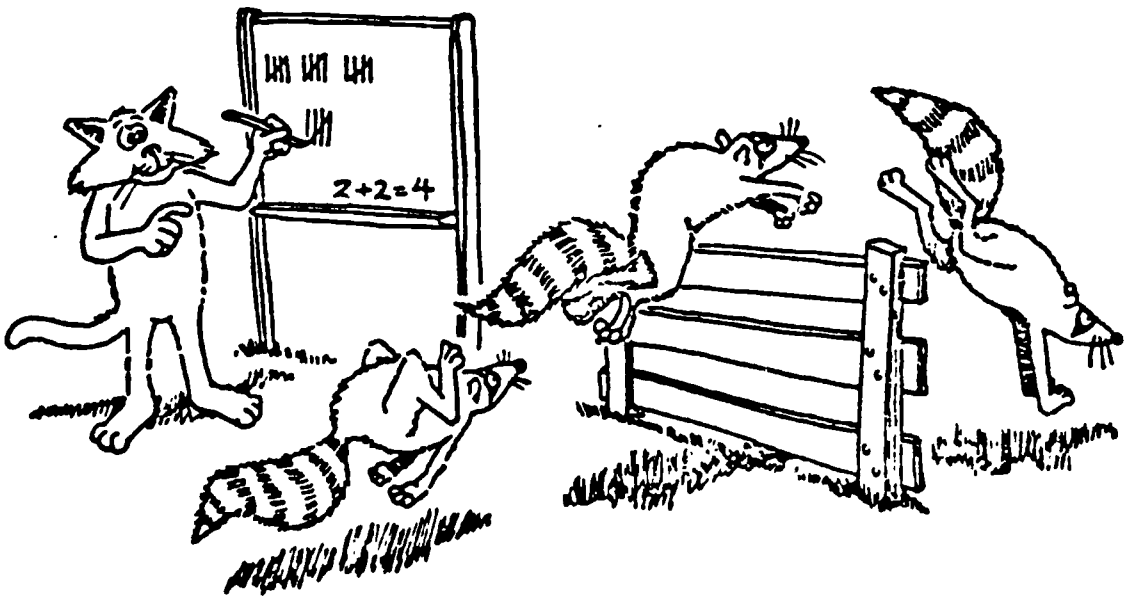


Figure 5. Mnemonic illustration shown to Pictures Plus subjects from Shriberg et al. (1982)

seen for the first six passages. Students in the control condition were shown typewritten copies of the passages and were instructed to use their "own best method" to learn the names and accomplishments.

Separate comparisons between conditions were made on the first six and on the last six passages For both experimenter-provided pictures (first six passages) and subject-generated images (last six passages), students in the Pictures and Pictures Plus conditions remembered substantially more central name-accomplishment information in comparison to controls. Moreover, the two keyword conditions did not show mean differences in central information recall. Thus, the keyword method increased name-accomplishment recall regardless of whether students were shown actual line drawings (about 200 percent facilitation) for the first six passages, or whether they had to generate their own mental images (over 100 percent facilitation) during the last six passages. For incidental information recall, Pictures Plus students outperformed controls when provided with actual line drawings, but there were no significant differences among conditions when students were asked to construct their own mental images. It should be noted, however, that the students were not specifically instructed to remember the incidental information.

In their second "famous" people experiment, Shriberg et al. found that a keyword group provided with pictures for all

twelve passages recalled significantly more central name-accomplishment information than did a keyword group required to generate all its own images. As in the first experiment, both keyword groups substantially outperformed controls (by about 200 percent for actual illustrations, and about 100 percent for subject-generated imagery).

Experiment 3 of the Shriberg et al. study extended the comparison between transformational and representational pictures from the learning of unconnected materials using illustrations (Levin et al., 1982) to the learning of prose materials using visual imagery. This experiment was designed to test the hypothesis set forth by Levin (1981) that transformational (mnemonic) and representational (nonmnemonic) visual images would have a differential effect on children's recall of explicitly stated text information. Eighth-grade students were presented with fictitious prose passages about "famous" people and their accomplishments. The people's names (e.g., Larry Taylor) were given to half the subjects, and their occupations (e.g., a tailor) were given to the other half. All the surnames were selected so that they corresponded to the names of occupations (e.g., Tom Butler vs. a butler; Charlene Fidler vs. a fiddler). For the occupation passages, imagery-instructed subjects could form direct images of the passage content (representation function), whereas for the name passages, subjects first had to convert a name into its auditorially identical

occupation, and then form an image (transformation function). Students in the occupation-control and name-control conditions were instructed to use their "own best learning strategy" for remembering the people and their accomplishments.

As predicted, the effect of transformational imagery was much more pronounced than the effect of representational imagery. In fact, subjects who simply constructed representational images of the passages' content (i.e., imagery-instructed subjects given the occupation passages) did not significantly outperform control subjects. The impressive results of Experiment 3 of the Shriberg et al. study highlight the gains that accrue to mnemonic transformational images. In contrast, no benefits were found to accrue to representational images. Such findings support the notion that the degree of imagery facilitation expected in children's prose-learning studies depends upon the kind of images generated relative to the kind of information that is to be learned.

Whereas all three Shriberg et al. experiments applied the keyword method to multiple-name factual passages containing only one attribute per name, a two-experiment study by McCormick and Levin (1982) utilized multiple-name paragraphs which contained multiple attributes per name (Levin, in press). Using passages which had an identical basic structure in order to be "potentially confusable", five pieces of biographical information were associated with each of four fictitious individuals. Rather

than providing keyword students with actual illustrations, or requiring the students to generate their own images, McCormick and Levin described the particular images to be generated by the students. In each of these images, a keyword for the "famous" individual's surname was to be related to a representation of the corresponding biographical data in one of three ways for Experiment 1: 1) Keyword-Paired, where each piece of biographical information was separately related to the keyword, resulting in five separate images per individual; 2) Keyword-Chained, where the keyword was related to the first piece of biographical information, and then the first piece of information was related to the second, the second was related to the third, and so forth, resulting in five separate images per individual; and 3) Keyword-Integrated, where the student began with the keyword and first biographical attribute, and cumulatively incorporated each new attribute into a single integrated image for each individual.

The nature of keyword use was demonstrated through a sample biography about a person named James Bernard, with St. Bernard (the dog) given as the keyword for James Bernard's last name. Thus, for the first sentence in the biography, "When James Bernard was a young man, he fell in a freak accident and broke both legs", students in all keyword groups were directed to make up a picture in their heads of "a St. Bernard with broken legs in casts", and were shown a drawing of what such a scene might look like (see Figure 6).

Figure 6. Sample mnemonic image (first sentence--all keyword conditions) from McCormick and Levin (1932)

For the second sentence in the biography, "Not too long after that, Bernard's house was completely destroyed by a tornado", the imagery instructions differed across the three keyword groups. Students in the Keyword-Paired condition were told to picture a scene where "a St. Bernard [is] looking over his shoulder at a tornado" (see Figure 7). Students in the Keyword-Chained condition were directed to make up an image of a scene where "broken legs, in casts [are] poking out of the top of a tornado" (see Figure 8). Students in the Keyword-Integrated condition were told to imagine a scene where "a St. Bernard with broken legs in casts [is] looking over his shoulder at a tornado" (see Figure 9).

For the last sentence in the sample biography, "Just recently Bernard began to hope that his luck had finally changed when he won a 10-speed bicycle in a raffle", students in each keyword condition were instructed to use their assigned pairing, chaining, or integrating strategy for constructing an appropriate mental image.

In addition to the three keyword groups, McCormick and Levin also included two control conditions, one with once-repeated biographical attributes (as in the Keyword-Paired and Keyword-Chained conditions), and one with multiply-repeated biographical attributes (as in the Keyword-Integrated condition). Performance for all students was based on 20 cued-recall questions in either a sequential or a scrambled order, with each question asking for

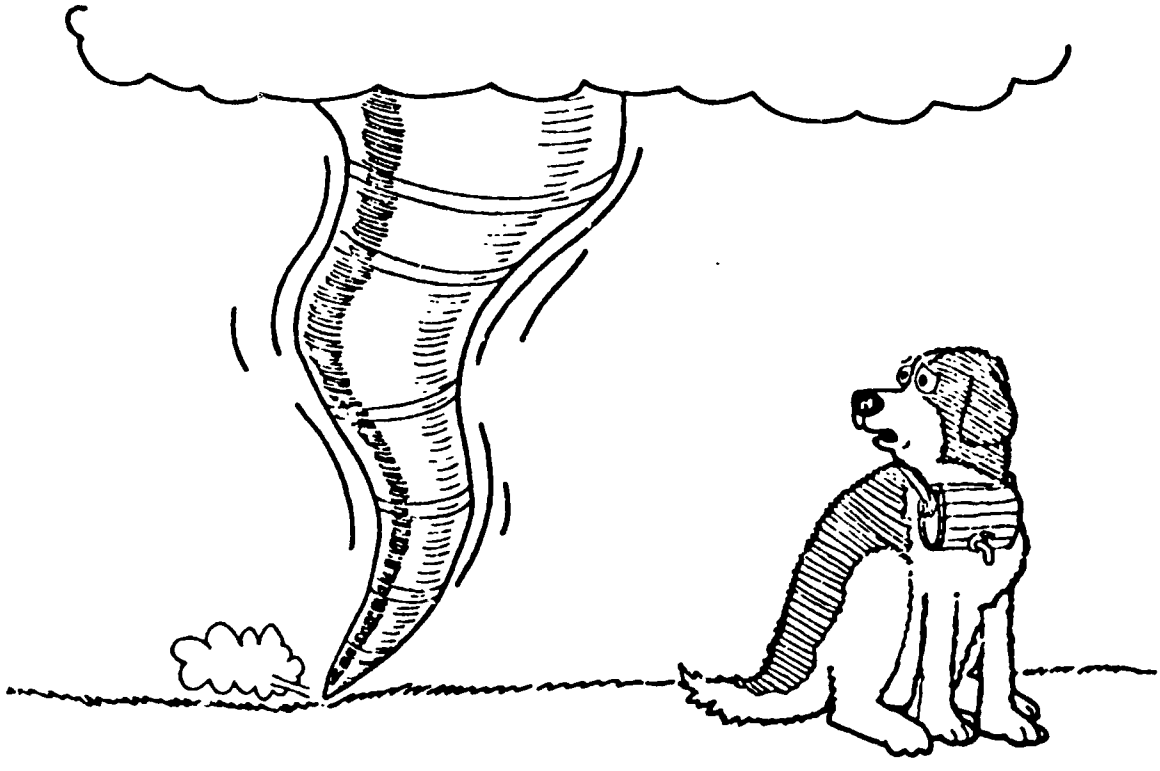


Figure 7. Sample mnemonic image (second sentence--Keyword-Paired condition) from McCormick and Levin (1982)

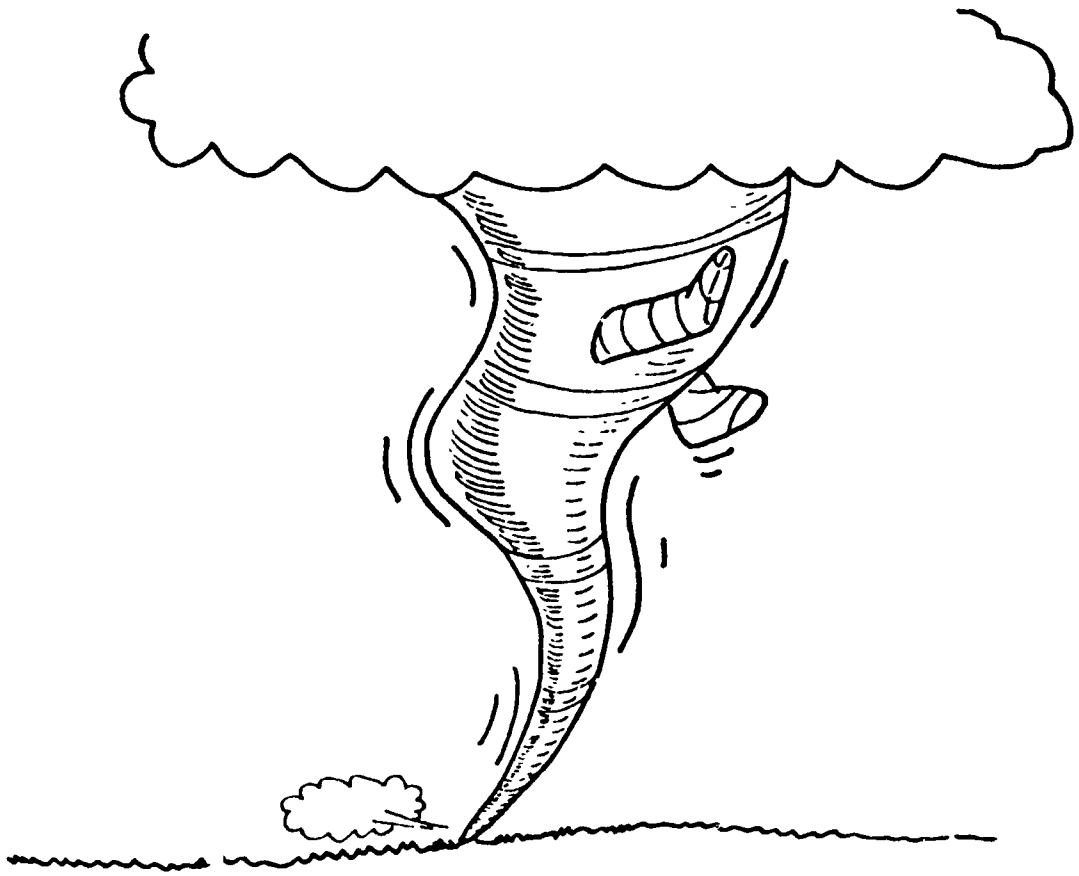


Figure 8. Sample mnemonic image (second sentence--Keyword-Chained condition) from McCormick and Levin (1982)

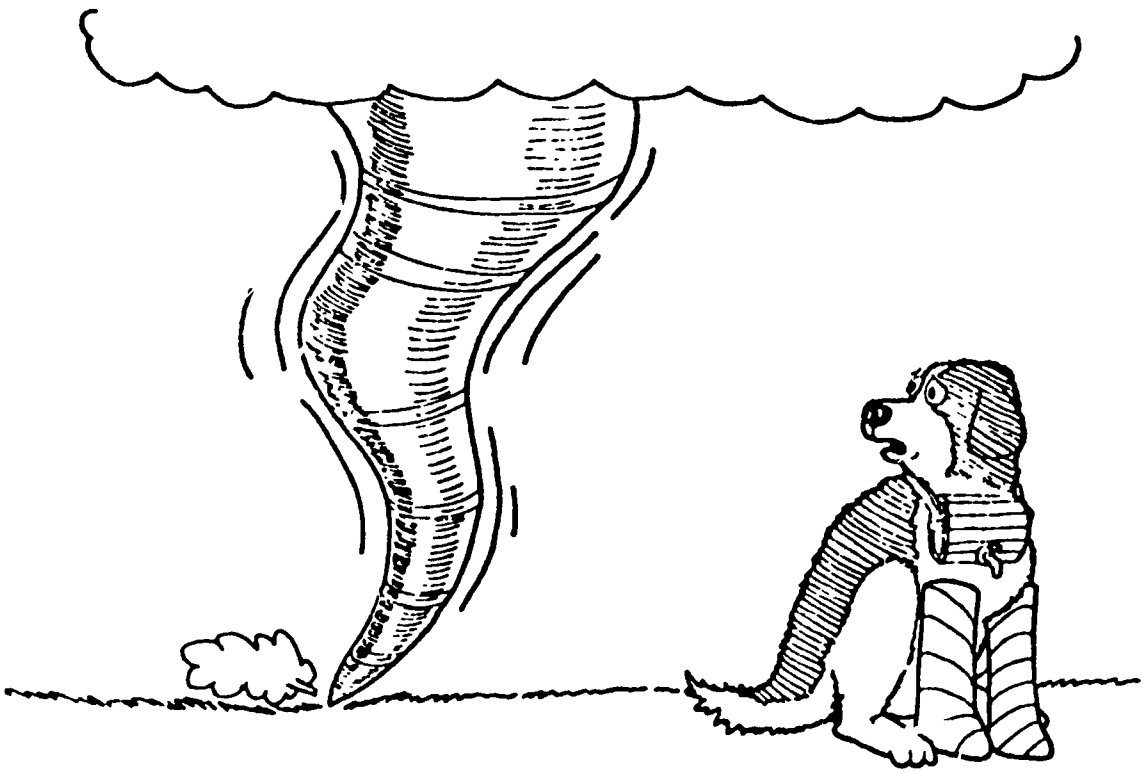


Figure 9. Sample mnemonic image (second sentence--Keyword-Integrated condition) from McCormick and Levin (1982)

a specific piece of biographical information about a specific individual. McCormick and Levin's major finding was that subjects in all three keyword conditions significantly outperformed both control groups, with anywhere from 25 percent to 40 percent facilitation. McCormick and Levin also carried out a pattern analysis to determine whether there were any processing differences among conditions. Results of the pattern analysis revealed that students in the Keyword-Chained and Keyword-Integrated groups tended to "cluster" more same-story information than did students in the Keyword-Paired group.

Although McCormick and Levin constructed their passages so as to be mutually interfering, examination of the data from Experiment 1 revealed within-passage, as well as between-passage, confusability. This was attributed to the fact that four of the five categories of information contained in each biography were job- or play-related, and that information for each of these categories could easily be interchanged. Experiment 2 was therefore designed in order to retain between-passage confusability, but to eliminate within-passage confusability. This was accomplished via a name-attribute matching test; by grouping same-category attributes together within a recognition paradigm, within-story information exchanges could no longer be made.

Of the three keyword conditions used in Experiment 1, the Keyword-Integrated and Keyword-Paired groups differed the most theoretically and statistically. Thus, these two groups, along

with their corresponding control groups--Cumulative Control and Simple Control, respectively--constituted the four conditions used in Experiment 2.

A self-paced recognition test was administered both immediately following passage presentation and two days later. On the immediate test, subjects in the Keyword-Integrated group outmatched and outclustered their control counterparts. (Keyword-Paired subjects also achieved higher levels of matching and clustering than their controls, but the differences were not statistically significant.) On the delayed test, however, both keyword groups statistically outperformed their respective controls, while the differences between the two keyword groups and between the two control groups were statistically negligible. McCormick and Levin concluded that the performance advantage of the keyword groups over controls in Experiment 2 appeared to be more comparable in magnitude to the keyword advantage obtained in previous prose-learning studies. Another encouraging result was that the keyword advantage was maintained over the two-day delay period, thereby suggesting that the keyword method may have long-term benefits for the recognition memory of prose materials.

Most recently, Levin, Shriberg, and Berry (in press) explored the application of multiple-name passages containing multiple attributes per name to relatively abstract prose information.

In a group-administered, four-experiment study, eighth-grade students were presented with prose passages about fictitious places and their distinguishing features. Each of the 20 attributes generated was randomly paired with a particular town. Consider, for example, the following paragraphs about a place called Fostoria and its two or four attributes:

two-attribute passage:

Fostoria has a lot to offer its people. People have considerable wealth, and everyone lives comfortably. Many of the townsfolk also become quite prosperous because the land has abundant natural resources.

four-attribute passage:

Fostoria has a lot to offer its people. People have considerable wealth, and everyone lives comfortably. Many of the townsfolk also become quite prosperous because the land has abundant natural resources. In addition, the town is especially well known for its advances in technology, for just about everything is run by computer. This progress has attracted many new residents, and statistics show a growing population.

Students in Experiment 1a were presented with ten town paragraphs with two attributes per town (as in the two-attribute passage about Fostoria), whereas students in Experiment 1b were

presented with five town paragraphs with four attributes per town (as in the four-attribute passage about Fostoria). After studying the appropriate number of paragraphs, students in both experiments were required to match town names with their attributes (associative recognition).

Levin (in press) differentiates between the attributes used in the earlier Shriberg et al. (1982) study and those used in the Levin et al. (in press) study:

> . . . most of those mentioned in the [Levin et al.] study were considerably less concrete, in the sense of their being amenable to direct pictorial representation. Contrast, for example, the means of depicting a counting cat or someone floating on one's back in the ocean [from Shriberg et al.] versus considerable wealth and abundant natural resources. Clearly, one-step-removed pictorial interpretations are needed in the latter case, in the form of symbolic representations (e.g., a stack of dollar bills for considerable wealth) and specific concretizations (e.g., an oil well for abundant natural resources). One of the major questions in this series of experiments was, Would the keyword method be adaptable to relatively abstract attributes of this kind (ms. p. 31-32)?

Four eighth-grade social studies classrooms were randomly assigned to Experiment 1a, whereas the four remaining eighth-grade social studies classrooms within the same school were assigned to Experiment 1b. Students in both experiments were randomly assigned to one of four experimental conditions within each classroom: 1) Verbal Control, which reiterated the name of the town and its attributes; 2) Separate Picture, which specified the name of the town, and presented each attribute in a separate picture symbol (see Figure 10); 3) Organized Picture, which specified the names of the town, and presented symbols and concretizations for the attributes in a single interactive illustration (see Figure 11), and 4) Organized Keyword Picture, which presented an auditorially-based keyword picture clue (designated by an arrow) for the name of the town which, in turn, was incorporated into the interactive illustration for the Organized Picture condition (see Figure 12).

Results of both Experiment 1a and Experiment 1b were consistent with component analyses of the various conditions. The finding that Organized Keyword Pictures were most beneficial for place-attribute matching supports the efficacy of keyword use of associative tasks. The inclusion of the keyword referent for the name of the town made it possible for Organized Keyword Picture subjects to link the attributes with the appropriate places. And both types of interactive pictures--Organized Picture and Organized Keyword Picture--were found to be equally effective

FOSTORIA

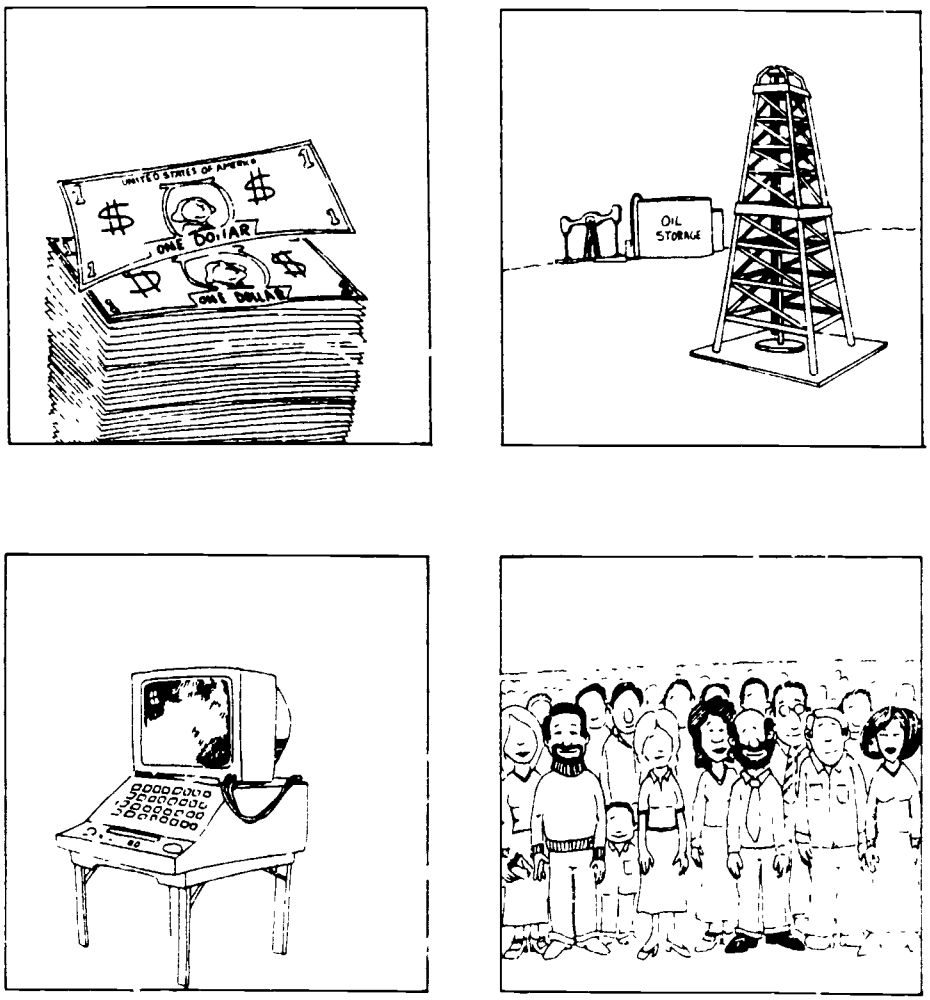


Figure 10. Separate Picture illustration (four attributes per town) from Levin et al. (in press)

