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Speech Perception in Schizophrenia

By H. C. BULL and P. H. VENABLES

Although there have been several reports of investigations of speech perception in schizophrenia (Laffal, 1961; Lawson, McGhie and Chapman, 1964) in all cases the assumption was made that the patients' difficulties arose, not from an inability to perceive the individual words, but from a deficiency in perceiving the words in a meaningful relationship to each other, as part of an organized pattern. In this study, however, instead of examining the performance of schizophrenic patients on a task involving the perception of sentences, as these earlier workers had done, we have used individual words as stimuli in a series of tests of speech perception.

Since schizophrenic patients have been reported to have raised auditory thresholds (Levine and Whitney, 1970; Emmerich and Levine, 1970) we decided to present the stimuli at various levels of intensity, and furthermore to test the auditory threshold of each subject. This was done to allow for the possibility that a poor performance on the task of speech perception could simply be a reflection of an impairment of auditory acuity.

Experiment I

Method

The auditory acuity (air conduction measurements) of each subject was tested for each ear by the method of limits, using two tones (one 1,000 Hz, and one 500 Hz). For each tone on each ear four runs on the M.P. Audiometer B 222 DT were given in order to establish a mean.

This was followed by a test of the subject's ability to discriminate speech sounds. The subjects were asked to listen to lists of English words and to repeat each word after they had heard it. They were instructed to guess when in doubt about a word. The words were presented to both ears simultaneously through earphones. A stereo Vortexion tape-recorder was used for the presentation of the material, and the subject wore a pair of Eagle SE-1 headphones. Two Advance Decade Attenuators were used to regulate the intensity of the stimuli in the two channels. The output was calibrated using an oscilloscope for a comparison to a continuous tone set at one KHz for the particular intensity. A Bruel and Kjaer 2203 sound level meter with a 4152 artificial ear was used for the setting of the intensity of the earphones.

The tests of speech perception were modelled on those used by Henkin and Daly (1968). There were four conditions, each consisting of the presentation of a list of 30 words. There were two lists of phonetically balanced words (from Fry the appropriate (1961) lists) and two lists of low pass filtered speech (these were phonetically balanced lists of words from which all the sounds above 500 Hz have been filtered off). A Rockland operational filter set at a high frequency cut-off of 500 Hz had a roll-off of 6 db per octave was used to obtain the lists of low pass filtered speech. The lists of low pass filtered speech were used in order to investigate the possibility that an impairment in the perception of speech might be a reflection of an impairment in the detection of sounds in the upper frequencies. If this were the case, it would be predicted that the performance of schizophrenic subjects would be similar to that of the control subjects on the lists of low pass filtered speech, but below those of the controls on the standard lists of phonetically balanced words.

One list of phonetically balanced words (PB) and one list of low pass filtered words (LPFS) were presented at an intensity of 80 db, and the other two LFPS lists were presented at 60 db (the LPFS lists were at these intensities before the speech was filtered).

There were forty-five male subjects. Thirty were schizophrenic patients (15 paranoid and 15 non-paranoid), and 15 were controls. All the subjects (experimental and control) were resident at Springfield Hospital, London, at the time of testing. None of the subjects had undergone lobotomy, and any subject who had been given ECT in the last three months, or who had been given ECT over a longer period, was excluded. None of the subjects showed evidence of gross brain damage; none of the patients were on their first admission, and most had been in hospital for a total of two years. The subjects were

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classified as either experimental or control on the basis of hospital diagnosis. Only patients who had been diagnosed as schizophrenic were included in the experimental group. The consensus diagnosis of schizophrenia was obtained from several psychiatrists in conference. The subjects in the control group included patients diagnosed as suffering from depression and psychiatric nurses. Any patient whose diagnosis included reference to organicity, alcoholism or subnormality was excluded. The schizophrenic subjects were classified as paranoid or non-paranoid on the basis of (1) hospital diagnosis and (2) that in addition there was evidence of a rigid and recurring delusional system in any patient classified as paranoid; no such delusional system was present in any of the non-paranoid patients. No catatonic patients were included. There were no significant differences between the mean ages or vocabulary scores (from Set B of the Mill Hill Vocabulary Scale, Raven, 1948) of the three groups (paranoid schizophrenic, non-paranoid schizophrenic and control). All the subjects were tested for cerebral dominance by a small battery of tests (Oddy and Lobstein, 1972) and who did not show right hand dominance on all of the tests were excluded.

