Some characteristics of verbal behaviour in presenile dementia

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SYNOPSIS Two experiments concerned with the statistical characteristics of speech in presenile dementia are described. Apart from a lowered rate of production of words under certain conditions no speech abnormalities were detected on the variables examined.

It has often been claimed that there are abnormalities of speech in dementia (Critchley, 1964; Stengel, 1943, 1964). The speech of demented subjects is described as showing a general poverty of vocabulary with a reduced range of expression. It becomes gradually more concrete, circumlocutory, and repetitive. Definite dysphasic signs have also been reported.

There have been few detailed investigations of speech in dementia that progress beyond a merely descriptive level. Ernst et al. (1970) examined a small group of patients with dementia for signs of aphasia. They found no general pattern of language disturbance but the most common abnormality was a difficulty in naming. All subjects were considered to show poverty of vocabulary. As far as difficulties in naming are concerned Stengel (1964) has claimed that these are not like the nominal dysphasia produced by focal lesions in the brain. Some confirmation of this viewpoint comes from Rochford (1971) who obtained evidence that the failure of patients with senile dementia to name correctly was more due to errors in the recognition of the object to be named. In contrast, subjects with dysphasia produced by focal lesions appeared to recognize the object correctly but could then not supply the correct name.

Barker and Lawson (1968) and Lawson and Barker (1968) also investigated naming in senile dementia. They required their subjects to name 24 objects and recorded the accuracy of the response together with its latency if it was correct. Overall the demented group did less well than age-matched normal controls but there were two other findings of interest. The normal tendency for subjects to be less efficient, whether measured by latency or accuracy, in producing the names that are less commonly encountered in everyday speech was exaggerated in the demented group. The other finding was that demonstrating the use of the object enhanced naming by the demented group but there was no similar effect for the controls.

The aim of this paper is to present two further experiments exploring speech in demented patients. In particular, these experiments are concerned with the statistical characteristics of verbal production and they differ from most previous investigations in using subjects with presenile rather than senile dementia.

METHODS

SUBJECTS

The experimental subjects used in both experiments came from the same population of early cases of presenile dementia. They were seen during admission to the Wessex Neurological Centre for investigation of this condition. The diagnosis was based on both clinical impression, including some degree of memory loss and intellectual deterioration, and evidence of primary cerebral atrophy as revealed by air encephalography. Because of the insidious onset of the condition it is impossible to specify the length of illness but the maximum was two years. None was so severely affected as to require long-term care in an institution. Cases with a history suggestive of arteriosclerotic dementia or having obvious dysphasic signs

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on routine neurological examination were excluded. The age range was 52 to 67 years and the subjects came from the same general population of cases of presumed Alzheimer's disease as used by the senior author in previous studies of the memory disorder in presenile dementia—for example, Miller (1973).

Control subjects were matched for age with the experimental group. They were either patients admitted to the same centre with extracranial pathology or patients convalescing from pulmonary tuberculosis in a local chest unit.

**EXPERIMENT 1**

The task used was based on the word fluency test in Thurstone's Primary Mental Abilities series of tests. The subject was asked to produce orally as many words as he could beginning with the letter 'S' within a five minute period. The subjects' responses were recorded in such a way as to allow the production of words to be analysed as a function of time. Repetitions of words were disregarded as were alternative grammatical forms of words already given—for example, the plural of a word given earlier in the singular form. There were 12 subjects in each group.

**RESULTS**

The production of words as a function of time is shown in Fig. 1. As was anticipated, the controls produced a significantly higher number of words (P < .02 using the \( t \) test). Both curves approximate to a straight line and, since neither appears to be reaching an asymptote, it is reasonable to suppose that neither group had exhausted its stock of appropriate words.

