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Response speed, recall and learning with nonsense-syllable compound stimuli.

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INTRODUCTION

The experiment reported here examined the effects of three kinds of nonsense-syllable compounds on speed of response, recall and learning. The compounds used were composed of (a) two syllables previously associated with the same response (convergent), (b) two syllables previously associated with different responses (divergent), and (c) one syllable previously associated with a particular response during experimental training and one syllable which had not been presented during such training (associated-nonassociated).

The stimulus environment of organisms, particularly of the higher species, is highly complex. Few, if any, of the stimuli which are isolated for experimental purposes are supposed to occur typically in such isolation. Instead, they occur in compounds with other stimuli. When the effects of single stimuli are studied, it is with the expectation that such fractionated information can later be combined into predictions concerning the effects of compounds. The principles of compounding cannot be formulated by studying unique aggregates of stimulus elements. Too many unique aggregates are possible. For this reason, investigations of compound stimuli must be designed to consider general types of compounds, and the value of the investigations depends on the generality of the types. The three types of compounds used in the present study appeared to have some generality in the sense that substantially the same differences in the effects of the three have been found over a wide variety of tasks.

However, little is known about the effects of compound stimuli on paired-associates learning. Paired-associates learning is exemplified by such frequently encountered tasks as associating a face with a name, or a price with a commercial article, or a foreign word with its counterpart in a native language. The present study employed a paired-associates technique in which nonsense-syllable stimuli were associated with nonsense-syllable responses. Despite the fact that many practical paired-associates tasks require associating a single response with a compound stimulus, such as associating a single word with its multi-word definition, only Shepard and Fogelsonger (1913) have investigated the effects of compound stimuli on paired-associates learning. Further information concerning the effects of this kind of stimulus on this kind of learning seemed desirable.

Although the present problem was in the tradition of studies of the effects of stimulus compounds, its most immediate origin was investigations of the effects of verbal context on word associations. Three research programs have investigated these effects: those of Howes and Osgood, Jenkins and Cofer and Musgrave.

In 1954, Howes and Osgood reported a series of three experiments using three-word contexts with test words which had been selected from a word-association list. The three-word contexts consisted of two kinds of words: strongly associated--i.e., eliciting desired response words with high probability; and neutral--i.e., eliciting desired response words with near zero probability. They selected members of the two classes of context words on the basis of E's judgments of strength of association between words rather than on the basis of empirical norms and assumed that the "neutral" words "had no appreciable effect upon the probability of the associative clusters." For example, they judged that the words "sinister," "devil" and "evil" were strongly associated with such response words as "night," "thief," and "dead." The stimulus word "eat," on the other hand, was judged neutral in regard to these responses, as were nonsense syllables and three-place numbers.

Among other results, their studies showed that increasing the number of "strongly associated" context words increased the frequency of the desired response words. Thus, they demonstrated that presentation of context words closely preceding test words could facilitate associative responses.

In a separate analysis of their data, they undertook to provide empirical evidence that their "neutral" words were in fact neutral. Their reasoning hinged on the proposition that if the words did not facilitate, they must have been neutral. This line of reasoning contained a logical error.

showing that the words did not facilitate, could logically lead to the conclusion that they were neutral only if facilitation and neutrality were the only possibilities. In this case, the words did not facilitate, but the possibility of inhibition or interference had been omitted. Their data, showing a slight reversal from the direction predicted for facilitation (which they accepted as proof of neutrality), hints that these words of weak or non-existent association with the responses had not a neutral but a negative effect. However, because the single stimuli alone were not used, the Howes and Osgood design did not include the condition necessary to test the possibility of a negative effect.

Jenkins and Cofer (1957) compared adjective-noun compounds, such as "loud woman," "swift eagle," "dark bread," "short memory," with their constituent nouns and adjectives in terms of percentage of occurrence of the most popular word-association responses and number of different responses to each stimulus. The median percentage of occurrence of the most popular responses to the compounds was smaller than that for the single words, and the number of different responses was greater. The adjectives were all appropriate modifiers and might, hence, have been expected to make the associations more specific. Such a result would have been reflected in a decrease in the number of different responses and in an increase in the frequency of the most popular responses--in short, just the reverse of the obtained results.

This study thus demonstrated that negative effects, in addition to the positive effects shown in the Howes and Osgood study, could be obtained by the addition of context words to word-association stimuli.

Musgrave (1958), in a series of five experiments, further investigated the effects of verbal compounds on word associations. In one experiment, associative chains were constructed in which each added word was the primary, i.e., the most popular response to the preceding word or words. For instance, beginning with the single stimulus word "hungry," its primary "food" was added to make the double stimulus "hungry food"; and the primary to this double stimulus, "eat," was then added to give the triple stimulus "hungry food eat." It was thought that with words chained in this way, an opportunity would be provided for some sort of "lines of thought" to develop, and thus for context to increase frequency of the primary and to decrease the number of different responses given to the singles, doubles and triples. Instead, as the stimulus chains lengthened, frequency of the primaries decreased and number of different responses increased.

Other types of context were explored in subsequent experiments. For example, when the stimulus list, itself, was considered a context, it was found that presenting a list of single words in a larger list otherwise composed of two-word stimuli resulted in smaller frequencies for the primaries and greater numbers of different responses, than presenting the same list of single words in a larger list otherwise composed of one-word stimuli. Context words, with varying degrees of association with the primaries of test words, were also employed. With context words which had not elicited that primary from any of 100 Ss used for normative purposes, frequencies of the primary as a response to the test word decreased. With context words which had elicited the desired primary with a range of positive frequencies, frequencies of the primary as a response to the test word decreased, remained constant and increased. Thus, this series of experiments demonstrated positive, negative and neutral effects of context. Musgrave suggested that differences in the effects could be explained in terms of degree of association of the context words with the response words in question and also in terms of association with other, competing, responses.

However, one difficulty of such context studies has been that context and test words of the compounds each elicit a number of responses. Because the responses for a single stimulus word can be arranged in rank-order of decreasing frequencies, they are often referred to as response hierarchies. So complex are the relationships both within and between such hierarchies, it seemed desirable to reduce the number and variety of responses involved by establishing stimulus-response (S-R) associations in the laboratory, using nonsense syllables and the paired-associates technique. The use of nonsense syllables has several advantages. First, they are the most common stimuli of studies of verbal learning; thus results of a study using nonsense-syllable stimuli are readily comparable to many other studies of verbal learning. Second, they have been calibrated for association value, thus obviating the need of a preliminary study for such a purpose. Third, they are not in the normal repertoire of college _S_s and, for this reason, amount of experience with them tends to be equal at the start of the experiment. Finally, their lengths and composition in terms of vowels and consonants are the same. The use of these syllables and the paired-associates technique had the further advantage of permitting specification of the strengths of associations for individual _S_s directly rather than by means of inferences from group norms.

In the area of verbal paired associates learning, Shepard and Fogelsonger describe five experiments exploring the effects of compounds of many sorts. Among them are the convergent, divergent and associated-nonassociated compounds selected for the present study because of their pertinence to the problem of verbal context.

Unfortunately, none of Shepard and Fogelsonger's experiments is free from one or more methodological shortcomings. In any one experiment, at most only three _S_s were used, and these _S_s not only varied widely in experience as experimental _S_s, but also often served in several experiments with no controls for order-sequence effects. Even if tests of the statistical significance of differences had been done, which they were not, Shepard and Fogelsonger's experiments would not have been interpretable due to these confoundings.

Consequently, the experiment reported here was designed as a more carefully controlled attack on problems of the effects of nonsense-syllable compounds involving convergent, divergent and associated-nonassociated stimulus-response relationships.

Although the Shepard and Fogelsonger method precluded reliable information, their results are suggestive. So, too, are the results of some 40 other studies of the effects of stimulus compounds. These studies, ranging across many situations--discrimination learning; word associations; classical conditioning of salivation, finger withdrawal, the knee jerk, the galvanic skin response (GSR); semantic differentiation, etc.--do not have sufficient similarity to paired-associates learning to constitute (even all together) a trustworthy basis for predictions. In addition, the information provided in nearly a third of them is incomplete in that data for responses to all the elements were not presented. However, whenever possible, these findings along with those of Shepard and Fogelsonger are drawn upon as some empirical rationale for predictions of the orders of effects of convergent, divergent and associated-nonassociated compounds and of various control conditions.

In order to develop these predictions, the convergent, divergent and associated-nonassociated compounds are described briefly, as are the control conditions. Predictions of the orders of response speed, recall and learning measures are then made for the experimental compounds and for control conditions.

Experimental Compounds and Control Conditions

The following description of the experimental compounds and control conditions may be clearer if reference is made to Appendix A, which presents the pairs of associates used in the training and test lists for each condition, and to Appendix D which presents a sample of the materials for an individual S.

For convergent compounds, associations are established experimentally between each of two or more stimuli (e.g., FAB, LIQ) which are presented separately and the same response (e.g., ROM). The two stimuli are then presented simultaneously. For divergent compounds, associations are established experimentally between each one of two or more stimuli (e.g., FAB, LIQ) and each one of two or more responses (e.g., ROM for LIQ, and JEL for FAB). These stimuli are then presented simultaneously. For associated-nonassociated compounds, an association is established experimentally between a stimulus (e.g., FAB) and a response (e.g., ROM). This stimulus is then presented in a stimulus compound (e.g., FAB LIQ) in which the other stimulus or stimuli (LIQ) had not been experimentally associated with the response (ROM).

In spatially or temporally sequential stimuli such as LIQ FAB--and written or spoken words are typically sequential--order of the stimulus elements in the sequence may be an influential variable (Howes & Osgood, 1954; Musgrave, 1958). Consequently, the stimuli of each of the three kinds of compound appeared in both orders. For convenience, the two orders for each kind of compound are designated I and II. Because order has a different basis in convergent, divergent and associated-nonassociated compounds, this factor cannot be regarded as orthogonal to kind of compound.

In addition to the six combinations of kind of compound and order within each--Convergent I, Convergent II, Divergent I, Divergent II, Associated-Nonassociated I, Associated-Nonassociated II--four control conditions were used: Continued Singles, New Singles, New Doubles I, and New Doubles II. In the Continued Singles condition, the single syllables of the training phase were the stimuli of the test phase. For the New Singles and both New Doubles conditions, the test stimuli were the same as those used in the test series for all other conditions, but these stimuli had not appeared during the training phase.