FOSTORIA

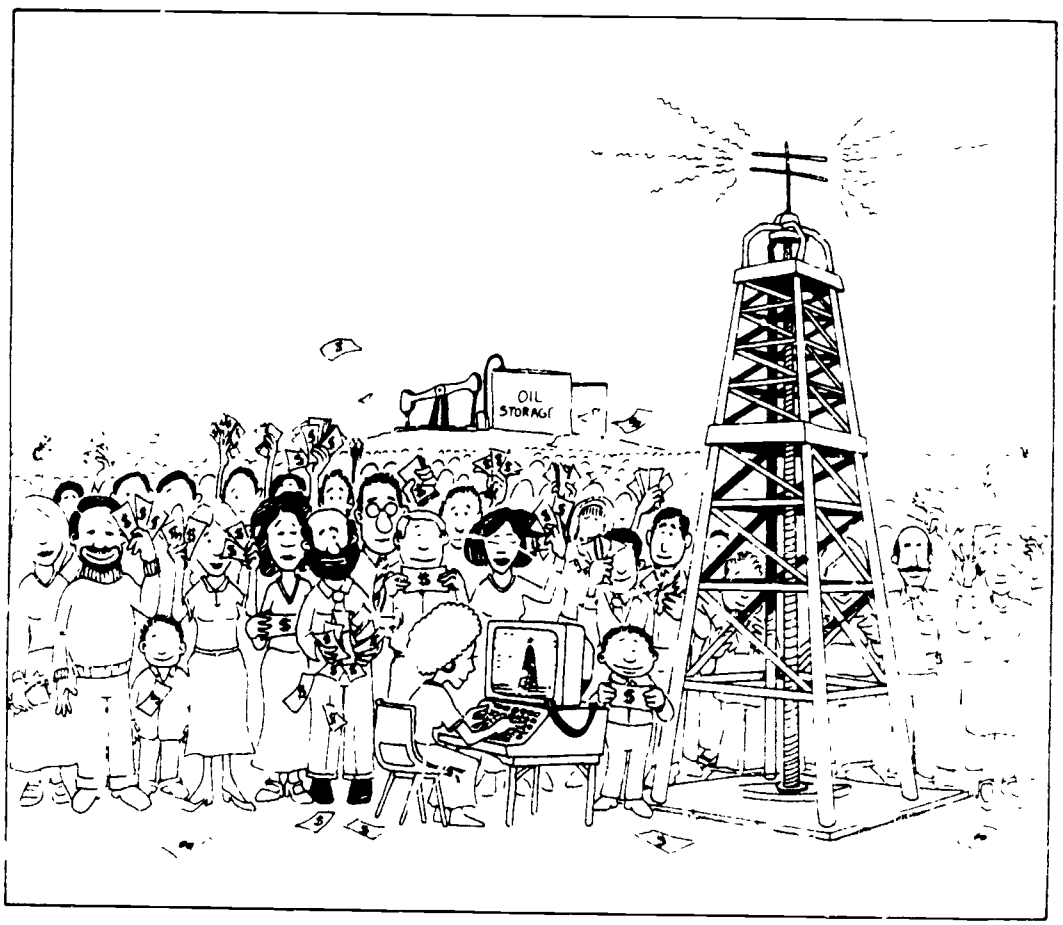


Figure 11. Organized Picture illustration (four attributes per town) from Levin et al. (in press)

FOSTORIA (frog)

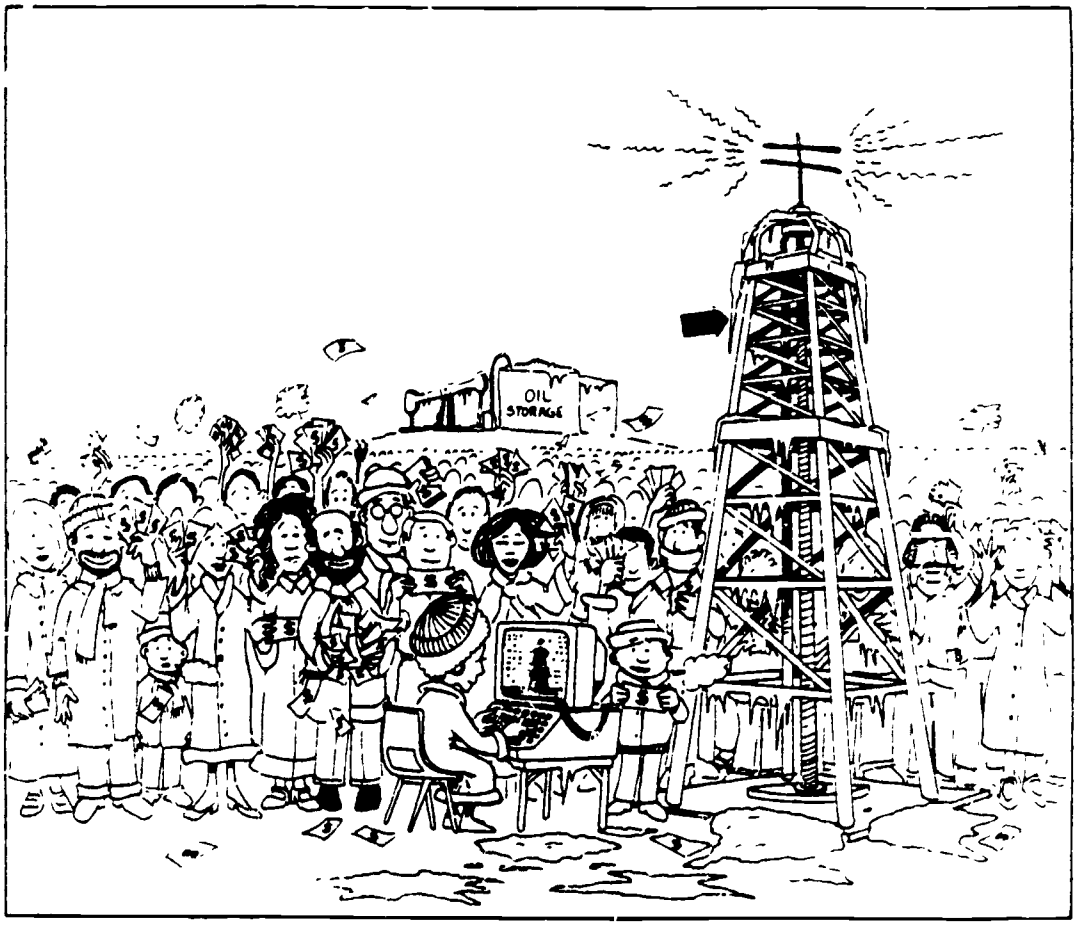


Figure 12. Organized Keyword Picture illustration (four attributes per town) from Levin et al. (in press)

for attribute grouping (ignoring the particular town with which the attributes were matched). Levin et al. therefore concluded that, when items (attributes) are presented together within some kind of organizational scheme, they are also likely to be remembered together. Thus, the pictorial symbols and concretizations used in Experiments 1a and 1b, when organized into interactive composite illustrations, proved facilitative for rendering the relatively abstract attributes more memorable.

As indicated by Levin et al. (in press), ". . . the rationale behind the inter-experiment number-of-towns and number-of-attributes manipulations was simply to compare the condition profiles with respect to learning a small amount of information about several places, on the one hand (Exp. 1a), versus a larger amount of information about fewer places, on the other (Exp. 1b)" (ms. p. 5). In an earlier experiment, Bower (1969) was concerned with a similar question--namely, how many stimulus pegs best facilitate the learning of a given number of associations. Specifially, Bower explored the effects of different numbers of pegwords for remembering associations from a 20-item list. Through manipulation of the number of pegs at 1, 2, 5, 10, and 20, Bower found that all pegword-imagery subjects remembered two to three times more than did control subjects on an end-of-session test of free recall, and that the number of items per peg had no differential effect on performance. Just as Bower's pegword-imagery subjects benefited from strategy instruction regardless of the number of

stimulus pegs, subjects in Experiments 1a and 1b of the Levin et al. study likewise benefited from keyword-picture instruction. This was true regardless of whether there were ten or five stimulus items (i.e., town names) with which to associate the attribute information. In Levin et al.'s following two experiments (Exps. 2a and 2b), then, only one passage format was used, namely that of five towns with four attributes per town.

The findings of Experiments 1a and 1b were encouraging in that they extended the success achieved by the keyword method with concrete prose content (Shriberg et al., 1982) to prose content that is more abstract. Having demonstrated that eighth-grade students could remember the critical place-attribute information through a recognition task, Levin et al. conducted Experiments 2a and 2b to find out how students would perform on a task of associative recall. A question of particular interest was, "Would the recall of picture subjects be tied to the specific concretizations and symbolizations contained in the pictures provided, or would students be able to decode these pictorial representations to get back to the town attributes as originally listed?" (Levin et al., in press, ms. p. 11). In Experiment 2a, students were told to try to remember the attribute information associated with each town, whereas in Experiment 2b, students were additionally instructed to remember the attribute information verbatim (i.e., exactly as stated).

Three of the four conditions employed in the previous experiments were included in Experiments 2a and 2b: Verbal Control, Separate Picture, and Organized Keyword Picture. The study pages for each condition were identical to those of Experiment 1b, with the exception that in the two picture conditions, the exact wording for the attributes was written above the illustrations. Following study of the five passages, students in Experiments 2a and 2b were required to list the attributes associated with each town, with students in Experiment 2b additionally instructed to use "exactly the same words," whenever possible, in their listing of the attributes.

Results of Experiments 2a and 2b showed benefits for the Organized Keyword Picture condition over the other two groups, regardless of the kind of recall instructions (non-specific or verbatim) that subjects were given. It should be noted, however, that although keyword subjects' absolute level of essence recall (sum of paraphrased and verbatim responses) was substantial (a mean of 67.5 percent correct), their absolute level of verbatim recall was considerably lower (a mean level of 35.4 percent correct). Nevertheless, overall, students in the Organized Keyword Picture condition successfully demonstrated, through recall as well as through recognition, that they could decode pictorialized symbols and concretizations back

into the verbal form in which they were originally presented.

As evidenced in the several prose studies cited in this review (Krebs et al., 1978; Levin et al., in press; McCormick & Levin, 1982; Shriberg et al., 1982; Snowman et al., 1980a; Snowman et al., 1980b), mnemonic picture strategies can be successfully applied to prose-learning tasks. Impressive results have been obtained from these studies with junior high school and college level subjects, with concrete and relatively abstract prose content, with multiple-name passages containing only one attribute per name or several attributes per name, and with tests of recognition and recall. The mnemonic keyword method in particular has shown consistent adaptability and striking performance benefits in a variety of prose-learning situations.

Chapter 3

Statement of the Problem

The preceding review has presented evidence to document the usefulness of mnemonic systems for tasks of associative learning, especially as they apply to memory for prose. Underlying most mnemonic systems is the notion of a "dual-coding" mechanism (Paivio, 1971), wherein verbal and visual processes together contribute to increased memory facilitation. Whereas concrete prose materials can be directly pictorialized in the form of provided illustrations or induced mental images (Levin's, 1981, representation function of pictures), abstract prose materials must first be encoded before they can be rendered picturable (Bellezza, 1981; Bugelski, 1970). An encoding operation can have a meaning-based (semantic) relationship with, or an acoustic-based (phonetic) resemblance to, the to-be-remembered abstract text content. Although both of these encoding operations have been successful in facilitating students' memory for various kinds of abstract information, there have been no controlled studies to date that have examined the relative benefits of semantic versus phonetic encoding systems on memory for abstract prose.

In the town-attribute prose study by Levin et al. (in press), the Organized Keyword Condition used a keyword for linking the

name of each town with its associated attributes. In Experiment 1b, for example, subjects were asked to remember that the town, Fostoria, was well known for its considerable wealth, abundant natural resources, advances in technology, and growing population. The four attributes were pictorialized through semantic encoding as "dollar bills", an "oil well", a "computer", and a "crowd of people", respectively [interpretation function (Levin, 1981)], but the town name, Fostoria, was pictorialized through a phonetic encoding operation as "frost" [transformation function (Levin, 1981)]. Subjects in the Organized Keyword Picture condition in Experiment 1b thus were presented with an interactive picture (see Figure 12) of a wintery scene wherein a "crowd of people" waving "dollar bills" were observing the nearby "oil well" being displayed on a "computer" screen. An arrow was pointing to a prominent accumulation of "frost".

Subjects in this Organized Keyword Picture condition had learned the mnemonic retrieval process by starting with the picture element designated by the arrow: When asked to find the attributes for Fostoria, for example, subjects were to think of the keyword for the name of the town--in this case "frost". The word, "frost", in turn, activated memory for the interactive picture which had "frost" in it. This transformed stimulus referent "primed the generation of dynamic images that effectively brought the to-be-associated units [here, the "dollar bills", "oil well", "computer", and "crowd of people"] into a meaningful

relationship [Fostoria is well known for its considerable wealth, abundant natural resources, advances in technology, and growing population]" (Paivio, 1971, p. 388).

The use of the mnemonic keyword method thereby transforms unfamiliar, difficult to remember, or abstract material into something more concrete. Bugelski (1970) claims that when such material is concretized, it is rendered more amenable for sentence, picture, or imagery strategies. Moreover, transformed material can be remembered as well as concrete material which is not transformed, regardless of whether it is processed through verbal or through visual mechanisms.

Even though Organized Keyword Picture subjects in Experiments 2a and 2b of the Levin et al. (in press) study--who were provided with a semantic encoding operation for remembering the abstract attributes--outperformed students in the other conditions, they nevertheless obtained relatively low levels of recall. A reasonable alternative approach was to investigate how students would perform when the to-be-learned abstract prose attributes were processed via phonetic encoding operations. The fact that abstract information appears to be especially amenable for recoding via an auditorially-based system, would lend additional support to a plan for constructing a double-keyword condition for learning the town-attribute information. Phonetic encoding could prove to be a viable alternative to semantic encoding for

retrieving the abstract attribute responses associated with each stimulus town name.

The purpose of the present study, then, was to compare the effects of a mnemonic semantic-based encoding operation (Levin's 1981, transformation function for stimulus items, and interpretation function for response items), versus a mnemonic phonetic-based encoding operation (Levin's 1981, transformation function for both the stimulus and response items) on students' memory for abstract expository prose information. Memory was assessed through tests of associative recognition and associative recall. In addition, comparisons were made both immediately following treatment and three days later.

The prose passages used in the present study were the same as those used in Experiments 1b, 2a, and 2b of the Levin et al. (in press) study, wherein each of five towns was associated with four attributes. These passages had been utilized successfully in the preceding memory experiments in that: 1) they were shown to be comprehensible to junior high school-age students; and 2) the five passages had attributes that could be mutually interfering so that any attribute could have logically been associated with any town or clustered with any other attribute.

The names of the towns (e.g., Fostoria) were all fictitious; thus, students could not have prior knowledge, or a "schema", for remembering any of the towns. As mentioned earlier, the names of unfamiliar places cannot be semantically encoded

(because of the absence of a schema), but can, instead be phonetically encoded in order to be rendered concrete and picturable. Thus, in the present study, the keyword method was utilized in both mnemonic strategy conditions for concretizing the names of the five towns. The twenty attributes, however, were encoded differentially: Students in the Keyword-Symbol Picture condition (called the Organized Keyword Picture condition in the previous Levin et al., in press, study) were taught the keyword method for remembering the names of the towns (phonetic encoding), and then taught a symbol (semantic encoding) operation for remembering the abstract attributes. Students in the Keyword-Keyword Picture condition were taught the keyword method for remembering both the names of the towns (phonetic encoding) and their abstract attributes (phonetic encoding).

Consider, for example, the passage about the town, Fostoria, which is paired with the following four attributes: considerable WEALTH, abundant natural RESOURCES, advances in TECHNOLOGY, and growing POPULATION. Students in the Keyword-Symbol Picture condition were presented with a drawing of the keyword referent for the name of the town (here, *frost* for Fostoria), and four symbols for the four attributes. Thus, Keyword-Symbol Picture subjects were shown a stack of dollar bills (for considerable WEALTH), an oil well (for abundant natural RESOURCES), a computer terminal (for advances in TECHNOLOGY), and a crowd of people (for growing POPULATION), along with *frost* (the keyword for

Fostoria), all interacting within one composite drawing (see Figure 13).

Students in the Keyword-Keyword Picture condition, on the other hand, were presented with picture referents all based on the sound of the word in capital letters from each attribute. Fostoria would be represented by the keyword, *frost*, as it was in the Keyword-Symbol Picture condition; the attributes, however, were also represented by keywords: a *well* (for considerable WEALTH), *race horses* (for abundant natural RESOURCES), *tacks* (for advances in TECHNOLOGY), and soda *pop* (for growing POPULATION). All five pictures for the keyword referents were shown to be interacting within a single composite drawing (see Figure 14).

In Experiments 1a and 1b (associative recognition) of the Levin et al. (in press) study, the Keyword-Symbol strategy both facilitated performance (relative to a control condition) and produced an impressively high absolute level of performance. In Experiments 2a and 2b (associative recall), however, the Keyword-Symbol strategy facilitated performance, but failed to obtain a high absolute level of verbatim recall. Due to the fact that in verbatim recall, subjects have to retrieve and produce (rather than recognize) the exact attribute labels, the question arose as to whether a strategy in which there was a closer auditory correspondence between the attribute label and its recoded response would be more beneficial in a verbatim recall situation.

POSTORIA *(frost)*

considerable WEALTH (dollar bills)

abundant natural RESOURCES (oil well)

advances in TECHNOLOGY (computer terminal)

growing POPULATION (crowd of people)

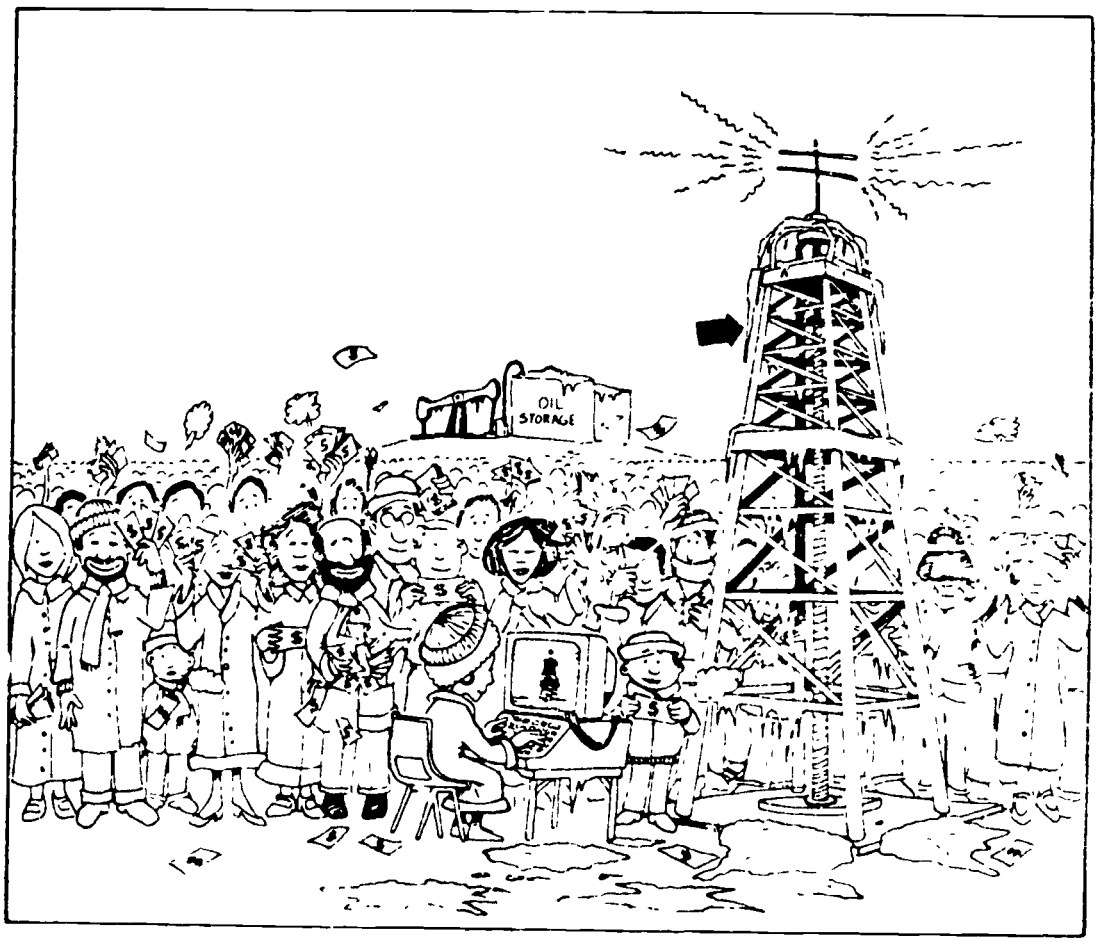


Figure 13. Mnemonic illustration shown to Keyword-Symbol Picture subjects in the present study

FOSTORIA *(frost)*

considerable WEALTH *(well)*

abundant natural RESOURCES *(race horses)*

advances in TECHNOLOGY *(tacks)*

growing POPULATION *([soda] pop)*

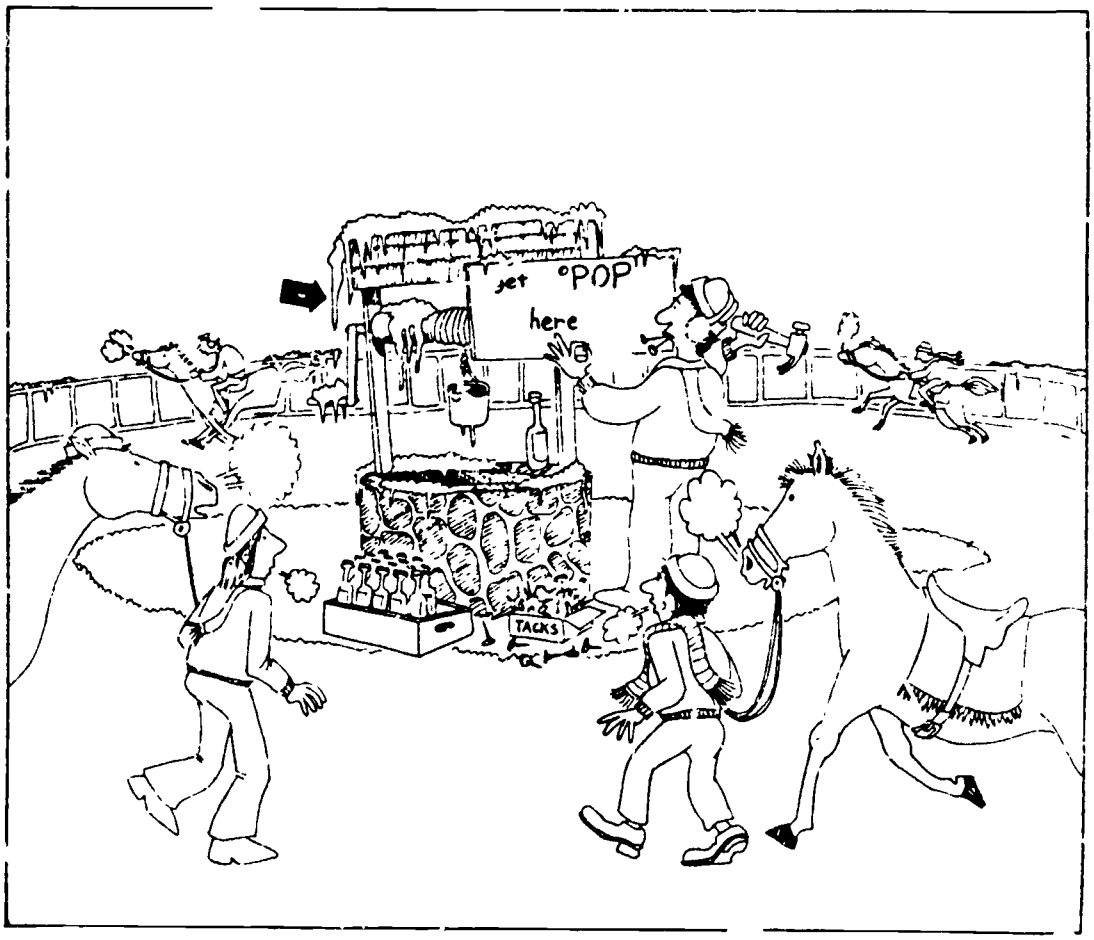


Figure 14. Mnemonic illustration shown to Keyword-Keyword Picture subjects in the present study

Pilot Study

To address this question, instructions and materials for a Keyword-Keyword Picture condition were constructed (such as the drawing for Fostoria shown in Figure 14), and a pilot study was conducted. Subjects were seventh graders in two social studies classrooms from the same school as the eighth graders that participated in the present study. The seventh graders were randomly assigned either to the Keyword-Keyword Picture condition or to a no-picture Verbal Control group. The pilot study showed that seventh graders could work successfully with the Keyword-Keyword Picture condition materials; moreover, Keyword-Keyword Picture subjects performed significantly higher than control subjects on a task of associative recall.

The goal of the present dissertation study was to compare directly the Keyword-Keyword Picture and Keyword-Symbol Picture strategy groups, in relation to each other and to two no-picture control groups, on tests of recognition and recall, administered both immediately following instruction and three days after instruction.

Research Questions

Whereas the Keyword-Symbol Picture (Organized Keyword Picture) group of the Levin et al. (in press) study and the Keyword-Keyword Picture group of the recent pilot study each achieved higher scores than their respective no-picture Verbal Control groups, it was predicted that, for the present study, students

in the two mnemonic picture conditions (Keyword-Symbol Picture and Keyword-Keyword Picture) would again outperform students in the two no-picture control conditions. This should be true for both associative recognition (Experiment 1) and associative recall (Experiment 2).

It was difficult to predict, however, whether or not there would be any performance differences between the two mnemonic picture groups. Findings from the earlier studies about towns and their attributes indicated that instruction in a combined keyword-symbol strategy (Levin et al., in press), as well as in a keyword-keyword strategy (the pilot study), showed increased memory for the relatively abstract prose information. The main goal of the present study was to determine whether either mnemonic treatment condition--Keyword-Symbol Picture or Keyword-Keyword Picture--would be superior to the other, on immediate and delayed tests of recognition and recall. For Experiment 2 (associative recall), it was anticipated that the types of responses made by students might differ according to the treatments that they received. For example, would students instructed in a keyword-keyword strategy produce more verbatim correct responses than students taught a keyword-symbol strategy, due to the fact that their keyword referents for the attributes were phonetically based? And would Keyword-Symbol Picture students taught a meaning-based strategy, rather than

a sound-based strategy, be more likely to produce essence correct (paraphrase) responses than Keyword-Keyword Picture students? Finally, would any treatment effects on types of responses made on Day 1 be maintained over time (three days later)? In addition, qualitative (pattern) differences associated with the two keyword variations were of interest.

Chapter 4

Method

Subjects

One hundred eighty-three students from eight eighth-grade classrooms in a single middle school building participated in the two-experiment study. The middle school services a university community in the midwest, where a large percentage of the students have parents who work in a professional capacity.

Experiments 1 and 2 consisted of both an immediate (Day 1) and a delayed (Day 4) test of recognition and recall, respectively. The scores from eleven students who were present on Day 1, but absent on Day 4, were excluded from the analyses. Data from the remaining 172 subjects who were present on both days of testing were utilized in the analyses of the results.

Four of the eight classrooms (N = 85 students) were randomly assigned to Experiment 1 (associative recognition), while the four remaining classrooms (N = 87 students) were assigned to Experiment 2 (associative recall). In both experiments, students within each classroom were randomly assigned to one of four instructional conditions (N = 20-23 students per condition).

