AN EXPERIMENT ON THE TEACHING VALUE OF A SCIENTIFIC FILM

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Films are being increasingly made and used for teaching purposes. Their power to augment knowledge and stimulate interest is being widely proclaimed in educational literature, in committees and meetings, and in the popular press. The holding of special conferences—the recent Scientific Film Association Conference on medical films, for example—and the setting up of bodies like the British Universities Film Council are further proof of the growing importance attached to teaching films by specialist teachers. It is therefore all the more surprising that the evidence on which all these discussions are based rarely amounts to more than the opinions and impressionistic judgments formed by individuals. Very little exact information is as yet available on the best methods of making scientific films and on the precise effects which the audience may expect from them.

There are at least three kinds of questions which need to be answered:

1. What makes an effective instructional film? What kind of subject-matter lends itself best to film presentation? What is the optimum length of a teaching film? How many facts can be put across in the given time? Should one concentrate on illustrating broad principles or detailed facts? In what form should the subject-matter be presented: by "live" scenes, animated diagrams, simple drawings, or by some combination of the three? Is the cost of elaborate production, the use of technicolour, and of special technical "effects" justified by the resultant increase in teaching power? Which devices aid understanding and memory most? How far must production technique depend on the kind of audience for whom the film is intended? What do audiences themselves like and find easy and interesting to follow—and why?

2. Having made the film, what is the best method of presenting it? Should it be preceded or followed by lectures, accompanied by a spoken or recorded commentary or written explanatory notes, and followed by discussion on some written test? Should the film be shown more than once?

3. Finally, the "perfect" film having been made and presented in the most effective manner, what overall advantages can the student hope to derive from its use? How will it compare with other methods, such as lectures or discussion classes or private reading in the same subject? In other words, is the expenditure of money, time, and trouble involved in teaching by films justified?

The answers to such questions are important both to makers of films and to teachers, and it would be quite easy, with existing techniques of research, to find them. But up to now very little work has been done in this field, especially in this country. Some research has been carried out on simple instructional films for school-children, such as the recent Australian experiment on different methods of presenting the same films (Commonwealth Office of Education, 1950), the investigations of the Scottish Educational Film Association and Scottish Film Council (1947, 1948), and of Philpott

(1946), and on Service personnel—for example, Vernon's research (1946) on naval recruits. Very few investigations have dealt with the more specialized films suitable for university students, and hardly any, so far as we are aware, with films intended for medical students.*

The Experiment

Our own experiment was on only a small scale and strictly limited in scope (Lewis and Steinberg, 1951). Its purpose was to assess the teaching value of one particular physiological teaching film to a group of medical students at University College, London, with special attention to: (i) the students' own evaluation of the film, (ii) changes in their factual knowledge following the film, and (iii) specific features of the film which might influence both its teaching efficacy and its appreciation by the students. No attempt was made to compare the film with other methods of teaching or with other films.

The film used was "The Carotid Sinus" made by Schweitzer (1950) at University College and intended to supplement lectures. It is a colour film, very expertly produced by professional personnel supplied by Imperial Chemical Industries, consists mainly of "live" scenes of animal experiments, and also includes some animated diagrams as well as verbal material. The film is accompanied throughout by a commentary written by the author and spoken by a professional commentator, and runs for about 40 minutes. The subjects were 72 members of a class of senior Second M.B. students. All had attended lectures on the circulatory system the previous session.

Our main tool of investigation was an objective test in the form of a questionnaire with "multiple choice" answers, which we constructed to cover the subject-matter of the film. The following question is an example: The carotid body is (a) another name for the carotid sinus, or (b) a different structure with a different function, or (c) part of the carotid sinus, or (d) the ganglion of the carotid sinus nerve. The student had to select the correct answer, of which there was only one in each question. One mark was allotted for each correct answer. The questionnaire contained 45 questions and took about half an hour to complete.

In addition, we constructed a "Film Appraisal Form," somewhat along the lines of that used by the Scientific Film Association, on which the students were asked to assign ratings to various technical and teaching features of the film, such as its general teaching quality, the technical quality of the animated diagrams, and the commentary.

The experiment was fitted into ordinary teaching time, and the film was shown to the students in the course of one of the periods normally set aside for scientific films. No warning was given that questionnaires were forthcoming or that an experiment would be carried out, as it was hoped to minimize the effects of any special expectation or attitudes towards the film. All questionnaires were filled in anonymously, each student being identified by a serial number only.

