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Ashley E. Maynard, Georgina R. Slavoff, John D. Bonvillian

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LEARNING & RECALL OF WORD-SIGN PAIRS: THE IMPACT OF SIGN ETYMOLOGY

Ashley E. Maynard
Georgina R. Slavoff
John D. Bonvillian

Abstract

In this study we examined the effect of providing information on the etymology or origin of a sign and memory for that sign. Eighty-two subjects, undergraduate students unfamiliar with American Sign Language (ASL), were presented lists of ASL signs and their English translation equivalents in one of three experimental conditions: sign etymology supplied, sign motor rehearsal, and no coding instructions provided. Subjects were tested immediately after list presentation and again after a one-week delay for cued item recall; the ASL signs served as the cues for the English words. In immediate recall, there were only small differences across experimental conditions. In delayed recall, those subjects who received the sign etymologies remembered more sign-word pairs than the subjects in the other two conditions. Those who received the etymologies also showed smaller decrements in recall levels across the one-week delay. Apparently, learning about a sign's origin facilitates long-term sign retention. These findings are interpreted within the framework that deeper, more distinctive, or more elaborative processing of information aids its retention.

Memory for vocabulary

The bane of many students who try to learn a second language is a failure to remember newly-presented vocabulary items. New entries in the students' lexicons all too often are rapidly forgotten despite considerable classroom time devoted to vocabulary drills and exhortations from their instructors to study harder. Historically, most efforts at building a vocabulary in a second language entail only the study of spoken language. In more recent years, however, growing numbers of students have begun to learn signed languages. Unfortunately for them, forgetting recently-learned vocabulary items appears to obey no language modality boundary; signs, too, are prone to be forgotten.

The acquisition of a sign vocabulary has become vitally important to a wide range of hearing persons in recent years. One

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group of hearing persons eager to learn signs is made up of individuals who wish to improve their communicative interactions with deaf relatives, deaf friends, deaf students, or deaf customers who sign. A second sign-learning group consists of people who, despite adequate hearing, are unable to produce useful spoken language. Some may have lost their ability to speak after a cerebrovascular accident or stroke, whereas other hearing but nonspeaking individuals (e.g., persons with autism, mental retardation, or cerebral-palsy) may never have attained even minimal spoken language skills. Many of these individuals, however, may be able to learn to communicate their basic needs and desires through signs (Christopoulou & Bonvillian 1985, Layton 1987). Because such sign-using aphasic, autistic, mentally retarded, and cerebral-palsied persons typically need teachers and caregivers who can communicate in signs, these teachers and caregivers constitute a third group of sign-learning hearing persons. Finally, there are hearing persons who simply want to learn signs as part of mastering a new language in a different mode. Any pedagogical or training approach that would facilitate the learning and retention of signs would benefit members of all these groups.

How then might the learning and retention of signs be facilitated? One approach might be simply to rehearse the sign. As many investigators (e.g., Atkinson & Shiffrin 1968, Bonvillian, Althaus, Orlansky & Slade 1987, Rundus & Atkinson 1970) have shown, the more times you repeat a particular item, such as a name, address, telephone number, word, or sign, the more likely you are to remember it. Although this approach often is successful in keeping particular information in an individual's immediate or working memory and, consequently, facilitating short-term item recall, such maintenance rehearsals typically have little positive effect on memory in the long run. Indeed, Craik and Watkins (1973) showed that the number of rehearsals that a particular item received was not a good predictor of that item's long-term recall. Rather, as Craik and Lockhart (1972, Lockhart & Craik 1990) have argued, the nature and duration of a memory trace is determined largely by the level at which the information is processed; deeper or more elaborative processing was associated

with higher item retrievability than was processing at a shallow level.

It has been repeatedly demonstrated that processing information at a deeper level facilitates memory. For example, when subjects comprehend the meaning of stimulus items, they are more likely to remember them. This observation has been the basis for an experimental approach that has revealed the powerful effects of increased depth of processing across a range of stimulus types, including words or sentences (Craik & Tulving 1975), nonmeaningful gestures (Woodall & Folger 1985), and pictures (Bower, Karlin & Dueck 1975). In the Bower et al. study, it was hypothesized that people would remember "nonsensical" pictures ("droodles") better if they were given explanations of the pictures than if no such explanations were provided. Subjects studied "droodles" at 10-second intervals, with one subject group receiving explanations of the pictures. All subjects then took a recall test and, one week later, a multiple-choice recognition test from which they were to choose the "droodles" they had seen previously. It was found that picture comprehension considerably enhanced item retention. A similar increase in depth of processing or stimulus elaboration at encoding might also facilitate sign learning and recall. After all, signs resemble words in that signs stand for concepts and are part of a language system, signs resemble gestures in that signs are motorically produced, and signs resemble pictures in that signs are visually transmitted.

