EFFECTS OF SEMANTIC RELATEDNESS UPON THE VERBAL RETENTION OF APHASIC ADULTS

Robert C. Marshall and Laurel J. Brown
Veterans Administration Hospital, Portland, Oregon

Aphasic adults frequently confuse associated or semantically related words (Spinnler and Vignolo, 1964; Bohering, Dudley and Coddere, 1967; Pizzamiglio and Appicciafuoco, 1971; Rinnert and Whitaker, 1973). In a study dealing with reduction of vocabulary in aphasia, Schuell and Jenkins (1961) presented 117 unselected aphasics sets of 4 pictures. Besides the stimulus word each set contained a word that rhymed with the stimulus word (i.e. chair-bear), a word associated with the stimulus word (i.e. chair-table) and a word unrelated to the stimulus word (i.e. chair-dog). Confusions of associated words were the most common problem for the 67 aphasics who made errors on the test. Addition of a visual cue in the form of a written word reduced in general the number of errors for each patient but associational confusions continued to be the predominant error type.

Other investigators have approached semantic confusions of aphasics somewhat differently. For the most part these studies have attempted to illustrate that semantic confusions are more common in aphasic than nonaphasic groups and that certain types of aphasic patients are more likely to exhibit semantic confusions than others. Pizzamiglio and Appicciafuoco (1971) constructed a 30 item multiple choice test designed to evaluate the ability of aphasics to understand the meaning of words in clusters of semantically similar alternatives. Four picture clusters containing pictures such as "hand", "foot", "leg" and "finger" were presented visually and subjects were asked to point to the picture having the highest degree of "associative overlapping" (Marshall and Cofer, 1963). Aphasics made significantly lower scores than nonaphasic groups; however, neither Broca's and Wernicke's nor Broca's and Amnestic aphasics matched for severity of overall comprehensional impairment performed differently on the test. Spinnler and Vignolo (1964) studied impaired recognition of meaningful sounds in aphasics, normals and brain-injured nonaphasics. Subjects pointed to one of 4 pictures in response to a tape recorded nonverbal sound that would normally be associated with one of the pictures. Errors were classified as acoustic errors (confusion of an acoustically similar sound), semantic errors (confusion of a semantically related sound), or odd errors (confusion of an unrelated sound). Associational errors were the most common error and a significantly greater number of aphasics fell

below the established cutoff score for the sound recognition test than either of the nonaphasic groups. A significantly greater number of Wernicke's aphasics fell below the established cutoff score than the Broca's or other classified aphasic types. Doehring, Dudley and Coderre (1967) essentially replicated the Spinnler and Vignolo study and also found that aphasics made significantly more sound association errors than nonaphasics and that posterior or Wernicke's patients performed significantly poorer than anterior or Broca's aphasics.

A brief review of the literature would seem to suggest that aphasics have substantially more difficulty than nonaphasics on word discrimination tasks where they must select a stimulus from a set of semantically related alternatives. It has not been clearly indicated, however, that semantic comprehension difficulties constitute a problem that is unique to any aphasic group. Moreover, no attempts have been made to determine aphasics' semantic comprehensional ability in messages longer than a single word. Inasmuch as reduced verbal retention span is a problem for virtually all aphasics (Schuell, Jenkins, Jiminez-Pabon, 1964), it seems possible that certain aphasics' tendency to confuse semantically related words might become more pronounced when message length is increased beyond a single word. The primary purpose of this investigation was to determine the effects of semantic relatedness upon aphasic adults' auditory retention of three verbal sequence lengths. Additional questions focused on the relationship between semantic confusions in aphasia and overall language impairment and whether or not semantic confusions were predominant in particular patient groups.

METHODS AND PROCEDURES

Subjects. Subjects for this study were 28 aphasic adults (25 males and 3 females) and 12 normal adult controls. Aphasic subjects were between 25 and 75 years of age with a mean of 51 years, aphasic as a result of a single cerebrovascular accident (CVA) and at least 4 months post CVA. Severity of aphasia was determined on the basis of subjects' overall percentile ranking on the Porch Index of Communicative Ability (PICA), (Porch, 1967) and only patients who fell between the 35th and the 95th percentile on the PICA were used as subjects.

Procedure. Subjects were administered 3 experimental tasks, each containing 45 items. For each task the subject pointed to a picture sequence in response to an auditory stimulus. In Experimental Task 1 (Figure 1), the subject saw 3 pictures and heard one stimulus word. In Experimental Task 2 (Figure 2), the subject viewed 3 two-picture sequences and heard a two-word sequence. In Experimental Task 3 (Figure 3), subjects saw 3 three-picture sequences and heard a 3 word sequence.