Testing on Continued Singles permits comparisons between compounds and elements composing the compounds. Because performance decrements are often obtained on the first post-criterion trial (Underwood, 1957), it was necessary to use a separate control group for these comparisons, rather than using speeds of responses to the critical training stimuli on the last pre-test trials of the experimental groups. The New Singles and New Doubles conditions were controls for effects of such factors as familiarization with the mode of presentation of the stimuli and experience with the paired-associates technique.

Predictions

The response measures of the test trials were speed of responses to the first stimulus of the test list, number of correct responses on the first two test or recall trials, and number of correct responses on the last two test or learning trials. These measures were not expected to be highly inter-correlated within combinations of kind of compound and order or within control conditions. Accordingly, in most cases, separate predictions were made for each measure.

The first set of predictions compared convergent, divergent, and associated-nonassociated compounds with each other. In connection with the last two of these compounds, predictions were made in regard to order. The second set of predictions concerned convergent, associated-nonassociated and divergent compounds, each compared separately with continued or new singles or new doubles. Then presented is the final set which summarizes comparisons among all combinations and controls.

Convergent, Divergent and Associated-Nonassociated Compounds Compared With Each Other

Grings and O'Donnell (1956) report that amplitudes of GSRs to compounds composed of two elements, both of which had been paired with shock, exceeded those to compounds composed of one element which had been paired with shock, and a second element which was presented for the first time on the test trial. In turn, amplitudes of GSRs to the latter compound exceeded those to compounds composed of one element which had been paired with shock and one which had been presented previously but had not been reinforced. Shepard and Fogelsonger compared convergent, associated-nonassociated and divergent stimulus compounds for latencies and for recall. For latencies, the rank-order of these relationships was the same as the rank-order of amplitudes of GSRs: the convergent compounds were faster than the associated-nonassociated compounds, which were faster than the divergent compounds. For recall, however, although convergent compounds produced the most correct responses, divergent compounds elicited more correct responses than did associated-nonassociated compounds. The reason for this reversal in ranks may be that Shepard and Fogelsonger scored either of the responses trained to the elements of the divergent compounds as correct. Responses not so trained and failures to respond were scored as incorrect.

On the basis of these data, the predicted order of decreasing speeds was convergent, associated-nonassociated, divergent compounds. But, because Shepard and Fogelsonger's scoring technique was to be used, the predicted order for recall was convergent, divergent, and associated-nonassociated compounds.

There are no reported comparisons of learning with the three kinds of compounds. Since essentially perfect recall of the response of convergent compounds was expected, no learning was expected. General principles of conflict are applicable to the prediction of learning with divergent and associated-nonassociated compounds. Unlike recall, learning uses only one of the responses originally learned to the elements of the divergent compounds. It was considered possible that the conflict between this response and the other response, which had been equally trained, but which during the test series was incorrect, would be sufficiently greater than the conflict among responses to associated-nonassociated compounds to lead to more rapid learning with associated-nonassociated compounds. For this reason, as well as in view of data concerning amplitudes of GSRs and latency, decreasing numbers of correct responses during learning were predicted for convergent, associated-nonassociated and divergent compounds.

Because the syllable nearest the response is apparently the more influential (Howes & Osgood, 1954; Musgrave, 1957), faster learning was expected for Divergent II than for Divergent I. However, since order should not effect amount of conflict, Divergent I and Divergent II were not expected to differ with respect to speed or recall measures.

For associated-nonassociated compounds, the strength of the associated relationship should be greater than the strength of relationships involving nonassociated elements. It was predicted, therefore, that Associated-Nonassociated II would have faster speeds and more correct responses during recall and learning than Associated-Nonassociated I.

Convergent, Divergent, and Associated-Nonassociated Compounds Each Compared With Controls

Convergent. Latencies of responses to convergent compounds nearly twice as long as latencies of responses to elements of such compounds separately have been reported (Shepard & Fogelsonger, 1913). Brown (1915) found reading speed for color names, each typed on the color named, slightly slower than speed for names alone.

Shepard and Fogelsonger found no difference between convergent compounds and the elements alone in percentages of responses recalled correctly. Pan (1926), however, found that compounds which included a context word "logically related to the response" produced better recall than did stimuli which did not include such a context word. Eight classical conditioning studies indicate that responses to convergent compounds are of greater amplitude than responses to their elements (Pavlov, 1927; Evans, 1930; Wendt, 1930; Garvey, 1932; Hilgard, 1933; Hull, 1940; Grings & O'Donnell, 1956; and Grings, 1957).

These findings, disregarding differences in situations, suggest the possible occurrence of slower speeds on at least the first or first few test trials, equal or better recall and equal or faster learning of responses to convergent compounds than of responses to continued singles. Because of non-specific transfer and associations established during the training phase, convergent compounds were expected to yield faster speeds and more correct responses on the learning trials than new singles and new doubles.

Divergent. The stimulus-response relationships of divergent compounds are those more commonly referred to as conflict. With such compounds, latencies of both motor responses (e.g., Hovland & Sears, 1938; Sears & Hovland, 1941) and verbal responses (Greenfeld, 1957) increase markedly over those for responses to the elements separately.

Even though both responses learned to the single syllables of divergent compounds are scored as correct, Shepard and Fogelsonger found that divergent compounds elicited fewer correct responses than the elements presented separately. Whether blocking, compromise and double reactions (Hovland & Sears, 1938; Sears & Hovland, 1941) were also scored was not indicated. No data on the learning of one or the other of the two responses have been reported.

Available findings led to the prediction that on the recall trial, relative to continued singles, divergent compounds would exhibit slower speeds and would elicit fewer occurrences of the two responses. With this initial disadvantage, it was expected that learning might be as slow for the divergent compounds as for either new singles or new doubles (Besch & Reynolds, 1958; Spiker & Holton, 1958).

Associated-Nonassociated. With respect to compounds involving associated-nonassociated relationships, Pavlov (1927) and more recent experimenters (e.g., Gagné, 1941) have investigated the effects of introducing an alien stimulus into either training or extinction phases of classical conditioning. Introduction of such a stimuli during training temporarily reduces response strength (external inhibition); their introduction during extinction increases response strength (disinhibition). Presentation of an associated-nonassociated compound for the test phase resembles presentation of an alien stimulus during the training phase of classical conditioning. Accordingly, performance impairment would be anticipated. Grings and O'Donnell found that the amplitude of GSRs to combinations of reinforced and novel stimuli was less than the amplitude of GSRs to the reinforced elements alone on the last acquisition trials. Later, however, Grings (1957) obtained a probably insignificant difference in the reverse direction.

Using an interpolation formula derived from Estes and Burke (1953), in conjunction with an assumption that one half the elements in a nonassociated stimulus are conditioned to the response, Schoeffler (1956) predicted probability of response for an associated-nonassociated compound in which the probability of the response to the associated stimulus approached 1.00. The obtained value was essentially the same as the predicted value of .75, thus suggesting that associated-nonassociated compounds are less effective in eliciting responses than the associated stimulus alone.

When a nonassociated stimulus was paired with an associated stimulus, latencies lengthened (Shepard & Fogelsonger, 1913). Confirming Shepard and Fogelsonger's results for recall, Lashley (1938) found that introduction of an associated stimulus into the stimulus compound caused percent of correct choices in a discrimination situation to fall. No data on learning have been reported.

The expectations based on these findings were that associated-nonassociated compounds would have slower speeds, and would produce fewer correct responses on the recall trial and slower learning throughout the test phase than continued singles. Since only one of the two elements of the associated-nonassociated compound is a "new" element, while the other is correctly associated, it was predicted that these compounds would have faster speeds and more correct responses on recall and learning trials than new singles or new doubles.

<u>All Experimental Compounds and Controls</u>

The preceding predictions for each of the combinations of kind of compound and order relative to each other and to control conditions are here presented as part of over-all predictions for speed, recall and learning measures. Comparisons among control conditions are also considered.

Two main types of comparison can be made between the control conditions: continued versus new, and singles versus doubles. All that is known of learning curves predicts faster speeds, better recall, and faster learning with continued singles than with either new singles or new doubles. However, the direction of differences between new singles and new doubles is less obvious. In simple reaction time situations, latencies of responses to compound stimuli are as short, or shorter, than those obtained with the most effective of the elements (Dunlop & Wells, 1910; Todd, 1912; and Jenkins, 1926). However, the paired-associates task has a discrimination aspect. And, on the assumption that number of relevant or irrelevant dimensions is functionally equivalent to number of elements, disjunctive or discriminative reaction times are apparently direct functions of the number of elements in stimulus compounds (Archer, 1954; Gregg, 1954; Hodge, 1958). Further, latencies of responses to all of Shepard and Fogelsonger's compounds were longer than those to single elements.

More responses were recalled correctly with continued singles than with continued doubles (Shepard & Fogelsonger, 1913). With respect to trials to criterion, Miller (1939) found fewer pairings were required with compound visual-aural stimuli than with either the visual or the aural stimulus element alone. In serial anticipation learning, however, number of trials with visual-aural stimuli and with visual stimuli alone did not differ (Pessin, 1932).

Again on the basis of the discrimination aspect of paired-associates learning, findings of some discrimination studies may be pertinent. Using elements from different stimulus modalities, Eninger (1952) found that monkeys reached criterion faster with compounds than with their elements. Also with monkeys, although compounds involving color proved no more discriminable than color as a single element, compounds involving form and shape as elements were more discriminable than either form or shape (Harlow, 1945; Meyer & Harlow, 1949; Warren & Harlow, 1952; Warren, 1953). Restle's (1959) human Ss reached criterion in fewer trials with compounds composed of unimodal elements than with the elements separately.

These findings suggested that both continued and new singles would have faster speeds and elicit more correct responses on recall trials than new doubles. However, it was considered possible that there would be no difference in the learning of responses to new singles and new doubles, or even faster learning with the latter.