In the United States, the signs that hearing adults would be likely to be taught come from American Sign Language or ASL. ASL is the principal means of communication among prelingually deaf persons in the U.S. (Padden 1980). Today, ASL is viewed by virtually all linguists as a complete language, although widespread acceptance of ASL as a legitimate language is relatively recent (Sacks 1989). In the past, ASL was described as primarily pantomime with a limited grammatical structure (as were sign languages used by deaf persons in other countries). More detailed and systematic accounts, however, revealed that ASL has an extensive vocabulary, distinct formational characteristics, and rule-governed grammatical and morphological processes (Klima & Bellugi 1979, Stokoe, Casterline & Croneberg 1965). These

same accounts identified the presence of many pantomimic or iconic (resembling the concepts they stand for) signs in ASL, but tended to downplay the significance of sign iconicity in ASL usage. Moreover, the pantomimic or iconic aspect of some ASL signs does not appear to play an important role in young children of deaf parents' early sign language acquisition (Folven & Bonvillian 1991, Orlansky & Bonvillian 1984). Instead, young children appear to learn ASL signs as elements of a conventionalized communication system much as children learning to speak acquire a spoken language vocabulary.

Although the effect of iconicity on young children of deaf parents' sign language acquisition may be limited, the iconic or pantomimic aspect of particular signs appears to help many hearing persons acquire them. Indeed, iconic signs typically are more easily learned and remembered by autistic children (Konstantareas, Oxman & Webster 1978), mentally retarded children (Reichle, Williams & Ryan 1981), and young children with normal abilities (Brown 1977). The usefulness of iconicity for the ASL vocabulary acquisition of hearing individuals, however, is severely constrained by the relatively low incidence of such signs. Only a small minority of ASL signs are iconic or pantomimic, with most estimates of the proportion of ASL signs with readily transparent meanings ranging between 10 and 15 percent (Lloyd, Loeding & Doherty 1985). The low incidence of such signs is borne out by the finding that when hearing individuals unfamiliar with ASL are asked to guess the meanings of ASL signs, they are correct on only a small fraction of the ASL signs shown to them (Hoemann 1975, Klima & Bellugi 1979).

Although only a small proportion of ASL signs are iconic or pantomimic, other ASL signs incorporate a minor feature of the referent into the sign. Because the tie between this feature and the meaning of the sign is not readily apparent—or downright obscure—few hearing persons accurately guess the meaning of the sign from this minor feature. If the tie between the particular feature and the meaning of the sign were to be explained to the learner, then it is probable that this information would facilitate the sign's learning and recall.

An explanation of the tie between feature and referent often is provided in stories about a sign's origin. That is, accounts of the etymology of signs often serve to illuminate the relationships between seemingly minor features and their referents. For example, the sign for 'girl' or 'female' is made with the thumb of a fist brushing down along the cheek toward the chin; this is purportedly where old-fashioned bonnet strings were tied. Interestingly, some of these reports may not be accurate, but such "etymologies" may persist because they help people understand and remember the signs. Thus, an explanation of a feature and referent relationship may need only be plausible to help someone comprehend the sign and remember it better.

In the present study, three different sign-learning conditions are examined. They were selected in part because they resemble the ways sign vocabulary often is taught to hearing students in a classroom setting. Teachers frequently demonstrate how each sign is formed, ask students to form or imitate each sign, and provide the translation equivalent for each sign. Teachers sometimes comment on a sign's origin and provide an explanation of the tie between the particular sign gesture produced and its meaning or referent.

In the current investigation, an experimenter demonstrated ASL signs while simultaneously uttering their respective English translation equivalents. The participants in the study were then given tests of immediate and delayed cued item recall. One group in this study, those persons in the "etymology" condition, received a brief explanation from an experimenter of the purported tie between each sign and its referent. A second group, those in the "motor rehearsal" condition, were instructed to repeat each sign after it was demonstrated by an experimenter. Those persons in the third, or control, condition received no instructions as to sign learning or recall; they were free to use any (or no) strategy to help them recall each sign and word pair. Although we believed that the etymology information might facilitate immediate recall, we anticipated that any encoding effects would be more pronounced over time. Thus, we hypothesized that those persons who received the sign etymologies would perform better than the participants in the other groups on the delayed cued recall test.

Furthermore, it was also hypothesized that the individuals in the etymology condition would show smaller decrements in performance between the immediate and delayed recall tests than those individuals in the other two conditions.

The experiment

The subjects were 82 undergraduate students (43 women, 39 men) from the University of Virginia who participated in return for credit in their introductory psychology course. Participation in the study was restricted to students who said they were unfamiliar with ASL signs and who were right-handed. None had any discernible visual or physical disabilities that might have impaired sign perception or production. One male student who did not complete the second part of the study was dropped from the investigation. The data analyses were conducted on the 82 subjects who completed both parts of the study.