Design and Materials

The prose passages used in this study (see Appendix A) were identical to those used in Experiments 1b, 2a, and 2b by Levin et al. (in press), with the exception that, in a few passages, some minor alterations were made to delete any concrete referents. All stories had originally been constructed from lists of five town names and 20 attribute terms, whereby each town was randomly paired with four of the attributes. The names of the towns (e.g., Fostoria) were all fictitious in order that students' prior knowledge of a particular place would not give them an advantage for remembering its attributes. The attribute terms were constructed so as to be relatively abstract in nature (e.g., advances in technology) and, thus, not amenable to direct pictorial representation. The ideas for all pictures used in the study were generated by the author and presented to a group of judges for review. (The notion that picture ideas may also be generated by the students themselves is discussed in Chapter 6.)

Students in both Experiment 1 and Experiment 2 were assigned to one of four instructional conditions: Keyword-Symbol Picture, Keyword-Keyword Picture, Control-Passage, or Control-List. The two keyword picture groups differed with respect to the manner in which the attribute terms were concretized:

Keyword-Symbol Picture - This condition provided semantically-based representations and conventional symbols for encoding the relatively abstract attribute information

(Levin's, 1981, interpretation function of pictures), and then integrated these four picture referents with a picture of a keyword referent for the name of the town.

Keyword-Keyword Picture - This condition provided phonetically-based concrete words for encoding the relatively abstract attribute information (Levin's, 1981, transformation function of pictures), and then integrated these four picture referents with a picture of another keyword referent for the name of the town.

Students in the no-picture control groups were instructed to use their "own best method" for remembering the towns and their associated attributes. The control groups differed with respect to their printed formats:

Control-Passage - This condition provided students with a secondary opportunity to read the story passages about each town and its four associated attributes.

Control-List - This condition provided students with a listing of each town name, along with its four associated attributes.

Although several possible control groups were considered, the Control-List condition had been used previously, both in the pilot study and in the four experiments by Levin et al. (in press). In fact, in the Levin et al. study, students presented with a picture listing of the attribute information (viz., Separate Picture condition) performed at the same level as did students shown a

verbal listing of that same information. It seemed worthwhile, therefore, to include the Control-List condition again in the present study, but also, to compare it with another control condition that provided a second exposure to the passage. By reading each passage a second time, students in the Control-Passage condition would have an opportunity to recite and review the critical passage information, and thus carry out some of the processes underlying SQ3R (Study, Question, Read, Recite, Review), a study technique highly recommended for effective prose processing. Other semantic strategies for remembering were not used here.

Students in both control conditions, then were neither taught a mnemonic strategy, nor provided with memory-enhancing pictures, for remembering the town-attribute associations. It is believed that the formats represented by the two control groups--namely, repeated reading of the to-be-learned passage information in its original prose form (Control-Passage), and removing the to-be-remembered information from the not-to-be-remembered prose context and presenting it in list form (Control-List)--represent the most ecologically valid control conditions for this learning situation.

Study booklets containing instructions and stimulus materials were constructed for each condition. The instructions for each group were approximately equal in length and level of difficulty.

Instruction pages at the beginning of each study booklet were read silently by the students themselves. Then, each story passage appeared in a single random order, followed by a study page for that passage. Although the five story passages were identical for all students in both experiments, the instruction pages and the study pages that followed the passages differed according to experimental condition. (See Appendices B and C for the instruction pages and study pages presented with each passage.)

Test forms were also constructed for each of the experiments. Students in the four classrooms assigned to Experiment 1 (associative recognition) were given a test with a random ordering of the five town names on the left, and a random ordering of the 20 attributes on the right. Instructions were given to fill in the letters of the associated attributes in the four blanks next to each town name. Students in Experiment 2 (associative recall) received a test form which listed the towns in the same random order as in Experiment 1, and which had four blank spaces under each town name. Instructions were given to write out the four attributes associated with each town, using the exact words of the attributes whenever possible. The formats for the delayed tests were identical to those of the immediate tests, except that the items were arranged in

a different random order. (See Appendix D for Day 1 and Day 4 test forms for Experiments 1 and 2.)

Procedure

All testing took place in the students' regularly scheduled English classes. Two teachers (designated Teacher A and Teacher B) each taught four eighth-grade English classes a day during the same class periods. All of Teacher A's students were tested on Monday (Day 1) and Thursday (Day 4), while Teacher B's students were tested on Tuesday (Day 1) and Friday (Day 4) of the same school week. (See Table 1 for a schedule of classroom assignments to teacher, experiment, and class period.)

On Day 1, all students received study booklets containing the five story passages, along with the instructions and study pages appropriate for their experimental condition. In both experiments, all four conditions were represented within each classroom. Because of the random assignment of booklets for all conditions within each classroom, the likelihood of experimenter bias was minimized. The students read the instructions to themselves, but were paced through the story passages and study pages. The same two female experimenters conducted all the testing: the primary experimenter (the present author) issued directions and read the passages,

Table 1

Assignment of Eighth-grade Classrooms to

Teacher X Experiment X Class Period

Class Period	Teacher A Classes		Teacher B Classes	
	Monday (Day 1)	Thursday (Day 4)	Tuesday (Day 1)	Friday (Day 4)
10:10	Recognition (Exp. 1)		Recall (Exp. 2)	
11:00	Recall (Exp. 2)		Recognition (Exp. 1)	
11:50	Recognition (Exp. 1)		Recall (Exp. 2)	
2:10	Recall (Exp. 2)		Recognition (Exp. 1)	

while the secondary experimenter (a hired assistant) assisted with the test administration and monitored the pacing.

After receiving instruction in one of the four experimental conditions, students in Experiment 1 were asked to perform a task of associative recognition, and students in Experiment 2 were asked to perform a task of associative recall. On Day 4, without prior notice to the students, the two experimenters returned to the classrooms to retest the students on the same test form that they had used on Day 1. On the delayed test, items were arranged in a different random order than on the immediate test.

Overview of the Procedure. At the beginning of Day 1, the study booklets were randomly distributed throughout each classroom, and students were asked to fill in some general identification information (name, date, sex, and name of English teacher) on the blue cover page. Before instructing the students to open their study booklets, the primary experimenter tried to put the class at ease, and then explained the necessity for quiet, independent work during testing. The students were next told that they were going to be reading several short passages:

> Each passage tells the name of a make-believe place, along with some of the features that make that place special. After each passage, you will be given time to look over a study page that will help you to remember the name

> of the place and the four features that describe that place. When you have read <u>all</u> the passages, you will be asked to <u>match</u> (Experiment 1)/<u>list</u> (Experiment 2) the features with the places they describe. Although you probably won't be able to remember everything you've read, your study booklets will contain some suggestions to help you do a good job.

Before being instructed to open their booklets, the students were encouraged to ask any questions they might have had regarding the testing. After the questions had been discussed, the experimenter directed the students to turn back their blue cover page and to read the directions and practice story on the pink pages that followed. The students were told to take as much time as they needed to read these pages silently to themselves and that--if any students finished before the rest of the class--they could reread these pages, but should <u>not</u> go on past the last pink page.

When all the students had finished reading the directions and practice story, the experimenter asked the class to turn the page to the first white page in their study booklets. This page contained the first passage about a town and its four attributes. The primary experimenter read this passage (as well as the four subsequent passages) aloud, asking the students to follow along silently. This pacing procedure was intended to eliminate possible decoding complications, and to prevent

students from attending to only certain parts of the story content. Immediately after each story passage had been read, the experimenter told the students to turn to the following page, which was the study page for that passage. Students were given 50 seconds (monitored by the secondary experimenter) for studying each study page. Although the passages were identical for all students, the study pages that followed differed according to instructional condition (to be described shortly).

When all five passages and study pages had been presented, the booklets were collected, and test forms were distributed. Students in the four classrooms assigned to Experiment 1 were asked to match the 20 attributes with the five town names (associative recognition), and students in the four classrooms assigned to Experiment 2 were provided with the five town names, and asked to list the four attributes associated with each (associative recall). Students in both experiments were given as much time as they needed (until the end of the 47-minute class period) to work on the tests.

Three days later, the two experimenters returned to the classrooms unannounced, and the students were asked to take the same test (with a different random ordering of items) again. The students were told to rely on the particular instructions that they had received three days earlier for remembering the town-attribute associations. As on Day 1, the students were given as much time as they needed to work on the tests.

For both experiments, the entire experimental procedure (learning and testing) lasted approximately 40 minutes on Day 1 (general introduction and call for questions = 7 minutes; students' silent reading of instructions = 10 minutes; reading and studying of passages and study pages = 8 minutes; maximum time provided for the Recognition Test or Recall Test = 15 minutes). Day 4 testing lasted approximately 15 minutes.

Details of the Procedure. The following is a description of the instructions read by the students in the keyword and control conditions. Complete instructions for all four conditions are provided in Appendix B.

All students were told that they would be reading several short stories about make-believe places and the features that make these places special. To get an idea of the kind of stories that they would be reading, they were asked to take a look at a sample story about a place with which they were probably already familiar:

> Some of our friends travel to CHICAGO regularly. Every time they visit, they never cease to marvel at the impressive SKYLINE. The city is also well known for its wide variety of RESTAURANTS, and our friends try to dine out as often as possible.

It should be noted that the sample story described a place with two associated attributes. In the actual test items, each story

described a place with four associated attributes. Students in all conditions were told to "pay attention to the exact wording" of these attribute terms.

Mnemonic Keyword Conditions

Students in the Keyword-Symbol Picture group were told to note the underlined attributes or features that CHICAGO is well known for: its impressive SKYLINE and its wide variety of RESTAURANTS. Keyword-Symbol Picture students were also told to notice that, in the words for each feature, one word was printed in capital letters, and that this word was the most important word in the feature. Students in this group were given a familiar symbol to help them remember the important word for each feature, and the name for that symbol was printed inside the parentheses next to the feature that it symbolized. For example, for the attribute, impressive SKYLINE, the word in capital letters was SKYLINE. The symbol for SKYLINE was "tall buildings", because "tall buildings" represent a SKYLINE. For the attribute, wide variety of RESTAURANTS, RESTAURANTS was the word in capital letters. The symbol for RESTAURANTS was "eating places", because RESTAURANTS are always places for eating. Keyword-Symbol Picture students were told that a special drawing, similar to the drawing for the sample story about CHICAGO, would accompany each story passage (see Figure 15).

In addition to learning the attributes, Keyword-Symbol Picture students would also need to learn a special technique

CHICAGO *(chicks)*

impressive SKYLINE (tall buildings) wide variety of RESTAURANTS (eating places)

Figure 15. Sample illustration shown to Keyword-Symbol Picture subjects in the present study

for associating these attributes with the appropriate town. To accomplish this, students were asked to notice the word in special italic print in the parentheses next to the name of the town. The word in italics would be a keyword--that is, a word or a couple of words that sound something like the name of the town, but which is much easier to picture. For CHICAGO, the word in italics was *chicks*, because *chicks* sounds something like CHICAGO. The picture for the keyword would then be included within the provided drawing, and would always be designated by an arrow.

To remember what CHICAGO was well known for, Keyword-Symbol Picture students would need to remember that the "sound-alike" word for CHICAGO was *chicks* (the arrow was pointing to the *chicks*). In the drawing, a number of *chicks* were being fed outside some "eating places" against a background of "tall buildings". Interpreting the symbols for "tall buildings" and "eating places" back into their original attribute terms, CHICAGO was well known for its impressive SKYLINE and wide variety of RESTAURANTS.

In summary, students in the Keyword-Symbol Picture condition were provided with a keyword for the name of the place, and symbols for the attributes associated with that place. A picture (with an arrow) representing the keyword for the name of the town, and four picture symbols representing the attributes, were then shown to be interacting within a single composite drawing.

Students in the Keyword-Keyword Picture condition were likewise told that the most important word of each attribute term was printed in capital letters. Students in this group would be provided with a sound-alike word (i.e., a keyword) for the capitalized word in each attribute. This keyword would be printed in italics inside the parentheses next to the attribute that it represents. For example, in the features, impressive SKYLINE and wide variety of RESTAURANTS, the words in capital letters were SKYLINE and RESTAURANTS, and their respective keywords were *ski line* and *rest*. Keyword-Keyword Picture students were told that a special drawing, similar to the drawing for the sample story about CHICAGO, would accompany each story passage (see Figure 16).

In addition to using a keyword to represent each attribute term, Keyword-Keyword Picture students were also give a keyword for remembering the name of the town. For CHICAGO, the keyword was *chicks*, because *chicks* sounds something like the name, CHICAGO. The picture for the keyword representing the name of the town would always be designated by an arrow. To remember what CHICAGO was well known for, then, Keyword-Keyword Picture students would need to remember that the arrow in the drawing was pointing to some *chicks*, which represent the place, CHICAGO. In the drawing, several *chicks* were in a *ski line* waiting to go skiing, while others were *rest*ing nearby. The keywords, *ski line* and *rest* represented SKYLINE and RESTAURANTS,

CHICAGO *(chicks)*

impressive SKYLINE *(ski line)* wide variety of RESTAURANTS *(rest)*

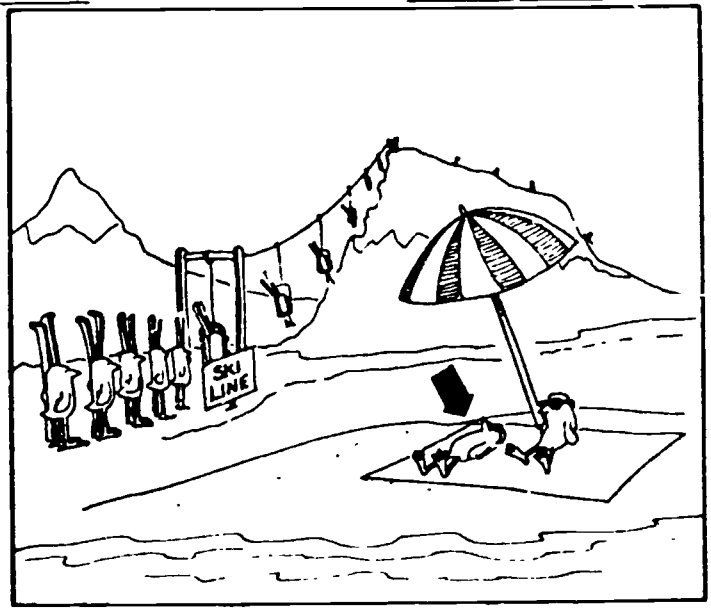


Figure 16. Sample illustration shown to Keyword-Keyword Picture subjects in the present study

respectively; hence, CHICAGO was well known for its impressive SKYLINE and its wide variety of RESTAURANTS.

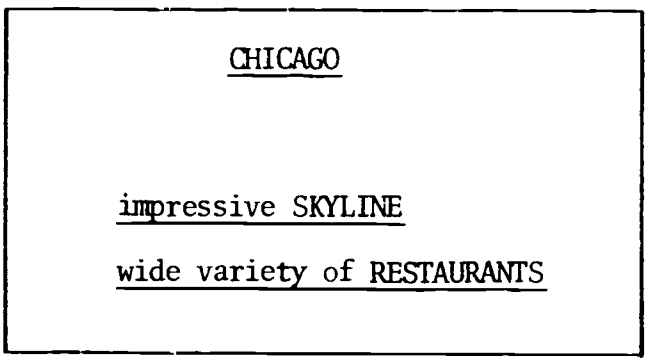
In sum, students in the Keyword-Keyword Picture condition were provided with a keyword for the name of each town, as well as with four additional keywords for the attributes describing that town. A picture (with an arrow) representing the keyword for the name of the town, along with four additional pictures representing the keyword referents for the attributes, were then shown to be interacting within a single composite drawing.

Control Conditions

As in the mnemonic conditions, students in the two no-picture control groups were told that the word in capital letters was the most important word in each attribute term--that if they could remember the word in capitals, there would be a good chance that they would remember the entire feature.

Control-Passage students were told that they would have the opportunity to read each story passage a second time, and that this second reading would help them to remember the town-attribute associations. A second reading of the sample story about CHICAGO, along with using their "own best method" of matching places and features, would help students in this condition to remember that CHICAGO was noted for an impressive SKYLINE and a wide variety of RESTAURANTS.

Students in the Control-List condition were provided with a printed listing of the name of each town, followed by its four attributes. In the sample story about CHICAGO, students were provided with the following list:



By using their "own best method" for studying lists, Control-List students would be able to remember that CHICAGO was famous for an impressive SKYLINE and for a wide variety of RESTAURANTS.

Chapter 5

Results

Scoring

All protocols were scored by the author who was "blind" with respect to subjects' experimental conditions. The "blind" scoring was accomplished by first scoring all test sheets according to a procedure previously developed for the Levin et al. (in press) and Keyword-Keyword Picture pilot studies, and then matching student names on the test sheets with student names on the study booklets. A printed code on the study booklets designated each student's instructional assignment.

For the recognition test (Exp. 1), two scores were assigned: One score reflected the number of correct town-attribute associations (total possible range = 0-20); the second score reflected the organization of attribute information, regardless of its town pairings. Following the scoring procedure developed by Levin et al. (in press), organization of attribute information yielded a clustering score of one point if two attributes were appropriately grouped, three points if three attributes were appropriately grouped, and six points if all four attributes were appropriately grouped (total possible range = 0-30). The assignment of one, three or six points was based on the number of possible pair

combinations within each correct attribute grouping. For example, if all four attributes for a town were correctly grouped, each attribute could form a pair with every other attribute, resulting in six attribute pairings or a clustering score of six points.

For the town-attribute pairings on the recall test (Exp. 2), subjects' responses were designated as verbatim correct, essence correct, or as errors of various kinds (total possible range for each = 0-20). To be a completely correct (one-point) verbatim response, the attribute had to be reproduced in exactly the same words as originally presented (with the exception that small function words, such as "in", "on", "of", "the", etc. could be omitted, inserted, or interchanged). Partially correct (half-point) verbatim responses had to include at least the major defining word (i.e., the word that had appeared in capital letters) of the attribute (e.g., for the attribute, advances in TECHNOLOGY, a response such as "good technology" would receive a half-point). A completely correct (one-point) essence response was an attribute term that was not stated in the same words as originally presented, but which was paraphrased. For example, for the attribute, citizen participation in local GOVERNMENT, a semantically complete essence correct response would be "citizens participate in the law". A partially correct (half-point) essence response would have an incomplete, but nevertheless, semantically-based relationship with the specified attribute term--for example, "climate" for comfortable TEMPERATURES the year round.

Errors consisted of omissions, repetitions, unrelated intrusions, over-specifications [an encoded symbol (e.g., an "oil well") or keyword referent (e.g., "race horses") for abundant natural RESOURCES], and incorrect town-attribute pairings.

Three answer sheets were randomly selected from each of the four conditions from Day 1 of the recall test. A second judge, who was "blind" to the particular conditions of the answer sheets, assigned partial or full verbatim and essence credit to subjects' responses, according to the scoring procedure described above. For the verbatim scores, there was 100 percent agreement between the two judges' scores, resulting in an inter-judge correlation of 1.00. For the essence scores, there was complete agreement on eight of the twelve protocols; on the remaining four, the two judges disagreed by one-half point on each, resulting in an inter-judge correlation of 0.999. Thus, the system used in the present study for scoring verbatim and essence recalls was deemed highly reliable.

For subjects taking the recall test (Exp. 2), two clustering scores were determined. An unconditional clustering score was fashioned after that used in Experiment 1 (total possible range = 0-30). Responses classified as errors in the over-specification category [e.g., "oil well" (semantically encoded referent) or "race horses" (phonetically encoded referent) for abundant natural RESOURCES] were included in the attribute clustering count. But,

because such a clustering measure was highly dependent on the total number of attributes recalled, a conditional clustering score was also computed. This was accomplished by taking a student's unconditional clustering score, dividing it by the total number of attributes (or attribute proxies) recalled, regardless of the correctness of their pairings, and then multiplying by 66.667 [the inverse of the total possible score for unconditional clustering (30) divided by the total possible score for number of attributes recalled (20), and then multiplied by 100]. In particular, conditional clustering score = $\frac{\text{unconditional clustering score}}{\text{total number of attributes recalled}} \times \frac{20}{30} \times 100$.

In addition to scores for town-attribute pairings and attribute clustering, a subtest score from the STEP Test, a standardized measure of reading achievement, was obtained for all but six of the subjects. (Appendix E contains a listing of STEP Test scores and performance data for town-attribute pairings and attribute clusterings for each student, arranged by test condition and instructional condition.)

Experiment 1: Recognition

As in the Levin et al. (in press) study, all pairwise comparisons among conditions for Experiment 1 (recognition) were

conducted using Dunn's procedure and a familywise Type I error probability of .05 per dependent variable (town-attribute pairings and attribute clustering) on each testing day (Kirk, 1968). Only subjects with complete (Day 1 and Day 4) data were included in the analysis. Table 2 presents the means and standard deviations for town-attribute pairings and attribute clusterings for all conditions, and Table 3 lists the t-values for the six pairwise comparisons. All comparisons were nondirectional, using a Dunn critical t of ±2.71, based on 81 error degrees of freedom.

Day 1 Results

For the town-attribute pairings on Day 1, students in the Keyword-Symbol Picture and Keyword-Keyword Picture groups substantially outperformed controls, with close to 100 percent facilitation for the Keyword-Symbol Picture group over each control group (see Table 2). There were no significant differences in performance between the two mnemonic keyword groups or between the two control groups.

Table 2 also indicates significant performance differences for each keyword-versus-control comparison on the attribute clustering variable. In fact, Keyword-Symbol Picture students realized over 100 percent more clustering than did Control-Passage

Table 2

Mean Recognition Performance for Each Condition (Day 1 and Day 4)

	Control-Passage (n = 22)	Control-List (n = 20)	Keyword-Symbol Picture (n = 22)	Keyword-Keyword Picture (n = 21)
Day 1				
Town-Attribute Pairings	$\bar{X}$ = 8.409 SD = 3.686	$\bar{X}$ = 8.500 SD = 4.033	$\bar{X}$ = 16.409 SD = 4.090	$\bar{X}$ = 14.190 SD = 5.115
Attribute Clustering	$\bar{X}$ = 10.273 SD = 4.852	$\bar{X}$ = 11.450 SD = 4.729	$\bar{X}$ = 23.682 SD = 7.047	$\bar{X}$ = 17.381 SD = 10.022
Day 4				
Town-Attribute Pairings	$\bar{X}$ = 6.545 SD = 3.488	$\bar{X}$ = 6.150 SD = 3.066	$\bar{X}$ = 14.045 SD = 5.956	$\bar{X}$ = 10.857 SD = 6.052
Attribute Clustering	$\bar{X}$ = 7.409 SD = 4.043	$\bar{X}$ = 6.350 SD = 2.796	$\bar{X}$ = 20.591 SD = 8.330	$\bar{X}$ = 13.048 SD = 9.346

Table 3

t-Values on Recognition Test for Each Pairwise Comparison
(Day 1 and Day 4)

	Day 1		Day 4	
Comparisons	Town-Attribute Pairings	Attribute Clustering	Town Attribute Pairings	Attribute Clustering
Control-List - Control-Passage	0.07	0.54	-0.26	-0.51
Keyword-Symbol Picture - Control-Passage	6.23*	6.35*	5.12*	6.47*
Keyword-Keyword Picture - Control-Passage	4.46*	3.33*	2.91*	2.74*
Keyword-Symbol Picture - Control-List	6.01*	5.65*	5.26*	6.82*
Keyword-Keyword Picture - Control-List	4.28*	2.71*	3.10*	3.17*
Keyword-Keyword Picture - Keyword-Symbol Picture	-1 71	-2.95*	-2.15	-3.66*

*Significant difference based on Dunn critical t(81) = ± 2.71

and Control-List students. Students in the two control groups performed comparably, but there was a significant performance difference between students in the two mnemonic groups, in favor of the Keyword-Symbol Picture condition. Performance for students in the Keyword-Keyword Picture condition was approximately midway between that for Keyword-Symbol picture students and controls.

Day 4 Results

Students' ability to match towns with their associated attributes on Day 4 followed an identical pattern to that for Day 1 (see again Table 2). Although absolute levels of performance were lower on Day 4--due to the increased time period between learning and testing--the significant difference between each keyword group and each control group was maintained. Again, just as on Day 1, there were no significant performance differences between the two control groups or between the two mnemonic groups.

Table 2 also indicates that the pattern of differences for attribute clustering on Day 4 was likewise identical to that of Day 1. Students in the Control-Passage and Control-List conditions performed comparably, but significant differences were obtained for the four keyword-versus-control comparisons, as well as for the comparison between the two mnemonic keyword groups. Most noteworthy was the near 225 percent facilitation of the Keyword-Symbol Picture group relative to the Control-List group, the

near 180 percent facilitation of the Keyword-Symbol Picture group over the Control-Passage group, and the more than 100 percent facilitation of the Keyword-Keyword Picture group over the Control-List group.

Experiment 2: Recall

Following Experiment 1 (recognition), all pairwise comparisons among conditions for Experiment 2 (recall) were conducted using Dunn's procedure and a familywise Type I error probability of .05 per dependent variable on each of the two testing days (Day 1 and Day 4). The dependent variables in Experiment 2 were verbatim correct recalls, essence correct recalls, an unconditional attribute clustering measure, and a conditional clustering measure. Table 4 presents the means and standard deviations for town-attribute pairings and attribute clusterings for all conditions, and Table 5 lists the t-values for the six pairwise comparisons on the four dependent variables. Again, all comparisons were nondirectional, with a Dunn critical t of ± 2.71, based on 83 error degrees of freedom.

