Experimental study of verbal association learning in patients with severe dysphasia

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Meaningless syllables (nonsense syllables) have frequently been used to study learning. Each nonsense syllable usually consists of three letters beginning and ending with a consonant and having a vowel in the middle. For a long time, interest has been directed to the possible association with words elicited by different nonsense syllables and various studies have been carried out (Glaze, 1928; Hull, 1933; Archer, 1960; Noble, 1961; Chang and Shepard, 1964) in order to 'calibrate' nonsense syllables according to their 'association value', that is to say, according to the ease with which they suggest familiar words. Several such lists have been compiled: the degree of association value usually varies from 100%, i.e., syllables that all subjects report as bringing forth associations with a particular word, to 0% i.e., syllables that all subjects report as not bringing forth any word association.

It has been found (Underwood and Schulz, 1960) that the ease with which a list of nonsense syllables is learned depends upon the ease with which associations with 'meaningful material' are made; the higher the meaningfulness, the faster the learning.

Conversely, by measuring the speed of learning lists of nonsense syllables of known association value, it is possible to make inferences about the readiness with which an individual can bring forth related verbal associations.

In a previous study (Wyke, 1962) it was found that it is easier to elicit correct verbal responses from dysphasic patients when the possible choice of response words was restricted by the stimulus situation than when this restriction was less stringent. It was then suggested that this might be the result of a basic breakdown of association of ideas rather than a simple alteration of verbal habits.

In the present paper an attempt is made to deal with this problem by examining the ability of patients with severe dysphasia to learn calibrated nonsense syllables as compared with the performance of patients with normal verbal functions. The purpose of the study is to ascertain the extent to which association processes are altered in patients with severe language defects.

The experimental subjects were 16 patients with the neurological disorders shown in Table I. Eight of these were dysphasic and a control group of eight patients had no dysphasia. Details of the language defects are shown in Table II. These dysphasic patients also showed defects of reading and writing. All of them, however, were able to copy written material as well as being able to match printed words with corresponding pictures.

The mean duration of the illness in the dysphasic group was three years (range two to four years). All but one had attended a speech therapy clinic for at least one year and their language defects were considered to be stable. The control group was selected to be within the same age range as the experimental group. Both groups had similar intellectual abilities, as defined by the performance tests of the Wechsler adult intelligence scale. The results of these tests are shown in Table III.
TABLE II

LANGUAGE DEFECTS IN DYSPHASIC GROUP

<table>
<thead>
<tr>
<th>Patient</th>
<th>Expression</th>
<th>Comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td>F.H.</td>
<td>+++</td>
<td>+</td>
</tr>
<tr>
<td>B.J.</td>
<td>+ +</td>
<td>-</td>
</tr>
<tr>
<td>M.M.</td>
<td>+ + +</td>
<td>+</td>
</tr>
<tr>
<td>P.C.</td>
<td>+ + + +</td>
<td>+</td>
</tr>
<tr>
<td>L.A.</td>
<td>+ + + +</td>
<td>+</td>
</tr>
<tr>
<td>S.H.</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>A.E.</td>
<td>+ +</td>
<td>+</td>
</tr>
<tr>
<td>C.H.</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