The gestural stimuli consisted of 44 signs as depicted in an ASL dictionary (Stokoe et al. 1965) and an English sign for word phrase book (Riekehof 1978). Four of these signs were used for practice purposes only; the remaining 40 were the actual test stimuli. The signs were selected from the two dictionaries according to the following criteria: (a) each sign consisted of a single unitary gesture; (b) signs did not closely resemble each other motorically; (c) no sign required either heightened facial expression or bodily movement; and (d) signs whose meanings were clearly transparent, such as pantomimic or highly iconic signs, were excluded. Signs were deemed to be transparent or not on the basis of previous research (Bellugi & Klima 1976, Hoemann 1975) and our own subjective judgments. Each of the 40 signs selected as a test stimulus item was then randomly assigned to one of two sets, resulting in two sets of 20 each.

Each of the 44 signs selected as practice and test stimuli was depicted on a 5x8 inch index card along with a one-word gloss in English. Each of the signs and its translation constituted one sign and word pair. Also on each card was a brief description of the sign's origin or etymology. In most cases, the etymology used was adapted from Riekehof's (1978) listing of the sign's origin. To control for any effects attributable to repetition of English

words, etymologies did not repeat any of the words given as English translation equivalents.

In the present study, we examined the effects of experimental condition on immediate and delayed recall. There were two independent variables: experimental (or instructional) condition and time. The three groups that constituted the first independent variable, experimental condition, were (a) providing each sign's etymology or origin, (b) having the subject motorically rehearse or repeat each sign, and (c) giving no specific instructions. The second independent variable, time, was a repeated measure consisting of immediate and delayed cued item recall. The immediate recall test was administered right after an experimenter had presented each of the two sets of sign-word pairs; the delayed recall test was administered one week later. The dependent variable was operationalized as the percentage of English words written down correctly to the sign cues on each of the recall tests.

Procedure

Each subject was tested individually by one of two adult female experimenters, the first and second authors. After signing up for a testing session, each subject was randomly assigned to one of the three experimental conditions. Placement was constrained to ensure that each condition had about the same number of subjects and equal proportions of men and women. The two experimenters tested approximately equal numbers of men and women in all instructional conditions. Prior to each session, the order of the 20 cards in the two sets of test stimuli was randomized. For their testing sessions, individual subjects entered a laboratory room and were seated facing their experimenter about 1.5 meters away. Each experimenter wore a plain dark top to enhance the visibility of her sign presentations. The experimenters demonstrated each sign while seated. Each subject, after completing an informed consent form that provided a brief overview of the study, was given a test booklet consisting of an instruction sheet and two answer sheets.

From reading the instruction sheet, the subjects learned they were participating in a study of memory and that they would be shown a series of ASL signs together with their English translation equivalents. It was explained that two sets of 20 ASL sign

and English word pairs would be shown. The subjects were told to remember as many of the sign-word pairs as they could. All were informed that they would be given a test of item recall after each list was presented, and that these tests would consist of the subjects writing the English translation equivalent of each sign following its demonstration by the experimenter. Anyone not sure of an item was told to record his or her best guess.

Coding and processing instructions varied according to the experimental condition to which the subject had been assigned. Subjects in the Etymology condition were told that the experimenter would briefly explain the derivation or origin of each sign after she had demonstrated the sign and given its English translation equivalent. Those in this condition were urged to pay attention to each sign's etymology. Subjects in the Motor Rehearsal condition were instructed to form or imitate each sign after it had been demonstrated by the experimenter. They were told to rehearse each sign motorically as often as they wished—but at least once—during the time allotted for that particular sign. Finally, subjects in the No Instructions (or control) condition received no specific coding or item rehearsal instructions. These subjects were free to employ any approach or strategy they thought might help them remember the sign-word pairs. Regardless of experimental condition, all were urged to remember as many of the sign-word pairs as they could.

After each subject finished reading the instruction sheet, the experimenter briefly reviewed what each subject was asked to do and answered any questions that had arisen. Next, each of the subjects was given a short practice set consisting of four ASL signs and their respective English translation equivalents. For the practice list, the subjects received the coding or rehearsal instructions appropriate for their experimental condition. After the practice list was completed, the subjects were told that they would not be responsible for remembering these four signs. The experimenter then resolved any problems or confusion that might have emerged during the practice list.

The actual test stimuli were then presented by an experimenter to each of the subjects. Each sign and word pair was presented at 8-second intervals, with the experimenter paced by an interval

timer. (For the subjects in the Etymology condition, the information on the sign's etymology or origin was supplied during this interval.) Immediately after all 20 word-sign pairs in a stimulus set had been presented, the experimenter administered a cued recall test by showing each sign again (without any verbal input) in a random order at 8-second intervals. (This randomization helped ensure that subjects would not simply focus on remembering a list of English words, but rather focus on learning the sign-word pairs.) The subjects were instructed to write the English translation equivalent for each sign, or their best guess for that sign, in the appropriate space on the answer sheet. After the immediate cued recall test of the first set of stimuli was completed, the experimenter instructed the subject to turn the page in the test booklet to the second answer sheet. The second set of word and sign stimuli was then presented and a test of cued recall given as before. The answer sheets were then collected and the subjects reminded to return one week later for the second part of the study. The subjects were not informed at this time as to what the second testing session would entail.