Day 1 Results

For the immediate test of recall given on Day 1, students in the Control-Passage, Control-List, and Keyword-Keyword Picture conditions obtained surprisingly low absolute levels of recall (see again group means in Table 4) for the town-attribute pairings. Only students in the Keyword-Symbol Picture condition

Table 4

Mean Recall Performance for Each Condition (Day 1 and Day 4)

	Control Passage (n = 21)	Control List (n = 23)	Keyword-Symbol Picture (n = 23)	Keyword-Keyword Picture (n = 20)
Day 1				
Town-Attribute Pairings (Verbatim Correct)	$\bar{X}$ = 4.639 SD = 2.974	$\bar{X}$ = 3.545 SD = 2.126	$\bar{X}$ = 8.065 SD = 2.881	$\bar{X}$ = 5.105 SD = 3.646
Town-Attribute Pairings (Essence Correct)	$\bar{X}$ = 5.917 SD = 3.793	$\bar{X}$ = 4.772 SD = 2.877	$\bar{X}$ = 12.696 SD = 4.285	$\bar{X}$ = 6.842 SD = 5.385
Attribute Clustering (Unconditional)	$\bar{X}$ = 5.810 SD = 5.913	$\bar{X}$ = 5.130 SD = 4.037	$\bar{X}$ = 20.478 SD = 6.186	$\bar{X}$ = 13.350 SD = 8.132
Attribute Clustering (Conditional)	$\bar{X}$ = 36.714 SD = 23.144	$\bar{X}$ = 39.047 SD = 23.537	$\bar{X}$ = 81.260 SD = 15.147	$\bar{X}$ = 65.594 SD = 21.972
Day 4				
Town-Attribute Pairings (Verbatim Correct)	$\bar{X}$ = 1.778 SD = 2.365	$\bar{X}$ = 1.364 SD = 1.356	$\bar{X}$ = 6.783 SD = 3.295	$\bar{X}$ = 4.079 SD = 3.909
Town-Attribute Pairings (Essence Correct)	$\bar{X}$ = 2.667 SD = 3.167	$\bar{X}$ = 1.932 SD = 1.954	$\bar{X}$ = 11.870 SD = 5.377	$\bar{X}$ = 5.447 SD = 5.482
Attribute Clustering (Unconditional)	$\bar{X}$ = 3.000 SD = 2.950	$\bar{X}$ = 1.739 SD = 2.072	$\bar{X}$ = 13.696 SD = 6.731	$\bar{X}$ = 9.750 SD = 8.783
Attribute Clustering (Conditional)	$\bar{X}$ = 28.554 SD = 18.503	$\bar{X}$ = 22.364 SD = 25.399	$\bar{X}$ = 78.542 SD = 15.410	$\bar{X}$ = 48.189 SD = 33.661

Table 5

t-Values on Recall Test for Each Pairwise Comparison (Day 1 and Day 4)

	Day 1				Day 4			
	Town-Attribute Pairings		Attribute Clustering		Town-Attribute Pairings		Attribute Clustering	
Comparisons	Verbatim	Essence	Uncond.	Cond.	Verbatim	Essence	Uncond.	Cond.
Control-List - Control-Passage	-0.64	-0.39	-0.36	0.37	-0.26	-0.34	-0.73	-0.85
Keyword-Symbol Picture - Control-Passage	4.48*	5.94*	7.88*	6.98*	6.12*	7.53*	9.07*	6.90*
Keyword-Keyword Picture - Control Passage	0.92	1.08	3.91*	4.37*	2.64	2.19	3.77*	2.62
Keyword-Symbol Picture - Control-List	5.24*	6.48*	8.44*	6.77*	6.52*	8.06*	10.02*	7.94*
Keyword-Keyword Picture - Control-List	1.58	1.49	4.36*	4.11*	2.95*	2.58	4.57*	3.52*
Keyword-Keyword Picture - Keyword-Symbol Picture	-3.48*	-4.77*	-3.78*	-2.42	-3.34*	-5.19*	-5.10*	-4.14*

*Significant difference based on Dunn critical $t(83) = \pm 2.71$

performed at reasonably high absolute levels of recall and, hence, obtained significantly higher scores than did students in the other three groups. This difference was true for both verbatim correct responses and for essence correct responses, with facilitation ranging from 58 percent (in favor of the Keyword-Symbol Picture group over the Keyword-Keyword Picture group for verbatim correct recalls) to 166 percent (in favor of the Keyword-Symbol Picture group over the Control-List group for essence correct recalls).

Probably the most unexpected finding for town-attribute recalls, was the performance levels of Keyword-Keyword Picture students. Whereas, in the recent pilot study, seventh-grade students who were taught a double-keyword mnemonic strategy had significantly outperformed controls for town-attribute pairings, the eighth graders in the present study did not benefit significantly from mnemonic instruction in the Keyword-Keyword Picture condition, even though their mean level of performance was somewhat higher than that for both control groups.

Tables 4 and 5 show a different pattern of results for the attribute clustering variables than for the town-attribute recall variables. For unconditional clustering (the correct grouping of two, three, or four attributes together, regardless of the appropriateness of their town pairings), the two mnemonic keyword groups significantly outperformed each of the control groups, with anywhere from 130 percent to almost 300

percent facilitation. Although the two control conditions performed comparably, there was a significant difference between the two keyword groups: Keyword-Symbol Picture students made substantially more correct attribute clusterings than did students in the Keyword-Keyword Picture condition. Thus, the Keyword-Keyword Picture group performed at an intermediate level between the Keyword-Symbol Picture group and controls.

For the conditional attribute clustering measure (determined by the unconditional clustering score in combination with the total number of attributes recalled) on Day 1, results were similar to those for the unconditional clustering measure, with the exception that there was not a significant difference in performance between the Keyword-Symbol Picture group and the Keyword-Keyword Picture group.

Day 4 Results

On the delayed test of recall (Day 4) for town attribute pairings, students' absolute levels of recall were predictably even lower than they had been on Day 1. The mean number of verbatim correct recalls for each control group, for example, was less than 2 out of a possible total of 20 (see again Table 4). But, whereas the Keyword-Keyword Picture group had performed comparably to the two control groups on this variable on Day 1, students in the Keyword-Keyword Picture group significantly outperformed students in the Control-List condition on Day 4. Although the

verbatim recall performance of Keyword-Keyword Picture subjects was also higher than that of Control-Passage subjects ($p < .01$), it was not statistically significant at the needed Dunn probability of .0083. As on Day 1, students in the Day 4 Keyword-Symbol Picture group recalled substantially more correct town-attribute associations than did students in the two control and Keyword-Keyword Picture conditions.

Day 4 essence correct recalls followed the same pattern as on Day 1, where the only significant comparisons favored the Keyword-Symbol Picture group over each of the other three groups.

The pattern of unconditional attribute clustering on Day 4 also resembled that of Day 1, where both keyword groups made more correct attribute associations than did the two control groups. The facilitation accrued to the mnemonic groups was impressive, ranging from 225 percent (for the Keyword-Keyword Picture group over the Control-Passage group) to almost 1,000 percent (for the Keyword-Symbol group over the Control-List group). The only other significant difference on this variable was between the two mnemonic groups, with students in the Keyword-Symbol Picture group outperforming Keyword-Keyword Picture students by almost 100 percent.

For the conditional clustering measure on Day 4, students in the Keyword-Symbol Picture group obtained substantially higher scores than did students in the other three conditions. As on Day 1, students in the Keyword-Keyword Picture condition

outperformed Control List students, but unlike Day 1, fell just short of the needed .0083 probability for outperforming students in the Control-Passage condition ($p < .01+$). Although there was no difference in performance between the two mnemonic groups on this measure on Day 1, on Day 4 Keyword-Keyword Picture students performed at a significantly lower level than did Keyword-Symbol Picture students.

STEP Test Results

Data from the standardized Step III Test of Reading Comprehension were made available to this author, for the purpose of determining whether STEP Test reading ability interacted with treatments from the present study. Subjects who participated in Experiment 1 and Experiment 2 in March 1982, took the eighth-grade level of the STEP Test in May (two months later) of the same school year.

A post hoc examination of the data was accomplished both by factorial ANOVA (dividing subjects into high and low reading levels based on the median), and by regression analysis, where the slopes relating reading scores to the dependent measures were compared. Such interaction analyses were lacking in power, however, both because of the very small Ns for each Experiment X Condition X Achievement Level subgroup, and because of the narrow range of reading levels obtained by a homogeneously high-performing group of students. [Out of a total possible score of 50, the mean of the present sample was 42.66, with a standard deviation of

5.81. This is considerably, and statistically ($p < .001$), above the national mean of 33.00.]

Although not statistically reliable, trends were revealed in both experiments, suggesting that there was a stronger relationship between reading achievement and performance in the Keyword-Keyword Picture condition than in the Keyword-Symbol Picture condition. Specifically, high reading achievement subjects in the Keyword-Keyword Picture group appeared to benefit much more than lows from that strategy, whereas in the Keyword-Symbol Picture group, the strategy elevated the performance of lows to that of highs. (The likelihood that lower-achieving verbal subjects may have more difficulty performing successfully in the Keyword-Keyword Picture condition than in the Keyword-Symbol Picture condition is addressed at length in the following chapter, Discussion and Implications.) Clearly, followup research directed at the interactions between verbal achievement and performance using phonetic versus semantic encoding strategies, using larger, more heterogeneous reading samples, is needed before any definitive claims can be made.

Chapter 6

Discussion and Implications

The purposes of the present study were threefold: 1) to determine the relative benefits of two different keyword-based mnemonic strategies for students' memory of abstract prose information; 2) to compare the benefits of the two mnemonic strategy conditions on a test of recognition versus a test of recall; and 3) to determine whether any effects obtained on the immediate test would hold up on the delayed test (three days later).

Magnitude of the Keyword Effect for Town-Attribute Pairings

The results of the present study support the effectiveness of keyword-based mnemonic strategies for remembering relatively abstract prose information, in tasks of both recognition and recall, and on tests administered immediately following instruction and three days later. In addition, the benefits realized by the Keyword-Symbol Picture subjects in this study are comparable with or superior to the benefits realized by keyword picture subjects in previous prose-learning studies. (It should be noted that in all nine of the previous prose-learning experiments, keyword subjects significantly outperformed controls, regardless of whether the keyword elaborations were pictures or images.)

Following McCormick (1981), Table 6 presents the magnitude of keyword effects (i.e.. each keyword picture group in comparison with the Control-Passage group), in terms of within-cell standard deviation units (Cohen, 1969; Levin. 1975), for the two experiments in the present study (listed above the dotted line), as well as for the nine previous prose-learning experiments (listed below the dotted line). In all keyword studies, the keyword method was presented via experimenter-provided pictures, subject-generated images, or experimenter-structured images. Each test in the nine earlier experiments had been classified according to whether learning was picture- or imagery-based, and then further subgrouped according to whether the test was administered immediately following learning or after a delay. Finally, an "average" standard effect size for each of the four derived groups (picture-immediate test, picture-delayed test, imagery-immediate test, and imagery-delayed test--see Previous Keyword Studies section at the bottom of Table 6) was determined as a yardstick by which to compare the effects obtained by keyword subjects in subsequent studies. Thus, for Experiments 1 and 2 of the present study, the keyword effects for pictures on each immediate test can be compared with the average keyword effect for pictures on immediate tests of previous experiments. In the same way, the keyword effects for pictures on each delayed test can be compared with the average keyword effect for pictures on delayed tests.

Table 6
Magnitude of the Keyword Effect in the Present Study and in Previous Prose-Learning Studies

	Condition	Size of the Keyword Effect (in terms of S. D. units)
Shriberg (1982)	Exp. 1: Recognition	
	Immediate Test	
	Keyword-Symbol (Picture)	1.88*
	Keyword-Keyword (Picture)	1.36
	Delayed Test	
	Keyword-Symbol (Picture)	1.54
	Keyword-Keyword (Picture)	0.89
	Exp. 2: Recall	
	Immediate Test	
	Keyword-Symbol (Picture)	1.59
	Keyword-Keyword (Picture)	0.22
	Delayed Test	
	Keyword-Symbol (Picture)	2.18
	Keyword-Keyword (Picture)	0.66
Shriberg et al. (1982)	Exp. 1: Recall	
	Keyword (Picture)	3.14
	Keyword (Imagery)	1.32
	Exp. 2: Recall	
	Keyword (Picture	3.07
	Keyword (Imagery)	1.74
	Exp. 3: Recall	
	Keyword (Imagery)	1.81
Levin et al. (in press)	Exp. 1a. Recognition	
	Keyword (Picture)	1.65*
	Exp. 1b: Recognition	
	Keyword (Picture)	1.34*
	Exp. 2a: Recall	
	Keyword (Picture)	1.50
	Exp. 2b: Recall	
	Keyword (Picture)	1.24
McCormick & Levin (1982)	Exp. 1: Recall	
	Keyword-Paired (Structured Imagery)	0.53
	Keyword-Chained (Structured Imagery)	0.59
	Keyword-Integrated (Structured Imagery)	0.71
	Exp. 2: Recognition	
	Immediate Test	
	Keyword-Paired (Structured Imagery)	0.58
	Keyword-Integrated (Structured Imagery)	1.02
	Delayed Test	
	Keyword-Paired (Structured Imagery)	1.05
	Keyword-Integrated (Structured Imagery)	1.30

Previous Keyword Studies
Average Keyword Effect Size on Immediate Tests (Picture) = 1.99
Average Keyword Effect Size on Immediate Tests (Imagery) = 1.04
Average Keyword Effect Size on Delayed Tests (Picture) = no data
Average Keyword Effect Size on Delayed Tests (Imagery) = 1.18

*Possible ceiling effect in keyword condition reduces size of effect

Keyword Effects for Experiment 1

For town-attribute pairings, both mnemonic groups, Keyword-Symbol Picture and Keyword-Keyword Picture, substantially outperformed controls on the immediate test of recognition. Since a "large" effect is indicated when the standard deviation unit difference is .80 or greater (Cohen, 1969), Keyword-Symbol Picture and Keyword-Keyword Picture subjects obtained impressive facilitation benefits over Control-Passage subjects, with effect sizes of 1.88 and 1.36, respectively. These results compare favorably with the average keyword effect for pictures from tests immediately following presentation of the prose passages. The Keyword-Symbol Picture group in particular, with an effect size of 1.88, came very close to the average effect size of 1.99. This is remarkable, considering that the average was inflated by the extremely large values of 3.14 and 3.07 from Experiments 1 and 2 of the Shriberg et al. (1982) study. The striking facilitation that accrued to keyword picture subjects in the Shriberg et al. experiments could be attributed to the fact that: 1) treatment and testing in the Shriberg et al. experiments were individually administered, whereas in the present study, treatment and testing were administered to large, classroom-size groups (see Pressley et al., 1982, for a discussion of the individual-versus-groups question); 2) the to-be-remembered information in the Shriberg et al. experiments was concrete, whereas in the present study the information was abstract; and

3) there was only one response (accomplishment) associated with each stimulus item ("famous" name) in the Shriberg et al. experiments, whereas in the present study four responses (attributes) had to be associated with each stimulus item (fictitious town). Despite the more difficult demands of the present study, the performance effects of Keyword-Symbol Picture subjects and Keyword-Keyword Picture subjects on the immediate test of recognition, closely resembled the average keyword effect for pictures. Moreover, if one notes the effect size for keyword pictures from the four Levin et al. (in press) experiments, for Organized Keyword Picture subjects over controls they are 1.65, 1.34, 1.50, and 1.24. In Experiment 1 of the present study, the effect sizes of 1.88 for Keyword-Symbol Picture subjects and 1.36 for Keyword-Keyword Picture subjects are comparable to the values obtained by Organized Keyword Picture subjects in the previous experiments. It should be pointed out, however, that the Keyword-Symbol Picture condition in Experiment 1 of the present study, and the Organized Keyword Picture condition in Experiment 1b of the Levin et al. (1982) study, were almost identical in regard to the instructions, passages, and pictures used. Thus, it is not surprising that, within their respective experiments, both groups produced similarly impressive effect sizes (1.88 and 1.34) relative to their nonmnemonic controls.

For town-attribute pairings on the delayed test of recognition, both keyword picture groups again significantly outperformed controls. Keyword-Symbol Picture subjects and Keyword-Keyword Picture subjects obtained effect sizes of 1.54 and 0.89, respectively, which exceeded Cohen's (1969) .80 value for "large" effects. Since all previous prose experiments with keyword pictures involved immediate tests only, there were no data available for the effects of keyword pictures on delayed tests by which to compare the delayed test results from Experiment 1. Nevertheless, the potency of keyword pictures on the delayed test of recognition is evident from the mean scores listed in Table 2: Not only did the Keyword-Symbol Picture and Keyword-Keyword Picture groups show greater facilitation than controls on Day 4 as well as on Day 1, but also, the absolute levels of performance were higher on the delayed test for the two mnemonic keyword picture groups than for controls on the immediate test. Thus, it is reasonable to conclude that mnemonic keyword picture strategies are beneficial for long-term retention of prose information, as measured by a three-day delayed test of associative recognition.

Keyword Effects for Experiment 2

In the second experiment of the present study, subjects were provided with the five town names and then asked to recall the four attributes associated with each town, using the

"exact words" of the attributes, whenever possible. Recall (Experiment 2) is generally considered to be a more complex task than recognition (Experiment 1) because the learner is expected to produce, rather than match, the responses associated with each stimulus term. For the sake of brevity, only the essence correct scores were considered for discussion, because these scores incorporate both verbatim and paraphrased recalls.

For town-attribute pairings on the immediate test of recall in Experiment 2, facilitation for the Keyword-Symbol Picture group over controls was substantial, with an effect size of 1.59. Unlike in Experiment 1, however, the effect for the Keyword-Keyword Picture group over controls was small, with an effect size of only .22. Thus, the benefits for associative pictures, wherein the response members were semantically based (Keyword-Symbol Pictures), were greater than those wherein the response members were phonetically based (Keyword-Keyword Pictures). In fact, the effect size of 1.59 for the Keyword-Symbol Picture group closely resembled the average effect for keyword pictures on immediate tests of 1.99. This is impressive, considering that the average is based on six earlier experiments--two of which involved a recognition paradigm (Levin et al., in press, Experiments 1a and 1b), and two of which involved a single concrete response term for each stimulus item (Shriberg et al., 1982, Experiments 1 and 2)--as opposed to the more difficult demands of the present study which utilized a recall paradigm for

remembering multiple abstract responses. Just as with the recognition test, the instructions and materials for the recall test were almost identical for the Keyword-Symbol Picture condition in the present study, and for the Organized Keyword Picture condition in Experiment 2b of the Levin et al. (1982) study. And just as with recognition, both groups produced similarly large effect sizes (1.59 and 1.24, respectively) for recall, relative to their nonmnemonic control subjects.

On the delayed test of recall, the picture effect for Keyword-Symbol Picture subjects was again substantial, as compared with controls, with an effect size of 2.18. It was impossible to compare this value with an average effect size, however, because none of the nine previous keyword experiments had utilized pictures on a delayed measure.

Although the effect size for Keyword-Keyword Picture subjects over controls had been "small" on the immediate test (.22), by Cohen's (1969) criteria, it increased to a "medium" effect on the delayed test (.66). Examination of the mean scores in Table 4 reveals that the Keyword-Keyword Picture group performed comparably to controls on Day 1. On Day 4, however, the level of recall of control subjects had decreased, whereas the level of recall of Keyword-Keyword Picture subjects remained almost the same as it had been on the immediate test. To put the results of Experiment 2 another way: On Day 4, control subjects recalled only 40 or 45 percent of what they had learned on Day 1,

whereas Keyword-Keyword Picture subjects and Keyword-Symbol Picture subjects recalled 80 and 93 percent, respectively, of Day 1 information.

Keyword Benefits for Attribute Clusterings

In addition to associating towns and attributes, subjects were also scored on their ability to group the appropriate attributes together, regardless of the correctness of the town-attribute pairings. For both the immediate and delayed tests of recognition (Experiment 1), each mnemonic keyword group outperformed each control group, while the difference between the two control groups was statistically negligible. The Keyword-Symbol Picture group evidenced more facilitation than did the Keyword-Keyword Picture group, with the latter group performing about midway between the Keyword-Symbol Picture group and controls.

In Experiment 2, both an unconditional clustering score and a conditional clustering score were computed. For the purposes of this discussion, attribute clustering was considered in terms of the conditional clustering score only. The conditional measure corrects subjects' clustering for the total number of attributes recalled.

On the immediate test of recall, there were no differences between the two control groups, and both keyword groups performed significantly higher than controls. Unlike Experiment 1, however, the two keyword groups performed at the same level. On the delayed

test of recall, again the two control groups performed comparably. The Keyword-Keyword Picture group significantly outperformed the Control-List group, but fell just short of statistical significance for outperforming the Control-Passage group at the needed Dunn level of ±2.71 (t = 2.62). The Keyword-Symbol Picture group produced more facilitation than did any of the other three groups.

In sum, both types of mnemonic pictures--Keyword-Symbol Pictures and Keyword-Keyword Pictures--appeared to facilitate the correct grouping of attribute terms in tasks of both recognition and recall, administered both immediately following learning and three days later.

Differences in Recall Patterns

Another issue of interest was whether the types of recall made by subjects in Experiment 2 related to the particular condition in which the subjects were instructed. Three questions were raised in regard to the critical town-attribute pairings: 1) Would subjects in the Keyword-Keyword Picture group who were taught a phonetically-based strategy, obtain more verbatim correct responses than subjects in the other three groups? 2) Would subjects in the Keyword-Symbol Picture group who were taught a semantically-based strategy, obtain more essence correct responses than subjects in the other three groups? and 3) Would such differential patterns obtained on Day 1 be maintained over the three-day delay period?

Responses that were recalled word-for-word, or that included the salient word of the attribute term (i.e., the word in all capital letters), were given one-point and a half-point, respectively, towards a verbatim correct score. Because subjects in the Keyword-Keyword Picture condition were taught a phonetic (sound-based) encoding strategy for learning the salient words of the attributes, it was anticipated that they would have the easiest access to the attribute terms as originally stated, and that they would obtain higher verbatim correct scores than subjects in the other groups. On both the immediate and the delayed recall tests, however, subjects in the Keyword-Symbol Picture condition who were taught a semantically-based encoding strategy, obtained significantly more verbatim correct recalls than subjects in any other condition. (It should be noted, however, that even though Keyword-Keyword Picture subjects did not perform at as high a level of verbatim recall as did Keyword-Symbol Picture subjects, they had a much higher proportion of verbatim recall relative to paraphrase, with .746 to .253 on Day 1, and an almost identical ratio of .748 to .251 on Day 4.) The only other significant difference among groups for verbatim recalls was on Day 4, when Keyword-Keyword Picture subjects outperformed subjects in the Control-List condition.

Essence correct recalls refers to responses which are either verbatim correct or paraphrased. Thus, an essence correct

score reflects both the verbatim correct recalls, as well as nonverbatim recalls which correctly paraphrase the attribute terms, either completely (one-point) or in part (half-point). Since Keyword-Symbol Picture subjects were instructed to learn the attributes via a semantically-based encoding system, it seemed reasonable to expect that this group would produce the greatest number of essence correct--that is, paraphrased--responses. This was indeed the case: For both Day 1 and Day 4, subjects in the Keyword-Symbol Picture group produced significantly more essence correct responses than did subjects in the other groups.

Finally, the data were examined to see if patterns of recall obtained on the immediate test held up over the three-day delay period. As reported in the Results chapter, Keyword-Symbol Picture subjects produced more verbatim correct and more essence correct responses than did subjects in the other three groups, on both the immediate and the delayed tests of recall. On Day 4, however, the Keyword-Keyword Picture group significantly outperformed Control-List subjects, and came very close to outperforming Control-Passage subjects for verbatim correct recalls. In other words, Keyword-Keyword Picture subjects who performed comparably with controls on Day 1, performed better than controls on Day 4. As discussed in the Results chapter, this effect can be attributed to the fact that scores for controls diminished considerably from Day 1 to Day 4, whereas

scores for the Keyword-Keyword Picture subjects diminished only slightly. Thus, the difference between the control groups and the Keyword-Keyword Picture group was negligible on Day 1 and much greater on Day 4.

Possible Explanations for the Superiority of Semantic Encoding Operations Over Phonetic Encoding Operations in Experiment 2

Before addressing the relative effectiveness of semantic versus phonetic encoding operations, it should first be determined whether or not subjects are actually using the strategies that were taught to them. The decision is not clearcut, but based on comments offered by subjects who participated in previous experiments, the answer is probably "yes". Control subjects in the Shriberg et al. (1982) study, for example, were questioned after testing as to how they remembered the passage information. In just about every case, the controls said that they had used rote memory to learn the critical name-accomplishment pairings. Considering that subjects in the Pictures and Pictures Plus groups overwhelmingly outperformed controls--namely, carrying out their strategy instructions. In addition, the number of symbols given by recall subjects in the Levin et al. (in press) study, and the number of symbol and keyword recalls given by subjects in Experiment 2 of the present study, suggest that subjects were indeed attending to the picture information. Besides, the symbol and keyword recalls offered by Keyword-Symbol Picture and Keyword-Keyword Picture subjects, respectively, had not even been mentioned in the text!

But did the different treatments take? Obviously, both mnemonic strategies were effective in Experiment 1, and the Keyword-Symbol Picture strategy was effective throughout Experiment 2, because of the significant differences obtained. The real issue, however, was whether or not the two strategy groups achieved maximum impact. Considering that the treatments were administered without previous training and to classroom-size groups, the guess is that subjects in the two strategy conditions did not perform at their highest possible levels. Experience with learning strategies has shown that students benefit from training, and that they profit more from individual instruction than from group instruction. This should be especially true for students in the Keyword-Keyword Picture condition, who had to learn a novel set of instructions without the benefit of individual instruction and feedback. In fact, as can be seen from the data in Tables 2 and 4, the Keyword-Keyword Picture condition is consistently associated with the largest variability--also a pattern hospitable to the aptitude-by-treatment-interaction hypothesis alluded to in the discussion of the STEP Test analysis.

For the critical town-attribute pairings, performance between the two mnemonic strategy groups was statistically negligible on the immediate and delayed tests of recognition in Experiment 1. In Experiment 2, however, subjects in the Keyword-Symbol Picture group significantly outperformed subjects in the Keyword-Keyword Picture group on both tests of recall. This superiority of a semantically-based picture strategy over a phonetically-based picture strategy

for recalling abstract prose information might be explainable in terms of three main considerations.