--- None, + Moderate, ++ Severe, +++ Very severe

TABLE III

SCORES OF DYSPHASIC AND CONTROL GROUPS ON WECHSLER ADULT INTELLIGENCE PERFORMANCE SCALE

<table>
<thead>
<tr>
<th>Test</th>
<th>Group</th>
<th>Patient</th>
<th>Digit Symbol</th>
<th>Picture Block Completion</th>
<th>Picture Design</th>
<th>Picture Arrange-ment</th>
<th>Object Assembly</th>
<th>I.Q.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dysphasic</td>
<td>F.E.</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>3</td>
<td>7</td>
<td>9</td>
<td>91</td>
</tr>
<tr>
<td></td>
<td>B.J.</td>
<td>6</td>
<td>9</td>
<td>6</td>
<td>10</td>
<td>9</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M.M.</td>
<td>10</td>
<td>18</td>
<td>12</td>
<td>14</td>
<td>12</td>
<td>129</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P.C.</td>
<td>12</td>
<td>10</td>
<td>17</td>
<td>10</td>
<td>12</td>
<td>116</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L.A.</td>
<td>6</td>
<td>13</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>99</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S.H.</td>
<td>8</td>
<td>10</td>
<td>13</td>
<td>13</td>
<td>9</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A.E.</td>
<td>6</td>
<td>10</td>
<td>13</td>
<td>14</td>
<td>11</td>
<td>113</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C.H.</td>
<td>7</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>8</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>N.J.</td>
<td>11</td>
<td>13</td>
<td>11</td>
<td>12</td>
<td>11</td>
<td>110</td>
<td></td>
</tr>
<tr>
<td></td>
<td>K.W.</td>
<td>15</td>
<td>12</td>
<td>13</td>
<td>10</td>
<td>11</td>
<td>112</td>
<td></td>
</tr>
<tr>
<td></td>
<td>J.K.</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>9</td>
<td>11</td>
<td>104</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G.P.</td>
<td>13</td>
<td>7</td>
<td>11</td>
<td>10</td>
<td>-</td>
<td>101</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L.L.</td>
<td>9</td>
<td>13</td>
<td>13</td>
<td>13</td>
<td>-</td>
<td>112</td>
<td></td>
</tr>
<tr>
<td></td>
<td>J.R.</td>
<td>10</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>-</td>
<td>109</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A.D.</td>
<td>14</td>
<td>12</td>
<td>15</td>
<td>9</td>
<td>12</td>
<td>114</td>
<td></td>
</tr>
<tr>
<td></td>
<td>W.R.</td>
<td>8</td>
<td>14</td>
<td>10</td>
<td>11</td>
<td>7</td>
<td>98</td>
<td></td>
</tr>
</tbody>
</table>

1In the final calculation of the dysphasic patients' I.Q., the subtest of digit symbol has been omitted, because due to their neurological disabilities seven patients used the left hand (non-dominant) for writing, slowing their performance.

PROCEDURE

A test card was presented to the subject and he was asked to copy the printed list. The test card and the subject's copy were removed from his sight and he was then asked to re-write in the same order what he had just copied. If he was not able to recall the contents of the card correctly, he was shown the card again and asked to copy and then recall it once more. This procedure was repeated until he was able to master the contents of the card to the criterion of three successive reproductions.

The cards with nonsense syllables and also those containing the words were presented first, followed by the card with the designs. The order of presentation of the test cards with the nonsense syllables and that with the words were randomized for each subject. All subjects learned the eight cards.

Testing was carried out in three to four sessions with the control group in and in four to five sessions with the dysphasic group, each session lasting about an hour. The subjects were allowed 10-minute rests between lists. This was done in order to avoid the effects of proactive inhibition, i.e., the influence of prior learning on present learning (Underwood, 1957).

RESULTS

The number of trials needed by each subject to learn the list of nonsense syllables, words, and designs for both the dysphasic group and the control group is shown in Table IV. The mean number of trials needed by each group to learn to find criteria for the lists of nonsense syllables of different association value is graphically displayed in Fig. 1. For con-

TEST MATERIAL

The test material consisted of six cards, each having three-letter nonsense syllables printed on it. The syllables were chosen from Glaze lists (modified by Hilgard, 1951) which are graded according to their degree of association value. Each card contained five nonsense syllables selected from the 100, 80, 60, 40, 20, and 0% association value lists respectively. The nonsense syllables were selected at random, subject to the restriction that no particular consonant would appear more than twice on a card and that not all the vowels would be present within the same card. Thus, on each card there were four different vowels with one vowel repeated once. This was to prevent guessing based on a belief that the five vowels were present within each list. In the case of lists with high association value care was taken to avoid resemblance to meaningful verbal sequences.

Two more cards were used, one with five three-letter words constructed similarly to the nonsense syllables, i.e., beginning and ending with a consonant and having a vowel in the middle, and one with five simple geometrical designs.

FIG. 1. Mean number of trials needed by dysphasics and non-dysphasic groups to learn to reach criteria.
The numbers of errors made by the dysphasic group and the control group were also analysed. The criterion for error was the reproduction of a syllable different from the printed list. Changes in position within the list, or incomplete reproduction (i.e., when the subject wrote only one or two letters of the syllable) were not scored as errors.