After each subject had departed, the answer sheets were scored for accuracy of recall. To be scored as correct, a subject needed to write the appropriate English translation equivalent of the sign presented. Slight errors in spelling of the translation equivalents were accepted as correct responses unless they resulted in different English words. All of the analyses of recall were based on the subjects' written English responses to the gestural sign stimuli from the two sets of 20 ASL signs each.

Each subject was tested again in the same room one week later by the same experimenter. In this delayed cued recall test, the experimenter demonstrated each of the signs in both sets of stimuli; neither the English translation equivalents nor etymologies were uttered by the experimenter. The signs on each list were presented in random order at 8-second intervals. After each sign was presented, the subject was instructed to write its English translation equivalent (or the subject's best guess) on the answer sheet. The answer sheet was then collected and subsequently scored for accuracy. After the answer sheet was collected, each subject was asked whether he or she had practiced or thought

about the signs and words over the course of the week between the two testing periods.

Results

Each subject was assigned two percentage correct recall scores, one for immediate and the other for delayed recall. Means and standard deviations were then computed for both sets of scores as a function of experimental condition (see Table 1). These scores reveal that there were both clear differences in mean recall levels over time by experimental condition as well as wide individual variability in recall levels.

Table 1: Mean percentage of sign-word pairs correctly recalled (standard deviations shown in parentheses).

	Experimental Condition		
Recall type	Etymology $n = 27$	Motor rehearsal $n = 26$	No instructions $n = 29$
Immediate	70.1 (18.2)	61.4 (16.3)	66.7 (15.9)
Delayed	48.9 (22.9)	33.4 (15.2)	37.9 (14.2)

The main prediction of the study was that subjects who were provided with the etymology of each sign, at initial presentation, would remember more sign-word pairs during delayed recall than either those subjects who used motor rehearsal or received no instructions. An analysis of variance for the three conditions (Etymology, Motor Rehearsal, and No Instructions) indicated a significant overall difference in delayed recall level, $F_{(2,79)} = 5.37$, $p < 0.01$. Individual t-tests confirmed the prediction that subjects in the Etymology condition would recall significantly more items than subjects in either the Motor Rehearsal condition ($t_{(51)} = 2.90$, $p < 0.005$, one-tailed) or the No Instructions condition ($t_{(54)} = 2.17$, $p < 0.025$, one-tailed). Percent of items correctly recalled by subjects in the Motor Rehearsal and No Instructions conditions were not significantly different from each other ($t_{(53)} = 1.15$, $p > 0.05$, two-tailed).

In immediate recall, the subjects in the Etymology condition again had the highest average recall levels of the three groups, but the mean scores did not differ significantly. There was no overall difference in the level of item recall by experimental condition, $F_{(2,79)} = 1.82$, $p > 0.05$. When analyzed separately, the percentage of items correctly immediately recalled by the subjects in the Etymology condition did not differ significantly from the recall levels of the subjects in either the Motor Rehearsal or No Instructions conditions. Furthermore, the subjects in the Motor Rehearsal and No Instructions conditions also showed no difference in mean recall levels.

Most persons recall noticeably fewer items after a lengthy delay than they do when they are asked for immediate recall. This general pattern was clearly evident in the present study: A repeated-measures ANOVA revealed a highly significant drop in item recall levels between Time 1 (immediate recall) and Time 2 (delayed recall), $F_{(1,79)} = 317.93$, $p < 0.0001$. Thus, as expected, the subjects' performance on the recall tests decreased over time, independent of experimental condition.

The second major hypothesis of the study was that any decrement in recall levels from Time 1 to Time 2 would be less for the subjects in the Etymology condition than for the subjects in either of the other two groups. Contrary to our expectations, the Time variable did not interact significantly with the condition, $F_{(2,79)} = 2.73$, $p > 0.05$. Individual, planned t-tests, however, revealed that the subjects in the Etymology condition showed a significantly smaller decrement between immediate and delayed recall ($M_{(\text{E-DIFF})} = 8.48$) than those subjects in the Motor Rehearsal ($M_{(\text{MR-DIFF})} = 11.19$) condition, ($t_{(51)} = 1.73$, $p < 0.05$, one-tailed) and those in the No Instructions ($M_{(\text{NI-DIFF})} = 11.52$) condition ($t_{(54)} = 2.14$, $p < 0.025$, one-tailed). These findings provide support for the second hypothesis. For the subjects in the Motor Rehearsal and No Instructions conditions, the decline in the number of items correctly remembered between immediate and delayed recall was very similar: $t_{(53)} = .25$, $p > 0.05$.

