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Delayed Auditory Feedback Vocal Intensity Changes in Schizophrenia

By F. G. SPEAR and R. L. BIRD

When speech processes are interfered with by the technique known as Delayed Auditory Feedback (D.A.F.) various disturbances result (Lee, 1950, 1951). These have been intensively investigated and have been found to depend upon the delay and amplification of the feedback (Black, 1951) and upon personality factors (Beaumont and Foss, 1957; Spilka, 1954). These differences have been shown to extend into psychiatric diagnoses (Goldfarb and Braunstein, 1958; Spear, 1963) and it has been possible to demonstrate that schizophrenic patients show less increase in vocal intensity under conditions of D.A.F. than do other psychiatric patients and normal subjects. It was thought worth while to investigate this difference further, using a slightly more refined method of measurement of the parameter under consideration and to seek clinical correlations with the findings.

Method

The technique used for producing conditions of D.A.F. has been described in the previous article (Spear, 1963) and was applied to 38 subjects. One of these subjects was unable to tolerate D.A.F. for more than three seconds and was therefore excluded from consideration. Speech under control and experimental conditions was recorded on tape. This tape was then replayed and the output recorded in two ways. First the output was fed into the circuit used in the preliminary study and thence to an EEG machine. This gave a tracing which approximated to the envelope of a rectified speech waveform. The length of this trace over a standard period of time is related to the mean vocal intensity. The ratio of lengths under control and experimental conditions was used as a measure of change in mean vocal intensity.

Second, the output from the tape recorder was fed into an average level recording voltmeter. When connected to the EEG machine this circuit was adjusted to give one pip per second with no input from the tape recorder. The tape used had a continuous 1,000-cycle note pre-recorded and this served as a calibration signal. It then became possible to count the number of pips under experimental and control conditions, subtract the number of seconds over which the average was taken and standardize this average between all readings. Although the variation due to minor changes in the control settings of the apparatus was allowed for in this way it did not cope with the variations in initial intensity. We therefore again considered the ratio of the mean intensity under control and experimental conditions.

As it was possible to count the number of pips in each second, we also studied the vocal intensity variation by examining the variance of these readings. The ratio of the variance of readings under control and under experimental conditions was used as a measure of change in vocal intensity variation.

All experiments were carried out by one of the authors (F.G.S.) and independent clinical assessments of the schizophrenic patients in this group (17 subjects) by the other (R.L.B.). An attempt was made to place them in rank order of severity according to the criteria of Langfeldt (1956). Acuteness of onset, thought disorder, "schizoid" premorbid personality, environmental stress, delusional content and affective loss or incongruity were each assessed on a four-point scale such that a high score indicated illness of the dementia praecox type whereas a low one indicated a schizophreniform illness. Thus an acute onset and considerable environmental stress would be given low scores while

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the presence of the other items would give high scores. These scores were then summed and the patients ranked.

Results

Thirty-seven subjects were considered: 17 schizophrenics (mean age 29·1 years, range 15–51); 12 other psychiatric patients (mean age 32·4 years, range 17–49); and 8 normals (mean age 31·6 years, range 21–54).

It was felt to be desirable to demonstrate that the two methods of measurement of vocal intensity change bore some relationship to one another. The ratios were ranked and Spearman's rho calculated for all sets of measurements (Siegal, 1956). There was a significant correlation between change in intensity measured by both methods (Rho = 0·76) and between change in intensity and change in variance (Rho = 0·77). It was then sought to confirm the findings of the previous paper that schizophrenic patients showed less change in intensity than other patients and normal controls. In view of the smaller number of subjects only three groups were considered: normals, schizophrenics and other psychiatric patients. Kruskal-Wallis one-way analysis of variance (a technique using ranks in which a statistic H, distributed as Chi squared, is calculated) demonstrated again that schizophrenic patients showed significantly ($H = 6{\cdot}32$, $df = 2$, $P < 0{\cdot}05$) less disturbance than the other groups. There was, however, no significant difference between the groups when changes in vocal intensity variation were considered.

The technique of measurement in intensity used in this experiment made it possible to compare the mean intensity between diagnostic groups under both control and experimental conditions by analysis of the variance between and within groups. There was no significant difference between groups under either condition. The mean variance for each group was also computed for the readings under control and experimental conditions. It is possible to examine the difference between variabilities of this type using Bartlett's test. This test involves the calculation of a ratio, B/C, which is distributed as chi squared, with degrees of freedom equal to one less than the number of groups examined. Details of computation are given by Brownlee (1949). Application of this test demonstrated no significant difference in vocal intensity variation under control conditions, and a significant ($B/C = 11{\cdot}98$, $df = 2$, $P < 0{\cdot}01$) difference under experimental conditions. This difference was due to a higher variance in the group of unselected psychiatric patients.