In summary, for response speeds on the recall trials for all 10 experimental and control conditions, the predicted order of decreasing values was: Continued Singles > Convergent I = Convergent II > Associated-Nonassociated II > Associated-Nonassociated I > Divergent I = Divergent II ≥ New Singles ≥ New Doubles I = New Doubles II. On subsequent trials, it was expected that this order would be preserved, perhaps until asymptotic levels were reached.

Number of responses correct on the recall trials were expected to fall in the order: Convergent I = Convergent II > Continued Singles > Divergent I = Divergent II ≥ Associated-Nonassociated II > Associated-Nonassociated I > New Singles ≥ New Doubles I = New Doubles II. Except for possible intrusions from the training lists, no correct responses were anticipated for new singles and both new doubles conditions.

Finally, the order for decreasing numbers of correct responses during the learning trials was expected to be: Convergent I = Convergent II ≥ Continued Singles > Associated-Nonassociated II > Associated-Nonassociated I ≥ Divergent II > Divergent I ≥ New Doubles I = New Doubles II ≥ New Singles.

METHOD

Subjects

Seventy-two undergraduate women were tested individually, being assigned as they appeared to two groups of four members each to serve in the two New Doubles conditions, and eight groups of eight members each to serve in the eight other conditions. Forty-eight additional Ss were tested but discarded because of failure to meet one or more of three criteria of performance on the single-syllable stimuli of the training lists. These criteria are described in the section on procedure.

Apparatus

The paired-associates were presented by raising the left and right shutters of a small window in a screen in front of a memory drum. The shutters were raised by means of solenoids, the activation of which was controlled by an electrically-driven cam arrangement. Raising the shutter on the left exposed the stimulus member of each pair alone for 2 sec. This shutter remained up during the 2 additional sec. during which raising the shutter on the right had exposed the response member of each pair. The inter-pair interval was 4 sec.

The drum could be moved horizontally along its axle so that the paired-associates of any one of several lists could be exposed through the window of the screen. The E sat behind the screen and drum; the front-face of the presentation window was observed through a periscope.

Latency of responses was obtained by means of a Gerbrand's electronic voice key and a Hunter Klockounter. Raising the left shutter, which exposed the stimulus, activated the voice key and through the voice key, the Klockounter. Each S held a ball microphone slightly in front of her mouth. Beginning to say the first letter of the response, acting through the voice key, stopped the Klockounter.

Paired-Associates

Forty nonsense syllables, selected from Glaze's (1928) list of syllables with high association values (100% and 93%) were used to construct 20 training lists and eight test lists. The four stimulus syllables and two response syllables which were presented for association in each training list had low similarity, in terms of letter duplication. These six syllables shared neither initial nor final consonants. As there were six syllables and only five vowels available, the "o" in the response syllable ROM was repeated in the stimulus syllable DOZ, but these two syllables never appeared as associates. The 32 syllables which were presented only once each perforce contained letters, particularly vowels, which duplicated those of the associated syllables. In order that test lists for all conditions would contain the same syllables, different conditions had different training lists.

Selection of the nonsense syllables and construction of training and test lists were based on findings from several preliminary studies. Because Ss stopped the Klockounter by spelling the response syllables into a microphone, it was necessary to find syllables with initial first letters which were equally effective in activating the voice key. In addition, stimulus-response pairs were equated for ease of learning.

In the first of the preliminary studies, training lists which included double-syllable stimuli, as well as traditional single-syllable stimuli, proved unexpectedly difficult. Lists composed of eight single stimuli and eight compound stimuli paired with four single-syllable responses could not be learned in a 50 min. period. Consequently, successive reductions were made in the number of stimuli and responses until four single stimuli and two responses remained. To further reduce the difficulty of the task, each of these four paired-associates were presented six times apiece before any compound stimuli were introduced. In addition, it proved desirable to instruct the Ss that there were only two response syllables, and to repeat throughout the instructions what these two syllables were.

The eight test lists used in the main experiment consisted of a single pair of associates presented four consecutive times. Two stimulus syllables (FAB and LIQ) and two response syllables (ROM and JEL) were used for these lists. For the Continued Singles and New Singles conditions each stimulus syllable was paired with each of the response syllables, making four different test lists: (1) FAB ROM, (2) LIQ ROM, (3) FAB JEL, and (4) LIQ JEL. For all other conditions, the two stimulus syllables appeared as a compound stimulus. Both possible orders of the two stimulus syllables were used in the compounds, and each order was paired with each response, thus making an additional four test lists: (1) LIQ FAB ROM, (2) FAB LIQ ROM, (3) LIQ FAB JEL, and (4) FAB LIQ JEL.

Each of the eight test lists was paired with one of the 20 training lists. These pairings counterbalanced the occurrence of particular stimulus syllables with particular response syllables. In addition, as the Convergent and Divergent training lists differed in the order of presentation of paired-associates, analogues of both these types of lists were employed in the other six conditions, thus counterbalancing for type of list.

Each training and test list combination consisted of 120 stimulus-response pairs. Appendix D presents, as a sample of such a combination, the stimulus materials for a S in the Convergent I condition. The materials were arranged on the drum in five lists of 24 pairs each. After the first list of 24 was presented, the drum was moved along the axle and rotated to the starting position for presentation of the next list of 24 and so on. The first of the five lists was made up entirely of six presentations of each of the four single-syllable stimuli and its appropriate response syllable. The order of these paired-associates units was randomized.

The second list contained two-syllable stimuli in addition to the single-syllable stimuli of the first list. For the two-syllable stimuli, each of the four original single syllables was paired with new stimulus syllables each of which appeared but once in the course of the experiment. The new syllables were selected and assigned to positions in the training lists by the use of a table of random numbers, with the stipulation that the new syllables should precede and follow each original syllable an equal number of times to insure experience with finding an associated syllable in either first or second position. In this and subsequent lists, 32 of these new syllables were introduced, eight different ones with each of the four original stimuli. The compound stimuli thus formed constituted associated-nonassociated compounds. They were used to prevent establishment of a "set-for-single-stimuli" by providing experience with compound stimuli. Also, they accustomed Ss to responding to stimulus compounds and to responding with only the two responses of the learning task.

In addition to the two-syllable stimuli, the second list introduced another departure from the simple single-syllable paired-associates of the first list: on certain trials, the stimulus syllable or compound of two syllables was followed by a blank instead of a response syllable. Thus, in case a

S had not responded before the opening of the second shutter, the blank provided an additional 2 sec. for responding without any prompt as to what the correct response should be. In this way, Ss were prepared to respond during the 4 sec. response period of the critical first test trial, which presented the stimulus followed by a blank. The use of a 2 sec. interval on the first test trial seemed unwise in the face of evidence from preliminary studies that this was insufficient time for anticipatory responses under Divergent, New Doubles and New Singles conditions. The second list of 24 paired-associates thus contained: (a) eight compound stimuli, each of which consisted of one of the original four stimuli plus a new syllable followed by the response appropriate to the original stimulus syllable; (b) three repetitions of each of the four original stimuli, each followed by its response syllable; and (c) one presentation of each of the four original stimuli, each followed by a blank. The first and second lists were considered preliminary practice in that none of the criteria used to measure learning during the training trials was based on performance for these two lists.

The third list of 24 items, like the first list, presented the four original stimuli six times each, followed by their responses. The pairs were arranged in random order in the list. The fourth list consisted of: (a) the original four stimuli presented singly two times each, followed by their responses; (b) the original four stimuli presented singly once each, followed by blanks; (c) the original stimuli paired with new syllables twice each, followed by the response appropriate to the original stimulus syllable; and (d) the original stimuli paired with new syllables once each, followed by blanks.

The fifth and final list began with 18 training paired-associates and ended with four test paired-associates. The training items were: (a) the original four stimulus syllables each followed by its response syllable; (b) the original four stimulus syllables each followed by a blank; (c) the original four paired with new stimulus syllables, with these compounds followed by the responses appropriate to the original stimulus syllables; (d) the original four paired with new stimulus syllables and followed by blanks. The stimuli of the test list were single-syllable stimuli for the New Singles and Continued Singles conditions, and two-syllable compounds for the remaining eight conditions. The first test stimulus was followed by a blank. The other three test stimuli were followed by the syllables for responses designated correct by E.

Procedure

The Ss were run in eight successive cycles, in each of which one S was run in each of the eight conditions other than New Doubles I and II. For the latter conditions, as there were only four Ss in each, one S was run in each of these conditions in every other cycle. With this restriction on the occurrence of conditions, the 54 different combinations of training lists and test lists (72 combinations in all) were assigned to a schedule sheet with the aid of a table of random numbers. Appropriate lists for the scheduled conditions were attached to the drum prior to the appearance of the S.

Each S was seated in front of the apparatus, asked to hold the microphone close to her mouth and to speak the word "Hello" when each shutter opened. This procedure was explained to S as necessary for adjusting the apparatus for her individual voice, and permitted coaching her in speaking loudly and clearly and in responding twice on every trial. E was seated behind the apparatus and out of sight. After being read the instructions (Appendix B), S practiced with the five training lists. The final list, as mentioned above, ended with four successive presentations of the particular compound stimulus or, in the case of the New Singles and Continued Singles conditions, the single-syllable stimulus which constituted the test stimulus. No new instructions or other comments preceded the presentation of the test list. On the first occurrence of the test stimulus, no response member was presented. Thus, on the first test trial, as the test stimulus was presented alone for 4 sec., it was possible to measure latencies up to 4 sec. rather than up to 2 sec. On the second occurrence of the test stimulus, the nonsense syllable for the correct response was exposed after 2 sec.

by the opening of the second shutter. These first two test trials were, in effect, recall trials. The third and fourth test trials, following the presentation of the correct response on the second trial, were learning trials. The nonsense syllable for the correct response was also presented on each of these trials.

Following completion of each S's participation, her performance was evaluated on the basis of three criteria: (a) correct responses on the last two presentations of each of the critical training syllables--i.e., the syllables which in the Convergent and Divergent conditions were paired together as compound stimuli in the test list, or the corresponding stimuli in the training lists of the other conditions; (b) on the last occurrence of the two critical syllables, response latencies should be within .300 sec. of each other; (c) an equal number of correct responses, plus or minus one response, for the 11 times each appeared in the last three lists. The first of these criteria was included to insure that Ss had actually learned the correct responses to the critical syllables before entering the test phase.