Fig. 1 illustrates the plan of the experiment. The class was randomly divided into two equal groups, A and B. First the students' existing knowledge was determined by testing them one day, entirely without warn-

*A useful summary of some relevant researches published and in progress is given in a report prepared by J. Shearman on behalf of the Film Section of the British Transport Commission (1950).

PLAN OF EXPERIMENT

FIG. 1.—The same questionnaire was used by both groups in all four trials.

ing, by the questionnaire (Trial I). Three days later half the class (Group A) were shown the film, and immediately afterwards they assessed its technical and teaching qualities on the appraisal form. The other half of the class (Group B) were not shown the film but were told that they would see it later in the term. Meanwhile they served as a control group. Four days after the film had been shown to Group A, the whole class (Groups A and B) was again tested by the same questionnaire on the carotid sinus (Trial II). After an interval of two months the questionnaire was given to all students for a third time (Trial III). One day later, Group B was shown the film, with Group A now acting as control group. Finally, four days after the film had been shown to Group B, both groups were again tested by the same questionnaire for a fourth time (Trial IV).

The purpose of using a control group each time was to eliminate the practice effects of merely repeating the same questionnaire and of any increase in knowledge resulting from other instruction and reading in physiology in the interim; this was especially necessary, as students could be supposed to be studying hard at that time of year.

Results and Discussion

(i) The results of the subjective appraisal made by Group A immediately after seeing the film were extremely favourable. Most students found all aspects of the technical quality high and the teaching features such as factual content, length, and general presentation of the film clear and interesting; three students spontaneously remarked that the questionnaire test taken three days earlier had helped them by directing their attention to important points in the film. However, one student, but only one, commented at the end of his appraisal: "An extremely well made film, but spoilt by the constant reminder of the quiz last Tuesday."

(ii) The mean scores obtained in the questionnaire are shown in Table I. The maximum possible score was 50. Before the film was shown (Trial I), the knowledge of the two groups was practically equal, though the

TABLE I.—Mean Scores on Carotid Sinus Questionnaire

	Group A		Group B	
	Mean	No. of Subjects*	Mean	No. of Subjects*
Trial I	28.97	39	26.00	33
Trial II	36.18	39	27.85	33
Trial III	36.17	29	29.23	26
Trial IV	37.1	20	40.58	19

(Maximum marks = 50)

* The gradual fall in the number of subjects is due to the exclusion of all subsequent results of those who for some reason failed to attend any one of the tests.

small initial difference between their scores has been taken into account in subsequent calculations. After the film had been shown, the score of Group A increased by 7.20, as compared with only 1.85 for Group B, the control group (Trial II). The difference in mean gain between the two groups (5.35) was tested by Student's *t*-ratio and found to be highly significant ($t=4.78$, d.f. 70, $P<0.001$). This may be interpreted as a mean increase in knowledge as a result of seeing the film of about 20% of the original mean score. The distribu-

FIG. 2.—Distribution of scores in Group A (39 students) before seeing the film (Trial I) and after seeing the film (Trial II). The faintly dotted lines represent the mean score for each trial.

tion of the scores of Group A before and after seeing the film is illustrated in Fig. 2. The third testing, after an interval of two months, showed the position to be still practically unchanged. Group A still maintained their gain two months after the film had been shown.

After the third testing, as will be remembered, the film was shown to Group B, who had not seen it before, but not to Group A. Group B now showed a striking improvement, exceeding their pre-film mean score by 11.35 marks, while Group A, now acting as control group, increased by only 0.93 marks, making a net gain for Group B of 10.42. This difference between the two groups is again statistically highly significant ($t=6.070$, d.f. 37, $P<0.001$).

The final position of the two groups was that Group B, who had seen the film after a series of questionnaires which may have acted as preparation and practice, derived even more benefit from the film than Group A, who saw the film after completing only one questionnaire. The difference in gain as between Test I and Test IV of the two groups (14.58 for Group B minus 8.13 for Group A (i.e., 6.45) is again statistically significant ($t=2.503$,

d.f. 37, $P < 0.02$). This suggests that, as one might expect, prolonged previous preparation tends to enhance the effect of a film, though it is doubtful whether the extra time required for such preparation is worth the gain. It is also possible that as a result of the preceding tests Group B expected that another questionnaire would be forthcoming and watched the film more attentively, or that other extraneous factors over which we had no control, such as private study, were having an increased effect with the greater proximity of examinations.