The results can be analysed in terms of the frequency of the words as they appear in normal, everyday usage. Normative data have been provided for this by Thorndike and Lorge (1944). While this survey is American and a little out of date, its inaccuracies may be presumed to affect both groups equally and it is believed to be adequate for present purposes. The percentages of the total number of words from each group falling within the different Thorndike–Lorge word frequencies are given in the Table. The demented group produced a higher proportion of words from the most commonly occurring categories and a lower proportion of rarer words. This trend is statistically significant (\( \chi^2 = 17.1, P < .05 \)).

It may be that all subjects tend to produce the more frequently used words first. Within the five minutes available the normal subject could have worked through a number of commoner words and started to produce some of the less common ones. The demented group, being slower to produce words, may not have exhausted the readily available common words by the end of the allotted time. They would then produce relatively fewer rare words within their total number of words. As a crude test of this hypothesis, the list of words produced by each subject was divided into two halves according to the order in which they were given. The number of common words (arbitrarily defined as those occurring

**TABLE**

**DISTRIBUTION OF WORDS (EXPRESSED AS PERCENTAGE OF TOTAL) ACCORDING TO FREQUENCY WITH WHICH THEY ARE RECORDED IN THE THORNDIKE–LORGE WORD COUNT (EXPRESSED AS NUMBER OF TIMES WORD OBSERVED TO OCCUR IN SAMPLE OF MILLION WORDS)**

<table>
<thead>
<tr>
<th>Thorndike–Lorge frequency</th>
<th>&gt; 100</th>
<th>50–99</th>
<th>40–49</th>
<th>30–39</th>
<th>20–29</th>
<th>10–19</th>
<th>1–9</th>
<th>&lt;1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dements</td>
<td>30.1</td>
<td>14.0</td>
<td>4.7</td>
<td>7.7</td>
<td>8.7</td>
<td>10.4</td>
<td>16.4</td>
<td>8.0</td>
</tr>
<tr>
<td>Controls</td>
<td>26.0</td>
<td>12.0</td>
<td>3.3</td>
<td>1.6</td>
<td>4.8</td>
<td>14.0</td>
<td>20.0</td>
<td>14.0</td>
</tr>
</tbody>
</table>
more than 50 times in a million in the Thorndike–Lorge count) was recorded for each half. Comparison of the number of common words occurring in the first half as opposed to the number in the second half was significant at the 1% level (by t test) in the control group but the same test was not significant in the experimental group.

**DISCUSSION**

This experiment indicates that patients with dementia are unable to produce words at a normal rate. There is also an apparent tendency for the demented subject to produce a relatively higher proportion of the more commonly used words. This is consistent with the experiments by Barker and Lawson which were described above and in which demented subjects were found to be relatively more impaired in naming where the name was a less commonly encountered word. The implication might be that in dementia all words become less available to the patient but that it is the rarer words that are most likely to be lost from his vocabulary.

Unfortunately, the subsidiary analyses indicate that the differential effect of word frequency might be an artefact in this experiment. The demented subject's lower rate of production of words may not have allowed him sufficient time to exhaust the readily available stock of common words and thus leaving him with a lower proportion of rarer words. The significantly higher number of very common words in the first halves of the normal group's lists shows that they were not limited in this way.

A further experiment is required to look at the word frequency effect in a way that is not subject to this type of artefact. One way of doing this is to use the subject's free speech. A sample of the subject's conversational speech can be taken and analysed in terms of the frequency with which different words occur. This resolves into a simple mathematical relationship, known eponymously as Zipf's law, which has been shown to apply to the speech of all types of subject. When the cumulative number of words in the sample is plotted against the logarithm of the word frequency in that sample the result is a straight line like that shown by the main part of the data in Fig. 2. (In fact there may be some deviation from a straight line at the extreme but this can be shown mathematically to be due to sampling and would not occur if there were a sample of infinite size). This relationship has been used very successfully by Howes (1964) in the study of aphasia due to focal lesions and any alteration in the parameters involved in the relationship can be taken as indicating certain characteristics of the speech of abnormal groups.