The second and third criteria were of particular importance in the Divergent, or conflict, condition, as they were designed to insure that responses to the two syllables were at equal or near-equal strength, thus guarding against the possibility that choice of response reflected nothing more than differential strengths. To equate selectivity through conditions, these two criteria were applied not only to the Divergent but to all other conditions as well. In connection with the third criterion it was assumed from the preliminary studies that the numbers of correct responses would be fairly stable across conditions. However, it was decided that any numbers of correct responses which deviated from the numbers of correct responses for the majority of Ss, even if equal between the two critical syllables, would be sufficient cause for replacing a S. If the performance of any S did not meet these criteria, her protocol was discarded and the next S to appear was assigned to the same condition.

Response Measures

To obtain the response latencies, which were transformed to response speeds, the opening of the shutter which revealed the stimulus syllable or syllables activated a voice key and "Klockounter." When S spoke, the voice key stopped the "Klockounter." Thus, the recorded interval was from onset of the stimulus to onset of the response. Response speed was the reciprocal of this recorded interval. Speeds were recorded for both correct and incorrect vocal responses on all four test trials; the discrimination in terms of correctness was only for recall and learning measures.

The recall measure was based on responses to the stimuli of the first two test trials. Response syllables which were correct during the training phase were scored correct for the recall trials; those which were incorrect were scored incorrect. Thus, for the Convergent, Associated-Nonassociated, and Continued Singles conditions, one of the two response syllables was correct, the other incorrect; but for the Divergent, New Singles and New Doubles conditions, both response syllables were correct. Reproduction of the correct response was judged adequate if all three letters of the syllable were spoken in the correct order prior to the opening of the shutter which revealed the response member of the paired-associates. If, prior to such reproduction of the correct response, S spelled all or part of the incorrect response, such blends were recorded but scored as correct.

Responses to the stimuli of the third and fourth test trials were the basis of the learning measures: (a) number of correct responses, and (b) speed of response. As the response designated correct by E had been presented on the opening of the second shutter at the end of the second test trial, only one response was scored correct for the third and fourth trials for all conditions, whereas both responses had been scored correct on the first and second test trials for the Divergent, New Singles and New Doubles conditions.

RESULTS

Training Trials

The single syllables which were to appear in the test compounds appeared in the last three training trials 11 times. Ss of all groups responded correctly to these syllables either 10 or 11 times. Fifty-eight Ss responded correctly to each syllable 11 times; 14 responded to one syllable 11 times and to the other 10 times.

Speeds on the last training trial for each of the single syllables which were to appear in the test compounds were averaged. Means and SDs for these syllables on these Criterion Trials for all 10 conditions are presented in Table 1. An analysis of variance (Table 2) indicated that there were no differences among conditions at the end of the training trials.

Rank-order correlations between means of speeds on Criterion Trials and means of speeds for the first, second, third and fourth test trials were .658 (p = .02), .648 (p = .02), .406 ($p < .05$), and .576 (p = .04), respectively. Because of the nonsignificant F for differences among conditions and because the values of the rhos were neither high nor markedly significant, covariance adjustment of test scores was not considered necessary.

Test Trials

Speeds. Means and SDs of speeds for each of the four

Table 1

Means and *SD*s of Speeds on Criterion Trials and on each of the Four Test Trials for All Conditions

Condition	Training		Test							
	Criterion Trials		Trial One		Trial Two		Trial Three		Trial Four	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Convergent I	1.117	.118	.936	.181	.906	.104	.949	.070	1.071	.170
Convergent II	1.119	.114	.916	.161	1.038	.248	1.102	.204	1.037	.291
Asso.-N.asso. I	1.104	.089	.867	.184	.945	.187	.998	.173	1.045	.164
Asso.-N.asso. II	1.037	.207	.850	.204	.939	.158	1.018	.170	.980	.230
Divergent I	1.034	.130	.823	.126	.688	.221	.841	.209	.917	.170
Divergent II	1.094	.184	.902	.275	.891	.164	.770	.230	.937	.242
New Doubles I	.967	.070	.450	.134	.596	.230	.809	.020	.933	.158
New Doubles II	1.031	.100	.403	.178	.655	.109	.927	.189	.939	.030
New Singles	1.086	.109	.563	.158	.714	.246	.948	.223	1.031	.158
Cont. Singles	1.052	.100	1.129	.174	1.077	.189	1.125	.178	1.114	.178

Table 2

Analysis of Variance of Mean Speeds for Critical Syllables on Criterion Trials for All Conditions

Source	*df*	*MS*	*F*
Conditions	9	.012	-
Error	62	.022	
Total	71		

test trials for all ten conditions are presented in Table 1; the means are plotted in Fig. 1. A Hartley test for homogeneity of variance ($\underline{F}$ = 21.25; $\underline{k}$ = 40, $\underline{n}$ = 8) approached significance, according to an extrapolation of the table supplied by Walker and Lev (1953). When the smaller of the unequal $\underline{n}$s ($\underline{n}$ = 4) was used, the $\underline{F}$ was not significant. On these grounds, the variances were considered homogeneous.

The $\underline{F}$s for Conditions, Trials, and Trials X Conditions were significant at less than .001 (Table 3). Because of the significant interaction variance, separate analyses of variance were carried out for each trial. Hartley tests indicated homogeneity of variance for Trial One ($\underline{F}$ = 4.75; $\underline{k}$ = 10; $\underline{n}$ = 8), for Trial Two ($\underline{F}$ = 5.64; $\underline{k}$ = 10; $\underline{n}$ = 8), and for Trial Four ($\underline{F}$ = 9.44; $\underline{k}$ = 10; $\underline{n}$ = 8). For Trial Three, the $\underline{F}$ was 13.25, which for $\underline{n}$ = 8, the larger of the unequal $\underline{n}$s, is significant ($.01 < \underline{p} < .05$), but falls far short of the 44.6 necessary for significance at the .05 level for $\underline{n}$ = 4, the smaller of the unequal $\underline{n}$s. On the whole, it was concluded that homogeneity of variance could be assumed for all trials.

Differences among Conditions (Table 4) were significant for Trials One ($\underline{p} < .001$), Two ($\underline{p} < .001$) and Three ($\underline{p} < .01$) but not for Trial Four.

Duncan range tests for Trial One (Table 5) indicated that there were no significant differences between orders for any condition, nor among the Convergent, Divergent and

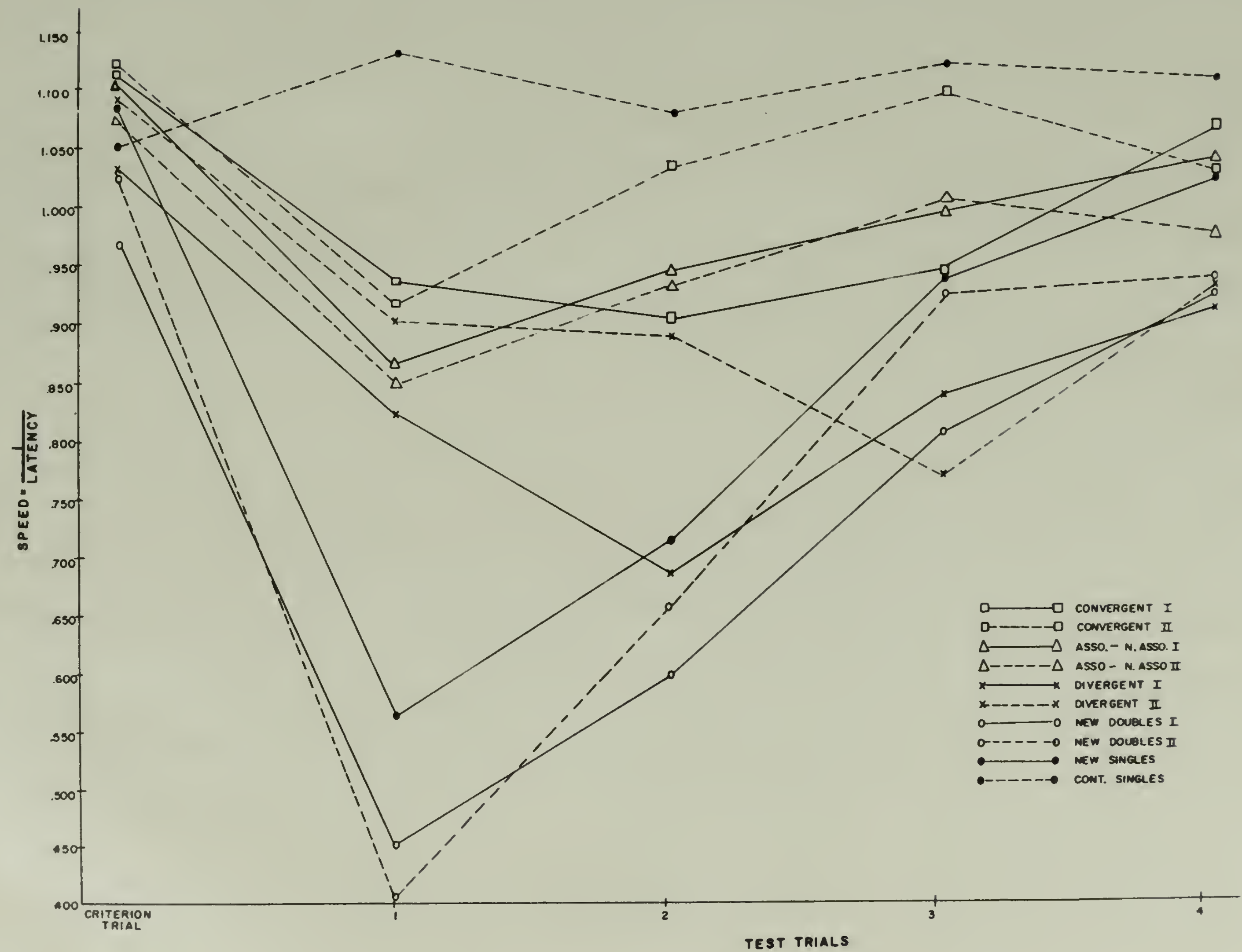

Fig. 1. Mean response speeds for each condition on the criterion and four test trials.