Figures 1, 2, and 3 also show the means by which the same picture stimuli were employed in all three tasks. Each possible

Figure 1. Example of One Word Picture Sequence
Stimulus: Point to ball.

Figure 2. Example of Two Word Sequence
Stimulus: Point to bat, ball.

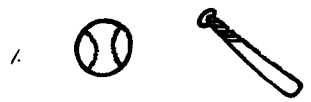

Figure 3. Example of Three Word Picture Sequence
Stimulus: Point to glove, ball, bat.

picture sequence was presented as the stimulus on one occasion and all pictures were displayed with 2" X 2" black and white drawings on 8½" X 11" white cards. A strip of magnetic recording tape was affixed to the base of each card and a standard American speaking male recorded the appropriate word sequence over the recording system of an Electronic Card Reader (ECR). All subjects heard the same stimulus presentations over the playback system of the ECR unit. Subjects were trained individually prior to the administration of each task. Three stimulus cards containing pictures other than those used in the actual experimental tasks were used for training. Subjects were given instruction, and if necessary demonstration, until training was accomplished.

Stimulus Selection. Selection of experimental task pictures was based on the frequency of 50 normal adults' responses to a 195 item word association task. The 195 words were all picturable nouns chosen from the 1964 Thorndyke and Lorge list. The 50 adults were instructed to write beside each word the noun they most commonly associated with that word. Table 1 shows that 15 words and the two most frequently occurring picturable noun responses to them were selected as task stimuli.

TABLE 1. EXPERIMENTAL TASK WORDS.

	Thorndyke-Lorge Word	Two most Frequently Occurring Responses	% of Total Responses
	BOY	GIRL, MAN	92%
H	BAT	BALL, GLOVE	90%
I	FORK	KNIFE, SPOON	90%
G	TABLE	CHAIR, DESK	78%
H	TOE	FOOT, FINGER	78%
	SHIRT	PANTS, TIE	46%
M	DOOR	WINDOW, HOUSE	42%
O	CAR	TRUCK, BUS	18%
D	BED	BLANKET, PILLOW	26%
	APPLE	ORANGE, PEAR	28%
	GLASS	SHOE, MOON	0%
L	COW	TREE, BRUSH	0%
O	BOAT	STAR, KING	0%
W	CUP	COOK, DOG	0%
	HAT	PEN, EGG	0%

For words designated as having a high degree of semantic relatedness (HSR) the two words most frequently elicited by the original stimulus word comprised at least 70% of all responses. For words designated as having a moderate degree of semantic relatedness (MSR), the two words most often evoked by the original stimulus word comprised at least 18% but not more of all responses. Words designated as having a low degree of semantic relatedness (LSR) were arbitrarily selected

by the experimenter and were never given in response to the original stimulus word.

Scoring of Responses. Subjects' responses to each stimulus were scored with a modified multidimensional scoring system similar to the 16 point system described by Porch (1971). Scores for the modified system were: 5 for an accurate, responsive, prompt response; 4 for an accurate delayed response; 3 for an accurate self-corrected response; 2 for an accurate response with one repeat; 1 for an accurate response with two repeats and zero for an error. Interscorer reliability was determined by having the experimenter and a scoring observer simultaneously score 1215 individual responses (135 from each of 9 subjects). Using the 0-5 point system the experimenter and the observer achieved perfect agreement on 94.5% of all responses scored and had an overall interscorer correlation of .995.

RESULTS

The 12 normal adults had no difficulties whatsoever with the experimental tasks. All responses of the normal subjects were accurate, responsive and prompt and received scores of 5 on the modified multidimensional system. For this reason no comparisons of the performances of aphasics and normals were attempted.

Figure 4 shows aphasic subjects' means for LSR, MSR, and HSR stimuli for each sequence length. To determine whether a significant interaction existed between the semantic relatedness and sequence length factors a 3 X 3 factorial analysis of variance was applied to the data. Observation of Figure 4 indicates the existence of a significant interaction between these two factors ($F=5.0769$; $df=2,54$; $p<.001$). This interaction primarily results from aphasics' performance on MSR words. While they had relatively little difficulty selecting MSR single words, they showed an inordinate decrement in their ability to retain MSR two-word sequences. This is not totally surprising, however, since the steepest decrement for LSR and HSR words also occurs when the message is increased from one to two words. In short, the data do not support the hypothesis that degree of semantic relatedness differentially effect aphasics' retention.