The total number of errors made by the dysphasic group was larger than that of the control group, the number of errors increasing in the lists corresponding to 60% association value in both groups. Few errors were made by either group in the lists corresponding to 100 and 80% association value.

Some of the errors made by both groups consisted of changes into words; examples of these are the nonsense syllable ‘fex’ recalled as fog; the syllable ‘flex’ recalled as flex.

The number of changes to meaningful words was considerably larger in the control group than in the dysphasic group. Thus, out of 211 errors made by the dysphasic group in the six lists of nonsense syllables, there were only 16 errors of changes to words. In the control group out of a total number of 146 errors, 24 were changes to words. The $\chi^2$ value for this comparison is significant at the 0.01 level of confidence ($\chi^2 = 6.80$).

The findings in this study show that patients with dysphasia have greater difficulty in learning lists of nonsense syllables than non-dysphasic subjects. However, this difference is not statistically significant when nonsense syllables have no ‘associative strength’, as in the case of syllables of 0% association value. The results also show that there is no significant difference between dysphasic and non-dysphasic subjects in the number of trials needed to learn a list of words or a series of simple designs. Further, the findings suggest that the difficulty encountered by dysphasic patients in learning lists of nonsense

### TABLE IV

<table>
<thead>
<tr>
<th>List</th>
<th>Dysphasic Group</th>
<th>Control Group</th>
</tr>
</thead>
</table>
| 100% Association value | 3 | 3 | 3 | 3 | 6 | 5 | 3 | 2 | 1 | 3 | 1 | 3 | 2 | 2 | 2 | 1 | 3
| 80% | 6 | 4 | 6 | 5 | 5 | 4 | 4 | 2 | 1 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 4
| 60% | 9 | 10 | 7 | 7 | 10 | 10 | 8 | 3 | 2 | 5 | 4 | 8 | 4 | 6 | 3 | 4 | 5
| 40% | 5 | 8 | 6 | 11 | 11 | 6 | 7 | 4 | 1 | 6 | 2 | 5 | 5 | 4 | 3 | 5 | 5
| 20% | 12 | 7 | 9 | 11 | 9 | 9 | 7 | 8 | 2 | 4 | 4 | 4 | 4 | 5 | 5 | 9 | 5
| 0% | 5 | 8 | 5 | 9 | 11 | 9 | 7 | 4 | 3 | 7 | 3 | 6 | 3 | 6 | 7 | 7 |
| Words | 2 | 3 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 2 | 2 |
| Designs | 3 | 4 | 2 | 5 | 3 | 2 | 3 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 2 |

Significant at 0.02, 0.05, 0.01 level of confidence

### TABLE V

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>D.F.</th>
<th>Mean Square</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Dysphasic Group</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Between subjects    | 7    | 12.1        | 4.7 | 5
| Between association value | 5      | 36.1        | 14.0 |
| Rem.                | 35   | 2.6         |     |
| B Control Group     |      |             |   |
| Between subjects    | 7    | 8.3         | 5.6 | 2
| Between association value | 5      | 13.7        | 9.2 |
| Rem.                | 35   | 1.4         |     |

Significant at 0.01 level

Significant at 0.001 level
sylables is only present when learning depends on
the ability to form an association with a particular
word.

It seems reasonable to assume that in learning a
list of nonsense syllables there are two main steps:
first, the transformation of individual letters into a
cohesive group of phonemes (this will apply whether
the symbols are speech sounds or their graphic sur-
rogates, i.e., letters in the present experiment); second,
the association of a particular word to the
nonsense syllables which serves as a stimulus. Thus,
when a subject is presented with the stimulus syllable
PIK, the first step in learning will be to bring these
three letters (P, I, K) into a cohesive group of
phonemes (PIK). Subsequently, the retention of the
syllable will depend on the readiness with which a
subject can form a meaningful association. The
meaningful link could be a simple transformation
of the nonsense syllable into a three-letter word, or
else the associative link could be derived from other
words of which the nonsense syllable forms only a
part.

If this is so, then slowness in learning may be due
to three sorts of difficulty: (a) a general difficulty in
learning; (b) a difficulty at the level of phonetic
organization; (c) a difficulty in forming rapid word
associations with a particular nonsense syllable.

It is pertinent to consider these different possibil-
ities in the order in which they have been mentioned.