Table 3

Analysis of Variance of Speeds on the Four Test Trials

Source	*df*	*MS*	*F*
Between *S*s			
Conditions (C)	9	.421	5.01*
Error	62	.084	
Within *S*s			
Trials (T)	3	.497	19.88*
T X C	27	.068	2.72*
Error	186	.025	

* $p = .001$

Table 4

Analyses of Variance of Speeds on each Test Trial

Source	df	Trial							
		One		Two		Three		Four	
		MS	F	MS	F	MS	F	MS	F
Conditions	9	.311	6.22**	.193	5.36**	.102	3.09*	.033	-
Error	62	.050		.036		.033		.040	

* $p < .01$

** $p < .001$

Table 5

Summary of Duncan Range Test of Speeds on Trial One

	Continued Singles	Convergent I	Convergent II	Divergent II	Associated-Nonassociated I	Associated-Nonassociated II	Divergent I	New Singles	New Doubles I	New Doubles II
Continued Singles	X									
Convergent I	-	X								
Convergent II	-	-	X							
Divergent II	-	-	-	X						
Associated-Nonassociated I	.05	-	-	-	X					
Associated-Nonassociated II	.05	-	-	-	-	X				
Divergent I	.05	-	-	-	-	-	X			
New Singles	.01	.01	.01	.01	.05	.05	.05	X		
New Doubles I	.01	.01	.01	.01	.01	.05	.05	-	X	
New Doubles II	.01	.01	.01	.01	.01	.01	.01	-	-	X

Associated-Nonassociated conditions.

Continued Singles, the fastest condition, differed significantly from Associated-Nonassociated I, Associated-Nonassociated II, and Divergent I ($p < .05$), and from the three slowest conditions, New Singles, New Doubles I and New Doubles II, which did not differ among themselves ($p < .01$). New Doubles II, the slowest condition, differed from Divergent I, Divergent II, Associated-Nonassociated I, Associated-Nonassociated II, Convergent I, Convergent II, and Continued Singles ($p < .01$). New Doubles I, the second slowest condition, differed from Associated-Nonassociated II and Divergent I ($p < .05$), and from Divergent II, Convergent I and Convergent II, Associated-Nonassociated I and Continued Singles ($p < .01$). New Singles, the third slowest condition, differed from Divergent I, Associated-Nonassociated I, and Associated-Nonassociated II ($p < .05$), and from Divergent II, Convergent I, Convergent II, and Continued Singles ($p < .01$).

For Trial Two (Table 6), the Duncan range test again showed that there were no significant differences between orders for any condition. However, on this trial, differences between several experimental conditions occurred. Divergent I differed significantly from Convergent II ($p < .01$), Associated-Nonassociated I ($p < .05$) and Associated-Nonassociated II ($p < .05$). In addition, Continued Singles differed from Divergent II ($p = .05$) and from New Singles, Divergent I, New Doubles I and New Doubles II ($p = .01$).

Table 6

Summary of Duncan Range Test of Speeds on Trial Two

	Continued Singles	Convergent II	Associated-Nonassociated I	Associated-Nonassociated II	Convergent I	Divergent II	New Singles	Divergent I	New Doubles II	New Doubles I
Continued Singles	X									
Convergent II	-	X								
Associated-Nonassociated I	-	-	X							
Associated-Nonassociated II	-	-	-	X						
Convergent I	-	-	-	-	X					
Divergent II	.05	-	-	-	-	X				
New Singles	.01	.01	.05	.05	-	-	X			
Divergent I	.01	.01	.05	.05	-	-	-	X		
New Doubles II	.01	.01	.05	.05	-	-	-	-	X	
New Doubles I	.01	.01	.01	.05	.05	-	-	-	-	X

New Singles differed not only from Continued Singles, but also from Convergent II ($p < .01$), Associated-Nonassociated I ($p < .05$), and Associated-Nonassociated II ($p < .05$). New Doubles II differed from Continued Singles and Convergent II ($p = .01$), and from the two Associated-Nonassociated conditions ($p = .05$). New Doubles I differed from Continued Singles, Convergent II, Associated-Nonassociated I and II ($p = .01$), and also from Convergent I and Divergent II ($p = .05$).

Fewer pairs of means differed significantly on Trial Three (Table 7). Orders did not differ from each other for any condition. Both Divergent conditions differed from Convergent II (Divergent I, $p < .05$; Divergent II, $p < .01$). Divergent II differed from each of the Associated-Nonassociated conditions ($p = .05$). Comparisons between experimental and control conditions and among control conditions show that Divergent I and II differed from Continued Singles ($p = .01$), Convergent II differed from New Doubles I ($p = .05$), and Continued Singles differed from New Doubles ($p = .05$).

An analysis of variance was done for each condition separately to investigate the effects of order and of trials (Tables 8 and 9). In no case was order a significant variable. However, significant increases in speeds occurred under Associated-Nonassociated, New Doubles, and New Singles conditions.

<u>Number Correct on Recall Trials</u>. For the Convergent,

Table 7

Summary of Duncan Range Test of Speeds on Trial Three

	Continued Singles	Convergent II	Associated-Nonassociated II	Associated-Nonassociated I	Convergent I	New Singles	New Doubles II	Divergent I	New Doubles I	Divergent II
Continued Singles	X									
Convergent II	-	X								
Associated-Nonassociated II	-	-	X							
Associated-Nonassociated I	-	-	-	X						
Convergent I	-	-	-	-	X					
New Singles	-	-	-	-	-	X				
New Doubles II	-	-	-	-	-	-	X			
Divergent I	.01	.05	-	-	-	-	-	X		
New Doubles I	.05	.05	-	-	-	-	-	-	X	
Divergent II	.01	.01	.05	.05	-	-	-	-	-	X

Table 8

Analyses of Variance of Speeds on the Four Test Trials with Order I and II of each Experimental Condition

Source	*df*	Condition					
		Convergent		Divergent		Associated-Nonassociated	
		MS	*F*	*MS*	*F*	*MS*	*F*
Between *S*s	15						
Order (O)	1	.052	-	.053	-	.005	-
Error	14	.080		.096		.093	
Within *S*s	48						
Trials (T)	3	.051	1.11	.062	2.38	.083	5.93*
T X O	3	.039	-	.053	2.04	.011	-
Error	42	.046		.026		.014	

* $p = .005$

Table 9

Analyses of Variance of Speeds on the Four Test Trials for each Control Condition

Condition	Source	df	MS	F
	Between Ss			
	Order (O)	1	.009	-
	Error	6	.040	
New Doubles	Within Ss			
	Trials (T)	3	.435	33.46**
	T X O	3	.010	-
	Error	18	.013	
	Trials (T)	3	.368	15.33**
New Singles	Ss	7	.089	3.71*
	T X Ss	21	.024	
	Trials (T)	3	.004	-
Continued Singles	Ss	7	.085	5.67**
	T X Ss	21	.015	

* $p = .01$

** $p = .001$

Associated-Nonassociated and Continued Singles conditions, which had only one response syllable designated as correct, all Ss responded correctly on the first two test trials. One S in the Associated-Nonassociated II condition on the first trial said "J-R-O-M," a blend of the first letter of JEL with the syllable ROM; but by the criteria set for correct responses, this was scored as correct.

For the Divergent, New Doubles and New Singles conditions either response was scored as correct on the recall trials. Tables 10 and 11 present the syllables which were said on all four trials for these conditions. All Ss in the two Divergent conditions spelled a syllable on each of the four trials. However, one S in Divergent I on the second trial responded after the opening of the second shutter had revealed the correct response and, hence, her response was marked incorrect. On the first trial one S in the Divergent I condition said "J-R-O-M," and one S in the Divergent II condition said "J-E-R-O-M." Both were scored correct.

For the New Doubles and New Singles conditions, not all Ss spelled a syllable on each trial. In the New Doubles I condition, one S made no response on either recall trial. In the New Doubles II condition, two Ss failed to respond on the first trial. One S in the New Singles condition made no response on the first trial and waited to read the response syllable on the second; these responses were scored incorrect.

Number Correct on Learning Trials. On the third and

Table 10

Responses Made by each S on each of the Four Test Trials under the Divergent I and Divergent II Conditions

Condition and Ss	Recall		Correct Response	Relearning	
	Trial One	Trial Two		Trial Three	Trial Four
Divergent I					
1	JEL	JEL	JEL	ROM	JEL
2	J-ROM	ROM	ROM	JEL	ROM
3	JEL	JEL	JEL	ROM	JEL
4	ROM	[Read] ROM	ROM	ROM	ROM
5	JEL	JEL	ROM	ROM	ROM
6	JEL	JEL	ROM	ROM	ROM
7	JEL	JEL	JEL	JEL	JEL
8	JEL	JEL	JEL	JEL	JEL
Divergent II					
1	ROM	ROM	JEL	JEL	JEL
2	JEL	JEL	JEL	JEL	JEL
3	ROM	ROM	JEL	JEL	JEL
4	ROM	ROM	ROM	ROM	ROM
5	ROM	ROM	ROM	JEL	JEL
6	JE-ROM	ROM	ROM	ROM	ROM
7	ROM	ROM	JEL	[Read] JEL	JEL
8	JEL	JEL	ROM	ROM	ROM

Table 11

Responses Made by each S on each of the Four Test Trials under the New Doubles I, New Doubles II and New Singles Conditions

Condition and Ss	Recall		Correct Response	Relearning	
	Trial One	Trial Two		Trial Three	Trial Four
New Doubles I					
1	ROM	ROM	ROM	ROM	ROM
2	ROM	ROM	JEL	JEL	JEL
3	ROM	ROM	JEL	JEL	JEL
4	No Response	No Response	ROM	ROM	ROM
New Doubles II					
1	No Response	ROM	ROM	ROM	ROM
2	ROM	ROM	JEL	JEL	JEL
3	ROM	ROM	ROM	ROM	ROM
4	No Response	No Response	JEL	JEL	JEL
New Singles					
1	ROM	ROM	JEL	JEL	JEL
2	ROM	ROM	ROM	ROM	ROM
3	JEL	JEL	JEL	JEL	JEL
4	ROM	ROM	JEL	JEL	JEL
5	JEL	ROM	ROM	ROM	ROM
6	No Response	[Read] ROM	ROM	ROM	ROM
7	ROM	ROM	JEL	JEL	JEL
8	ROM	ROM	ROM	ROM	ROM

fourth test trials, again all Ss in the Convergent, Associated-Nonassociated and Continued Singles conditions responded with the correct syllable on each trial. For the other conditions there was a single response designated correct on these trials, as the correct syllable had been presented with the opening of the second shutter at the end of the second test trial. All Ss in the New Doubles and New Singles conditions responded with the correct syllable on the third and fourth trials. Thus, all of these Ss responded correctly after one exposure of the correct response. Three Ss in the Divergent I condition responded with the incorrect syllable on the third test trial, but all responded correctly on the fourth test trial. One S in the Divergent II condition responded with the incorrect syllable on both the third and fourth trials. On the third trial another S responded only after the second shutter had opened; this response was scored incorrect.

