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RESEARCH DEPARTMENT

A METHOD OF ASSESSING THE ACCEPTABILITY OF STEREOPHONIC SYSTEMS

Report No. L-042

(1981/1)

THE BRITISH BROADCASTING CORPORATION
ENGINEERING DIVISION

RESEARCH DEPARTMENT

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SUMMARY

In view of the need to compare systems of stereophony, a subjective method of making this comparison has been evolved. The results of a pilot experiment which shows the efficacy of this method are described in this report.

1. INTRODUCTION

At present various audio-frequency systems are being considered for the broadcasting of stereophony. The preferred method is to use two channels as employed in stereophonic gramophone records, but the transmission of two channels presents radio-frequency and line transmission problems which so far have not been solved.

It is for this reason that the E.M.I. Percival system has been devised. It transmits by line and radio a monophonic signal plus a narrow-band steering signal which is used to distribute the output between two loudspeakers to produce a stereophonic effect. The detailed description of this system has appeared elsewhere.^{1,2} The Percival system is open to the objection that it produces unpleasant fluttering effects on some types of programme, and while E.M.I. are endeavouring to overcome these deficiencies it seems very unlikely that they can be eliminated completely.

A system which has been suggested for domestic use as an alternative to stereophony, and not taken too seriously in this country, is the Stereophoner, which divides the signal between two loudspeakers by passive electrical networks in such a way that the high frequencies come from the left and the low frequencies from the right, while middle frequency components of the sound appear in the central region of the stage.

A somewhat similar device has been evolved by Research Department for use in producing special effects in stereophonic productions. This piece of equipment, which has been called the Spreader, distributes all frequencies reasonably uniformly across the sound stage. It was, however, not intended as a substitute for stereophony. (The Stereophoner and Spreader are shown in schematic form in Fig. 1.)

2. COMPARISON OF SYSTEMS

In view of the obvious need to compare the relative merits of at least the E.M.I. Percival system and normal stereophony, a method has been evolved and tried in pilot form. Listeners were presented with short samples of programme material, and