First, whereas phonetic encoding operations are sound-based, semantic encoding operations are meaning-based and supported by basic tenets underlying schema theory. Anderson (1977) states that "in every domain of human experience, perception, comprehension, and interpretation involve an interaction of input with existing knowledge" (p. 471). Moreover, when the new information is abstract in nature, the learner is obliged to generate "concrete scenarios", and then to fit (or reconstruct) these representations into his or her existing knowledge of the subject:

> If linguistic understanding is abstract and, therefore, impoverished of situationally specific detail, how is it that the representations we get into our heads when we comprehend sentences are so rich? This is a troublesome question only when it is assumed that words and sentences "have" meanings. The meaning is not in the message. A message is a cryptic recipe that can guide a person in constructing a representation. The representation which accounts for a message will usually include elements that are not explicitly contained in the message. These imported elements will be the ones required to maintain consistency with the schemata from which the representation is built . . . (Anderson, 1977, p. 422).

The Keyword-Symbol Picture condition fits the view of schemata described by Anderson, with the exception that, in the present study, the "concrete scenarios" were experimenter-provided, rather than generated by the subjects themselves. Thus, the abstract, to-be-remembered attribute terms were presented to subjects via illustrations of specific concretizations or conventional symbols (e.g., a computer for "technology" and a thermometer for "temperature", respectively; Levin et al., in press). With computer, thermometer, and other concretizations and symbols already in their knowledge base, Keyword-Symbol Picture subjects were able to correctly associate these attribute representations with the appropriate towns, and then later, during recall, translate these representations back into verbatim or paraphrased verbal terms.

Second, a semantic encoding operation lends itself naturally to paraphrase by eliciting meaning-related phrases and synonyms as substitutes for the original attribute terms. Thus, in addition to outperforming Keyword-Keyword Picture subjects for verbatim correct recalls, Keyword-Symbol Picture subjects also scored significantly more essence correct responses.

The Keyword-Keyword Picture group, however, was probably at a disadvantage for making essence correct responses, because instruction in this condition emphasized a sound-related, rather than a meaning-related, strategy. Subjects in

the Keyword-Keyword Picture condition were taught a phonetically-based keyword for the one important word that appeared in all capital letters in each attribute term. When subjects remembered the keywords and utilized the appropriate retrieval process, they were likely to produce either completely correct or partially correct verbatim responses. But Keyword-Keyword Picture subjects who were not able to remember specific keywords did not have an alternative link to lead them to paraphrased descriptions of the attribute terms. This was in sharp contrast to subjects in the Keyword-Symbol Picture group who, by interpreting symbols into terms that had the same meaning as, but different wording from, the attribute terms as originally stated, nevertheless received credit for their responses.

Consider, for example, the attribute term, friendly and HOSPITABLE community. Keyword-Symbol Picture subjects who remembered the picture of the two people greeting each other with a handshake, received essence correct credit for the response, "people are nice to each other". Keyword-Keyword Picture subjects, on the other hand, who were provided with the keyword, hospital, and shown a picture of a hospital setting, did not receive any credit--verbatim or essence- for the response, "hostile". This was the case even though the response was phonetically similar to the word, hospitable, the word which had appeared in all capital letters in the attribute term. Thus, while Keyword-Symbol Picture subjects could often choose

from among several correct alternative responses (paraphrases) through the use of a semantically-based strategy, Keyword-Keyword Picture subjects were restricted to remembering both the exact keyword referent which was provided, as well as the specific attribute term from which it was derived.

The third consideration cannot be completely separated from the second, in that it too pertains to the number of alternative responses that subjects could make in the Keyword-Symbol Picture condition versus the Keyword-Keyword Picture condition. The Keyword-Symbol Picture condition has already been described as a schema-related strategy. Since Keyword-Symbol Pictures present the new, to-be-learned information in terms of the learner's existing knowledge (i.e., specific concretizations and conventional symbols), the learner is likely to be very amenable to semantic encoding operations. In fact, teachers tend to spontaneously introduce new concepts in terms of what their students already know, and "schema theory" and "semantic encoding operations" may be no more than fancy labels for the way that information is naturally imparted in most classrooms.

By contrast, learning via phonetic encoding operations is not typical of what goes on in most classrooms. Other than conventional rhymes, such as "Thirty days has September . . .", which are learned by rote, students do not tend to acquire new information via sound-based operations in any systematic way. Lower ability Keyword-Keyword Picture subjects in the present

study, for example, did not benefit from a phonetic encoding strategy, whereas lower ability Keyword-Symbol Picture subjects performed comparably to higher ability subjects when instructed in a semantic encoding strategy. Recall also the earlier discussed tentative findings related to potential aptitude-by-treatment interactions. Therefore, unlike learning via a semantic Keyword-Symbol Picture condition, learning via a phonetic Keyword-Keyword Picture condition could be a novel, and perhaps a trying, experience for many students.

Furthermore, a simplified breakdown of the processes underlying the Keyword-Symbol Picture and Keyword-Keyword Picture strategies (see Table 7) indicates that an "extra step" may be required during retrieval in the latter condition. Whereas Steps 1 through 3 are identical for both groups, subjects in the Keyword-Symbol Picture condition do not necessarily need to go beyond Step 4 to score points. Subjects in the Keyword-Keyword Picture condition, however, must proceed to Step 5 in order to receive credit.

Perhaps another way of stating the Keyword-Symbol Picture advantage and the Keyword-Keyword Picture disadvantage is as follows: Although subjects in the Keyword-Symbol Picture group were instructed to recall attribute terms verbatim if possible, they could still obtain essence correct credit if exact words were not used. Through semantic encoding, Keyword-Symbol Picture

Table 7

Steps Needed For Retrieval of Attribute Information in the Keyword-Symbol Picture Versus Keyword-Keyword Picture Conditions

Step	Keyword-Symbol Picture Condition	Keyword-Keyword Picture Condition
1	Given the name of the town (e.g., Fostoria), recall the keyword (viz., frost)	Given the name of the town (e.g., Fostoria), recall the keyword (viz., frost)
2	Think back to the picture that had the keyword (frost) in it	Think back to the picture that had the keyword (frost) in it
3	Remember what else was in the picture with the keyword (viz., an oil well, a computer, dollar bills, and a crowd of people)	Remember what else was in the picture with the keyword (viz., race horses, tacks, a well, and [soda] pop
4.	At this point, the learner can interpret the picture symbols any way he or she wishes, and probably receive at least partial, and maybe full, essence credit (e.g., "lots of money" for considerable WEALTH) (more direct retrieval path)	The learner must match the keyword for each attribute with the "correct" attribute term. To do this, the learner must recall the previously presented attributes (for verbatim credit), or use his/her schema for attributes of places (for essence credit) (more complex retrieval path)
5.	To receive full verbatim credit for a response, the picture symbols must be translated back into the four attribute terms as originally stated (i.e., abundant natural resources, advances in technology, considerable wealth, and growing population)	To receive verbatim credit for a response, the keyword must be transformed back into the words that they were derived from. For full verbatim credit, recall of an individual word should lead to recall of the remaining words in that attribute term (e.g., remembering RESOURCES [from race horses] should lead to memory for abundant natural resources, TECHNOLOGY [from tacks] for advances in technology, WEALTH [from well] for considerable wealth, and POPULATION [from pop] for growing population)

subjects had direct (semantic-based) retrieval routes by which to identify the attribute terms. Keyword-Keyword Picture subjects, on the other hand, were restricted to an indirect, more complex retrieval process for recalling the specific word in each attribute term, and the word by itself received only partial verbatim correct credit. To earn full verbatim correct credit, Keyword-Keyword Picture subjects then had to jump from that single word to the entire attribute description (Table 7, Step 5).

Suggestions For Future Research

Failure of subjects in the Keyword-Keyword Picture condition to perform comparably with those in the Keyword-Symbol Picture condition has been attributed to the fact that phonetic systems involve more difficult and unusual processing than do semantic systems. Since schooling has provided students with practice in semantic systems, it is not surprising that subjects in the Keyword-Symbol Picture condition outperformed Keyword-Keyword Picture subjects on most protocols. One possible way to reduce this Keyword-Symbol Picture advantage would be to conduct training sessions in both mnemonic strategies, until subjects are equally adept at storing and retrieving information in semantic and phonetic encoding systems. After training, a direct Keyword-Symbol Picture versus Keyword-Keyword Picture comparison could be made (such as through a recall task, as in Experiment 2 of the present study), using prose passages that had not been used

during training. A hypothesized outcome would be that Keyword-Keyword Picture subjects would benefit more from training than would Keyword-Symbol Picture subjects.

Another area of investigation might also serve to lessen the Keyword-Symbol Picture advantage as it now stands. In the present study, all twenty attributes can be designated as positive in that they are desirable characteristics that serve to enhance the appeal of the towns they describe. An interesting question would be to study passages that contained twenty mixed attributes, say, ten positive and ten negative. The attributes for Fostoria, for example, might be in considerable debt, abundant natural resources, behind technologically, and growing population. The two negative attributes, in considerable debt and behind technologically, might continue to be symbolized by the same symbols that were used in the present study, "dollar bills" and "a computer", but some cue would be needed to indicate that they were negative, rather than positive. In a dissertation study by Desrochers (1980), college students were asked to learn the genders of masculine and feminine French nouns. Those students who were shown pictures of the nouns which included a man or a woman to designate the gender, significantly outperformed students who were shown the same pictures of the nouns but devoid of the gender cues. In a similar fashion, picture subjects in a

follow-up study about towns and their attributes, could be shown a valence cue for the positive and/or negative attributes. For example, a devil could be incorporated into the symbols for the negative attributes and/or a "happy face" for the positive attributes. Because the inclusion of half-positive/half-negative attributes, instead of all-positive attributes, would require subjects to process information beyond that of symbol interpretation, Keyword-Symbol Picture subjects might not achieve the degree of facilitation that they realized in the present study.

A third direction for future research would be to investigate the salience of picture components in interactive illustrations, regardless of the condition for which they were constructed. Specifically, this issue relates to whether size, placement, or perceived "activity" of a picture component would affect the memorability of that component. For example, in the Keyword-Keyword Picture illustration accompanying the passage about Fostoria (see Figure 14), the race horses would probably be deemed "more salient" than the tacks. If this were judged to be the case, would Keyword-Keyword Picture subjects be more likely to remember abundant natural RESOURCES (from the

keyword, race horses) than advances in TECHNOLOGY (from the keyword, tacks)? A worthwhile endeavor might be to delineate the characteristics and to investigate the magnitude of the effects of picture salience on the learning of accompanying text information in future experiments involving the use of experimenter-provided illustrations. An independent sample of judges could assign a salience value to each picture component, and tests, such as those used in Experiment 2 of the present study, could then be administered to determine whether high-salient picture components are better predictors of recall than low-salient picture components.

Another fertile area for research would be to replicate the design of the present study based on student-generated symbols or concretizations and student-generated keywords. Prior to constructing the illustrations, the experimenters could visit classrooms of students who were similar demographically (i.e., in age, ability level, socio-economic status, and educational background) to students who would be participating as subjects in the study. The former would be taught how to generate symbols or keywords when provided with each of the 20 abstract attribute terms. The most frequently generated symbol and keyword for each attribute term would then be selected for

inclusion in the Keyword-Symbol Picture and Keyword-Keyword Picture conditions, respectively. Perhaps these student-generated symbols and keywords could also be "weighted" according to a preestablished percentage-of-occurrence formula. Subsequent analyses of the recognition and recall protocols would reveal how subjects performed in the two strategy groups when the provided illustrations were based on symbols and keywords that were peer-generated rather than experimenter-generated.

Probably one of the most important areas for future research would be the exploration of imagery effects in tasks involving the learning of abstract prose. Through the use of experimenter-provided pictures, the Keyword-Symbol Picture group and the Keyword-Keyword Picture group were able to significantly outperform controls in tasks of recognition, and the Keyword-Symbol Picture group showed superiority over the other three groups in tasks of recall. It is not certain, however, whether these effects would hold if, instead of illustrations, subjects had to generate their own interactive mental images. Since it would not be economically feasible or ecologically valid for educators to construct mnemonic illustrations for all prose learning tasks (other than, perhaps, for the purposes of training),

the efficacy of subject-generated images for the learning of abstract prose information should be explored. The research of Shriberg et al. (1982) and McCormick and Levin (1982) are encouraging "first studies" in support of keyword imagery for the learning of prose information. In Experiments 1 and 2 of the Shriberg et al study, keyword subjects who generated their own interactive mental images recalled more concrete associations than did no-keyword/no-imagery controls. And keyword subjects in the McCormick and Levin study, who were told exactly what to image, significantly outperformed their no-keyword/no-imagery control subjects on a recall measure and on an immediate and delayed multiple-choice test.

Finally, no area of educational research would be complete without data to explain age effects and individual differences. Certainly a developmental study could be carried out to determine whether the benefits that accrued to the eighth graders in the present study via semantic versus phonetic encoding operations would also accrue to younger and older subjects. Further, within a particular age group, a standardized test of verbal achievement (such as the STEP Test) could be administered, and the results correlated with scores from treatments used in the present study. Ideally, this aptitude-by-treatment interaction procedure should be tried on a relatively large, heterogeneous sample, in order that any differences might be clearly delineated. The Keyword-Symbol Picture strategy should be investigated in order to

determine if subjects' ability to benefit from symbols and concretizations is related to individual differences. According to Spiro (1977), implicit throughout schema theory models is the powerful determining force of idiosyncratic factors. The wave of the future, then, should be in the directions of "an increasing emphasis in discourse memory research on individual differences in prior knowledge, personal inference rules, attitudes, etc." (p. 161). The Keyword-Keyword Picture strategy also should be further explored because of the apparently strong relationship between verbal ability and performance in this condition. Since the processes underlying phonetic encoding systems appear to involve verbal fluency and verbal expansion, it seems reasonable to determine whether verbal ability is a predictor of performance in the Keyword-Keyword Picture condition.

Educational Significance of the Study

The results of this study support the efficacy of semantically- and phonetically-based strategy applications for the learning of abstract prose information. The fact that semantic encoding operations were shown to facilitate students' learning on both recognition and recall protocols may be due to the schema-related nature of the Keyword-Symbol Picture condition. Schema-based strategies are believed to enhance learning because new information is introduced in terms of the learner's existing knowledge.

Phonetic encoding operations also have proved to be facilitative for prose learning, but on the recognition protocols only. It has been suggested that through training, phonetically-based strategies, such as the Keyword-Keyword Picture strategy, might enhance recall memory by providing a novel alternative or auxiliary route to semantically-based learning. As an alternative route, educators investigating modality preferences might find that carefully developed, phonetically-based strategies will provide certain groups of special learners with the necessary auditory approach for succeeding in school. As an auxiliary route, Dretzke (1982) has proposed that, during retrieval, students who are proficient in the use of both semantic and phonetic encoding strategies, could either apply the two operations in conjunction with each other or, more likely, rely on whichever of the two operations is more helpful or available for remembering a particular piece of prose information.

Indeed, both the Keyword-Symbol Picture condition and the Keyword-Keyword Picture condition are viable strategies that can be taught to large, classroom-size groups. The present study proved that, by means of printed study booklets and a minimal amount of experimenter instruction, students can be taught these strategies in a relatively short amount of time. Learning involved memory of several pieces of abstract information embedded within an expository prose format. Students in the strategy

conditions demonstrated that they could remember more information than controls, both immediately following learning and three days later.

One of the most important implications of the present study is the effect of strategy usage on recognition and recall memory. In Experiment 1 (recognition), the two keyword strategy groups outperformed controls on Day 4 as well as on Day 1. And in Experiment 2 (recall), even though the Keyword-Symbol Picture group outperformed all other groups on both the immediate and the delayed tests, the Keyword-Keyword Picture group on Day 4 retained 80 percent of what it had recalled on Day 1--a figure twice as high as that for controls. Future researchers will surely want to investigate the effects of increased delay intervals on performance, to determine how long semantically-based versus phonetically-based treatments will benefit learners.

Now that the present study has established that mnemonic strategies can be successfully and efficiently utilized in the teaching of abstract prose information, reasonable "next steps" would be to apply these strategies to the learning of a variety of curricular content with students of several different age levels. As suggested earlier in this chapter, students can be trained in the Keyword-Symbol Picture and Keyword-Keyword Picture strategies through practice using experimenter-provided pictures.

After becoming proficient in the use of both strategies, the students can then be taught to generate their own mental images instead of relying on the illustrations. In time, the goal would be for the students to spontaneously apply these strategies through the use of mental imagery, to the learning of other information that they encounter in school. Jones and Hall (1982) and Pressley and Dennis-Rounds (1980) have made significant initial progress in this area of keyword strategy maintenance and transfer.

References

Anderson, R. C. The notion of schemata and the educational enterprise: General discussion of the conference. In R. C. Anderson, R. J. Spiro, & W. E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Erlbaum, 1977.

Anderson, R. C., Spiro, R. J., & Montague, W. E. (Eds.). Schooling and the acquisition of knowledge. Hillsdale, N.J.: Erlbaum, 1977.

Atkinson, R. C. Mnemotechnics in second-language learning. American Psychologist, 1975, 30, 821-828.

Atkinson, R. C., & Raugh, M. R. An application of the mnemonic keyword method to the acquisition of a Russian vocabulary. Journal of Experimental Psychology: Human Learning and Memory, 1975, 104, 126-133.

Begg, I., & Paivio, A. Concreteness and imagery in sentence meaning. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 821-827.

Bellezza, F. S. Mnemonic devices: Classification, characteristics, and criteria. Review of Educational Research, 1981, 51, 247-275.

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

Bower, G. H., & Clark, M. C. Narrative stories as mediators for serial learning. Psychonomic Science, 1969, 14, 181-182.

Brown, E., & Deffenbacher, K. Forgotten mnemonists. Journal of the History of the Behavioral Sciences, 1975, 11, 342-349.

Bugelski, B. R. Words and things and images. American Psychologist, 1970, 25, 1,002-1,012.

Cohen, J. Statistical power analyses for the behavioral sciences. New York: Academic Press, 1969.

Denburg, S. D. The interaction of picture and print in reading instruction (abstracted report). Reading Research Quarterly, 1976-1977, 12, 176-189.

Desrochers, A. Effects of an imagery mnemonic on the acquisition and retention of French article-noun pairs. Unpublished doctoral dissertation, University of Western Ontario, London, 1980.

Dillingofski, M. S. The effects of imposed and induced visual imagery strategies on ninth grade difference-poor readers' literal comprehension of concrete and abstract prose. Unpublished doctoral dissertation, University of Wisconsin, Madison, 1980.

Dretzke, B. J. Personal communication, September 15, 1982.

Higbee, K. L. Recent research on visual mnemonics: Historical roots and educational fruits. Review of Educational Research, 1979, 49, 611-629.

Jensen, A. R., & Rohwer, W. D., Jr. Verbal mediation in paired-associate and serial learning. Journal of Verbal Learning and Verbal Behavior, 1963, 1, 346-352.

Jensen, A. R., & Rohwer, W. D., Jr. Syntactical mediation of serial and paired-associate learning as a function of age. Child Development, 1965, 36, 601-608.

Jones, B. F., & Hall, J. W. School applications of the mnemonic keyword method as a study strategy by eighth graders. Journal of Educational Psychology, 1982, 74, 230-237.

Kirk, R. E. Experimental design: Procedures for the behavioral sciences. Belmont, California: Brooks/Cole, 1968.

Koenke, K. R. The roles of pictures and readability in comprehension of the main idea of a paragraph. Paper presented at the annual meeting of the American Educational Research Association, Chicago, 1968.

Krebs, E. W., Snowman, J., & Smith, S. H. Teaching new dogs old tricks: Facilitating prose learning through mnemonic training. Journal of Instructional Psychology, 1978, 5, 33-39.

Lesgold, A. M., DeGood, H., & Levin, J. R. Pictures and young children's prose-learning: A supplementary report. Journal of Reading Behavior, 1977, 9, 353-360.

Levin, J. R. Determining sample size for planned and post hoc analysis of variance comparisons. Journal of Educational Measurement, 1975, 12, 99-108.

Levin, J. R. What have we learned about maximizing what children learn? In J. R. Levin & V. L. Allen (Eds.), Cognitive learning in children: Theories and strategies. New York: Academic Press, 1976.

Levin, J. R. On functions of pictures in prose. In F. J. Pirozzolo & M. C. Wittrock (Eds.), Neuropsychological and cognitive processes in reading. New York: Academic Press, 1981.

Levin, J. R. Pictures as prose-learning devices. In A. Flammer & W. Kintsch (Eds.), Discourse processing. Amsterdam: North-Holland, in press.

Levin, J. R., Divine-Hawkins, P., Kerst, S., & Guttmann, J. Individual differences in learning from pictures and words: The development and application of an instrument. Journal of Educational Psychology, 1974, 66, 296-303.

Levin, J. R., Johnson, D. D., Pittelman, S. D., Hayes, B. L., Levin, K. M., & Shriberg, L. K. A comparison of semantic- and mnemonic based vocabulary-learning strategies. Paper to be presented at the annual meeting of the American Educational Research Association, Montreal, April, 1983.

Levin, J. R., & Lesgold, A. M. On pictures in prose. Educational Communication and Technology, 1978, 26, 233-243

Levin, J. R., McCormick, C. B., & Dretzke, B. J. A combined pictorial mnemonic strategy for ordered information. Educational Communication and Technology Journal, 1981, 29, 219-225.

Levin, J. R., McCormick, C. B., Miller, G. E., Berry, J. K., & Pressley, M. Mnemonic versus nonmnemonic vocabulary-learning strategies for children. American Educational Research Journal, 1982, 19, 121-136.

Levin, J. R., Shriberg, L. K., & Berry, J. K. A concrete strategy for remembering abstract prose. American Educational Research Journal, in press.

Levin, J. R., Shriberg, L. K., Miller, G. E., McCormick, C. B., & Levin, B. B. The keyword method in the classroom: How to remember the states and capitals. Elementary School Journal, 1980, 80, 185-191.

Loisette, A. Assimilative memory or how to attend and never forget. New York: Funk and Wagnalls Co., 1896.

McCormick, C. B. The effect of mnemonic strategy variations on students' recall of potentially confusable prose passages. Unpublished doctoral dissertation, University of Wisconsin, Madison, 1981.

McCormick, C. B., & Levin, J. R. A comparison of different prose-learning variations of the mnemonic keyword method. Unpublished manuscript, University of Wisconsin, Madison, 1982.

McGivern, J. E., & Levin, J. R. The keyword method of vocabulary learning: An interaction with vocabulary knowledge. Contemporary Educational Psychology, in press.

Meyer. B. J. F. The organization of prose and its effects on memory. Amsterdam: North-Holland, 1975.

Miller, W. Reading with and without pictures. Elementary School Journal, 1938, 38. 676-682.

Norman, D. A. Memory and attention (2nd ed.). New York: Wiley & Sons, 1976.

Paivio, A. Effects of imagery instructions and concreteness of memory pegs in a mnemonic system. Proceedings of the 76th Annual Convention of the American Psychological Association, 1968, 77-78.

Paivio, A. Imagery and verbal processes. New York: Holt & Co., 1971.

Paivio, A., & Csapo, K. Concrete-image and verbal memory codes. Journal of Experimental Psychology, 1969, 80, 279-285.

Pressley, M. Imagery and children's learning: Putting the picture in developmental perspective. Review of Educational Research, 1977, 47, 585-622.

Pressley, M., & Dennis-Rounds, J. Transfer of a mnemonic keyword strategy at two age levels. Journal of Educational Psychology, 1980, 72, 575-582.

Pressley, M., Levin, J. R., & Delaney, H. D. The mnemonic keyword method. Review of Educational Research, 1982, 52, 61-91.

Pressley, M., Levin, J. R., & Miller, G. E. The keyword method and children's learning of foreign vocabulary with abstract meanings. Canadian Journal of Psychology, in press.

Read, J. D., & Barnsley, R. H. Remember Dick and Jane? Memory for elementary school readers. Canadian Journal of Behavioral Science, 1977, 9, 361-370.

Rohwer, W. D., Jr. Constraint, syntax and meaning in paired-associate learning. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 541-547.

Rohwer, W. D., Jr. Elaboration and learning in childhood and adolescence. In H. W. Reese (Ed.), Advances in child development and behavior (Vol. 8). New York: Academic Press, 1973.

Rohwer, W. D., Jr., & Harris, W. J. Media effects on prose learning in two populations of children. Journal of Educational Psychology, 1975, 67, 651-657.

Royer, J. M., & Cable, G. W. Facilitated learning in connected discourse. Journal of Educational Psychology, 1975, 67, 116-123.

Samuels, S. J. Attentional process in reading: The effect of pictures on the acquisition of reading responses. Journal of Educational Psychology, 1967, 58, 337-342.

Schallert, D. L. The role of illustrations in reading comprehension. In R. J. Spiro, B. C. Bruce, & W. F. Brewer (Eds.), Theoretical issues in reading comprehension: Perspectives from cognitive psychology, linguistics, artificial intelligence, and education. Hillsdale, N.J.: Erlbaum, 1980.

Shepard, R. N. Recognition memory for words, sentences, and pictures. Journal of Verbal Learning and Verbal Behavior, 1967, 6, 156-163.

Shriberg, L. K., Levin, J. R., McCormick, C. B., & Pressley, M. Learning about "famous" people via the keyword method. Journal of Educational Psychology, 1982, 74, 238-247.

Snowman, J., Krebs, E. W., & Kelly, F. J. Enhancing memory for prose through learning strategy training. Paper presented at the annual meeting of the American Educational Research Association, Boston, April 1980. (a)

Snowman, J., Krebs, E. W., & Lockhart, L. Improving recall of information from prose in high-risk students through learning strategy training. Journal of Instructional Psychology, 1980, 7, 35-40. (b)

Spiro, R. J. Remembering information from text: The "state of schema" approach. In R. C. Anderson, R. J. Spiro, & W. E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Erlbaum, 1977.

Webster's New Collegiate Dictionary. Springfield, Mass.: G. & C. Merriam Co., 1953.

Weintraub, S. The effect of pictures on the comprehension of a second grade basal reader. Unpublished doctoral dissertation, University of Illinois, 1960.

Wollen, K. A. Effects of relevant or irrelevant pictorial mediators upon forward and backward recall. Paper presented at the meeting of the Psychonomic Society, St. Louis, November, 1968.

Yates, F. A. The art of memory. London: Routledge & Kegan Paul, 1966.