The order in which the four conditions (i) PB at 80 db, (ii) PB at 60 db, (iii) LPFS at 80 db, and (iv) LPFS at 60 db were given to each subject was randomized. The number of words correctly reported by each subject from each list was recorded and this score was converted into a percentage of the number of words in the list. Practice trials were given at the beginning of each list.

Results

The mean auditory thresholds for the three groups are shown in Table I. There were no significant differences in auditory threshold between the groups to either the 1,000 Hz or the 500 Hz tone in either the right or the left ears ($F_{2,42} = 0{\cdot}826$ ns). Thus any differences found between the groups in speech perception cannot be thought to be due to differences in auditory acuity. This finding is a little surprising in view of Levine and Whitney's (1970) finding that schizophrenics have raised auditory thresholds; however, Ludwig, Wood and Downs (1962) also failed to obtain any significant differences between the auditory detection thresholds of the schizophrenic and control subjects.

The mean percentages of words perceived correctly on the tests of speech perception for the three groups are shown in Table II. There were no significant differences between the scores for the paranoid and non-paranoid groups ($F_{1,28} = 4{\cdot}08$ ns) on the PB list at 80 db. Although the score for the control group was greater than that for either of the schizo-

Table I

Experiment I: Mean auditory thresholds

		L. ear 1,000 Hz	R. ear 1,000 Hz	L. ear 500 Hz	R. ear 500 Hz
Paranoid schizophrenics ..	Mean	31·33	32·40	32·20	31·06
	S.D.	6·51	5·08	4·21	3·96
Non-paranoid schizophrenics ..	Mean	31·73	32·13	30·33	31·20
	S.D.	4·06	3·60	4·51	4·72
Controls	Mean	30·20	29·53	29·52	31·00
	S.D.	3·63	4·10	4·56	4·28

Table II

Experiment I: Mean per cent correct on tests of speech perception

	PB 80 db	PB 60 db	LPFS 80 db	LPFS 60 db
Paranoid schizophrenics ..	87·53%	71·26%	62·20%	25·86%
Non-paranoid schizophrenics ..	83·13%	68·13%	52·80%	22·46%
Control	90·46%	82·92%	72·40%	47·46%

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phrenic groups, this difference did not quite reach significance ($F_{2,42} = 3{\cdot}13$ ns). The control group performed significantly better than the schizophrenic groups on all the other lists; in other words, on the PB list at 60 db ($F_{2,42} = 8{\cdot}74$; $p < {\cdot}01$), on the LPFS list at 80 db ($F_{2,42} = 11{\cdot}22$; $p < {\cdot}01$), and on the LPFS list at 60 db ($F_{2,42} = 24{\cdot}19$; $p < {\cdot}01$).

The results would seem to suggest, therefore, that schizophrenics do show an impairment in the perception of speech sounds and that this difference is more marked in the filtered rather than the unfiltered speech, also at low rather than high intensities.

Since there has been some evidence to suggest that it may be the left hemisphere that is associated with a schizophrenic illness (Flor Henry, 1969a and 1969b; Gruzelier, 1973), it was decided to carry out a further experiment to determine whether the difficulty in speech perception was associated more particularly with the right or the left hemisphere. It was also of interest to see whether varying the levels of intensity of the speech sounds would affect the hemisphere differentially.

Experiment II

Method

This was almost the same as in the previous experiment. Again there were three groups of 15 subjects (paranoid schizophrenics, non-paranoid schizophrenics, controls). All the subjects were selected according to the criteria outlined in the previous experiment, and there were no significant differences between the mean ages or vocabulary scores (from Set B of the Mill Hill Vocabulary Scale, Raven, 1948) of the different groups.

Since the tests of auditory threshold which were done in the previous experiment had revealed no significant differences, this part of the previous experiment was not repeated. The test of auditory perception was the same as in the previous experiment and again comprised the four conditions of a list of PB words at 80 db, a list of PB words at 60 db, a list of LPFS words at 80 db and a list of LPFS words at 60 db. The word lists were exactly the same as in the previous experiment, except that instead of all the words in each list being presented to both ears simultaneously half of the words in each list (15 words) were presented to one ear and half to the other ear. Continuous white noise at 60 db intensity was fed into the ear which was not being given words for identification. This was done to reduce the effectiveness of the ipsilateral connections from the ears to the temporal lobes (Rosenzweig, 1951). In this way it was hoped that any differences which were obtained between the scores from the material presented to the left and right ears might give some indication of interhemispheric differences. The equipment used was the same as for the previous experiment, with the exception that, instead of the material to both ears coming from the tape recorder, a white noise generator, which was calibrated in the same way as the output from the tape recorder, was used to give a supply of continuous white noise to one channel.