An entirely unexpected effect was uncovered when recall performance was examined to determine whether or not there were

any sex differences in recall levels. Women, in immediate recall, remembered significantly more sign-word pairs than the men: $F_{(1,80)} = 7.01$, $p < 0.01$. Moreover, the only experimental condition in which the men remembered in immediate recall about as many items as the women, occurred when the subjects were instructed to rehearse the signs motorically. In delayed recall, the women subjects still tended to remember more sign-word pairs than the men, but the difference was not statistically significant: $F(1,80) = 3.5$, $p > 0.05$. A series of simple regression analyses was then performed. Sex of the subject was found to be a significant predictor of performance in immediate recall, $R^2 = 0.08$, but not in delayed recall, $R^2 = 0.04$.

Throughout all the analyses there was wide variability in the subjects' recall levels. The subjects, in immediate recall, remembered as few as 12 of the 40 sign-word pair stimuli and as many as 39; in delayed recall, the range was from 1 to 35 correctly recalled items. This wide subject variability raised concerns that the assumption underlying the statistical analyses of relatively constant variance, or homoscedasticity, might not be met. Homoscedasticity was then assessed using *t*-tests, and the data sample found to be relatively homogeneous; the assumption was not violated. Finally, the wide range in individual recall levels in delayed recall did not appear to be related to item practice or sign rehearsal by the subjects during the week between recall tests. When queried by the experimenters, most of the subjects reported that they had either not thought at all about the signs and words during the intervening week or had thought about them very little. None of the subjects reported practicing the signs between the two recall tests.

Serial position effects

Another way to examine the impact of experimental condition on recall is to analyze the relationship between memory for an item and that item's list location, i.e. its serial position, during item presentation. For the present analyses, each 20-item set of sign-word pairs was separated into three sections: primacy, intermediate, and recency. The primacy portion of each list was identified as the first four sign-word pairs presented in the learning trial; the

intermediate section consisted of items 5 to 16; and the recency portion was defined as the last four sign-word pairs presented, items 17-20. As can be seen in Figures 1 and 2, serial position effects differed in the three experimental conditions in both immediate and delayed recall. (For depiction of serial position effects in both immediate and delayed recall, the subjects' recall scores were combined across serial positions 1-4, 5-8, 9-12, 13-16, and 17-20 in each of the figures.)

In immediate recall (see Figure 1), presentation list location appeared to have no discernible impact on recall likelihood for subjects in the Etymology ($F_{(2,78)} = 0.56$, $p > 0.05$) or Motor Rehearsal ($F_{(2,75)} = 0.30$, $p > 0.05$) conditions. In contrast, the subjects in the No Instructions condition tended to remember the terminal items on the presentation list more accurately—a recency effect. An ANOVA revealed an overall significant difference in recall levels in the No Instructions condition across the three item presentation sections ($F_{(2,84)} = 3.25$, $p < 0.05$). Subsequent Newman-Keuls tests revealed that those items at the end of the presentation list tended to be remembered more often (df = 84, $p < 0.05$); other comparisons were not significant.

In delayed recall (see Figure 2), the subjects in the No Instructions condition evidenced a significant drop in recall performance over the serial position of item presentation $F_{(2,84)} = 6.76$, $p < 0.01$. These subjects remembered the primacy section items ($M = 48.7\%$) more than either the intermediate section ($M = 36.5\%$) or the recency section ($M = 31.5\%$) items (df = 84, $p < 0.05$). In contrast, the subjects in the Etymology condition showed little change in recall level over serial position of item presentation, $F_{(2,78)} = 1.20$, $p > 0.05$. Finally, the subjects in the Motor Rehearsal condition were found to differ overall in recall likelihood by serial position, $F_{(2,75)} = 4.53$, $p < 0.05$. Subsequent Newman-Keuls post-hoc tests revealed that these subjects recalled significantly more of the sign-word pairs presented at the beginning of the list ($M = 42.8\%$) than at the end ($M = 26.0\%$) of the list (df = 75, $p < 0.05$); neither the primacy nor recency section items, however, differed significantly from the intermediate portion items ($M = 32.7\%$). These serial position analyses, taken