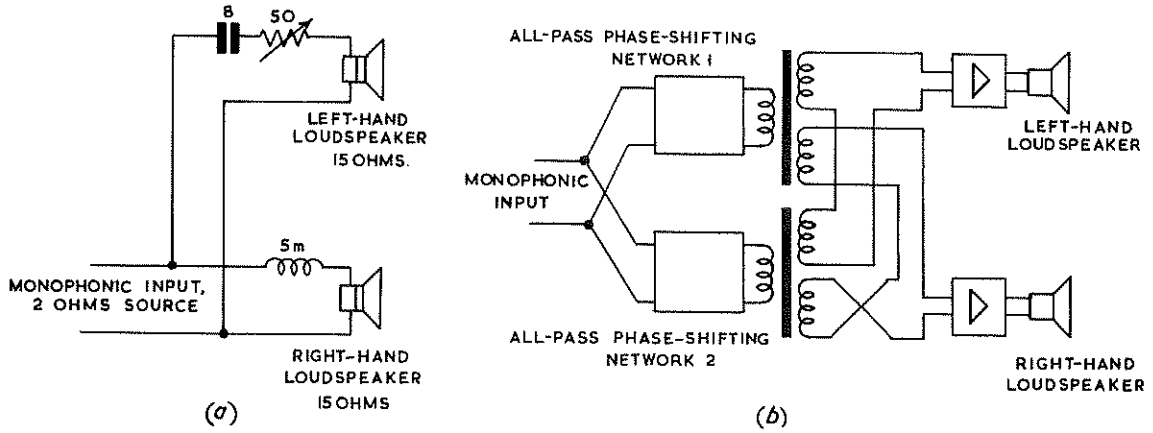


Fig. 1 - Schematics of Stereophoner and Spreader

(a) Stereophoner (b) Spreader

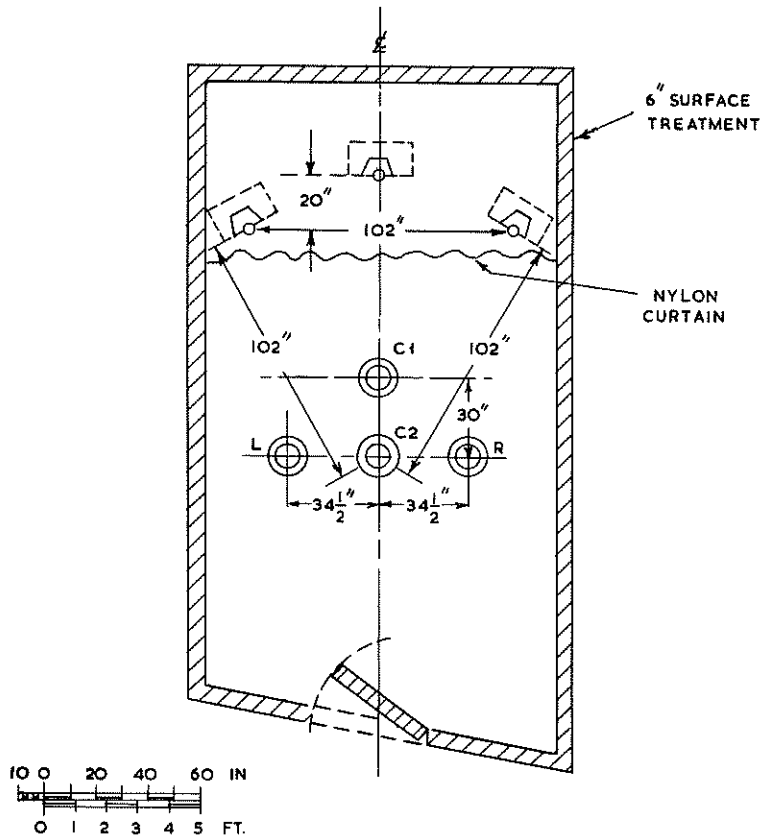


Fig. 2. - Plan of listening room showing positions of listeners

asked to listen carefully and give an opinion, awarding marks to each sample on a comparative basis with normal monophony, which was presented to them as a control. The reproduction was carried out on two loudspeakers in the normal positions with

another loudspeaker in the centre to give the corresponding monophonic signal. The procedure was explained by a tape recording so that all the subjects received exactly the same briefing. The script of this recording is given in the Appendix. The important comparison was considered to be between E.M.I. Percival and normal stereophony, but it was decided to include the Stereophoner and the Spreader to confuse the issue and give another basis for comparison, so making it more difficult for experienced subjects to decide exactly what was happening.

The subjects listened at the positions shown as C1, C2, L and R in Fig. 2, in the Kingswood listening room. Two types of subjects were used — experienced subjects who are accustomed to this sort of test and subjects inexperienced in subjective testing. The rating was carried out on a scale of +5 to -5 with respect to monophony. One group consisted of twelve experienced subjects who listened at points C1 and C2; the other group consisted of twelve inexperienced subjects who made tests at C1, L and R. In all the tests subjects were placed in groups of three closely spaced.

The test passages consisted of fifteen-second excerpts from the following items: an orchestral piece, a treble recitative from a church service, a reading from the Lesson, unaccompanied choir, and an organ solo. The test passages were presented in a random order and the test sessions were divided into two quarter-hour periods with a gap of several hours between. Only monophony (the control) was specifically identified for the subjects as a basis for comparison, the other excerpts being described as "sounds coming from a wide area of the stage". (See Appendix.)