(iii) Finally, in order to identify possible gaps in the students' knowledge or the efficiency of the film, we carried out a detailed analysis of the answers to individual questions and of the changes they underwent after the film had been shown.

A few questions were so well answered before the film that there was hardly any room for improvement. For instance, all but one student knew before seeing the film that "in the intact animal an increase of pressure in the carotid sinus causes a fall of blood pressure." Other questions were badly answered before the film was presented and showed anything up to 70% improvement after the film. Occasionally a student who had answered a question correctly before would somehow get it wrong after seeing the film. One or two curious mistakes crept into the answers after the film; for instance, one or two students referred to a physiologist named "Shelley," possibly as a result of seeing the names "Bronk and Stella" in one of the scenes of the film.

To find out what level of subject-matter was most sensitive to film influence, we asked three senior physiologists to assign to each of our test questions a mark, α for "very important fact," β for "moderately important fact," γ for "not very important." The α questions involved mainly points of principle, like that noted in the preceding paragraph, while the γ questions were questions about details or about facts peculiar to the film, such as the name of the first physiologist to observe carotid sinus phenomena or the approximate diameter of the carotid sinus nerve in the cat. We compared the mean amount of improvement which occurred for ten questions which were agreed to be α and for ten agreed to be γ .

The results are shown in Table II. The students were found to have had considerably more previous knowledge of α questions—i.e., questions of principle—before

TABLE II.—Improvement of Group A After Seeing the Film

	10 " α " Questions	10 " γ " Questions
(a) Maximum possible No. of correct answers in each trial . .	390	390
(b) No. of answers wrong in Trial I	83	221
(c) Answers wrong in Trial I but correct in Trial II	33	114
(d) % improvement	39.8	51.6

" α " questions are those rated "very important"

" γ " questions are those rated "not very important."

"% improvement" expresses the number in (c) as a percentage of (b).

the film (presumably derived from lectures and reading) than of the more detailed γ questions. There was therefore less room for improvement in α questions than in γ questions. Of 83 α questions wrongly answered before the film, 33, or 40%, were answered correctly after the film; for γ questions the corresponding figures are 221 and 114—i.e., an improvement of 52%.

It is obviously impossible to say on the basis of these results what would have happened to the α questions if

the students had not answered them so much better before seeing the film than they answered the γ questions. Therefore, in order to answer the question of whether knowledge of principles or knowledge of details was most affected by the film further experiments would have to be carried out, preferably with less-advanced students.

Our pilot study was not intended to provide answers to the many questions raised in the opening paragraphs of this article. It is obvious that much more intensive and extensive research should be carried out. However, the results presented show that in this one particular case, at least, a scientific film did have more than entertainment value; there is no doubt that in our experiment the film contributed appreciably to the knowledge of our group of students. In addition, in the course of the experiment we gained valuable insights into the students' own reactions and specific difficulties. We hope that the work reported will encourage others to carry out much-needed further research into these various aspects of medical and general teaching.

Summary

1. The effect on the knowledge of a class of senior Second M.B. students of a physiological film on the carotid sinus was assessed by means of repeated testing with a questionnaire constructed for the purpose.

2. Significant increases in knowledge were found after showing the films to two groups of students under slightly different experimental conditions.

3. An analysis of the answers given to individual questions before and after showing the film was carried out.

4. The results of a subjective "appraisal" of the film by the students were overwhelmingly favourable to its technical and teaching qualities.

5. It is hoped that the methods used in this experiment and the results described may interest those who make and use teaching films and will stimulate further research.

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A survey of the 1949 incomes of physicians in the United States has been carried out by the A.M.A.'s Bureau of Medical Economic Research and the Office of Business Economics (*J. Amer. med. Ass.*, July 28, p. 1237). More than 55,000 doctors took part; the average net income from medical practice of the 30,000 doctors whose returned questionnaires have already been analysed is \$11,058 (approximately £3,900). The average earnings of physicians are above those of lawyers. The survey shows that the highest incomes are not being earned by doctors in the large metropolitan areas, and demonstrates also that there was no nation-wide shortage of physicians in 1949—had there been, the average income of doctors would have been much higher. There appear to be great economic advantages in practising medicine in smaller cities.