**EXPERIMENT 2**

Subjects were engaged in conversation with the experimenter and encouraged to talk about themselves and their past. The whole situation was deliberately loosely structured with the experimenter's main aim being to keep the subject talking. The conversation was recorded on a tape recorder and the subject's utterances were transcribed later so that a consecutive sequence of 2,000 words could be taken for analysis. Five experimental and five control subjects participated. Although demented subjects with extreme poverty of speech could not be used, the experimental group still contained subjects whose verbal expression did seem very limited on clinical grounds. The number of subjects was kept low because of the very tedious nature of the experiment but the outcome is such as to indicate that, say, even doubling the number of subjects would not be likely to affect the general picture.

**RESULTS**

Each 2,000-word sample was considered separately in terms of the particular words that were
used and the number of times each individual word appeared in the sample. The results of the five subjects in each group were then analysed to give the mean number of words used once in each sample, mean number of words used twice, etc. These averaged data are shown graphically in Fig. 2 as the cumulative number of words of a given frequency or below (expressed as a proportion of the total) plotted against the logarithm of the frequency. Apart from the expected deviation at the upper extremity, it can be seen that the two curves give very good approximations to straight lines over a large part of the range. The two sets of data are almost identical. There is no question of any statistical analysis of differences between the groups giving a result that even remotely approaches the usually accepted significance levels.

**DISCUSSION OF RESULTS**

Although experiment 1 has shown demented subjects to be slow in producing words, this investigation indicates that the statistical characteristics of the words produced are normal, at least as expressed in free speech. If demented subjects were less able to retrieve and use the rarer words, then this would have been shown by an alteration in the slope of the straight line given in Fig. 2. If all words had become less available to an equal extent in dementia there would have been an alteration in the mean frequency of the words with the graph showing a consequent shift to the right along the abscissa.

**GENERAL DISCUSSION**

Experiment 1 has shown that demented subjects have a reduced rate of production of words. This experiment also gives some evidence that dements might have a selective loss of the ability to retrieve rarer words. This word frequency effect is consistent with some previous reports but further analysis of the data from experiment 1 revealed that this effect might be at least partly due to an artefact. In experiment 2, which involved a statistical analysis of subjects' free speech, no differences of any kind were found between the experimental and control groups. In particular, there was no evidence of a selective impairment for rarer words, which implies that the word frequency effect in experiment 1 was wholly due to an artefact.

There is a possible inconsistency between the results of the two experiments. It is tempting to interpret the smaller number of words produced by the dements in experiment 1 as reflecting a general lowering of the availability of words in the demented subject's vocabulary. Such a lowered availability was not revealed in experiment 2 by a shift to the right of the graph in Fig. 2. It must therefore follow that the demented's slowness in producing words in experiment 1 must represent something other than reduced availability of words per se.

The resolution of this difficulty could lie in the fact that the two experimental situations were very different. In experiment 1 speed was important and the subject was required to produce words to fit a very arbitrary criterion. There was no time constraint in experiment 2 where the rate of production of words would not affect the result and the usual flow of conversational speech was being examined. This leads to two possible hypotheses. The first is that demented subjects can actually retrieve words with normal facility but, where the natural flow of words is not required as in experiment 1, they are slow to decide whether any retrieved word meets the given criterion before making an overt vocalization.

The second hypothesis supposes a two-stage process in word production regardless of whether the words follow in the usual sort of sequence or have to meet some criterion before being uttered. Words have to be retrieved from the vocabulary and then have to be expressed or vocalized. The first process may be normal in dementia, thus resulting in the failure to find differences in experiment 2, but the actual rate of expression of words once produced might be reduced. This hypothesis would account for the slowness found in experiment 1 but would also result in a prediction applicable to experiment 2. While the analysed statistical characteristics would be normal, the rate at which demented subjects spoke would be reduced. It is the experimenter's subjective impression that this may have been so but, by the time that this further analysis appeared desirable, most of the interviews had been wiped off the tape. As a result it has been decided to leave this particular
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REFERENCES