DISCUSSION

Training Trials

One objective of the preliminary experimentation was construction of training lists and development of a training procedure which assured comparable performance levels among experimental and control conditions prior to initiation of the test trials. That such homogeneity of performance levels had been achieved was indicated by the almost identical numbers of correct responses for each condition during the last 11 presentations of each of the critical training stimuli and by the very low F for differences among conditions with respect to response speeds on the last two presentations of the critical training stimuli.

Test Trials

The second objective of the preliminary experimentation was lists and a procedure which assured not only that Ss made some overt vocalization within 4 sec. after the presentation of the compounds on the first test trial but also that only one or the other of the two training responses occurred on that and subsequent test trials. With the exception of four failures to respond on the first test trial and four failures to respond on the three later trials, all Ss responded with one or the other of the two training responses or with, in three cases, blends of the two training responses. The results for the test trials are discussed first in terms of compound stimuli, then verbal context.

Stimulus Compounds

Speed. In the main, the rank-orders of experimental and control conditions for speed were those which had been predicted. Table 12 indicates that individual conditions deviated from the predicted rank orders by only one or two rank-order positions. A comparison between the observed and predicted positions of a single condition on a single test trial may be made by following the line which joins these two positions on Table 12. A number of the predicted differences among subsets of conditions and between specific pairs of conditions were not significant. On the first test trial, Divergent II had been predicted to rank after the two Associated-Nonassociated conditions, and the latter had been predicted in reverse order. Otherwise, conditions were in the predicted order. Lack of significant differences between the experimental compounds on this trial was probably due to the training procedure which had accustomed S to making rapid, correct responses. It is possible that on the first test trial, Ss in the Convergent and Divergent conditions may have fixated one or the other of the two syllables, found it familiar, and began to respond to it before fixating the other syllable and finding that syllable also familiar.

On the second test trial, the two Associated-Nonassociated conditions, in addition to being in reverse order, were

Table 12

Comparisons of Predicted and Observed Rank-Orders of Conditions for Speeds

Trial One Observed	Predicted	Trial Two Observed
Cont. Singles	Cont. Singles	Cont. Singles
Convergent I	Convergent I	Convergent II
Convergent II	Convergent II	Asso.-N.asso. I
Divergent II	Asso.-N.asso. II	Asso.-N.asso. II
Asso.-N.asso. I	Asso.-N.asso. I	Convergent I
Asso.-N.asso. II	Divergent I	Divergent II
Divergent I	Divergent II	New Singles
New Singles	New Singles	Divergent I
New Doubles I	New Doubles I	New Doubles II
New Doubles II	New Doubles II	New Doubles I

Trial Three Observed	Predicted	Trial Four Observed
Cont. Singles	Cont. Singles	Cont. Singles
Convergent II	Convergent I	Convergent I
Asso.-N.asso. II	Convergent II	Convergent II
Asso.-N.asso. I	Asso.-N.asso. II	Asso.-N.asso. I
Convergent I	Asso.-N.asso. I	New Singles
New Singles	Divergent I	Asso.-N.asso. II
New Doubles II	Divergent II	New Doubles II
Divergent I	New Singles	Divergent II
New Doubles I	New Doubles I	New Doubles I
Divergent II	New Doubles II	Divergent I

faster than Convergent I rather than slower as predicted. Also, Divergent I was predicted to be faster, not slower than New Singles. The wider spread of means of the experimental compounds on this second trial may have reflected Ss' discovery that both syllables were familiar.

On Trial Three, for the first time, the Associated-Nonassociated conditions were in the predicted order, whereas, the two Divergent conditions reversed, thus departing from prediction. In addition, New Singles and New Doubles II both exceeded the speed of the Divergent conditions. Thus, new stimulus-response associations were easier to learn than associations which involved negative transfer.

On the last trial, New Singles again moved higher in the rank-ordering, improving faster than either New Doubles condition. This may be a further indication of the difficulty of learning associations with compound stimuli relative to that with single stimuli.

Recall. No incorrect response occurred on the first two trials with the two Convergent conditions and the Continued Singles condition. In addition, no incorrect responses occurred with Associated-Nonassociated I, and Associated-Nonassociated II yielded a less perfect recall only in that one S began to spell the incorrect response and then corrected herself before the 2-sec. interval anticipation had elapsed. With the New Singles, and two New Doubles conditions, some Ss failed to respond and others responded incorrectly. On the whole, therefore, these results were those which had been predicted.

Learning. Number of correct responses on the learning trials did not prove sufficiently sensitive to test the predicted rank-order. Perfect scores were made for both learning trials by the Ss of all conditions except Divergent I and Divergent II.

Overall Pattern. The pattern of results for speed, recall and learning measures suggests that the Convergent condition lowered performance relative to the Continued Singles condition. Although no difference on any particular test trial was significant, the trends were separate across all four trials. The poorer performance with the Convergent compounds may have been due to a longer time required to look at and perhaps to read two-syllable stimuli and/or to dissimilarity between presentation of one nonsense syllable alone and presentation of that syllable simultaneously with another nonsense syllable. Ss had had experience with each of the test syllables presented with another syllable but their training had not included presentation of the test syllables with another syllable to which a response had been associated experimentally. Clearly, however, the Convergent associations did not summate to yield faster speeds than the Continued Singles.

The Associated-Nonassociated conditions also resulted in consistently poorer performance than Continued Singles.

Although there is some evidence that the Associated-Nonassociated condition did not produce response speeds quite as fast as those for the Convergent conditions, the differences were slight. Possibly, presentation of Associated-Nonassociated compounds during training had accustomed Ss to quick selection of the associated syllable and immediate disregard of the nonassociated syllable. In the introduction of a novel stimulus element, the introduction per se may be novel, the element may be novel, or both. With the procedure followed here, the introduction of a novel element was no longer completely novel, nor was doubleness, as such. However, the nonassociated element of the first test stimulus was novel in that it had not been presented previously in the experimental situation. Presumably, then, the novelty of this element was chiefly responsible for the differences between the Associated-Nonassociated conditions and the Continued Singles and Convergent conditions. The prediction of faster speeds and better recall for Associated-Nonassociated II than for Associated-Nonassociated I was not supported.

On the first two trials, response speeds and numbers of correct responses for the New Singles and New Doubles conditions, with one exception, were lower than speeds and correct responses for the other conditions. However, by the last two trials these differences had been narrowed or eliminated. Speeds on the first test trial did not fall as low for the New Singles condition as for the New Doubles, and the slope of the learning curve was steeper for the New Singles. These results, added to those of the preliminary studies concerning the difficulty of two-syllable stimuli compared with one-syllable stimuli, suggest the desirability of enlarging available information concerning the difficulty of multi-element stimuli, the possible interaction of number of stimulus elements with length of list, and so on.

Results for the Divergent conditions form a pattern which differs sharply and in several ways both from the apparently asymptotic speeds of the Continued Singles condition and from the pattern of increasing speeds which characterized the other seven conditions. The responses of Ss in this condition showed vacillation, providing instances not only of response blends but also of response alternation from trial to trial even after the correct response had been presented. Both Divergent conditions produced slower speeds than the Continued Singles condition on all four test trials. With only three exceptions, all comparisons with the Continued Singles condition were significant. In general, the Divergent conditions also produced slower speeds than any other experimental condition across the test trials, and, after the first trial, the response speeds were almost as slow or slower than those for the New Singles and New Doubles conditions. Thus, predictions concerning the rank-ordering of the Divergent groups in relation to other conditions were supported. However, the prediction that Divergent II would produce better performances than Divergent I on the learning trials was not supported.

Andreas (1958) has suggested that conflict studies have failed to control for changes from single stimuli on the training trials to double stimuli on the test trials which could account for performance decrements in terms of primary stimulus generalization rather than in terms of "conflict." His own procedure eliminated such changes by using only double stimuli during training. In the present study, where comparisons with Continued Singles were to be made, this procedure could not be used. Instead, practice with double stimuli was provided by inclusion of associated-nonassociated stimuli during training. Assessment of the effect of doubleness *versus* singleness was provided for by inclusion of New Doubles conditions in addition to a New Singles condition. Also, and perhaps most importantly, the Convergent conditions served as a control for stimulus change. Such a control would seem desirable for future studies of conflict where any slower speeds for Convergent conditions than for Continued Singles conditions would be interpreted as possibly due to primary stimulus generalization and any slower speeds for Divergent conditions than Convergent conditions would be interpreted as due to conflict.

Verbal Context

In their verbal context experiments, Howes and Osgood, Jenkins and Cofer, and Musgrave used familiar words as stimuli. Such words differ from the nonsense-syllable stimuli of the present experiment in having associations with more than one response word. Consequently, word compounds often cannot be classified as one of the three types of compounds constructed as limiting cases for the present study.

With words, it is easier to obtain fairly pure cases of divergent compounds than of convergent, for even synonyms do not have completely overlapping response hierarchies. Frequently, word compounds involve both convergent-divergent relationships with the latter predominant, which may account for the fact that word-association data contain more cases of interference than of facilitation. The adjective-noun compounds of Jenkins and Cofer probably involved both convergent and divergent relationships--i.e., their adjectives were appropriate modifiers of their nouns, yet it is doubtful that the response hierarchies of these words overlapped extensively. Similarly, Howes and Osgood's "strongly associated" context words may have had response hierarchies which contained other strongly associated words than those which they considered.