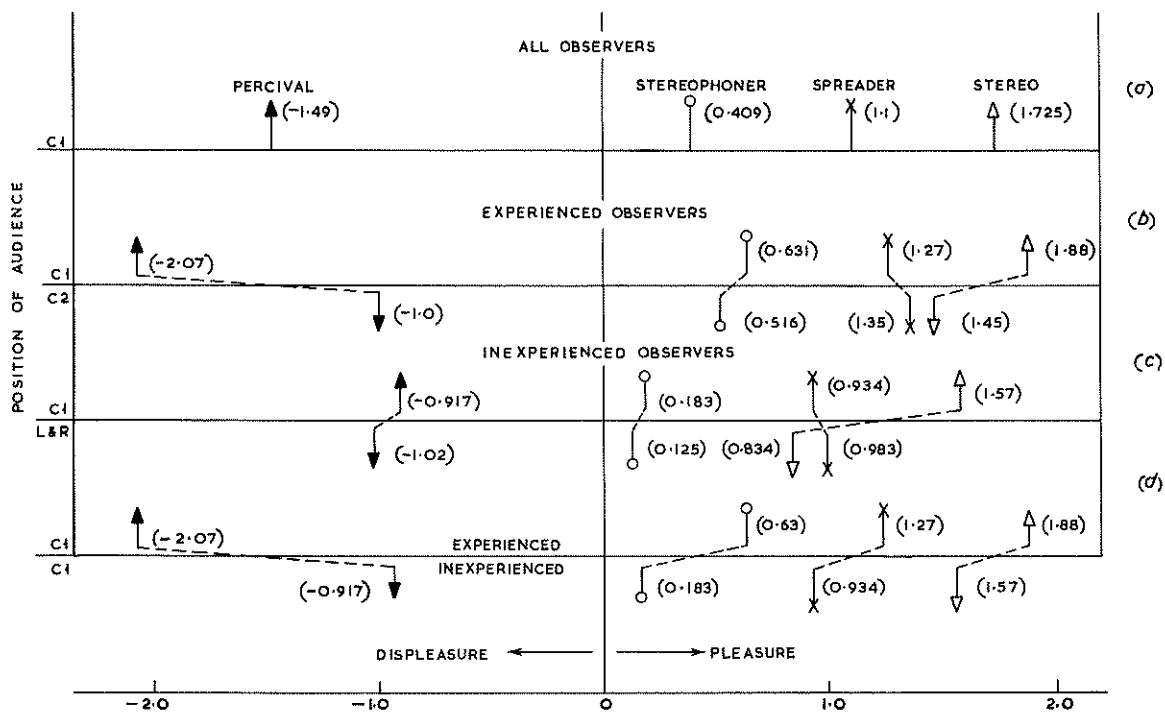


Fig. 3 - Subjective rank order of stereophonic systems

- (a) All observers (b) Experienced observers
 (c) Inexperienced observers (d) Comparison between (b) and (c)

3. DISCUSSION OF RESULTS

The average gradings from the data are shown in Fig. 3. Fig. 3(a) gives the data from all subjects and it will be seen that the Stereophoner, Spreader and stereophony are all preferred to monophony, whereas monophony is preferred to the E.M.I. Percival system. The results from the experienced subjects are shown for positions C1 and C2 in Fig. 3(b). This clearly indicates that the more distant listening position reduces the discrimination between the various systems. The same effect is in evidence to a slight extent with the inexperienced subjects in Fig. 3(c), comparing position C1 with L and R. In Fig. 3(d) the comparison between experienced and inexperienced subjects for position C1 shows the greater discrimination due to experience.