Results also suggest that semantic confusions in aphasia are related to the degree of relatedness between stimuli from which the aphasic must make a selection. Table 2 shows aphasic subjects' means and standard deviations for each level of semantic relatedness for all experimental tasks.

FIGURE 4

Aphasic Subjects' Means For LSR, MSR, And HSR Stimull At Each Verbal Sequence Length

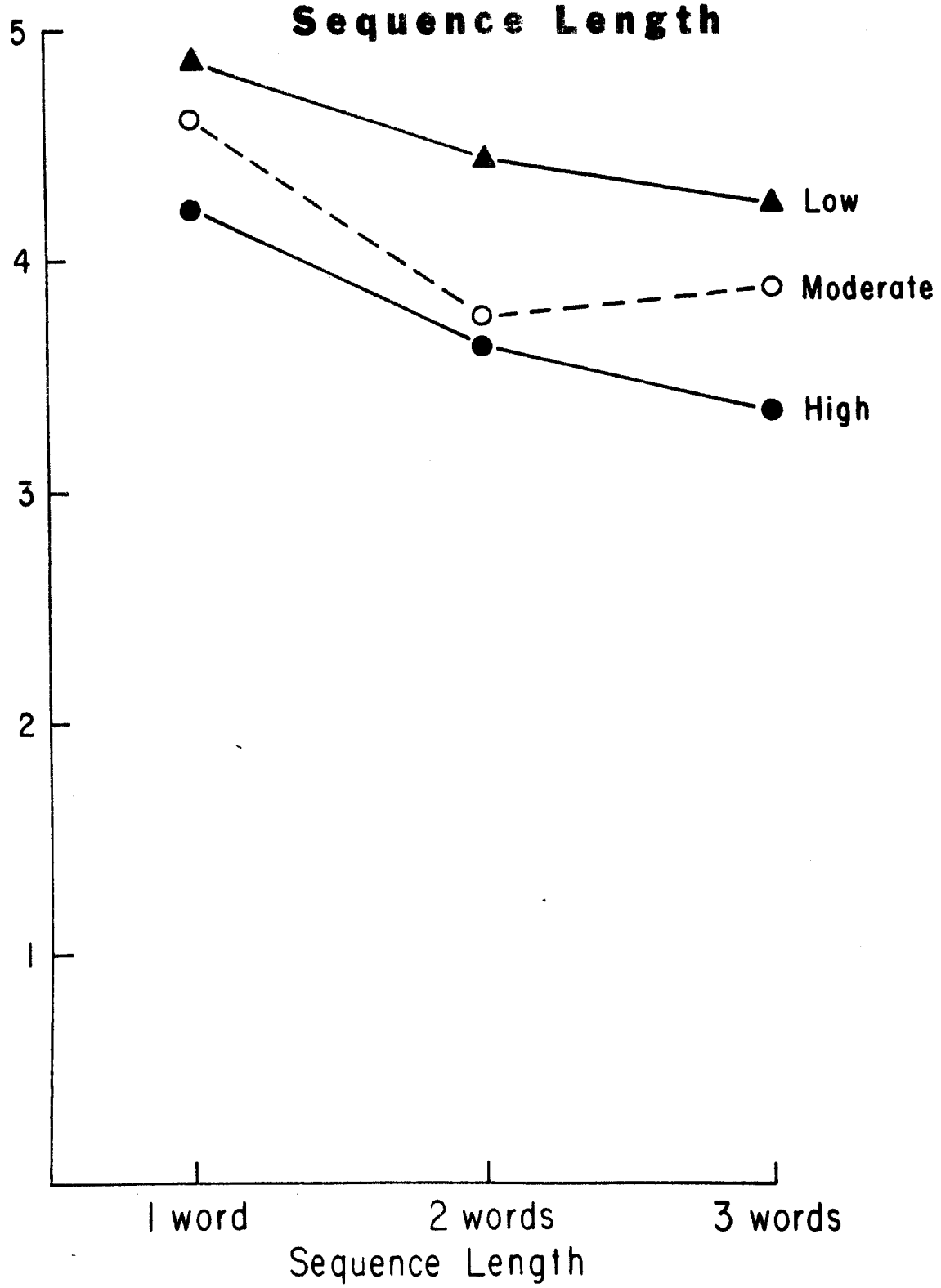

FIGURE 5

Regression Line For Aphasic Subjects' Overall Means And Overall PICA Percentiles

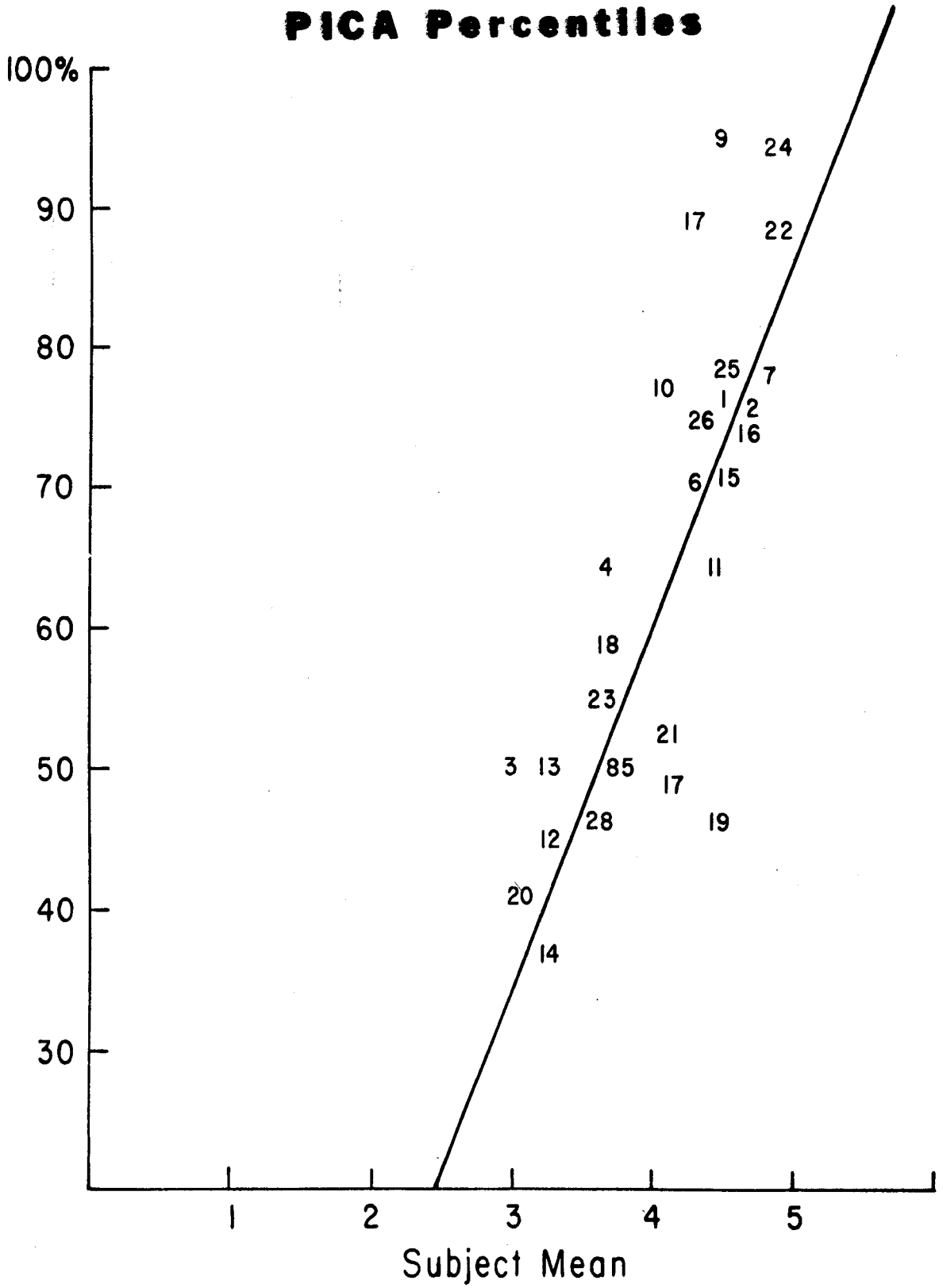

TABLE 2. APHASIC SUBJECTS' MEANS (N=28) AND STANDARD DEVIATIONS FOR EACH SEMANTIC RELATEDNESS LEVEL.