Also, Howes and Osgood's compounds containing "neutral" context words, and Musgrave's containing "zero-association" context words are difficult to classify as either divergent or associated-nonassociated. Resolution of the problem may be made in terms of strength of association between the context word and competing response words. Thus, if a context word, in addition to having no association with the response typically elicited by the test word, has a strong primary association of its own, the compound of context and test words would be called divergent. If, on the other hand, a context word is weakly associated with the words of its own response hierarchy in addition to those of the test word's hierarchy, the compound would be called associated-nonassociated. To establish a cut-off point on the dimension of strength of word-word association which would permit classification of the more ambiguous cases, more empirical information than now exists would be required. However, gross differences in association strength are readily judged.

With results of the present study concerning the effects of compounds in the single-response case to serve as a baseline, the next step toward an explanation of verbal context phenomena is to use the paired-associates technique to establish nonsense-syllable response hierarchies. That this can be done has been shown by Sugarman and Goss (1959). Hierarchies of responses to stimuli involving various amounts and kinds of overlap should be formed to represent the various situations of verbal context studies. Stimuli with such response hierarchies could then be combined to form compounds which could explore with great precision the role prior associations play in producing context effects.

SUMMARY

The present study was concerned with the effects on response speed, recall, and learning of three kinds of nonsense-syllable compounds: (a) Convergent compounds composed of two syllables each of which had been associated with the same response; (b) Divergent compounds, composed of two syllables each of which had been associated with a different response; and (c) Associated-Nonassociated compounds, composed of one syllable which had been associated with a response and one which had not been presented during training. Although this experiment was suggested by investigations of the effects of verbal context on word associations, studies concerning a wide variety of compound stimuli, many of them non-verbal in nature, were used to make predictions concerning the three response measures. In general, the predicted rank order from best to poorest performance of Convergent, Associated-Nonassociated and Divergent was obtained. However, some predicted differences were not significant and, in some instances, the observed rank order differed in several details from that predicted.

A paired-associates procedure was used with 72 undergraduate women as Ss to establish associations between the single stimulus syllables which were to comprise the compounds and one of two response syllables. The two-syllable compounds, formed by placing the syllables in both possible

orders (called I and II), were then presented for two recall trials and two learning trials. Continued Singles, New Singles and New Doubles conditions were used as controls.

All experimental compound conditions were slower on the first test trial than Continued Singles; the two Associated-Nonassociated and the Divergent I conditions were significantly slower. In addition, all experimental compound conditions were significantly faster on the first test trial than the New Singles or New Doubles conditions. Although differences among the experimental compound conditions were not significant, the rank-order of decreasing response speeds for the Convergent, Associated-Nonassociated, Divergent conditions was that which had been predicted.

On the remaining three test trials, Continued Singles did not improve, suggesting that asymptotic speeds had been reached. In contrast, speeds for the two Associated-Nonassociated conditions improved significantly, as did those for the New Singles and New Doubles conditions. Speeds for the Convergent conditions also improved but not significantly. Only the two Divergent conditions did not exhibit either stable behavior or reasonably steady improvement. Instead, speeds fell on the second recall trial, markedly for Divergent I, moderately for Divergent II. After the second trial, when the presentation of the correct response syllable might have been supposed to resolve conflict, speeds fell sharply for Divergent II on Trial Three. By Trial Four, speeds had improved for both Divergent conditions but were still slower than those of other conditions, thus suggesting the continued presence of conflict.

All *S*s in the Continued Singles, Convergent, and Associated-Nonassociated conditions responded on the first two test trials with correct responses. One *S* in the Divergent, three in the New Doubles, and one in the New Singles conditions either waited too long to respond or made no response at all.

On the two learning trials, only the Divergent conditions produced any errors.

Compound stimuli for paired-associates learning were thus demonstrated to have effects on response speed, recall and learning measures of several kinds, depending on the nature of the stimulus-response associations of the compounds. These findings were discussed in relation to stimulus compounds and verbal context. It was concluded that these results concerning single response hierarchies could be used as baselines in research involving multi-word hierarchies for more precise studies of verbal context effects.

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APPENDIX A

Materials

CONVERGENT

TRAINING

S	R		S	R
LIQ	ROM		LIQ	JEL
FAB	ROM		FAB	JEL
CUS	JEL		CUS	ROM
DOZ	JEL		DOZ	ROM

TEST

	S	R	S	R
ORDER I:	LIQ FAB	ROM	LIQ FAB	JEL
ORDER II:	FAB LIQ	ROM	FAB LIQ	JEL

DIVERGENT

TRAINING

S	R		S	R
LIQ	ROM		LIQ	JEL
FAB	JEL		FAB	ROM
CUS	ROM		CUS	ROM
DOZ	JEL		DOZ	JEL

TEST

	S	R	S	R
ORDER I:	LIQ FAB	ROM	LIQ FAB	JEL
	FAB LIQ	JEL	FAB LIQ	ROM
ORDER II:	FAB LIQ	ROM	FAB LIQ	JEL
	LIQ FAB	JEL	LIQ FAB	ROM

ASSOCIATED-NONASSOCIATED

TRAINING

(LIKE CONVERGENT) S	R	S	R	(LIKE DIVERGENT) S	R	S	R
TEX	ROM	TEX	JEL	TEX	ROM	LIQ	ROM
FAB	ROM	FAB	JEL	FAB	JEL	NAV	JEL
CUS	JEL	CUS	ROM	CUS	ROM	CUS	ROM
DOZ	JEL	DOZ	ROM	DOZ	JEL	DOZ	JEL
LIQ	ROM	LIQ	JEL	TEX	JEL	LIQ	JEL
NAV	ROM	NAV	JEL	FAB	ROM	NAV	ROM
CUS	JEL	CUS	ROM	CUS	ROM	CUS	ROM
DOZ	JEL	DOZ	ROM	DOZ	JEL	DOZ	JEL

TEST

	S	R	S	R
ORDER I:	LIQ FAB	ROM	LIQ FAB	JEL
	FAB LIQ	ROM	FAB LIQ	JEL
ORDER II:	LIQ FAB	ROM	LIQ FAB	JEL
	FAB LIQ	ROM	FAB LIQ	JEL

CONTINUED SINGLES

	(LIKE CONVERGENT)				(LIKE DIVERGENT)			
	S	R	S	R	S	R	S	R
TRAINING	LIQ	ROM	LIQ	JEL	LIQ	ROM	LIQ	JEL
	FAB	ROM	FAB	JEL	FAB	JEL	FAB	ROM
	CUS	JEL	CUS	ROM	CUS	ROM	CUS	ROM
	DOZ	JEL	DOZ	ROM	DOZ	JEL	DOZ	JEL

	S	R
TEST	LIQ	ROM
	FAB	ROM
	LIQ	JEL
	FAB	JEL

NEW SINGLES AND NEW DOUBLES

	(LIKE CONVERGENT)				(LIKE DIVERGENT)			
	S	R	S	R	S	R	S	R
TRAINING	TEX	ROM	TEX	JEL	TEX	ROM	TEX	JEL
	NAV	ROM	NAV	JEL	NAV	JEL	NAV	ROM
	CUS	JEL	CUS	ROM	CUS	ROM	CUS	ROM
	DOZ	JEL	DOZ	ROM	DOZ	JEL	DOZ	JEL

	S	R
NEW SINGLES TEST	LIQ	ROM
	FAB	ROM
	LIQ	JEL
	FAB	JEL

NEW DOUBLES TEST

	S	R	S	R
ORDER I:	LIQ FAB	ROM	LIQ FAB	JEL
ORDER II:	FAB LIQ	ROM	FAB LIQ	JEL

APPENDIX B

Instructions

This study is concerned with how fast you can learn pairs of nonsense syllables. Pairs of syllables will be presented over and over until you know which one goes with which.

The window in front of you is closed by a left shutter and a right shutter. When the study begins the left shutter will go up and expose a nonsense syllable or pair of syllables. Shortly thereafter, the shutter on your right will go up and expose another single nonsense syllable. The right-hand syllables are two in number: R-O-M and J-E-L. They will always appear singly. Your task will be to learn which of these two syllables regularly goes with a particular syllable or syllables on the left.

When the left shutter goes up exposing a syllable or pair of syllables, you are to anticipate what the syllable on the right will be--either J-E-L or R-O-M. You are to indicate what the right-hand syllable will be by spelling it out <u>before</u> it is exposed by the raising of the right-hand shutter. Spell out the syllable you expect to appear on the right <u>loudly</u> <u>and</u> <u>distinctly</u>. Don't pronounce it. Then when the syllable is exposed by the raising of the right shutter, whether or not you anticipated it correctly, spell out the revealed syllable. In other words, each time you are to spell twice, beginning with the very first syllable.

When you see the syllable or syllables on the left always anticipate the syllable on the right by spelling out that anticipated syllable. While your anticipations may not always be correct, you can learn most effectively by always anticipating. Even if the syllables look unfamiliar, be sure to respond before the right-hand shutter opens. Be sure to say either R-O-M or J-E-L, and learn as soon as you can which one goes with the syllables on your left.

On certain trials, the right-hand shutter will open revealing a blank instead of a syllable. Thus, on these trials you will have no check as to what the correct response should be, and, of course, you cannot read a syllable as there will be nothing there to read. Instead of reading, repeat what you said before the second shutter opened. In case you have not already responded when the second shutter opens, use the extra time provided by the blank to make a guess and then repeat it. After one or more blank trials, the opening of the right-hand shutter will again reveal the correct response. Do not assume that the trial following a blank trial will also be blank. It may contain a response syllable which it is your task to anticipate correctly. Therefore, proceed on every trial as instructed. That is, when you have seen the syllable or syllables on the left-hand side, try to spell the correct response syllable--R-O-M or J-E-L--before the opening of the right-hand shutter and spell twice just as you said "Hello" twice.

Do you have any questions?

Remember, when the left-hand shutter goes up you will see either one syllable or two syllables. You are then to say loudly either J-E-L or R-O-M. The right-hand shutter will then go up and you will see the correct syllable: either R-O-M or J-E-L. Spell out the one you see. Each of the syllables or pairs of syllables on the left will be regularly followed by one of the two response syllables. It is your task to learn which of the two response syllables goes with each of the syllables on the left. You are to respond twice on every trial, beginning with the very first trial, as soon as the left-hand shutter goes up and you have a chance to see the first left-hand syllable or syllables. O.K. Let's begin.