Yuille, J. C., & Paivio, A. Abstractness and recall of connected discourse. Journal of Experimental Psychology, 1969, 82, 467-471.

Appendix A

Story Passages for All Conditions

HAMMONDTOWN has been a much talked-about place lately. It has been making headlines in the news on account of its winning SPORTS teams. In addition to its success in athletics, the town is noted for its old-fashioned CHARM. The town is easy to reach, thanks to an efficient mass TRANSPORTATION system. The people who live there are relaxed and happy, which is probably why they have such a long LIFE span.

PLEASANTVILLE is a favorite stop on the historical tour. Visitors are impressed with legends of heroism and with the exciting town HISTORY. But the town has been progressive in the arts too, offering excellent CULTURAL opportunities in the local museum and civic center. Further, it is well known for its successful AGRICULTURAL program, with the primary livelihood being farming. The need for workers with the crops and livestock has resulted in many available JOBS and, hence, every adult has work.

FOSTORIA has a lot to offer its people. People have considerable WEALTH, and everyone lives comfortably. Many of the townsfolk also become quite prosperous because the land has abundant natural RESOURCES. In addition, the town is especially well known for its advances in TECHNOLOGY. This progress has attracted many new residents, and statistics show a growing POPULATION.

PINECHESTER is situated in a prominent spot on the seacoast. It is therefore not surprising that the town is known to be an important port of COMMERCE for trade and industry. Moreover, citizen participation in local GOVERNMENT has resulted in a just and smooth-running political system. The climate is also appealing, with comfortable TEMPERATURES the year 'round, so coats and jackets are never needed. School children attend classes out-of-doors, and the town boasts a high level of LITERACY.

TAPPANWOOD attracts visitors from all over the world. First and foremost, it is known for its many RECREATIONAL facilities. Because law enforcement and security have been tightened, the town is also free of CRIME. The area especially appeals to city dwellers who leave buildings and highways behind in favor of the town's beautiful SCENE. In addition to its natural loveliness, it is regarded as a friendly and HOSPITABLE community.

Appendix B

Instructions for All Conditions

Control-Passage Instructions (Recognition Task)

DIRECTIONS

You have just been told that you will be reading several stories about make-believe places and the features that make them special. To give you an idea of the kind of stories that you'll be reading, take a look at the following story about a place you may already know something about:

> Some of our friends travel to CHICAGO regularly. Every time they visit, they never cease to marvel at the impressive SKYLINE. The city is also well known for its wide variety of RESTAURANTS, and our friends try to dine out as often as possible.

In this story, notice the two underlined features that CHICAGO is well known for: its impressive SKYLINE and its wide variety of RESTAURANTS. Make sure you pay attention to the exact wording of the features that are presented, because that is what you will be asked for later on.

Notice that in the words for each feature, there is one word that is printed in all capital letters. That word in capital letters is the most important word in the feature -- if you can remember that word, there is a good chance that you might be able to remember the whole feature.

In your study book, you will read each story twice. Each time you read the story, the most important word of each feature will be in capital letters -- just like in the box on this page. Now turn to the next page, and read the story once again. Notice again that SKYLINE is the most important word of the feature, impressive SKYLINE, and that RESTAURANTS is the most important word of the feature,

wide variety of RESTAURANTS.

> Some of our friends travel to CHICAGO regularly. Every time they visit, they never cease to marvel at the impressive SKYLINE. The city is also well known for its wide variety of RESTAURANTS, and our friends try to dine out as often as possible.

In addition, you should try to match an impressive SKYLINE and a wide variety of RESTAURANTS with a place called CHICAGO. Use whatever method you would normally use to remember information like that. That is, once you read the important features, try real hard to remember the place that they are matched with. For this story, the features are the impressive SKYLINE and the wide variety of RESTAURANTS, so try your best to remember that they go with a place called CHICAGO. Using your own best method of matching places and features should help you to remember that, for this example, CHICAGO is noted for an impressive SKYLINE and a wide variety of RESTAURANTS.

So, if you were asked, "What is CHICAGO well known for?" try to think back to the features for CHICAGO -- CHICAGO is famous for its impressive SKYLINE and for its wide variety of RESTAURANTS.

From now on, the whole class will be reading the stories together. Only each make-believe place will have four, rather than two, features that make that place special.

After you read each passage, you will be given time to study the name of the place and the features that go with that story.

Finally, after all the stories have been read, you will be asked to list the four features that describe each place. Remember that it is important that you use the exact words of the features, if possible, when you write down your answers.

Control-List Instructions (Recognition Task)

DIRECTIONS

You have just been told that you will be reading several stories about make-believe places and the features that make them special. To give you an idea of the kind of stories that you'll be reading, take a look at the following story about a place you may already know something about:

> Some of our friends travel to CHICAGO regularly. Every time they visit, they never cease to marvel at the impressive SKYLINE. The city is also well known for its wide variety of RESTAURANTS, and our friends try to dine out as often as possible.

In this story, notice the two underlined features that CHICAGO is well known for: its impressive SKYLINE and its wide variety of RESTAURANTS. Make sure you pay attention to the exact wording of the features that are presented, because that is what you will be asked for later on.

Notice that in the words for each feature, there is one word that is printed in all capital letters. That word in capital letters is the most important word in the feature -- if you can remember that word, there is a good chance that you might be able to remember the whole feature.

In your study book, you will be provided with a separate listing of the features to help you remember the features for each place. For example, look in the box on the next page, and notice how impressive SKYLINE and wide variety of RESTAURANTS are listed for your convenience:

CHICAGO

impressive SKYLINE

wide variety of RESTAURANTS

In addition, you will need to match an impressive SKYLINE and a wide variety of RESTAURANTS with a place called CHICAGO. Use whatever method you would normally use to remember information like that. That is, once you read the features, try real hard to remember the place that they are matched with. For this story, the features are impressive SKYLINE and wide variety of RESTAURANTS, so try your best to remember that they go with a place called CHICAGO. Using your own best method of matching places and features should help you to remember that, for this example, CHICAGO is noted for an impressive SKYLINE and a wide variety of RESTAURANTS.

So, if you were asked, "What is CHICAGO well known for?" try to think back to the features for CHICAGO -- CHICAGO is famous for its impressive SKYLINE and for its wide variety of RESTAURANTS.

From now on, the whole class will be reading the stories together. Only each make-believe place will have four, rather than two, features that make that place special.

After you read each passage, you will be given time to study the name of the place and the features that go with that story.

Finally, after all the stories have been read, you will be asked to match all of the features with the places they describe. Paying attention to the exact words of the features should help you to remember which features go with which places.

Keyword-Symbol Instructions (Recognition Task)

DIRECTIONS

You have just been told that you will be reading several stories about make-believe places and the features that make them special. To give you an idea of the kind of stories that you'll be reading, take a look at the following story about a place you may already know something about:

> Some of our friends travel to CHICAGO regularly. Every time they visit, they never cease to marvel at the impressive SKYLINE. The city is also well known for its wide variety of RESTAURANTS, and our friends try to dine out as often as possible.

In this story, notice the two underlined features that CHICAGO is well known for: its impressive SKYLINE and its wide variety of RESTAURANTS. Make sure you pay attention to the exact wording of the features that are presented, because that is what you'll be asked for later on.

Notice that in the words for each feature, there is one word that is printed in capital letters. That word in capital letters is the most important word in the feature -- if you can remember that word, there is a good chance that you might be able to remember the whole feature.

In your study book, you will be given a familiar symbol to help you remember the important word for each feature. This symbol will be printed inside the parentheses next to the feature that it symbolizes. For example, in the feature, impressive SKYLINE, the word in capital letters is SKYLINE. A good symbol for SKYLINE is "tall buildings", because "tall buildings" often stand for a SKYLINE. In the feature, wide variety of RESTAURANTS, RESTAURANTS is the word in capital letters;

the symbol for RESTAURANTS is "eating places", because "eating places" often stand for RESTAURANTS. For each story that you'll be reading, you will see the features written out, with the most important word in capital letters. Then you will see a familiar symbol printed in parentheses right next to the feature. You will also be given a picture made up of these symbols.

In addition to learning about the features, you will need to match them with the right place. For example, how do you match impressive SKYLINE and wide variety of RESTAURANTS with a place called CHICAGO?

CHICAGO *(chicks)*

impressive SKYLINE (tall buildings) wide variety of RESTAURANTS (eating places)

Look at the picture on this page. Notice that above the picture, next to the name of the place, is a word in special italic print. The word in italics is a word or a couple of words that sounds something like the name of the place, but that is much easier to picture. For CHICAGO, the word in italics is *chicks*, because

chicks sounds something like CHICAGO. The arrow in the drawing will always point to a picture for the word in italics. In this case, the arrow is pointing to the *chicks*, which stand for the place, CHICAGO. In the picture, notice that the *chicks* are being fed outside some "eating places" against a background of "tall buildings". Because of the arrow, we know that *chicks* is the word in italics for the place, CHICAGO -- whereas "tall buildings" and "eating places" symbolize impressive SKYLINE and wide variety of RESTAURANTS, the features that describe CHICAGO.

So, if you were asked, "What is CHICAGO well known for?" the place CHICAGO, should remind you of the word in italics, *chicks*. This, in turn, should remind you of the picture of the *chicks* being fed outside some "eating places" against a background of "tall buildings". Therefore, CHICAGO is well known for its impressive SKYLINE and its wide variety of RESTAURANTS.

From now on, the whole class will be reading the stories together. Only each make-believe place will have four, rather than two, features that make that place special.

After you read each passage, you will be given time to learn about a place and its features. For each feature, the most important word will be in capital letters, and you will be given a familiar symbol to help you remember that word. You will also be given a word in italics to help you remember the name of the place. Finally, you will be given time to study a picture which contains the four symbols for the features, and the word in italics (shown by an arrow) for the name of the place.

Later, after all the stories have been read, you will be asked to match all of the features with the places they describe. Paying attention to the exact words of the features should help you to remember which features go with which places.

Keyword-Keyword Instructions (Recognition Task)

DIRECTIONS

You have just been told that you will be reading several stories about make-believe places and the features that make them special. To give you an idea of the kind of stories that you'll be reading, take a look at the following story about a place you may already know something about:

> Some of our friends travel to CHICAGO regularly. Every time they visit, they never cease to marvel at the impressive SKYLINE. The city is also well known for its wide variety of RESTAURANTS, and our friends try to dine out as often as possible.

In this story, notice the two underlined features that CHICAGO is well known for: its impressive SKYLINE and its wide variety of RESTAURANTS. Make sure you pay attention to the exact wording of the features that are presented, because that is what you'll be asked for later on.

Notice in the words for each feature, there is one word that is printed in all capital letters. That word in capital letters is the most important word in the feature -- if you can remember that word, there is a good chance that you might be able to remember the whole feature.

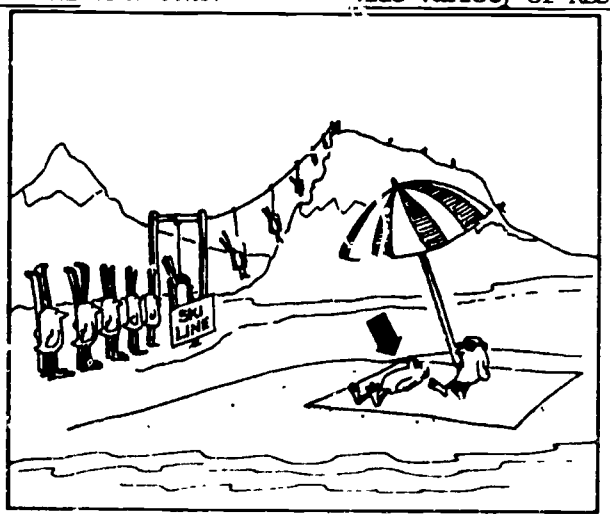
In your study book, you will be given a "word clue" in special italic print to help you remember that important word in each feature. A word clue is a word that sounds something like the important word that you want to remember, and it will be printed next to the feature that it sounds like. For example, in the feature, impressive SKYLINE, the word in capitals is SKYLINE. A good word clue for SKYLINE is *ski line*, because they sound somewhat alike. In the feature,

wide variety of RESTAURANTS, RESTAURANTS is the word in capital letters, and the word clue for RESTAURANTS is *rest*. For each story that you'll be reading, you will see the features written out, with the most important word in capital letters. Then you will see the word clue in italics in the parentheses right next to the feature. You will also be given a picture with the word clues in it.

In addition to learning about the features, you will need to match them with the right place. For example, how do you match impressive SKYLINE and wide variety of RESTAURANTS with a place called CHICAGO?

CHICAGO *(chicks)*

impressive SKYLINE *(ski line)* wide variety of RESTAURANTS *(rest)*



Look at the picture on this page. Notice that above the picture, next to the name of the place, is another word clue. For CHICAGO, the word clue is *chicks*, because *chicks* sounds something like CHICAGO. The arrow in the drawing will always point to the picture of the word clue for the name of the place -- in this case, the arrow is pointing to the *chicks*, which stand for the place, CHICAGO. In the picture, notice that some *chicks* are in a *ski line* waiting to go skiing, while others are *resting* nearby. Because of the a , we know that *chicks* is the word clue

for the place, CHICAGO -- whereas *ski line* and *rest* stand for the impressive SKYLINE and the wide variety of RESTAURANTS, the features that describe CHICAGO.

So, if you were asked, "What is CHICAGO well known for?" the place, CHICAGO, should remind you of the word clue, *chicks*. This, in turn, should remind you of the picture with some *chicks* in a *ski line* and other *chicks resting*. Therefore, CHICAGO is well known for its impressive SKYLINE and its wide variety of RESTAURANTS.

From now on, the whole class will be reading the stories together. Only each make-believe place will have four, rather than two, features that make that place special.

After you read each passage, you will be given time to learn about a place and its features. For each feature, the most important word will be in capital letters, and you will be given a word clue to help you remember the name of the place. Finally, you will be given time to study a picture which contains the four word clues for the features, and the one word clue (shown by an arrow) for the name of the place.

Later, after all the stories have been read, you will be asked to match all of the features with the places they describe. Paying attention to the exact words of the features should help you to remember which features go with which places.

Control-Passage Instructions (Recall Task)

DIRECTIONS

You have just been told that you will be reading several stories about make-believe places and the features that make them special. To give you an idea of the kind of stories that you'll be reading, take a look at the following story about a place you may already know something about:

> Some of our friends travel to CHICAGO regularly. Every time they visit, they never cease to marvel at the impressive SK NE. The city is also well known for its wide variety of RESTAURANTS, and our friends try to dine out as often as possible.

In this story, notice the two underlined features that CHICAGO is well known for: its impressive SKYLINE and its wide variety of RESTAURANTS. Make sure you pay attention to the exact wording of the features that are presented, because that is what you will be asked for later on.

Notice that in the words for each feature, there is one word that is printed in all capital letters. That word in capital letters is the most important word in the feature -- if you can remember that word, there is a good chance that you might be able to remember the whole feature.

In your study book, you will read each story twice. Each time you read the story, the most important word of each feature will be in capital letters -- just like in the box on this page. Now turn to the next page, and read the story once again. Notice again that SKYLINE is the most important word of the feature, impressive SKYLINE, and that RESTAURANTS is the most important word of the feature,

wide variety of RESTAURANTS.

> Some of our friends travel to CHICAGO regularly. Every time they visit, they never cease to marvel at the impressive SKYLINE. The city is also well known for its wide variety of RESTAURANTS, and our friends try to dine out as often as possible.

In addition, you should try to match an impressive SKYLINE and a wide variety of RESTAURANTS with a place called CHICAGO. Use whatever method you would normally use to remember information like that. That is, once you read the important features, try real hard to remember the place that they are matched with. For this story, the features are the impressive SKYLINE and the wide variety of RESTAURANTS, so try your best to remember that they go with a place called CHICAGO. Using your own best method of matching places and features should help you to remember that, for this example, CHICAGO is noted for an impressive SKYLINE and a wide variety of RESTAURANTS.

So, if you were asked, "What is CHICAGO well known for?" try to think back to the features for CHICAGO -- CHICAGO is famous for its impressive SKYLINE and for its wide variety of RESTAURANTS.

From now on, the whole class will be reading the stories together. Only each make-believe place will have four, rather than two, features that make that place special.

After you read each passage, you will be given time to study the name of the place and the features that go with that story.

Finally, after all the stories have been read, you will be asked to match all of the features with the places they describe. Paying attention to the exact words of the features should help you to remember which features go with which places.

Control-List Instructions (Recall Task)

DIRECTIONS

You have just been told that you will be reading several stories about make-believe places and the features that make them special. To give you an idea of the kind of stories that you'll be reading, take a look at the following story about a place you may already know something about:

> Some of our friends travel to CHICAGO regularly. Every time they visit, they never cease to marvel at the impressive SKYLINE. The city is also well known for its wide variety of RESTAURANTS, and our friends try to dine out as often as possible.

In this story, notice the two underlined features that CHICAGO is well known for: its impressive SKYLINE and its wide variety of RESTAURANTS. Make sure you pay attention to the exact wording of the features that are presented, because that is what you will be asked for later on.

Notice that in the words for each feature, there is one word that is printed in all capital letters. That word in capital letters is the most important word in the feature -- if you can remember that word, there is a good chance that you might be able to remember the whole feature.

In your study book, you will be provided with a separate listing of the features to help you remember the features for each place. For example, look in the box on the next page, and notice how impressive SKYLINE and wide variety of RESTAURANTS are listed for your convenience:

CHICAGO

impressive SKYLINE

wide variety of RESTAURANTS

In addition, you will need to match an impressive SKYLINE and a wide variety of RESTAURANTS with a place called CHICAGO. Use whatever method you would normally use to remember information like that. That is, once you read the features, try real hard to remember the place that they are matched with. For this story, the features are impressive SKYLINE and wide variety of RESTAURANTS, so try your best to remember that they go with a place called CHICAGO. Using your own best method of matching places and features should help you to remember that, for this example, CHICAGO is noted for an impressive SKYLINE and a wide variety of RESTAURANTS.

So, if you were asked, "What is CHICAGO well known for?" try to think back to the features for CHICAGO -- CHICAGO is famous for its impressive SKYLINE and for its wide variety of RESTAURANTS.

From now on, the whole class will be reading the stories together. Only each make-believe place will have four, rather than two, features that make that place special.

After you read each passage, you will be given time to study the name of the place and the features that go with that story.

Finally, after all the stories have been read, you will be asked to list the four features that describe each place. Remember that it is important that you use the exact words of the features, if possible, when you write down your answers.

Keyword-Symbol Instructions (Recall Task)

DIRECTIONS

You have just been told that you will be reading several stories about make-believe places and the features that make them special. To give you an idea of the kind of stories that you'll be reading, take a look at the following story about a place you may already know something about:

> Some of our friends travel to CHICAGO regularly. Every time they visit, they never cease to marvel at the impressive SKYLINE. The city is also well known for its wide variety of RESTAURANTS, and our friends try to dine out as often as possible.

In this story, notice the two underlined features that CHICAGO is well known for: its impressive SKYLINE and its wide variety of RESTAURANTS. Make sure you pay attention to the exact wording of the features that are presented, because that is what you'll be asked for later on.

Notice that in the words for each feature, there is one word that is printed in capital letters. That word in capital letters is the most important word in the feature -- if you can remember that word, there is a good chance that you might be able to remember the whole feature.

In your study book, you will be given a familiar symbol to help you remember the important word for each feature. This symbol will be printed inside the parentheses next to the feature that it symbolizes. For example, in the feature, impressive SKYLINE, the word in capital letters is SKYLINE. A good symbol for SKYLINE is "tall buildings", because "tall buildings" often stand for a SKYLINE. In the feature, wide variety of RESTAURANTS, RESTAURANTS is the word in capital letters;

the symbol for RESTAURANTS is "eating places", because "eating places" often stand for RESTAURANTS. For each story that you'll be reading, you will see the features written out, with the most important word in capital letters. Then you will see a familiar symbol printed in parentheses right next to the feature. You will also be given a picture made up of these symbols.

In addition to learning about the features, you will need to match them with the right place. For example, how do you match impressive SKYLINE and wide variety of RESTAURANTS with a place called CHICAGO?

CHICAGO *(chicks)*

impressive SKYLINE (tall buildings) wide variety of RESTAURANTS (eating places)

Look at the picture on this page. Notice that above the picture, next to the name of the place, is a word in special italic print. The word in italics is a word or a couple of words that sounds something like the name of the place, but that is much easier to picture. For CHICAGO, the word in italics is *chicks*, because

chicks sounds something like CHICAGO. The arrow in the drawing will always point to a picture for the word in italics. In this case, the arrow is pointing to the *chicks*, which stand for the place, CHICAGO. In the picture, notice that the *chicks* are being fed outside some "eating places" against a background of "tall buildings". Because of the arrow, we know that *chicks* is the word in italics for the place, CHICAGO -- whereas "tall buildings" and "eating places" symbolize impressive SKYLINE and wide variety of RESTAURANTS, the features that describe CHICAGO.

So, if you were asked, "What is CHICAGO well known for?" the place CHICAGO, should remind you of the word in italics, *chicks*. This, in turn, should remind you of the picture of the *chicks* being fed outside some "eating places" against a background of "tall buildings". Therefore, CHICAGO is well known for its impressive SKYLINE and its wide variety of RESTAURANTS.

From now on, the whole class will be reading the stories together. Only each make-believe place will have four, rather than two, features that make that place special.

After you read each passage, you will be given time to learn about a place and its features. For each feature, the most important word will be in capital letters, and you will be given a familiar symbol to help you remember that word. You will also be given a word in italics to help you remember the name of the place. Finally, you will be given time to study a picture which contains the four symbols for the features, and the word in italics (shown by an arrow) for the name of the place.

Later, after all the stories have been read, you will be asked to list the four features that describe each place. Remember that it is important that you use the exact words of the features, if possible, when you write down your answers.

Keyword-Keyword Instructions (Recall Task)

DIRECTIONS

You have just been told that you will be reading several stories about make-believe places and the features that make them special. To give you an idea of the kind of stories that you'll be reading, take a look at the following story about a place you may already know something about:

> Some of our friends travel to CHICAGO regularly. Every time they visit, they never cease to marvel at the impressive SKYLINE. The city is also well known for its wide variety of RESTAURANTS, and our friends try to dine out as often as possible.

In this story, notice the two underlined features that CHICAGO is well known for: its impressive SKYLINE and its wide variety of RESTAURANTS. Make sure you pay attention to the exact wording of the features that are presented, because that is what you'll be asked for later on.

Notice in the words for each feature, there is one word that is printed in all capital letters. That word in capital letters is the most important word in the feature -- if you can remember that word, there is a good chance that you might be able to remember the whole feature.

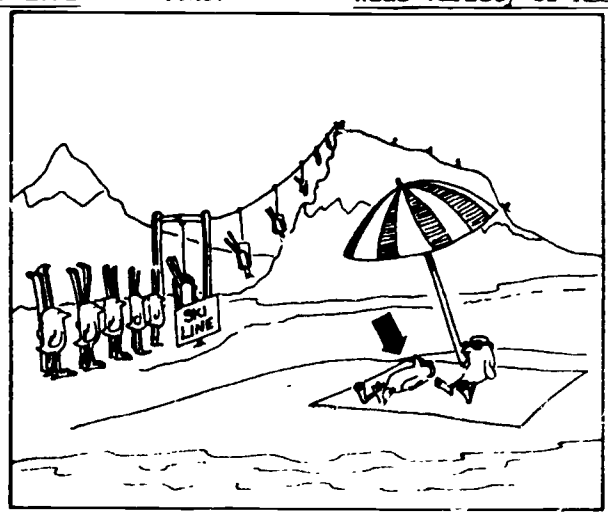
In your study book, you will be given a "word clue" in special italic print to help you remember that important word for each feature. A word clue is a word that sounds something like the important word that you want to remember, and it will be printed next to the feature that it sounds like. For example, in the feature, impressive SKYLINE, the word in capitals is SKYLINE. A good word clue for SKYLINE is *ski line*, because they sound somewhat alike. In the feature,

wide variety of RESTAURANTS, RESTAURANTS is the word in capital letters, and the word clue for RESTAURANTS is *rest*. For each story that you'll be reading, you will see the features written out, with the most important word in capital letters. Then you will see the word clue in italics in the parentheses right next to the feature. You will also be given a picture with the word clues in it.

In addition to learning about the features, you will need to match them with the right place. For example, how do you match impressive SKYLINE and wide variety of RESTAURANTS with a place called CHICAGO?

CHICAGO *(chicks)*

impressive SKYLINE *(ski line)* wide variety of RESTAURANTS *(rest)*



Look at the picture on this page. Notice that above the picture, next to the name of the place, is another word clue. For CHICAGO, the word clue is *chicks*, because *chicks* sounds something like CHICAGO. The arrow in the drawing will always point to the picture of the word clue for the name of the place -- in this case, the arrow is pointing to the *chicks*, which stand for the place, CHICAGO. In the picture, notice that some *chicks* are in a *ski line* waiting to go skiing, while others are *resting* nearby. Because of the arrow, we know that *chicks* is the word clue

for the place, CHICAGO -- whereas *ski line* and *rest* stand for the impressive SKYLINE and the wide variety of RESTAURANTS, the features that describe CHICAGO.

So, if you were asked, "What is CHICAGO well known for?" the place, CHICAGO, should remind you of the word clue, *chicks*. This, in turn, should remind you of the picture with some *chicks* in a *ski line* and other *chicks resting*. Therefore, CHICAGO is well known for its impressive SKYLINE and its wide variety of RESTAURANTS.

From now on, the whole class will be reading the stories together. Only each make-believe place will have four, rather than two, features that make that place special.

After you read each passage, you will be given time to learn about a place and its features. For each feature, the most important word will be in capital letters, and you will be given a word clue to help you remember the name of the place. Finally, you will be given time to study a picture which contains the four word clues for the features, and the one word clue (shown by an arrow) for the name of the place.

Later, after all the stories have been read, you will be asked to list the four features that describe each place. Remember that it is important that you use the exact words of the features, if possible, when you write down your answers.