Stimulus Length	Semantic Relatedness Level	Mean	SD
One Word	Low	4.83	.0063
	Mod.	4.62	.0116
	High	4.21	.0231
Two Words	Low	4.42	.0184
	Mod.	3.73	.0378
	High	3.61	.0353
Three Words	Low	4.23	.0295
	Mod.	3.85	.0341
	High	3.30	.0368

Subjects had significantly more difficulty selecting ($p<.01$) sequences of MSR than LSR words and except for the HSR two word sequences, significantly more difficulty ($p<.01$) selecting HSR than MSR sequences.

For the most part the results of this study indicate that semantic confusions in aphasia are more closely related to the degree of aphasia rather than being reflective of a processing deficit on a semantic level. This is quite apparent in Figure 5 which plots each aphasic's overall mean score for the three auditory tasks against their overall percentile ranking on the PICA. The correlation between the auditory tasks and overall communicative ability was .793. This tends to support earlier large number studies of Schuell (1964) and Smith (1971) that show auditory ability in aphasia to be generally reflective of overall language ability.

The argument against a specffic semantic processing deficit is even more apparent in Table 3 which compares the performance of 9 subjects, matched for severity, who would ordinarily be classified as Broca's aphasics.

TABLE 3. MEANS FOR LSR, MSR AND HSR STIMULI FOR WERNICKE'S (N=9) AND BROCA'S (N=9) APHASICS MATCHED FOR SEVERITY.

	ONE WORD			TWO WORDS			THREE WORDS		
	Low	Mod.	Hi	Low	Mod.	Hi	Low	Mod.	Hi
Wernicke's	4.84	4.62	4.48	4.60	3.88	3.81	4.40	4.04	3.56
Broca's	4.88	4.64	4.14	4.54	3.88	3.81	4.51	3.96	3.41

The two groups of subjects performed almost identically on all experimental tasks. In all instances one tailed t-tests to determine the significance of difference in the mean scores for the matched groups were statistically nonsignificant ($p<.05$). Strangely the only measurable difference in the mean scores for the two matched groups occurred on the HSR one-word sequences. In this instance, however, subjects expected to present problems in semantic processing, performed superiorly to those expected to have little difficulty with this process.

DISCUSSION

In general the findings of this study support the not too surprising fact that associational confusions are common in aphasia and that aphasic adults exhibit significantly more of these confusions than nonaphasics. There is some reason to believe that semantic confusions in aphasia vary directly with the degree of semantic relatedness between the stimuli from which the aphasic must make a selection. This statement must be interpreted cautiously, however, since in this study aphasics performed approximately the same on the MSR two-word sequences and the HSR two-word sequences. It may be possible that this may have been due to the manner in which the stimuli were selected. In Table 2 it can be seen that the two most frequent associational responses to the words in the MSR group in some cases occurred with near equal frequency. Conversely, the two most frequent responses to words selected as HSR words reflected a preference on the part of the 50 normals for one specific word. Luria (1972) has hypothesized that for aphasics alteration of the neurodynamic regulatory mechanism may result in an unselective organization of associations such that all possible associations have an equal probability of being selected. In Luria's terms the incoming stimulus excites an associational matrix from which the individual selects a response. It seems plausible that the more extensive this matrix, the more difficult it would be for the aphasic to select an appropriate response. This may possibly be the case with the MSR stimuli in that more associational responses, and hence more confusions, might be expected with words like "shirt" and "bed" than words such as "boy" and "bat" which seem to generate a limited number of associative responses.

Results of this study failed to establish that semantic relatedness differentially effects aphasics' retention. Should this have been the case, subjects would have been expected to exhibit proportionately greater decrements in retentional ability for MSR words than LSR words and proportionately greater decrements in HSR words than MSR words. Instead the principle factor influencing retention was simply the length of the message to be retained. From a methodological standpoint one could question the use of sequences of related words to ascertain the effects of semantic relatedness on retention. Individuals rarely have the necessity to remember a series of single words, however, the use of more meaningful units such as sentences brings

syntactical factors into play. It may be that it is unwarranted and essentially meaningless to attempt to separate linguistic processes in the study of aphasia. These processes, the syntactical, the semantic and the phonological are interrelated. They are learned simultaneously; and in communication they are dealt with simultaneously. The relevance of partitioning them for the sake of test construction and then drawing inferences from patient's performance of these tests must be seriously questioned.

Finally, perhaps the most important finding of this study was that a common problem for aphasics, namely that of confusion of words associated in meaning, was positively related to overall language ability but not confined to any particular patient group. This would seem to further substantiate a unitary view of aphasia as earlier postulated by Schuell and others.

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