The ranking of the schizophrenic patients on the change in mean vocal intensity score was then compared with their position on the schizophreniform — dementia praecox continuum. Rho was again calculated and a correlation coefficient of 0·48 obtained ($0{\cdot}01 < P < 0{\cdot}05$). The direction of this correlation was such that the patients at the dementia praecox end of the continuum were more disturbed by D.A.F. while the patients at the schizophreniform end were less disturbed. That is, the dementia praecox patients were nearer to normal in their responses.

Discussion

Despite the relative crudity of the experimental and recording techniques in this experiment and the preliminary study, it has been possible to demonstrate on both occasions a significant difference between schizophrenic patients and other groups. It has also been possible to demonstrate a small but significant correlation between the response to D.A.F. and some clinical features of the illness. Obviously this finding awaits independent confirmation but some discussion of its occurrence would not be out of place.

A previous investigation (Spilka, 1954) has shown that schizoid normal subjects show differences from controls of the same kind as we found in our schizophrenics. It is often held that these people with schizoid personalities are those who, if they become schizophrenic, develop dementia praecox. Langfeldt, as well as accepting the importance of the schizoid personality for the development of a dementia praecox type of illness, also considers that such people can develop a schizophreniform illness in response to stress. If it is the schizoid personalities which develop dementia praecox, there is a contradiction with our findings that dementia praecox patients are more nearly

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normal in their response. Examination of the original data shows that this contradiction does arise. There were only three patients in whom there was convincing evidence of a schizoid pre-morbid personality. They were all placed at the dementia praecox end of the scale. It therefore seems that in schizophrenic patients there are factors which have a more important effect than schizoid personality has in determining vocal intensity response to D.A.F.

These factors seem to be related to the schizophreniform type of illness, that is, to those illnesses which, while having some schizophrenic features, are precipitated by external or by psychological factors, have an acute onset, minimal disturbance of thought and affect and a good prognosis.

The other significant finding of this study; that the variance of vocal intensity readings was significantly greater in the group of unselected patients under experimental conditions; was quite unexpected. This group was, in fact, fairly homogeneous, consisting mainly of patients suffering from endogenous and reactive depressions, with a few mixed neurotic states and personality disorders. The results may be worth further investigation. It may be related to other evidence of instability in some of the patients in this group.

Summary and Conclusions

The effects of delayed auditory feedback (D.A.F.) on vocal intensity and vocal intensity variation were examined in 37 subjects, 17 schizophrenics, 12 other psychotic patients and 8 normals.

It was found that the change in vocal intensity under control and experimental conditions was significantly ($P < 0.05$) less in the schizophrenic group. This change correlated ($Rho = 0.48$, $0.01 < P < 0.05$) with a clinical assessment of the illness based on Langfeldt (1956). The correlation was such that the patients least disturbed by D.A.F. were classified as suffering from a "schizophreniform" illness. This may be related to factors in the illness.

The vocal intensity variation was found to be significantly ($P < 0.01$) greater under experimental conditions in the group of "other psychiatric patients". No explanation is offered for this as the finding was unexpected and therefore no data were available for adequate investigation.

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References

Beaumont, J. T., and Foss, B. M. (1957). "Individual differences in reacting to delayed auditory feedback", *Brit. J. Psychol.*, **48**, 85–89.

Black, J. W. (1951). "The effects of delayed side-tone on vocal rate and intensity", *J. Speech Hear. Dis.*, **16**, 55-63.

Brownlee, K. A. (1949). *Industrial Experimentation* (4th Ed.). London: H.M.S.O.

Goldfarb, W., and Braunstein, P. (1958). "Responses to delayed auditory feedback in schizophrenic children". In *Psychopathology of Communication*, Ed. Hoch, P. H., and Zubin, J. New York: Grune & Stratton.

Langfeldt, G. (1956). "The prognosis in schizophrenia", *Acta Psychiat. et Neurol.*, Suppl. 110.

Lee, B. S. (1950). "Effects of delayed speech feedback", *J. Acoust. Soc. Amer.*, **22**, 824–826.

—— (1951). "Artificial stutter", *J. Speech Hear. Dis.*, **16**, 53–54.

Siegal, S. (1956). *Non-Parametric Statistics*. New York: McGraw-Hill.

Spear, F. G. (1963). "Delayed auditory feedback: some effects on the speech of psychiatric patients", *B. J. Psychiat.*, **109**, 235–239.

Spilka, B. (1954). "Relationships between certain aspects of personality and some vocal effects of delayed auditory feedback", *J. Speech. Hear. Dis.*, **19**, 491-503

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