Appendix C

Study Pages for All Conditions

Control-Passage Study Pages

(SECOND READING)

HAMMONDTOWN has been a much talked-about place lately. It has been making headlines in the news on account of its winning SPORTS teams. In addition to its success in athletics, the town is noted for its old-fashioned CHARM. The town is easy to reach, thanks to an efficient mass TRANSPORTATION system. The people who live there are relaxed and happy, which is probably why they have such a long LIFE span.

(SECOND READING)

PLEASANTVILLE is a favorite stop on the historical tour. Visitors are impressed with legends of heroism and with the exciting town HISTORY. But the town has been progressive in the arts too, offering excellent CULTURAL opportunities in the local museum and civic center. Further, it is well known for its successful AGRICULTURAL program, with the primary livelihood being farming. The need for workers with the crops and livestock has resulted in many available JOBS and, hence, every adult has work.

(SECOND READING)

FOSTORIA has a lot to offer its people. People have considerable WEALTH, and everyone lives comfortably. Many of the townsfolk also become quite prosperous because the land has abundant natural RESOURCES. In addition, the town is especially well known for its advances in TECHNOLOGY This progress has attracted many new residents, and statistics show a growing POPULATION.

(SECOND READING)

PINECHESTER is situated in a prominent spot on the seacoast. It is therefore not surprising that the town is known to be an important port of COMMERCE for trade and industry. Moreover, citizen participation in local GOVERNMENT has resulted in a just and smooth-running political system. The climate is also appealing, with comfortable TEMPERATURES the year 'round, so coats and jackets are never needed. School children attend classes out-of-doors, and the town boasts a high level of LITERACY.

(SECOND READING)

TAPPANWOOD attracts visitors from all over the world. First and foremost, it is known for its many RECREATIONAL facilities. Because law enforcement and security have been tightened, the town is also free of CRIME. The area especially appeals to city dwellers who leave buildings and highways behind in favor of the town's beautiful SCENERY. In addition to its natural loveliness, it is regarded as a friendly and HOSPITABLE community.

Control-List Study Pages

HAMMONDTOWN

winning SPORTS teams

old-fashioned CHARM

efficient mass TRANSPORTATION system

long LIFE span

PLEASANTVILLE

exciting town HISTORY

excellent CULTURAL opportunities

successful AGRICULTURAL program

many available JOBS

FOSTORIA

considerable WEALTH

abundant natural RESOURCES

advances in TECHNOLOGY

growing POPULATION

PINECHESTER

important port of COMMERCE

citizen participation in local GOVERNMENT

comfortable TEMPERATURES the year 'round

high level of LITERACY

TAPPANWOOD

many RECREATIONAL facilities

free of CRIME

beautiful SCENERY

friendly and HOSPITABLE community

Keyword-Symbol Study Pages

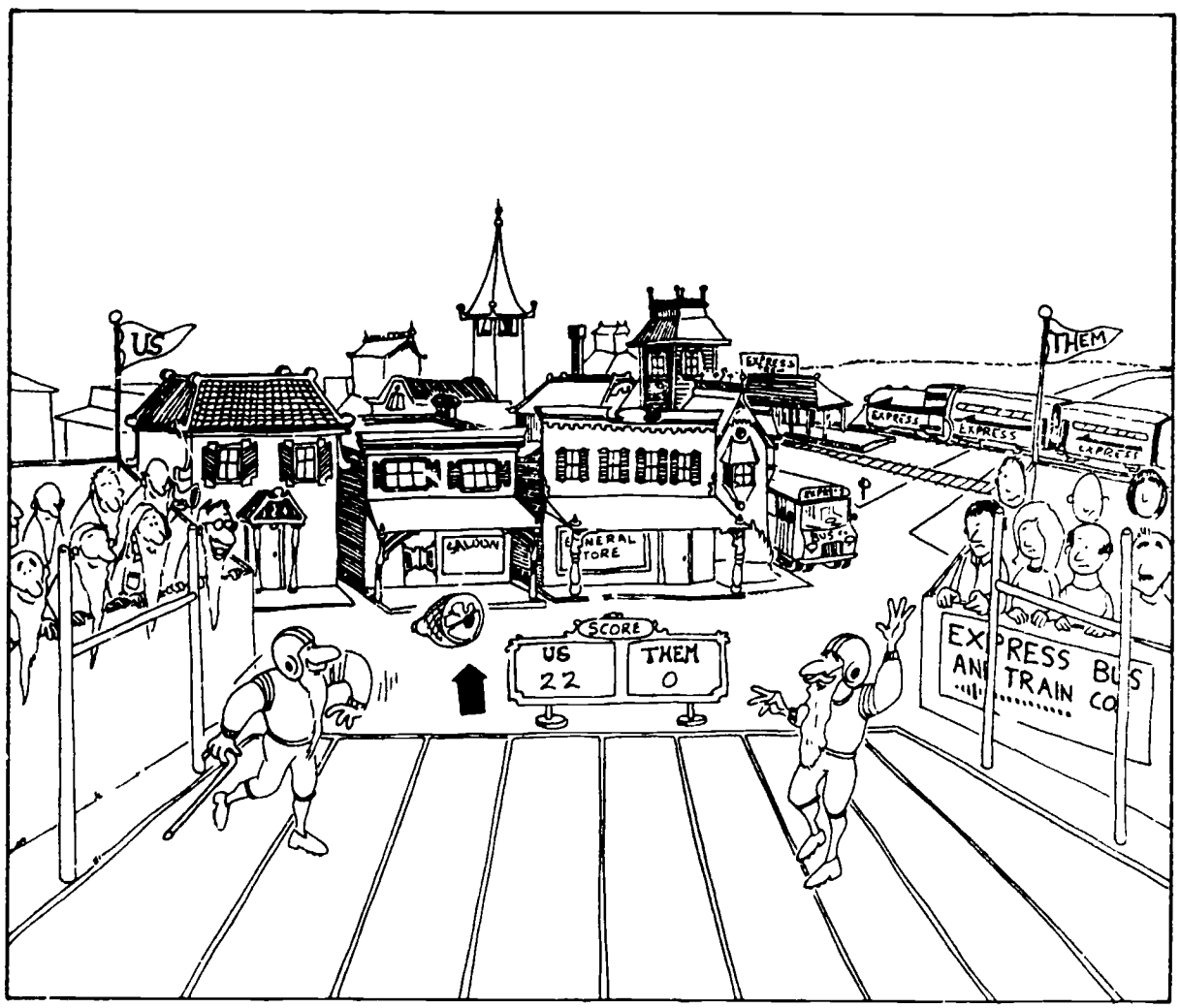
HAMMONDTOWN *(ham)*

winning SPORTS teams (game on athletic field)

old-fashioned CHARM (quaint, old-fashioned buildings)

efficient mass TRANSPORTATION system (express bus and train)

long LIFE span (very old people)



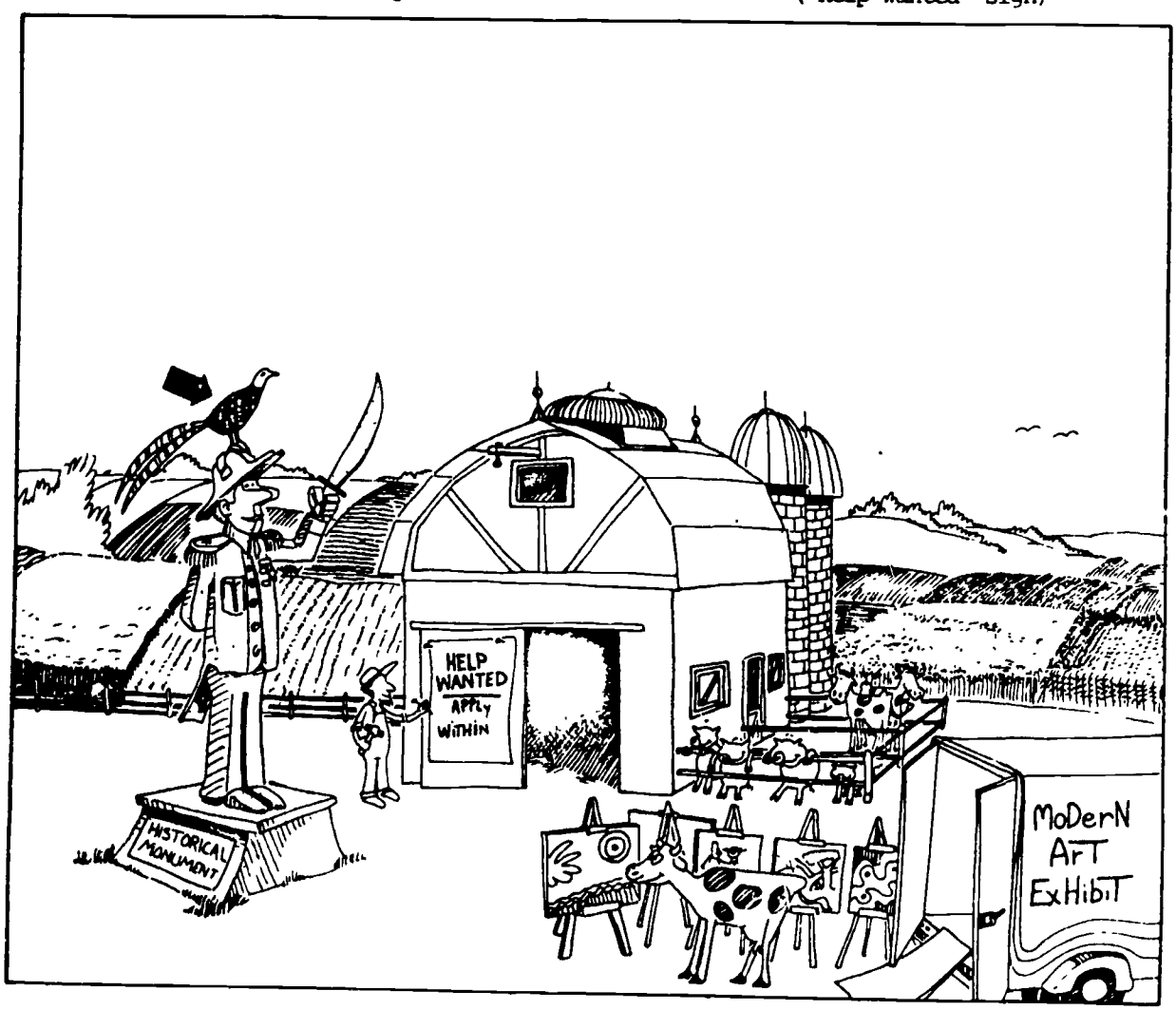
PLEASANTVILLE *(pheasant)*

exciting town HISTORY (historical monument)

excellent CULTURAL opportunities (art exhibit)

successful AGRICULTURAL program (farm rich in crops)

many available JOBS ("help wanted" sign)



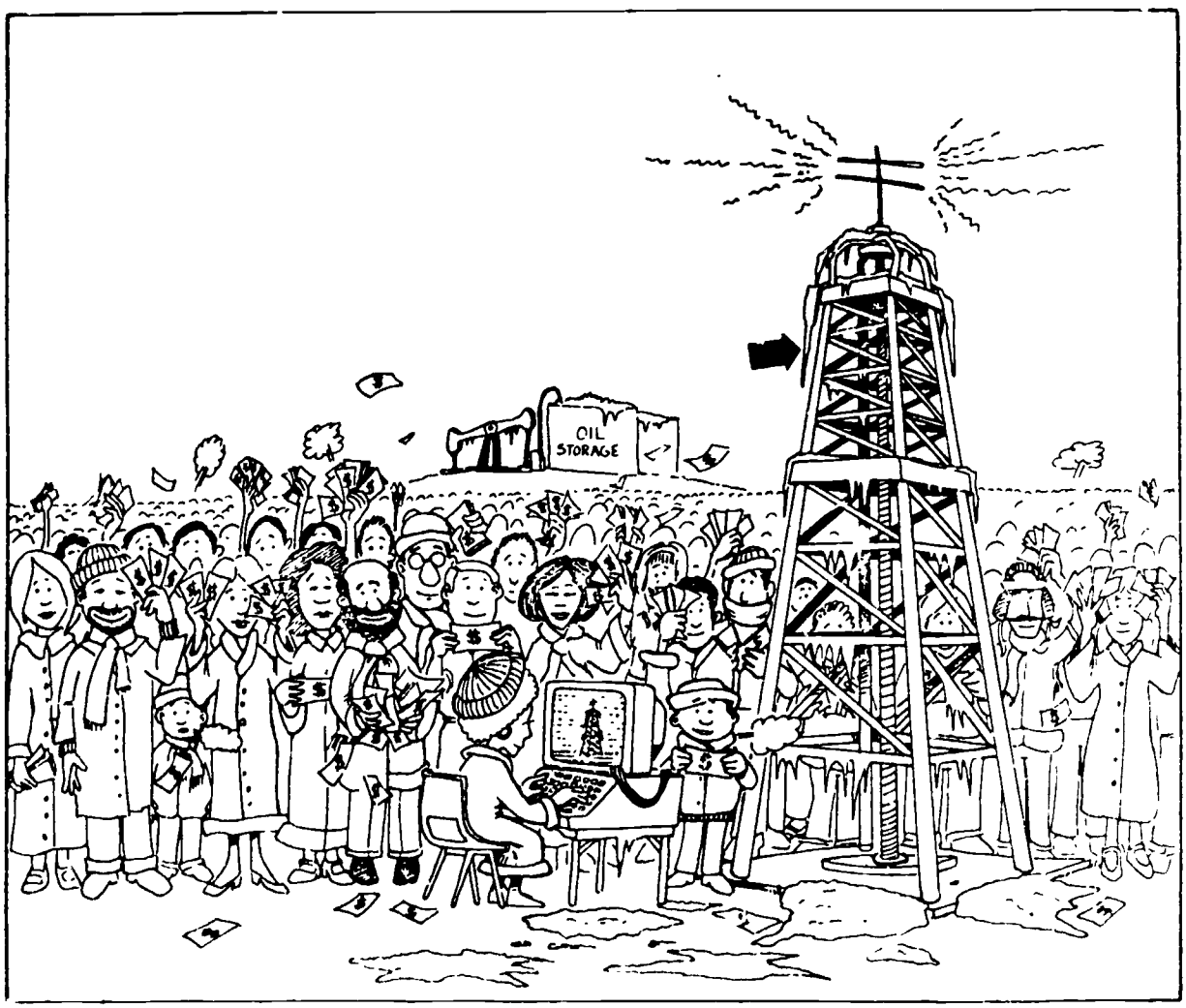
FOSTORIA *(frost)*

considerable WEALTH (dollar bills)

abundant natural RESOURCES (oil well)

advances in TECHNOLOGY (computer terminal)

growing POPULATION (crowd of people)



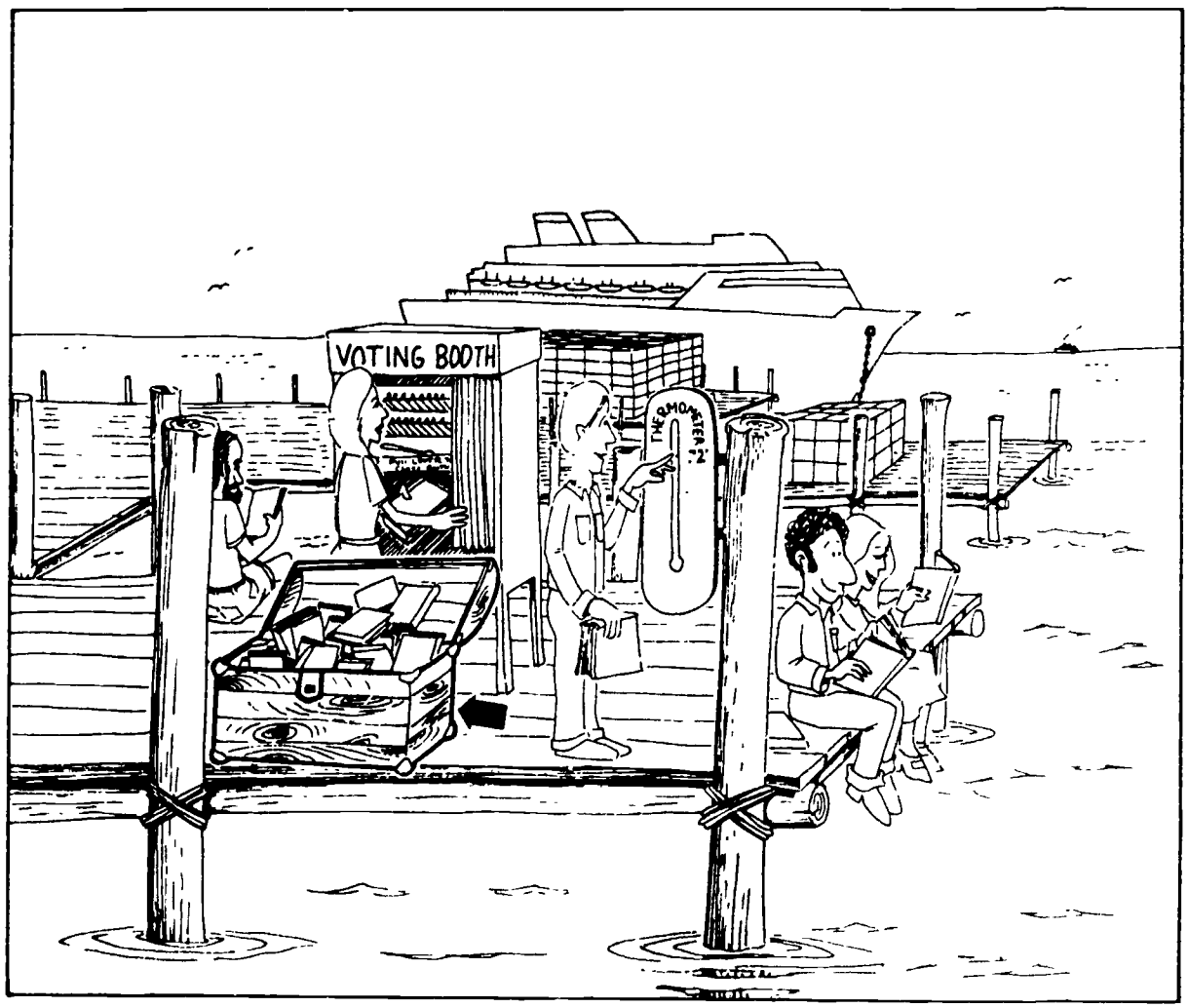
PINECHESTER *(pine chest)*

important port of COMMERCE (shipping dock)

citizen participation in local GOVERNMENT (voting booth)

comfortable TEMPERATURES the year 'round (thermometer at 72°)

high level of LITERACY (books)



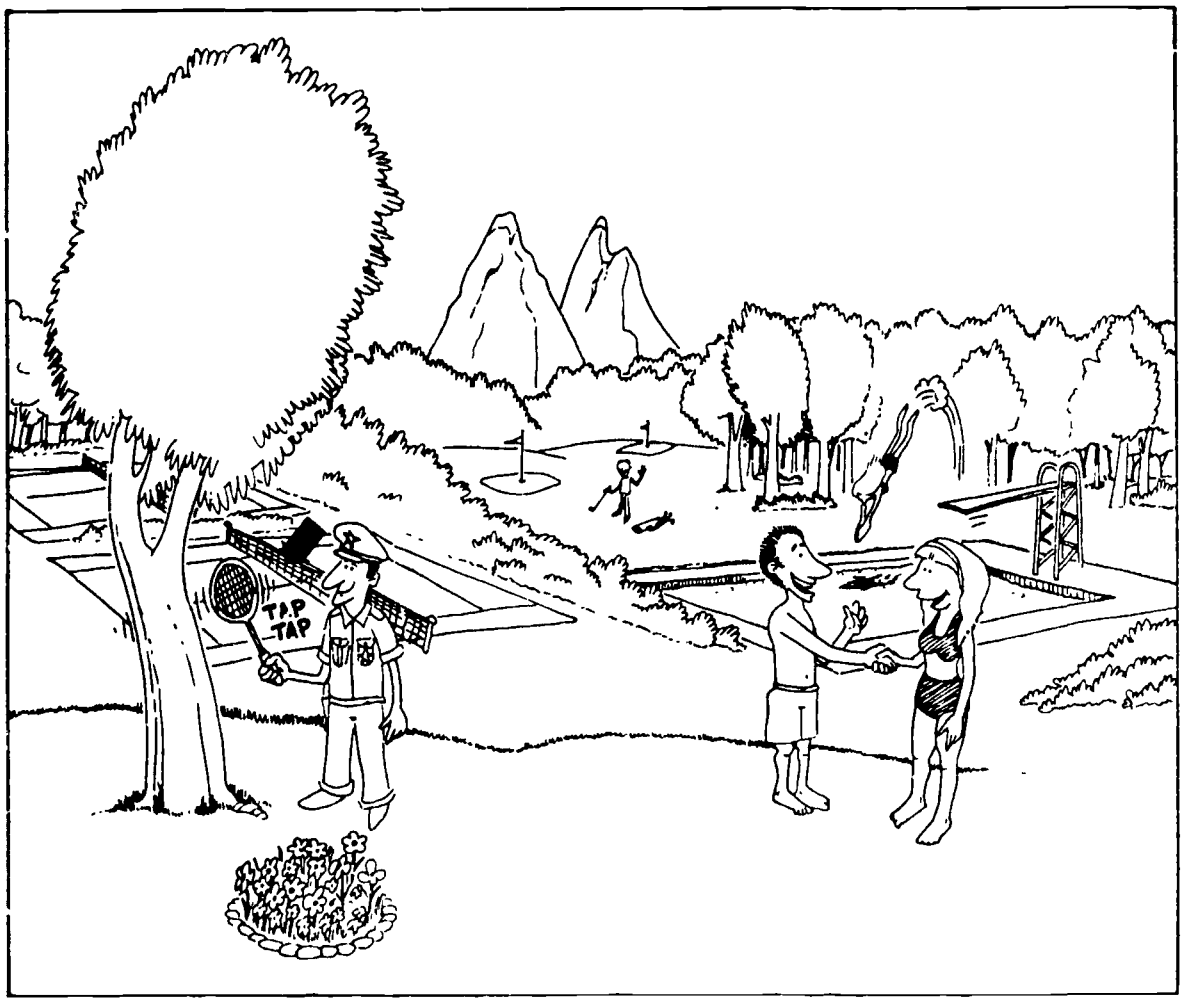
TAPPANWOOD *(tap-on-wood)*

many RECREATIONAL facilities (swimming pool, tennis courts, golf course)

free of CRIME (relaxed policeman)

beautiful SCENERY (mountains, lake, trees)

friendly and HOSPITABLE community (people shaking hands)