APPENDIX C

Speeds for Individual Ss

Trial One

	Convergent S			Divergent S			Associated Nonassociated S	
I	BM	.971	I	SD	.769	I	DS	1.031
	AC	.838		JT	.745		SG	1.015
	CL	.771		NK	.715		CB	.693
	EK	1.210		MH	.766		JM	.705
	AC	1.133		FM	.754		JMcK	.761
	DU	.832		GS	1.046		AR	1.168
	NY	1.042		GC	.997		SN	.865
	NR	.698		AR	.793		KC	.700
II	DF	1.049	II	RK	1.012	II	BS	.853
	GR	1.028		CA	.978		MB	.991
	ES	.949		SF	.856		AK	.592
	HJ	.669		GL	.503		EC	.757
	BO	.747		EK	1.111		JL	1.251
	KR	.786		JW	1.243		NO	.829
	HJ	1.102		JW	.481		CG	.657
	RH	.994		CD	1.030		FH	.871

	New Doubles		New Singles		Continued Singles	
I	DP	.547	JB	.550	BM	1.267
	JC	.485	EW	.628	CC	1.003
	RN	.516	JM	.599	BL	.982
	MR	.250	BO	.622	GG	1.081
			DW	.552	BJ	1.474
II	JW	.250	BB	.250	BW	1.200
	JJ	.250	CR	.492	HF	1.050
	BH	.599	PG	.809	JC	.978
	CM	.514				

Speeds for Individual Ss (continued)

Trial Two								
	Convergent			**Divergent**			**Associated Nonassociated**	
	S			S			S	
I	BM	.995	I	SD	.796	I	DS	1.104
	AC	.758		JT	.694		SG	1.107
	CL	.849		NK	.559		CB	.823
	EK	.971		MH	.316		JM	.848
	AC	.906		FM	.860		JMcK	1.016
	DU	1.076		GS	.493		AR	1.175
	NY	.895		GC	.995		SN	.620
	NR	.804		AR	.794		KC	.874
II	DF	1.069	II	RK	.865	II	BS	.777
	GR	1.052		CA	.843		MB	1.212
	ES	.923		SF	.943		AK	.798
	HJ	.696		GL	.584		EC	.841
	BO	.806		EK	.776		JL	1.127
	KR	1.310		JW	.990		MO	.996
	HJ	1.453		JW	1.094		CG	.865
	RH	1.000		CD	1.036		FH	.901
	New Doubles			**New Singles**			**Continued Singles**	
I	DP	.734		JB	.966		BM	1.197
	JC	.699		EW	.958		CC	.900
	RN	.701		JM	.511		BL	1.068
	MK	.250		BO	.783		GG	1.158
				DW	.728		BJ	1.293
II	JW	.749		BB	.301		BW	.702
	JJ	.486		CR	.527		HF	1.184
	BH	.665		PG	.940		JC	1.121
	CM	.720						

Speeds for Individual Ss (continued)

Trial Three

	Convergent S			Divergent S			Associated Nonassociated S	
I	BM	.980	I	SD	.694	I	DS	1.112
	AC	.841		JT	.621		SG	.868
	CL	.941		NK	.516		CB	.955
	EK	.946		MH	.971		JM	1.003
	AC	.858		FM	1.070		JMcK	.997
	DU	1.017		GS	.957		AR	1.335
	NY	1.021		GC	1.071		SN	.744
	NR	.991		AR	.827		KC	.969
II	DF	.991	II	RK	.748	II	BS	.953
	GR	1.103		CA	.951		MB	1.362
	ES	1.242		SF	.956		AK	1.091
	HJ	.717		GL	.599		EC	1.001
	BO	.953		EK	.758		JL	1.023
	KR	1.317		JW	1.069		MO	1.006
	HJ	1.190		JW	.346		CG	.755
	RH	1.305		CD	.729		FH	.951

	New Doubles		New Singles		Continued Singles	
I	DP	.829	JB	1.048	BM	1.119
	JC	.881	EW	1.008	CC	.973
	RN	.794	JM	.773	BL	1.067
	MR	.730	BO	.970	GG	1.079
			DW	1.006	BJ	1.547
II	JW	.871	BB	1.096	BW	1.107
	JJ	.877	CR	.483	HF	1.096
	BH	.961	PG	1.199	JC	1.012
	CM	.997				

Speeds for Individual Ss (continued)

Trial Four

	Convergent S			Divergent S			Associated-Nonassociated S	
I	BM	1.168	I	SD	.884	I	DS	1.047
	AC	1.338		JT	.789		SG	1.222
	CL	1.005		NK	.744		CB	.779
	EK	1.162		MH	1.129		JM	1.173
	AC	1.111		FM	1.072		JMcK	.936
	DU	.807		GS	.819		AR	1.160
	NY	1.092		GC	1.144		SN	1.165
	NR	.881		AR	.758		KC	.877
II	DF	.591	II	RK	1.172	II	BS	.747
	GR	.942		CA	1.112		MB	1.288
	ES	1.136		SF	.961		AK	.937
	AJ	.926		GL	.700		EC	.812
	BO	.722		ER	.686		JL	1.375
	KR	1.267		JW	1.321		MO	.903
	HJ	1.430		JW	.734		CG	.805
	RH	1.280		CD	.809		FH	.970

	New Doubles		New Singles		Continued Singles	
I	DP	1.165	JB	.881	BM	1.028
	JC	.814	EW	1.265	CC	.863
	RN	.868	JM	.940	BL	1.009
	MR	.884	BO	.981	GG	1.016
			DW	1.053	BJ	1.388
II	JW	.814	BB	1.144	BW	1.061
	JJ	1.039	CR	.802	HF	1.243
	BH	.972	PG	1.183	JC	1.302
	CM	.929				

Speeds for Individual Ss (continued)

Criterion Trial

	Convergent S			Divergent S			Associated-Nonassociated S	
I	BM	1.022	I	SD	.990	I	DS	1.212
	AC	1.305		JT	.823		SG	1.210
	CL	.970		NK	.901		CB	1.061
	EK	1.189		MH	1.113		JM	1.043
	AC	1.149		FM	1.146		JMcK	.983
	DU	1.184		GS	1.210		AR	1.199
	NY	1.138		GC	1.081		SN	1.076
	NR	.978		AR	1.006		KC	1.048
II	DF	.969	II	RK	1.216	II	BS	1.152
	GR	1.218		CA	1.326		MB	1.418
	ES	1.016		SF	1.116		AK	.992
	HJ	1.118		GL	.756		EC	.822
	BO	.896		EK	1.138		JL	1.283
	KR	1.234		JW	1.173		MO	1.118
	HJ	1.308		JW	1.144		CG	.882
	RH	1.196		CD	.884		FH	.919

	New Doubles		New Singles		Continued Singles	
I	DP	1.020	JB	1.077	BM	1.187
	JC	1.014	EW	1.075	CC	.909
	RN	.963	JM	1.338	BL	1.013
	MR	.874	BO	1.098	GG	1.077
			DW	.996	BJ	1.206
II	JW	.914	BB	1.086	BW	.973
	JJ	1.004	CR	1.014	HF	1.000
	BH	1.149	PG	1.002	JC	1.051
	CM	1.057				

APPENDIX D

Sample Training and Test Lists for An Individual Subject

Convergent I

CUS	JEL	DOZ	WAT*	JEL	CUS	JEL
DOZ	JEL	CUS		JEL	FAB	ROM
FAB	ROM	SOC*	LIQ	ROM	DOZ	JEL
LIQ	ROM	FAB		ROM	LIQ	ROM
CUS	JEL	DOZ			CUS	JEL
LIQ	ROM	CUS		JEL	DOZ	JEL
DOZ	JEL	FAB		ROM	FAB	ROM
FAB	ROM	LIQ		ROM	LIQ	ROM
DOZ	JEL	FAB	REG*	ROM	CUS	JEL
CUS	JEL	DOZ		JEL	FAB	ROM
FAB	ROM	CUS			LIQ	ROM
LIQ	ROM	FAB		ROM	DOZ	JEL
DOZ	JEL	DOB*	CUS	JEL	LIQ	ROM
LIQ	ROM	LIQ		ROM	FAB	ROM
FAB	ROM	JIN*	DOZ	JEL	CUS	JEL
CUS	JEL	FAB			DOZ	JEL
LIQ	ROM	LIQ		ROM	FAB	ROM
FAB	ROM	LIM*	FAB	ROM	DOZ	JEL
DOZ	JEL	DOZ		JEL	LIQ	ROM
CUS	JEL	CUS		JEL	CUS	JEL
LIQ	ROM	LIQ	JAZ*	ROM	LIQ	ROM
DOZ	JEL	DOZ		JEL	FAB	ROM
FAB	ROM	LIQ			DOZ	JEL
CUS	JEL	CUS	PAC*	JEL	CUS	JEL

* Syllable which was used only once

Sample Training and Test Lists for An Individual S (continued)

Convergent I

DOZ		JEL	BAL*	CUS	JEL
CUS	BEC*	JEL	DOZ	RAC*	
PUF*	DOZ	JEL	CUS		
FAB		ROM	HON*	FAB	ROM
CUS		JEL	FES*	LIQ	ROM
LIQ		ROM	DOZ		
FAB	KEN*	ROM	FAB	HOL*	
TIC*	CUS		CUS	MAK*	
DOZ	VIF*	JEL	VIS*	DOZ	JEL
LIQ	SUT*	ROM	LIQ		
LOV*	FAB		WEV*	FAB	ROM
SAR*	LIQ	ROM	HIL*	CUS	JEL
CUS			LIQ	BUR*	ROM
DOZ			FAB		
LIQ			DUC*	LIQ	
CUS	HOB*	JEL	DOZ	BAS*	JEL
FAB		ROM	FAB		ROM
LIQ	NOV*		LIQ		ROM
FAB	VIN*	ROM	DOZ		JEL
DOZ		JEL	CUS		JEL
FAB			LIQ	FAB	
LIQ			LIQ	FAB	ROM
CUS		JEL	LIQ	FAB	ROM
GUL*	DOZ		LIQ	FAB	ROM

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