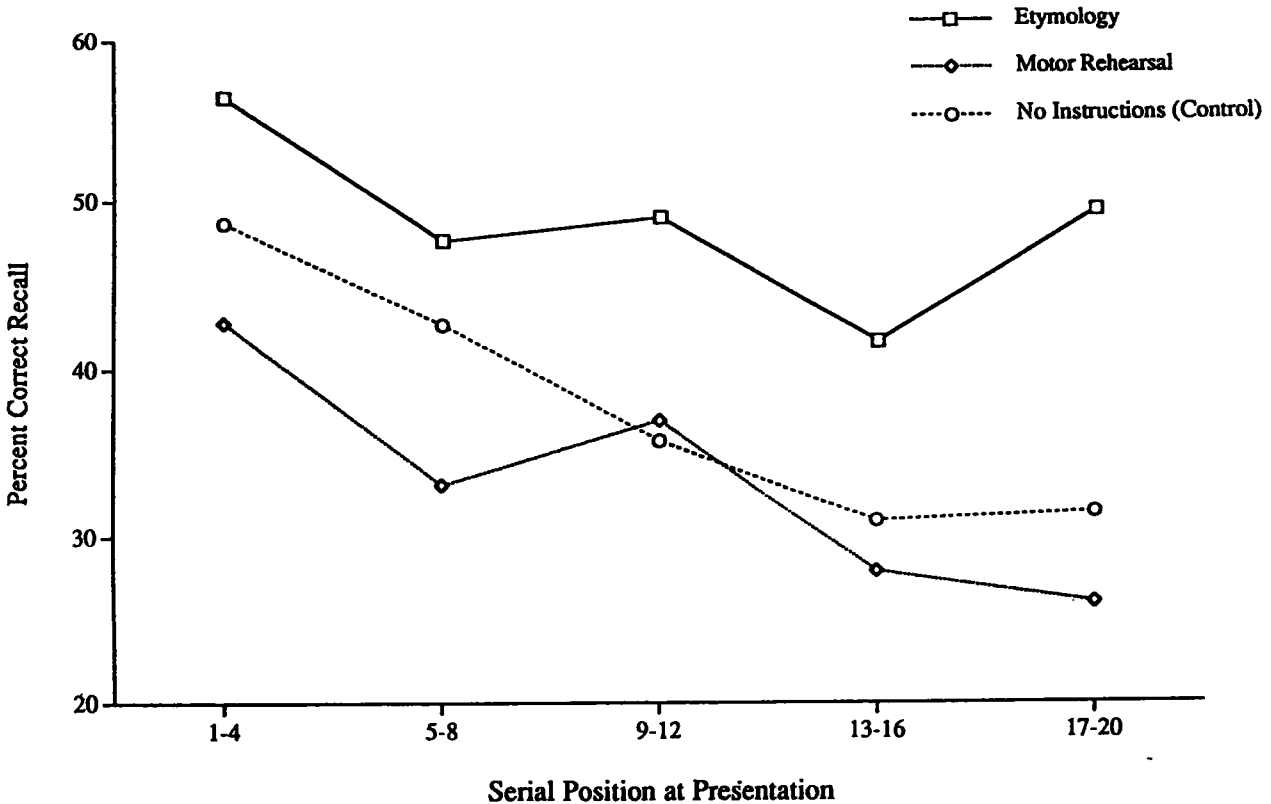

Figure 1. Subjects' correct **immediate** recall in three conditions as a function of serial position of items at presentation.