Keyword-Keyword Study Pages

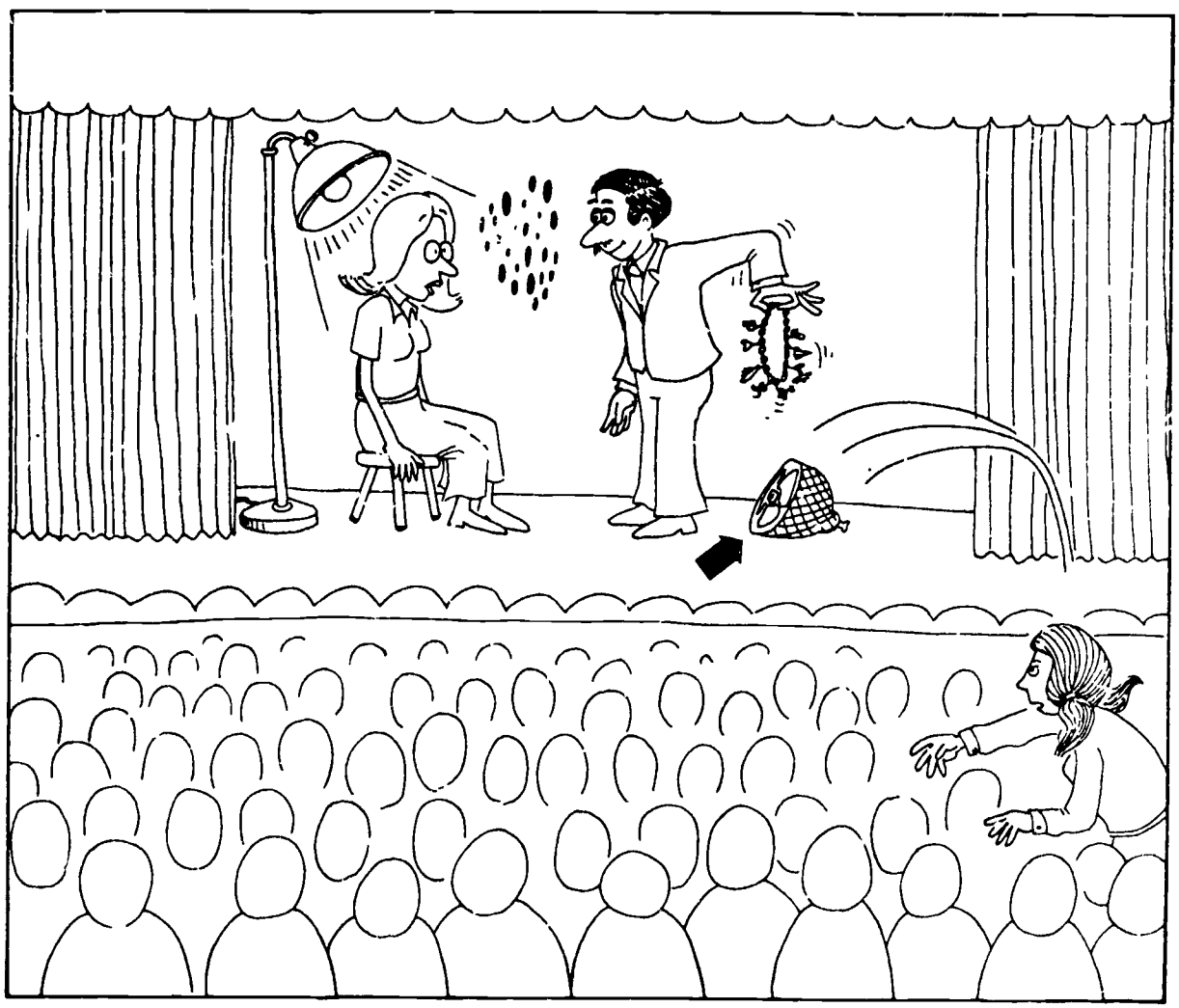
HAMMONDTOWN *(ham)*

winning SPORTS teams *(spots)*

old fashioned CHARM *(charms)*

efficient mass TRANSPORTATION system *(trance)*

long LIFE span *(light)*



PLEASANTVILLE *(pheasant)*

exciting town HISTORY *(his store)*

excellent CULTURAL opportunities *(vulture)*

successful AGRICULTURAL program *(angry vulture)*

many available JOBS *(jogs)*

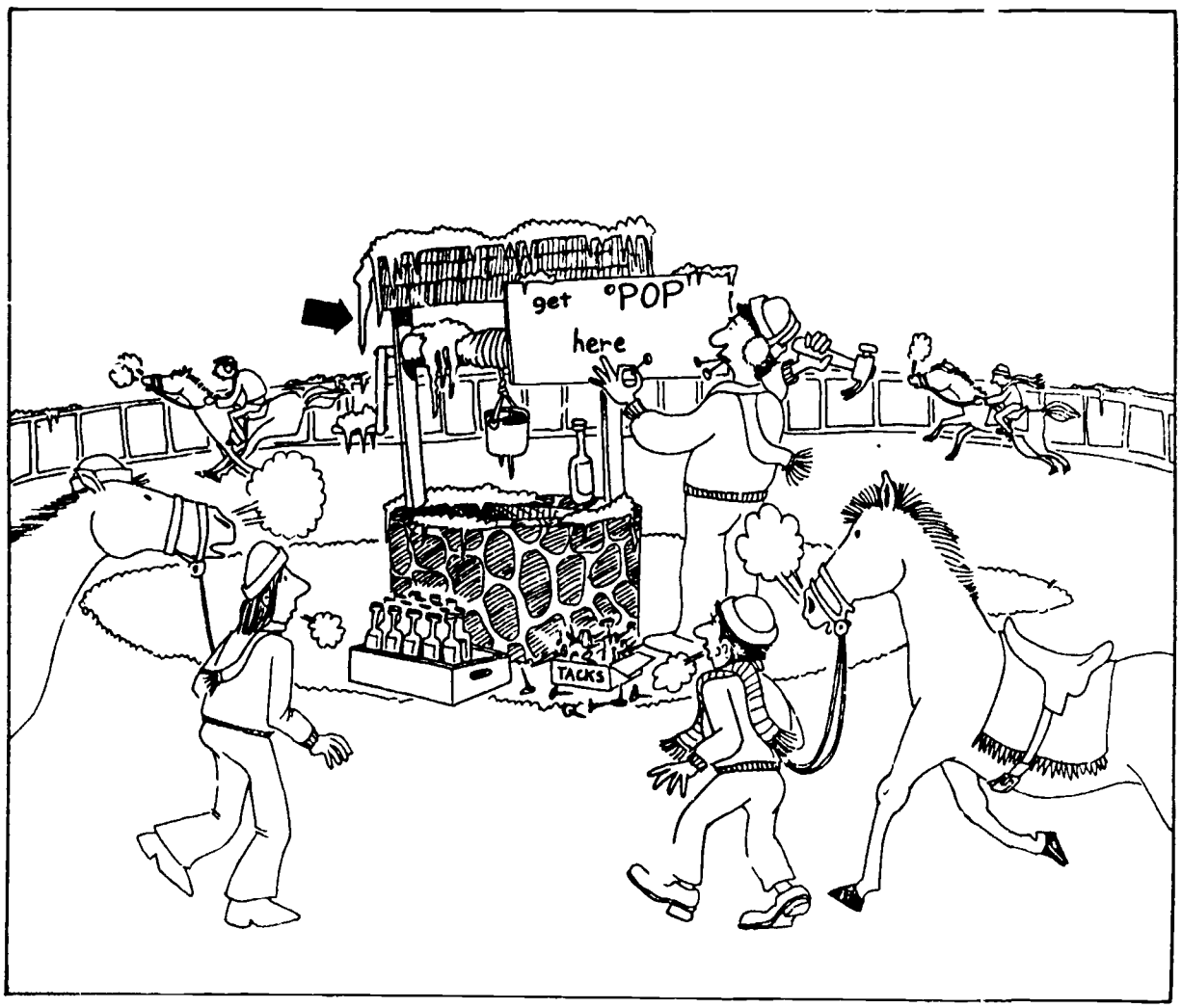
FOSTORIA *(frost)*

considerable WEALTH *(well)*

abundant natural RESOURCES *(race horses)*

advances in TECHNOLOGY *(tacks)*

growing POPULATION *([soda] pop)*



PINECHESTER *(pine chest)*

important port of COMMERCE *(camera)*

citizen participation in local GOVERNMENT *(glove)*

comfortable TEMPERATURES the year 'round *(temple)*

high level of LITERACY *(litter)*

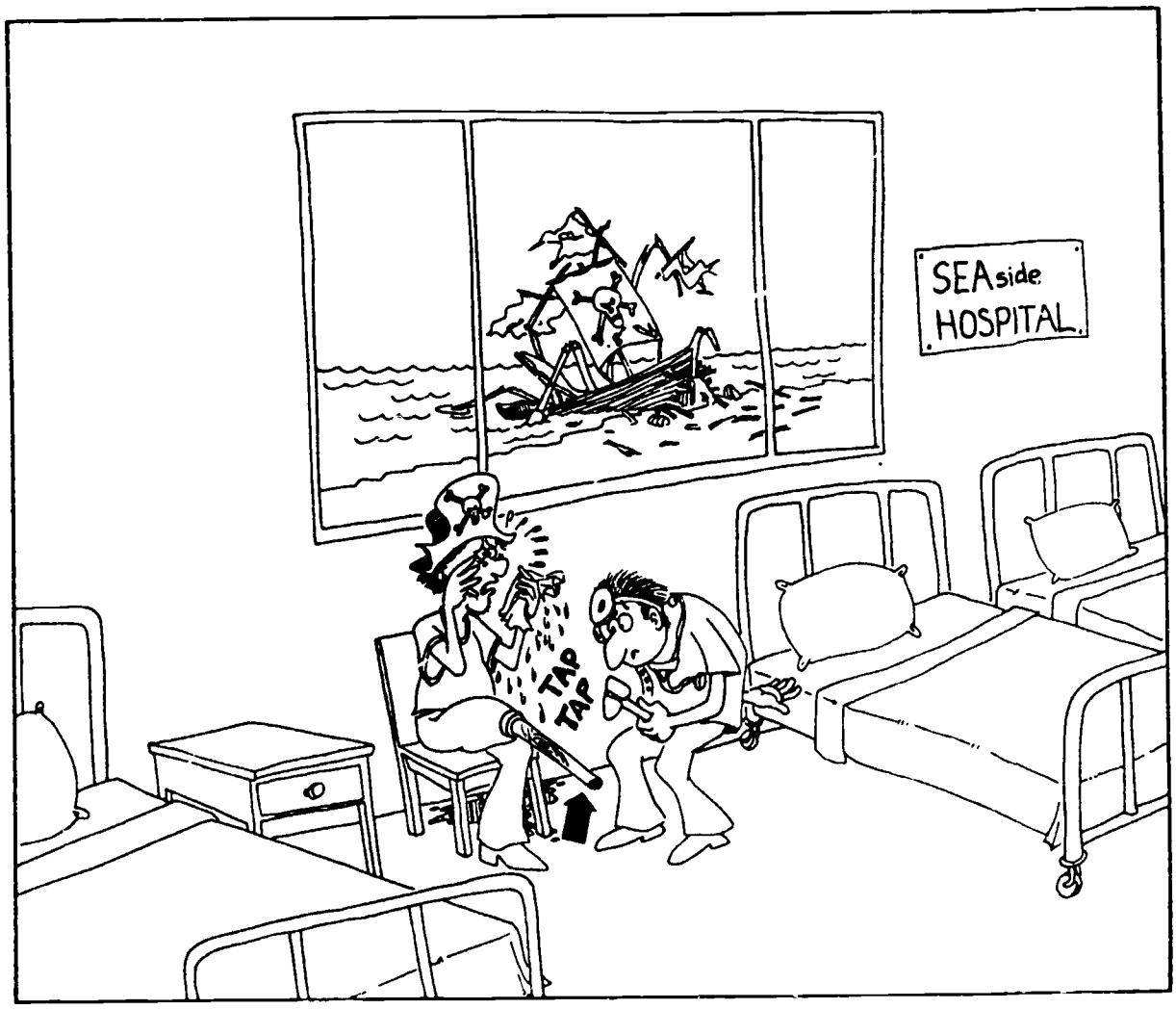
TAPPANWOOD *(tap-on-wood)*

many RECREATIONAL facilities *(wreck)*

free of CRIME *(cry)*

beautiful SCENERY *(sea)*

friendly and HOSPITABLE community *(hospital)*



Appendix D

Test Pages for All Conditions

Recognition Test: Day 1

Name _____

Directions: Below, to the left, is a list of the places that you just read about in the passages. Remember that there were four important features matched with each place. Now, below to the right, is a list of all the features for all the places. Your task is to identify the four features that go with each place, and to write the letters of these features in the blanks provided. Even though you may not be able ro remember everything, please fill in all the blanks.

FOSTORIA	___ ___ ___ ___	a) excellent cultural opportunities
		b) long life span
		c) exciting town history
PLEASANTVILLE	___ ___ ___ ___	d) important port of commerce
		e) successful agricultural program
		f) growing population
HAMMONDTOWN	___ ___ ___ ___	g) many recreational facilities
		h) citizen participation in local government
		i) free of crime
PINECHESTER	___ ___ ___ ___	j) comfortable temperatures the year 'round
		k) winning sports teams
		l) old-fashioned charm
TAPPANWOOD	___ ___ ___ ___	m) advances in technology
		n) friendly and hospitable community
		o) efficient mass transportation system
		p) many available jobs
		q) beautiful scenery
		r) abundant natural resources
		s) high level of literacy
		t) considerable wealth

Recognition Test: Day 4

Name _____

Directions: A few days ago, you were given special instructions for learning about make-believe places and the features that describe these places. At the end of the lesson, you were asked to match the features with the places they go with. Today, you will be asked to do the same task again.

Below, to the left, is a list of the places that you had read about in the passages. Remember that there were four important features matched with each place. Now, below to the right, is a list of all the features for all the places. Try very hard to think back to the instructions that you were given in your study book for remembering this information. Then, using the method that you were instructed in, try to identify the four features that go with each place, and to write the letters of these features in the blanks provided.

Even though you probably won't be able to remember everything, please fill in all the blanks.

TAPPANWOOD ____ ____ ____ ____

HAMMONDTOWN ____ ____ ____ ____

PLEASANTVILLE ____ ____ ____ ____

PINECHESTER ____ ____ ____ ____

FOSTORIA ____ ____ ____ ____

a) free of crime

b) growing population

c) long life span

d) citizen participation in local government

e) high level of literacy

f) important port of commerce

g) abundant natural resources

h) many recreational facilities

i) friendly and hospitable community

j) comfortable temperatures the year 'round

k) successful agricultural program

l) efficient mass transportation system

m) exciting town history

n) many available jobs

o) old-fashioned charm

p) considerable wealth

q) winning sports teams

r) beautiful scenery

s) advances in technology

t) excellent cultural opportunities

Recall Test: Day 1

RL-1

Name _____

Directions: Below is a list of the places that you just read about in the passages. Recall that there were four important features matched with each place. Your task is to remember the four features that go with each place, and to write in these features in the blanks provided. Whenever possible, use exactly the same words for the features that were used in the passages and study pages.

Even though you may not be able to remember every word in a feature, or every feature for a place, please write in as much as you can remember. Write as much as you can about each feature on each line.

FOSTORIA

_____

_____

_____

_____

PLEASANTVILLE

_____

_____

_____

_____

HAMMONDTOWN

PINECHESTER

TAPPANWOOD

Recall Test: Day 4

RL-3

Name _____

Directions: A few days ago, you were given special instructions for learning about make-believe places and the features that describe these places. At the end of the lesson, you were asked to write in the features that go with each place. Today, you will be asked to do the same task again.

Below is a list of the places that you had read about in the passages. Recall that there were four important features matched with each place. Try very hard to think back to the instructions that you were given in your study book for remembering this information. Then, using the method that you were instructed in, try to remember the four features that go with each place, and to write in these features in the blanks provided. Whenever possible, use exactly the same words for the features that were used in the passages and study pages.

Even though you probably won't be able to remember every word in a feature, or every feature for a place, please write in as much as you can remember. Write as much as you can about each feature on each line.

TAPPANWOOD

_____

_____

_____

_____

HAMMONDTOWN

_____

_____

_____

_____

PLEASANTVILLE

PINECHESTER

FOSTORIA

Appendix E

Raw Scores for All Subjects by Task Condition and Treatment Condition

Treatment Condition: Control-Passage

Task Condition: Recognition

	Day 1		Day 4		
Subject Number	Town-Attribute Pairings	Attribute Clusterings	Town-Attribute Pairings	Attribute Clusterings	STEP Test Score
CP-RN-01	9	10	8	7	39
CP-RN-02	15	16	4	15	48
CP-RN-03	7	5	5	7	41
CP-RN-04	13	14	13	19	42
CP-RN-05	5	11	5	4	50
CP-RN-06	5	8	6	7	44
CP-RN-07	9	5	9	6	34
CP-RN-08	2	4	6	4	42
CP-RN-09	8	9	9	7	47
CP-RN-10	6	4	6	4	47
CP-RN-11	5	12	4	4	49
CP-RN-12	9	13	2	6	42
CP-RN-13	6	5	6	5	45
CP-RN-14	6	5	3	5	42
CP-RN-15	14	15	10	9	49
CP-RN-16	10	19	8	6	42
CP-RN-17	10	12	12	10	43
CP-RN-18	5	10	8	4	43
CP-RN-19	7	7	8	5	41
CP-RN-20	17	21	12	15	47
CP-RN-22	9	13	2	6	48
CP-RN-23	8	8	4	8	48

Treatment Condition: Control-List

Task Condition: Recognition

Subject Number	Day 1 Town-Attribute Pairings	Day 1 Attribute Clusterings	Day 4 Town-Attribute Pairings	Day 4 Attribute Clusterings	STEP Test Score
CL-RN-01	13	12	9	8	42
CL-RN-02	9	7	10	10	41
CL-RN-03	5	7	6	7	38
CL-RN-04	10	24	14	15	47
CL-RN-05	12	11	7	7	49
CL-RN-07	6	12	5	3	47
CL-RN-08	15	16	9	6	45
CL-RN-09	3	9	3	5	32
CL-RN-10	7	9	7	6	36
CL-RN-11	8	16	1	6	43
CL-RN-12	6	9	3	8	47
CL-RN-13*	8	16	1	7	--
CL-RN-14	7	7	6	4	46
CL-RN-16	11	10	7	4	43
CL-RN-17	13	14	6	8	49
CL-RN-18	2	7	6	5	46
CL-RN-19	16	19	5	3	26
CL-RN-20	4	7	8	7	29
CL-RN-21	11	10	4	5	45
CL-RN-22	4	7	6	3	43

*Not included in STEP Test X Condition analysis

Treatment Condition: Keyword-Symbol Picture

Task Condition: Recognition

	Day 1		Day 4		
Subject Number	Town-Attribute Pairings	Attribute Clusterings	Town-Attribute Pairings	Attribute Clusterings	STEP Test Score
KS-RN-01	20	30	20	30	48
KS-RN-02	10	10	2	4	27
KS-RN-03	10	7	7	8	45
KS-RN-04*	18	24	18	24	--
KS-RN-05	18	24	18	24	48
KS-RN-06	6	11	4	15	45
KS-RN-07	17	21	13	11	48
KS-RN-08	20	30	20	30	45
KS-RN-09	17	21	10	24	41
KS-RN-10	16	22	18	24	35
KS-RN-12*	12	30	8	19	--
KS-RN-13	18	24	18	24	45
KS-RN-15	20	30	20	30	43
KS-RN-16	20	30	18	24	47
KS-RN-17	14	24	5	7	43
KS-RN-18	20	30	20	30	41
KS-RN-19	20	30	18	24	39
KS-RN-20	18	24	20	30	39
KS-RN-21	20	30	18	24	47
KS-RN-22	15	18	10	12	49
KS-RN-23	20	30	13	24	50
KS-RN-24	12	21	11	11	31

*Not included in STEP Test X Condition analysis

Treatment Condition: Keyword-Keyword Picture

Task Condition: Recognition

	Day 1		Day 4		
Subject Number	Town-Attribute Pairings	Attribute Clusterings	Town-Attribute Pairings	Attribute Clusterings	STEP Test Score
KK-RN-01*	13	12	5	6	--
KK-RN-02	20	30	16	18	50
KK-RN-03	14	13	5	4	43
KK-RN-04	20	30	20	30	49
KK-RN-05	9	5	4	5	33
KK-RN-06	8	8	4	3	30
KK-RN-07	20	30	20	30	50
KK-RN-09	9	5	5	5	48
KK-RN-10	20	30	20	30	47
KK-RN-11	9	15	5	10	40
KK-RN-12	17	21	9	5	47
KK-RN-13	16	19	14	16	47
KK-RN-14	20	30	16	22	47
KK-RN-15	15	18	6	6	42
KK-RN-16	17	21	13	12	47
KK-RN-18	20	30	18	24	38
KK-RN-19	5	6	2	5	45
KK-RN-20	8	4	11	9	43
KK-RN-21	18	24	15	18	48
KK-RN-22	8	5	8	6	38
KK-RN-23	12	9	12	10	35

*Not included in STEP Test X Condition analysis

Treatment Condition: Control-Passage

Task Condition: Recall

Subject Number	Day 1 Town-Attribute Pairings		Day 1 Attributes		Day 4 Town-Attribute Pairings		Day 4 Attributes		STEP Test Score
	Verbatim	Essence	Unconditional Clustering	Number Recalled	Verbatim	Essence	Unconditional Clustering	Number Recalled	
CP-RL-01	2.5	3.5	1	4	0.0	0.0	0	2	39
CP-RL-02	3.0	4.0	1	5	0.0	0.0	1	5	43
CP-RL-03	3.5	4.5	6	6	0.5	2.0	0	2	35
CP-RL-04	0.0	0.0	0	4	0.0	0.0	3	4	43
CP-RL-05	5.0	5.0	3	7	0.0	0.0	0	2	45
CP-RL-06	3.5	4.0	4	9	0.5	1.0	3	6	43
CP-RL-07	0.0	0.0	1	5	0.0	0.0	6	7	43
CP-RL-08	3.5	4.0	3	6	1.0	2.0	1	4	39
CP-RL-09	2.0	4.0	3	6	0.5	1.0	1	3	44
CP-RL-10	7.5	10.0	9	13	3.0	4.0	2	6	42
CP-RL-11	7.0	8.0	9	10	0.0	0.0	6	9	43
CP-RL-12	1.5	1.5	4	9	0.5	0.5	1	5	33
CP-RL-13	0.0	0.0	4	8	0.0	0.0	2	3	34
CP-RL-14	2.5	3.5	4	9	2.5	5.0	4	7	41
CP-RL-15	10.0	11.0	13	13	6.5	8.5	6	10	48
CP-RL-16	7.5	12.5	14	16	3.5	6.5	6	9	41
CP-RL-17	9.5	13.0	16	15	7.0	9.0	7	11	48
CP-RL-18	2.5	3.5	1	5	1.0	1.5	1	2	38
CP-RL-19	0.5	0.5	1	4	0.0	0.0	1	4	30
CP-RL-20	9.0	10.0	22	17	5.5	7.0	11	13	49
CP-RL-21	3.0	4.0	3	8	0.0	0.0	1	6	38

Treatment Condition: Control-List

Task Condition: Recall

Subject Number	Day 1 Town-Attribute Pairings		Day 1 Attributes		Day 4 Town-Attribute Pairings		Day 4 Attributes		STEP Test Score
	Verbatim	Essence	Unconditional Clustering	Number Recalled	Verbatim	Essence	Unconditional Clustering	Number Recalled	
CL-RL-01*	0.5	0.5	1	4	0.5	0.5	0	1	--
CL-RL-02	0.0	0.0	6	6	0.0	0.0	0	3	36
CL-RL-03	1.5	1.5	0	5	1.0	1.0	0	4	43
CL-RL-04	5.0	5.0	6	9	0.0	0.0	3	3	40
CL-RL-05	3.5	5.0	6	5	2.0	4.0	3	4	48
CL-RL-06	0.5	1.0	0	8	3.0	5.0	3	8	37
CL-RL-07	5.5	7.0	8	9	4.0	5.5	4	7	42
CL-RL-08	4.0	4.0	5	7	0.5	0.5	1	4	49
CL-RL-09	2.5	3.5	4	8	0.0	0.0	2	5	37
CL-RL-10	3.0	5.0	3	6	0.5	1.0	0	5	44
CL-RL-11	1.0	1.0	0	5	0.0	0.0	0	2	35
CL-RL-12	6.5	9.0	10	12	4.0	5.0	2	6	46
CL-RL-13	1.5	4.5	12	13	0.0	0.0	8	11	42
CL-RL-14	2.0	2.0	1	3	0.0	0.0	0	1	34
CL-RL-15	2.5	4.5	3	5	1.0	1.0	0	2	48
CL-RL-16	4.0	5.5	6	9	1.0	3.0	0	5	47
CL-RL-17	2.0	3.0	0	5	1.5	2.0	1	8	49
CL-RL-18	4.0	4.0	4	7	0.0	0.0	2	4	47
CL-RL-19	8.5	9.5	8	12	2.0	2.0	1	3	49
CL-RL-20*	5.0	6.5	9	10	1.0	1.5	1	4	--
CL-RL-21	4.0	5.0	7	8	3.5	4.0	6	4	41
CL-RL-22	7.0	12.0	15	16	3.0	5.0	2	5	50
CL-RL-23	4.0	6.0	4	9	1.5	1.5	1	5	33

*Not included in STEP Test X Condition analysis

227

Treatment: Keyword-Symbol Picture Task Condition: Recall

Subject Number	Day 1 Town-Attribute Pairings		Day 1 Attributes		Day 4 Town-Attribute Pairings		Day 4 Attributes		STEP Test Score
	Verbatim	Essence	Unconditional Clustering	Number Recalled	Verbatim	Essence	Unconditional Clustering	Number Recalled	
KS-RL-01	9.5	15.5	21	17	8.0	13.5	18	16	44
KS-RL-02	6.5	17.0	27	19	6.0	16.0	27	19	43
KS-RL-03	9.5	16.0	24	18	9.5	16.0	24	18	45
KS-RL-04	7.0	13.5	22	17	3.0	7.0	19	16	36
KS-RL-05	6.5	9.0	24	17	6.5	11.5	25	18	49
KS-RL-06	7.5	12.0	24	18	9.5	18.0	24	18	47
KS-RL-07	6.0	11.0	13	12	4.0	7.0	12	12	46
KS-RL-08	11.5	16.5	25	18	10.0	16.5	25	18	49
KS-RL-09	6.5	8.0	15	14	5.5	7.5	13	12	48
KS-RL-10	10.0	17.0	24	18	9.0	16.0	22	17	42
KS-RL-11	5.0	7.0	10	10	5.0	9.0	13	11	45
KS-RL-12	10.5	17.0	24	18	7.0	15.5	22	18	39
KS-RL-14	9.5	13.0	14	15	9.5	16.0	19	16	49
KS-RL-15	12.5	15.5	21	17	10.0	15.5	21	17	46
KS-RL-16	9.0	16.5	21	18	5.5	13.5	15	15	41
KS-RL-17	9.5	13.5	27	19	8.0	15.0	27	19	46
KS-RL-18	2.0	5.0	4	9	1.0	1.5	4	7	16
KS-RL-19	3.5	4.0	27	19	0.0	0.0	6	9	50
KS-RL-20	10.5	16.0	22	17	9.5	16.0	22	17	42
KS-RL-21	9.0	13.5	24	18	9.0	11.5	22	17	41
KS-RL-22	5.5	10.0	18	16	3.0	6.5	11	13	30
KS-RL-23	5.0	7.0	13	13	4.0	5.0	12	10	38
KS-RL-24	13.5	18.5	27	19	13.5	19.0	27	19	50

228

Treatment: Keyword-Keyword Picture

Task Condition: Recall

Subject Number	Day 1 Town-Attribute Pairings		Day 1 Attributes		Day 4 Town-Attribute Pairings		Day 4 Attributes		STEP Test Score
	Verbatim	Essence	Unconditional Clustering	Number Recalled	Verbatim	Essence	Unconditional Clustering	Number Recalled	
KK-RL-01	1.5	1.5	13	13	0.0	0.0	0	3	45
KK-RL-04	2.0	2.0	10	12	2.0	2.5	1	8	47
KK-RL-05	11.0	13.0	24	18	9.5	10.5	24	18	50
KK-RL-06	6.5	10.0	16	15	7.5	9.0	19	16	43
KK-RL-07	7.0	11.0	12	11	7.0	12.0	10	12	45
KK-RL-08	2.5	3.5	3	4	0.5	1.0	0	1	44
KK-RL-09	0.5	1.0	0	4	0.5	1.0	0	3	40
KK-RL-10	4.0	5.0	24	18	2.5	2.5	12	12	45
KK-RL-12	8.5	11.0	18	16	7.5	9.5	18	16	43
KK-RL-13	12.5	20.0	30	20	12.0	17.5	27	19	47
KK-RL-14	2.5	4.0	4	6	2.0	2.0	1	5	33
KK-RL-15	3.5	3.5	16	15	3.0	3.0	13	14	46
KK-RL-16	9.5	14.0	17	15	9.0	13.0	14	14	49
KK-RL-17	1.5	1.5	11	12	0.0	0.0	0	1	35
KK-RL-18	2.0	2.0	3	4	0.0	0.0	4	5	35
KK-RL-19	0.0	0.0	9	9	0.0	0.0	6	7	29
KK-RL-20	4.0	6.5	5	8	2.5	4.5	2	6	38
KK-RL-21	3.0	3.0	15	13	0.0	0.0	10	10	38
KK-RL-22	5.0	5.5	24	18	3.5	3.5	21	16	39
KK-RL-23	10.0	12.0	13	13	8.5	12.0	13	13	47

229