Each subject heard 15 words in the right ear and 15 in the left ear in each of the four conditions. In each condition, for half of the subjects in each group the stimuli were presented to the right ear first, and for the other half they were presented to the left ear first. The order in which the lists were presented to each subject was randomized. Again, the number of words correctly reported for each half-list was recorded, and this score was converted into a percentage. Practice trials were given before each condition.

Results

The mean percentages correct on the tests of speech perception for the three groups are shown on Table III. There was an overall

Table III

Experiment II: Mean per cent correct on tests of speech perception

	PB 80 db		PB 60 db		LPFS 80 db		LPFS 60 db	
	L. ear	R. ear	L. ear	R. ear	L. ear	R. ear	L. ear	R. ear
Paranoid schizophrenics	76·93%	77·80%	61·27%	66·60%	40·47%	45·32%	26·20%	20·13%
Non-paranoid schizophrenics ..	74·60%	81·27%	56·33%	64·93%	37·37%	41·40%	15·13%	21·33%
Controls	93·13%	94·07%	82·67%	82·20%	51·60%	56·13%	38·67%	37·00%

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groups difference on all the data ($F_{2,42} = 11{\cdot}54$; $p < {\cdot}01$). Although the differences between the scores from the PB lists and LPFS lists were significant ($F_{1,42} = 533{\cdot}94$; $p < {\cdot}01$), the interaction between this factor and the group factor was not ($F_{2,42} = 0{\cdot}663$ ns). Similarly, the differences in the results due to the presentation of the stimuli at two levels of intensity (80 db and 60 db) were highly significant ($1,42 = 124{\cdot}44$; $p < {\cdot}01$), but the interaction between this factor and the group factor was not ($F_{2,42} = 1{\cdot}09$ ns). Again, for the differences between the scores from the stimuli presented to the right or left ears, there was an overall difference ($F_{1,42} = 6{\cdot}496$, $p < {\cdot}01$), but the interaction between this factor and the group factor was not significant ($F_{2,42} = 2{\cdot}27$ ns). Since none of the interactions between the various combinations of these factors with the groups factor were significant, it would seem that there was an overall difference between the scores from the schizophrenic and control groups which was independent of variations in intensity of the kind of speech material, and of the two ears. Since there were no significant differences between the scores from the paranoid and non-paranoid groups ($F_{1,28} = 0{\cdot}36$ ns), it would seem that on this task of speech perception the performance of both the schizophrenic groups was impaired, irrespective of the ear to which the stimuli were presented or of the experimental conditions.

These results would seem to confirm those obtained in the previous experiment, indicating that schizophrenic patients do suffer from an impairment in speech perception. There was no support, however, for the suggestion that the impairment could be associated with one hemisphere rather than the other, since although there was overall difference between the scores from the stimuli presented to the right and left ears this difference was independent of any group differences.

Since in both of the experiments on speech perception, on the lists of low pass filtered speech, the performance of the schizophrenic subjects was inferior to that of the controls, the notion that the impairment in speech perception could have arisen as a result of an impairment in the detection of sounds in the upper frequencies must be rejected.

The fact that in both of these experiments the schizophrenic patients were shown to suffer from an impairment in speech perception means that on any task in which the perception of spoken material is involved, the performance of schizophrenics is likely to be impaired. As a result of this finding the various reports of schizophrenic impairment in many areas (for example, on information processing tasks, learning tasks and short term memory) should at least be reconsidered. The possibility that the poor results obtained by the schizophrenic patients on such tasks could simply be a reflection of an impairment in the perception of spoken material should certainly be investigated.

Summary

An experiment is reported in which the ability of schizophrenics to perform tests of speech perception for individual words was compared to that of control subjects. The results indicate that schizophrenic patients do suffer from an impairment in the perception of individually spoken words presented at various levels of intensity. No support was obtained for the suggestion that this impairment could be associated with the presentation of stimuli to the left rather than the right cerebral hemisphere. The implications of this finding for the reports of schizophrenic impairment in many areas is considered.

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