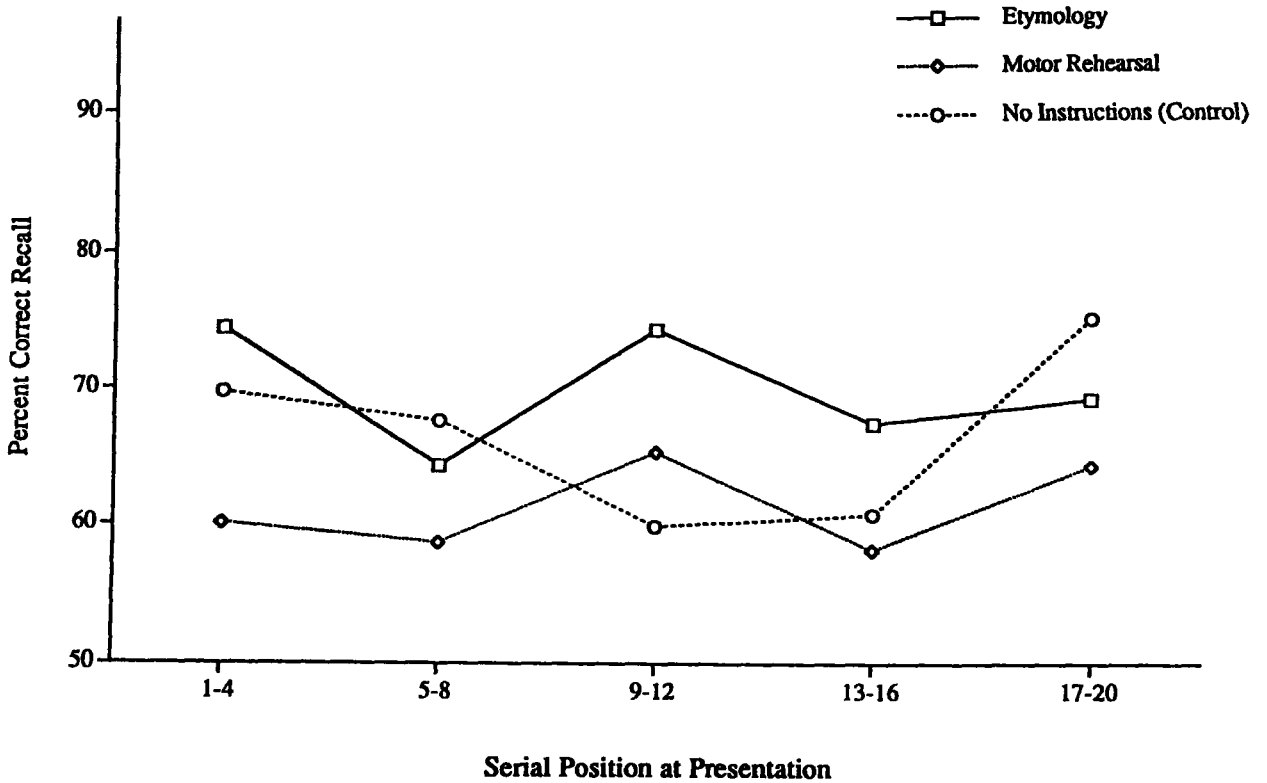

Figure 2. Subjects' correct **delayed** recall in three conditions as a function of serial position of items at

together, thus reveal that the subjects in the three experimental conditions differed in their recall patterns as well as their total recall.

Discussion

This study sought to answer the question: What is the effect of providing information about the origin or etymology of a sign on the likelihood that a sign will be remembered? The answer to this question is that such information appears to be quite helpful in facilitating a sign's long-term retention. More specifically, we formulated two hypotheses regarding the effect of providing sign etymologies on recall. The first was that subjects in the condition where sign etymologies were supplied would have higher delayed recall levels of sign-word pairs than the subjects not given the sign etymologies. The second, albeit related, was that the subjects who had the etymologies provided would show smaller decrements in recall levels over time than the subjects in the other two experimental conditions. The data confirmed both these hypotheses. We had also anticipated that sign etymology information would facilitate subjects' immediate recall. Although the data were in the direction expected—higher average recall levels for subjects in the Etymology condition—the differences between the groups were not statistically significant.

Why did the subjects in the Etymology condition typically remember many more sign-word pairs over time than the subjects in the other two conditions? One interpretive approach, levels of processing, is based on the assumption that memory is the product of both the perception of an event and its comprehension. According to this approach, if what a subject encodes of an event has meaning (i.e. uses semantic processing), then a subject is more likely to remember that event than if a more superficial or nonsemantic aspect of the event is encoded (Ellis & Hunt 1993). Presumably, the subjects in the Etymology condition processed the to-be-remembered information at a deeper or semantic level and consequently outperformed those subjects who had processed the information at a more shallow, nonsemantic level. The present data also are in accord with the findings of numerous studies (e.g., Craik & Tulving 1975, Bower et al. 1975) that have

underscored the importance of comprehension or depth of processing in the retention of information.

Although the levels of processing approach appears to provide a fully adequate interpretive framework for the present findings, alternative explanations need to be considered as well. This is true especially in light of findings that nonsemantic information may be retained as long as semantic information, depending on the circumstances of the particular task involved (Nelson, Walling & McEvoy 1979). In the present study, the cued recall task required successful pairing of a sign with its English translation equivalent, a task clearly facilitated by learning about each sign's etymology. If the memory task had been different, say the production of a sign's handshape, location, or movement, then the outcome might have favored those subjects who received motor rehearsal instructions. One alternative explanation of the present findings would be that the etymologies effectively tied together or integrated each sign-word pair, the task actually being tested. In this distinctiveness approach (Craik 1979), the higher retention level shown by the subjects who received the sign etymologies was determined in part because the information encoded largely specified the event being remembered. A second alternative, the elaboration hypothesis, would claim that the etymologies related additional information to each sign and that this additional information proved helpful in item retention. It should be noted, however, that all three explanations we have outlined are somewhat interrelated. The elaboration approach was first advanced (Craik & Tulving 1975) to help explain why certain semantic information helped subjects although other information did not. Moreover, as subjects would broaden the amount of information they knew about a to-be-remembered event, or event elaboration, that event often would become more distinctive. The interrelated nature of these three interpretive approaches makes it difficult to determine which is the best explanation for the present findings.

As a group, the subjects in the Motor Rehearsal condition tended to recall fewer sign-word pairs correctly than the other subjects. Although this outcome was consistent with the interpretive frameworks discussed above, it ran counter to the expecta-

tions of a university-level sign language instructor and many of the students in her class—when asked by the first author, they had predicted that the rehearsal of signs immediately after they were presented would prove the most effective learning and recall strategy. Their expectations may have been based in part on their experiences learning ASL signs, as they often practiced newly-presented signs by rehearsing them motorically. Despite the relatively poor performance of the subjects in the Motor Rehearsal condition in the present study, it would be premature to dismiss this approach to sign learning. The motor rehearsal of signs probably helps students to learn how to form signs correctly (Wright, Bonvillian & Schulman 1993).