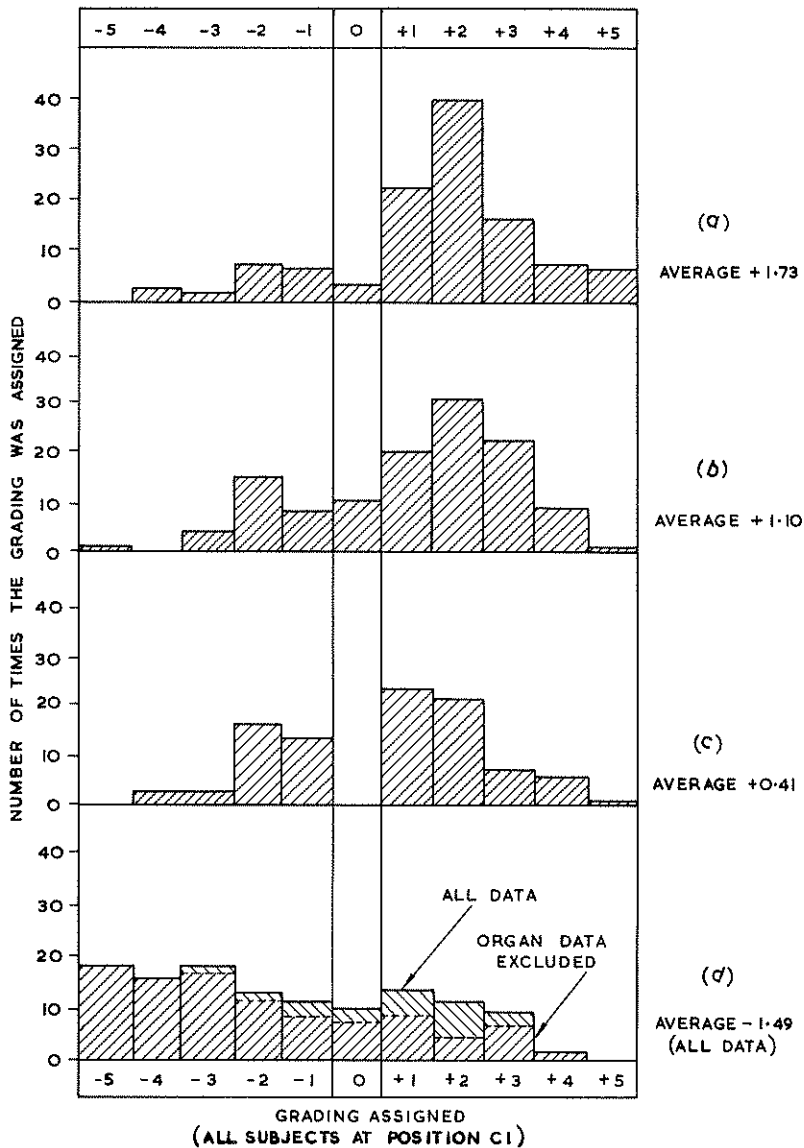


Fig. 4 - Histograms showing ratings for various systems
 (a) Stereo (b) Spreader
 (c) Stereophoner (d) Percival

All the results are shown in Table 1. Fig. 4 shows, under the grade numbers, the number of times each grade was recorded by all subjects in position C1. The average grading for stereophony, taking monophony as zero, is +1.73. The average grading for the E.M.I. Percival system is -1.49, for the Spreader +1.10 and for the Stereophoner +0.41.

Fig. 4(d) shows the effect of omitting organ results from the data. This seems to indicate that organ music is rather favourable to the E.M.I. Percival system.

A different approach is illustrated in Fig. 5 which shows five diagrams for the different types of programme material. The vertical axis is the total tabulated in Table 1 for the E.M.I. Percival system plotted against the sum of the values for