(a) Generalized difficulty in learning cannot be
invoked as the explanation for the different results
obtained from the dysphasic and non-dysphasic
subjects. There was no significant difference
between dysphasics and controls in learning lists of
words, lists with no 'associative strength', or a series
of simple designs.

(b) Nor does the explanation of this difference lie
in the difficulty of transforming the individual letters
into a cohesive group of phonemes. This is inferred
from the fact that there was no evidence to suggest
that the subjects were learning the individual letters
rather than the syllables. If they had done so, there
would have been no difference in the number of
trials needed to learn the different lists, as all the
lists were constructed in a similar manner having the
same number and kind of letters differing only
in the association value of the syllables. Yet, as can
be seen in Fig. 1, the mean number of trials needed
to learn the different lists varied considerably.

(c) Therefore the third possibility, difficulty in
forming rapid meaningful association with a particu-
lar nonsense syllable, is a more likely explanation.

First, the results show that there is no significant
difference between the two groups, in the number of
trials needed to learn a list with no 'associative
strength'. As it is known that these syllables possess
no association value, the speed of learning is not
likely to be facilitated by the ability to form mean-
ful associations. Second, results show no significant
difference between the dysphasic and non-dysphasic
subjects in learning words.

Words are per se meaningful symbols, therefore the
speed of learning individual words need not neces-
sarily depend upon the ability to form rapid associ-
ations with other words. Moreover, in the present
experiment, associative processes in learning the list,
rather than the individual words, were greatly mini-
imized. There were only five three-letter words selected
in such a way as to avoid similarity between the
words and possible verbal sequences.

The hypothesis that the slowness with which
dysphasic subjects learn nonsense syllables stems
from their inability to form meaningful associations
to the stimulus syllable is supported by the supple-
mentary observations reported in this paper.

For example, the non-dysphasic subjects trans-
formed nonsense syllables into words more fre-
quently than the dysphasic subjects. This suggests
that the use of meaningful links as mediating factors
in verbal learning is more readily available to the
non-dysphasic subject than it is to the dysphasic.

The observations reported here show that the
breakdown of association processes in patients with
dysphasia extends beyond that found in verbal
response such as in naming objects, responding to
spoken stimulus words, or providing verbal responses
to visual stimuli (see Schuell and Jenkins, 1961;
Wyke, 1962) to include other aspects of verbal be-
haviour, i.e., learning and recall. Moreover, further
evidence is provided for the suggestion that dys-
phasia is not merely a specific loss of expression and
comprehension of speech but is a more fundamental
verbal disorganization. It would appear that the
breakdown of verbal ability is at the level of the more
intricate semantic connexions.

It is important to point out that even in cases of
severe dysphasia, as is the case in the present study,
the semantic mediating processes that exist in
normal verbal behaviour are not completely lost.
Analysis of the results shows that the number of
trials needed by the dysphasic subject to learn lists
with high association value were smaller than those
required to learn lists with low association value.
This would suggest that the availability of mean-
ful connexions is reduced but not abolished. In this
respect it is relevant to note that it has been pointed
out (Jenkins, 1961) that the association processes
mediating learning in normal subjects may not be
invariable in their mode of operation, since they can
be inhibited, facilitated, or interfered with by various
activities of the subject. Whether the factors that
inhibit association processes in normal subjects are
similar to those in dysphasic subjects remains to be seen.

SUMMARY

An analysis of verbal association processes in learning nonsense syllables was undertaken in eight patients with dysphasia and eight patients with neurologic disorders without dysphasia.

The pattern of learning shows that patients with dysphasia have greater difficulty in learning nonsense syllables than non-dysphasic patients, when learning depends upon the ability to form associations with a particular word. This suggests that the breakdown of association processes, which has been shown to occur when dysphasics are required to name objects and respond to spoken stimulus words, also accounts for the impairment of other aspects of language function, namely, verbal learning and recall.

Some theoretical implications of this finding are discussed.

I should like to thank Mr. V. Logue, Professor C. Oldfield, and Mr. M. Piercy for their advice, Miss E. Butfield, Principal of the West End School of Speech Therapy, for the evaluation of language defects in the dysphasic subjects, and the Paddington Group Hospital Committee for facilities provided. I am also grateful to Mr. A. Winfield, Linguistics Research Unit, Oxford, for statistical help.

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