There are, however, no readily apparent reasons why the women subjects typically outperformed the men. One possible explanation is that the women subjects may have processed the sign and word stimuli more effectively or deeply than the men. Some support for this explanation comes from the outcome of the Motor Rehearsal condition, the one experimental condition where there were no sex differences in recall levels and subjects were specifically instructed to engage in a particular type of information processing, item rehearsal. In the other two conditions, where substantial sex differences were evident, the subjects had greater freedom to adopt their own coding and recall strategies. Other possible explanations might be that the presence of only female experimenters may have influenced the subjects' performance, or that the women students were naturally more adept at such coding and recall tasks. This latter explanation seems rather unlikely, however, as all the subjects were students from a highly selective university.

That the experimental conditions had an impact on the subjects other than just affecting their recall totals is evident in the serial position curves. Because the present study utilized a randomized cued recall test rather than free recall, it was anticipated that the U-shaped curve indicative of pronounced primacy and recency effects in immediate memory would be largely eliminated. Indeed, the subjects in the Etymology and Motor Rehearsal conditions showed little difference in recall level by input position in immediate recall. In contrast, the subjects in the No In-

structions condition showed a strong recency effect and slightly higher recall of initial list items. Then, in delayed recall, these same subjects showed a substantial decline in recall level by increasing serial position. This pattern would be consistent with an interpretation that the items early in the presentation list were processed to a more permanent memory store, whereas terminal list items were in a shorter term, more fragile, memory. The relatively consistent and high levels of recall across serial positions probably in the Etymology condition is indicative of more permanent memory storage of these stimulus items.

In the search for more effective ways to teach sign vocabulary, researchers in the future may wish to expand upon or vary some of the approaches used in the present study. One interesting variation would be to have subjects generate their own versions of each sign's possible origin or etymology. Such an approach might engender deeper and more active processing of each word and sign pair presented. The "etymologies" so generated might prove to be effective personal memory or retrieval cues, thus facilitating long-term retention. A related research approach would be to try to determine what characteristics constitute those etymologies that are maximally effective in promoting long-term retention. Certain sign etymologies appeared to be more helpful than others in facilitating recall, yet it is unclear why they do so. Possible characteristics might be that effective etymologies are plausible, distinct, easily imaged, or make the sign appear more iconic. The use of visual imagery also should be examined to determine its impact on sign learning and retention. In this approach, each subject might be instructed to visualize how a sign is formed and to construct an image of the sign's referent after having the sign demonstrated and its translation equivalent provided by the experimenter. If Paivio (1971, 1990) is correct, the use of both verbal and visual memory codes might facilitate retention.

One implication of the present findings is that providing students with the etymologies of the signs they are learning probably is an effective way to increase many students' retention of sign vocabulary. Sign language instructors thus may wish to expand their discussion of the origins of the signs they are introduc-

ing to their students. Correspondingly, the students might wish to focus more on learning the etymologies of newly-presented signs as an aid to vocabulary retention. It is not clear, however, whether providing students with information about the origins or derivations of signs would promote greater fluency in ASL in the long run. After all, young children of deaf parents typically acquire command of ASL in only a few years, and they probably receive only a very limited amount of information on the etymology of the signs they are learning.[1] Rather, the information on the origins of signs probably will prove most beneficial to those individuals who wish primarily to acquire and retain a sign language vocabulary. The present findings also raise the possibility that providing students with the etymologies or historical bases of characters in an ideographic writing system, such as Chinese, might aid the students in their learning and retention of these characters.

Finally, although receiving explanations about the origins or derivations of signs clearly aided their retention by undergraduate students, such an instructional approach would likely affect different sign-learning groups differently. Certain persons with cerebral palsy or an expressive speech aphasia, for instance, might benefit from having the etymologies of the signs they are learning explained to them. In contrast, it is much less likely that low-functioning autistic or mentally retarded individuals would reap a similar benefit from such information. Thus, the usefulness of etymology information on sign learning and retention probably rests on the characteristics of the learner as well.

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1. It is perhaps worth noting here that children interacting in sign language with deaf parents are constantly processing contextual as well as lexical information when they use signs. Ed.

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Ashley E. Maynard is a fourth-year undergraduate student at the University of Virginia. She expects to receive her B.A. in May 1994 with a double major in Psychology and Cognitive Science and to begin graduate study in September 1994.

Georgina R. Slavoff has completed three years of graduate study in Psychology at the University of Virginia, receiving her M.A. in May 1993. Her principal research interests are psycholinguistics and cognition in human and nonhuman primates.

John D. Bonvillian is an Associate Professor at the University of Virginia. He received his B.A. in 1970 from the Johns Hopkins University and his Ph.D. in Psychology from Stanford University in 1974. Address for correspondence: Department of Psychology, Gilmer Hall, University of Virginia, Charlottesville, VA 22903-2477.

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