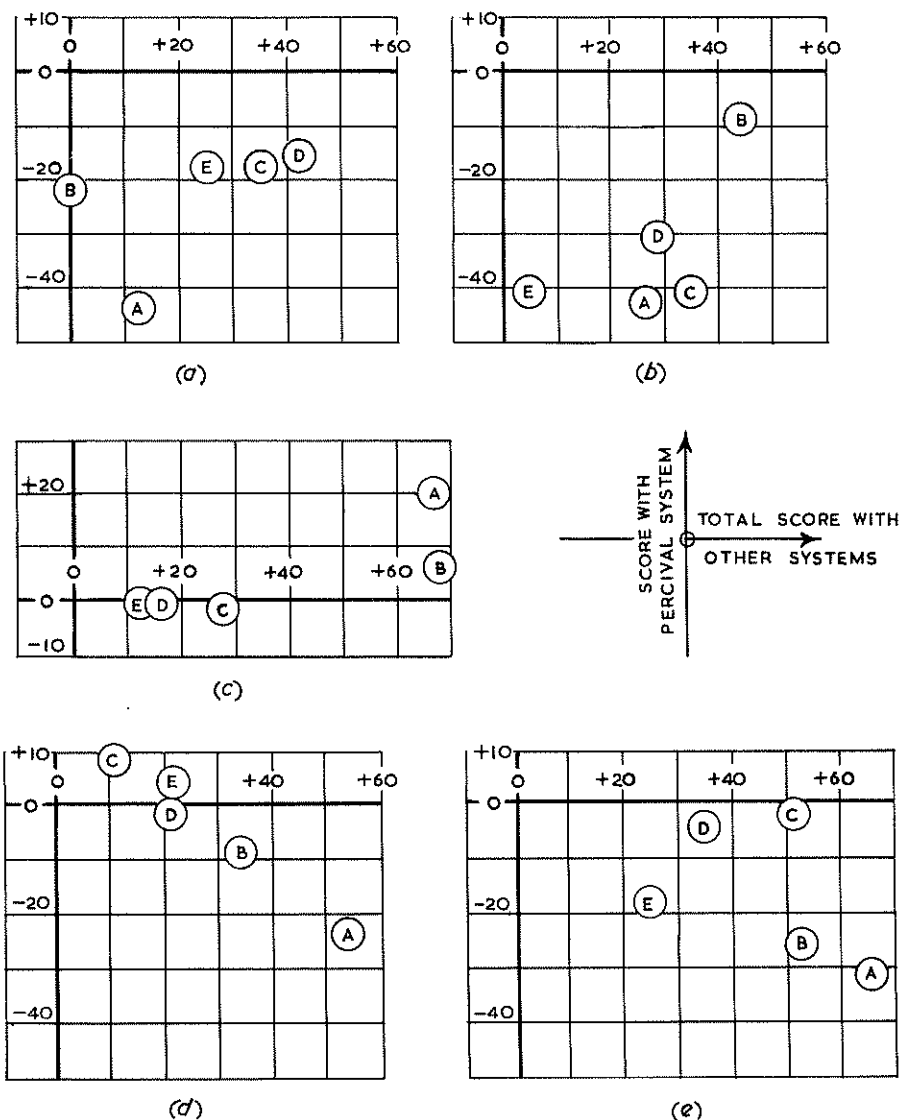


Fig. 5 - Rating of Percival system compared with other systems

(a) Choir (b) Treble voice (c) Organ
(d) Speech (e) Orchestra

each of the other systems on the horizontal axis. The letters A to E relate to the five sets of experimental data listed in Table 1, the test conditions being as follows:

Test Condition A.	Experienced subjects at position C1.
Test Condition B.	Experienced subjects at position C2.
Test Condition C.	Inexperienced subjects at position C1.
Test Condition D.	Inexperienced subjects at position L.
Test Condition E.	Inexperienced subjects at position R.

It will be seen from the figure that point A always lies near one end of the distribution, and D and E generally appear at the other.

From Fig. 5(a), (b), (d) and (e) it can be seen that test A (experienced subjects) leads to a lower rating of the E.M.I. Percival system than test B (inexperienced subjects). It is realised that the proportion of B.B.C. programme material in categories (a), (b) and (c) of Fig. 5 is very small but this factor does not arise in the case of (d) and (e). These two examples quite clearly illustrate on the part of the subjects a definite objection to the E.M.I. Percival system, as compared with monophony.

4. CONCLUSIONS

Preliminary experiments have established a method which gives a reliable comparison in assessing the acceptability of different stereophonic systems, even although only a small group of subjects was used.

The results of the experiments are surprising in that the performance of the Stereophoner and the Spreader are better than expected. The Spreader particularly would appear to offer a form of pseudo-stereophony which for some types of programme would be almost as acceptable as stereophony, in spite of its obvious inability to provide positional information. The other very surprising feature of the results is the poor performance of the E.M.I. Percival system, even compared with monophony. It remains to be seen whether the modifications being carried out by E.M.I. to the Percival system can improve the performance appreciably; there is some doubt on this point.

The important (and unexpected) conclusion is that should it not be possible for any reason to radiate stereophony, the Spreader and the Stereophoner are reasonably inexpensive devices which can be employed by the listener himself to produce the effects of pseudo-stereophony, without involving the broadcasting authority in anyway.

5. REFERENCES

1. "A Compressed Bandwidth Stereophonic System for Radio Transmission", W.S. Percival, Proc. I.E.E., Vol.106, Part B, Supplement No.14, p.234, March 1959.
2. D.E.L. Shorter and G.J. Phillips, "A Summary of the Present Position of Stereophonic Broadcasting", B.B.C. Engineering Monograph No. 29, p. 20, para. 6.4, April 1960.

APPENDIX I

TEXT OF MESSAGE RECORDED ON INSTRUCTION TAPE

You are going to take part in an experiment which is concerned with stereo-phony — and I am using the word in the least precise sense.

You will hear many different forms of so-called stereo; they will have only one thing in common — the sounds will appear to be coming to you from a wide area of the stage. In all other respects they will sound different.

We want to know what the differences mean to you. You are here in the role of the man who says,

"I have heard a lot of talk about stereo — that cuts no ice with me. I know what I like. Let me hear some and I'll tell you whether I think it is worth having, compared with what I've got already."

To put you into the frame of mind of this man we arrange for you to hear, first, about a quarter of a minute of each programme excerpt, played to you from a single loudspeaker in the middle of the stage — just as you would normally hear it from radio, disk or tape.

Then you will hear the same thing again, but coming from all over the stage, and this will be more pleasing or less pleasing, more pleasant or less pleasant than from the single loudspeaker. You have merely to decide which. Write a plus sign to mean more and a minus sign to mean less.

The comparison will then be repeated exactly as before, and this time you will decide how big the difference is. If the pleasure or displeasure is extreme, you will write down 5. If it is less than extreme you will write down 4-3-2-1 putting in the halves if you need to.

Zero will be used to express the opinion:— "I couldn't care less which kind of sound reproduction is used, so far as this item is concerned."

Do not say to yourself, "This item sounds all right, or all wrong — but what would that other sort of programme have sounded like?" You will have the opportunity of hearing a variety of different programme items as the test proceeds — we want your opinion on them one at a time.