WHAT'S THE USE OF LECTURES?

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Jossey-Bass Publishers
San Francisco

CHAPTER ONE

EVIDENCE OF WHAT LECTURES ACHIEVE

The lecture is as effective as other methods for transmitting information.

Most lectures are not as effective as discussion for promoting thought.

Changing attitudes should not normally be the major objective of a lecture.

1. Lectures are relatively ineffective for teaching values associated with subject matter.
2. Lectures are relatively ineffective for inspiring interest in a subject.
3. Lectures are relatively ineffective for personal and social adjustment.

Lectures are relatively ineffective for teaching behavioral skills.

In the United States lecturing is the most common method when teaching adults. And so it is all over the world. In spite of opportunities for innovation provided by changing technology and educational research, surveys over decades show remarkably little change in the dominant use of lectures (Marris, 1964; Hale, 1964; Saunders and others, 1969; Costin, 1972; Bowles, 1982; Karp, 1983; Nance and Nance, 1990; Gunzburger, 1993; and Lesniak, 1996). With pride architects build terraced lecture halls in colleges and universities equipped with the best projection facilities. They represent a conception of education in which teachers who know give knowledge to students who do not and are therefore supposed to have nothing worth contributing. This is not the conception in this book. Indeed we will look in Part Four at how students can contribute.

The dominance of lecturing is not confined to educational establishments. In commerce and industry the same is true (Glogovsky, 1970). At trade conferences and meetings of professional associations, lectures take pride of place over conferring and meeting with other people. The event typically gets under way with a

keystone lecture, periodically reconvenes for large-group lectures, and usually wraps up with a valedictory address.

In politics lectures are called speeches. In churches they are called sermons. Call them what you like; what they are in fact are *more or less continuous expositions by a speaker who wants the audience to learn something.* For our purposes that is a working definition. It implies psychological processes of learning. So in Part Two we must look at those processes. The learning that speakers want their audience to acquire could be of different kinds. There are four logically distinct kinds of objective: (1) the acquisition of information, (2) the promotion of thought, (3) changes in attitudes, and (4) behavioral skills.

I shall argue, with reservations, that on the available evidence:

1. The lecture is as effective as any other method for transmitting information, but not more effective. Programmed learning and PSI—the personalized system of instruction—may be an exception. (See Table 1.1.)
2. Most lectures are not as effective as discussion methods to promote thought.
3. Changing student attitudes should not normally be the major objective of a lecture.
4. Lectures are ineffective to teach behavioral skills.

Therefore the main objective of lectures should be the acquisition of information by the students. Administrative, economic, or other considerations may force their use for the promotion of thought, attitudes, or behavioral skills, but lectures should not be accepted as the normal vehicle to achieve these objectives.

The Lecture Is as Effective as Other Methods for Transmitting Information

When comparing the effectiveness of lectures with any other method, there are three possible conclusions: they are more effective, they are less effective, or there is no significant difference.

Table 1.1 summarizes experimental comparisons of lectures with other teaching methods where acquisition of information is the criterion of effectiveness. With the exception of comparisons with PSI, the majority of comparisons show no significant difference. Those that do show a difference are fairly evenly balanced either way. It is hard to avoid the conclusion that, with the exception of PSI, lectures are as effective as other methods to teach facts, but not more effective.

TABLE 1.1. NUMBER OF EXPERIMENTAL COMPARISONS OF LECTURES WITH OTHER METHODS WHERE ACQUISITION OF INFORMATION IS THE MAIN CRITERION.

Teaching Method	Lectures Less Effective	No Significant Difference	Lectures More Effective
Programmed learning and PSI-related[a]	20	17	8
Discussion (various)	18	54	22
Reading and independent study	10	21	9
Inquiry (e.g., projects)	6	6	3
Other (mostly audio, TV, computer-assisted learning)	27	57	20

Note: Some explanation is needed for the classification of teaching methods used in this and later tables. Teaching methods can vary in a multitude of ways. There is no single dimension on which all can be distinguished.

I regard a lecture as a period of more or less continuous exposition by the teacher. I admit that the phrase "more or less" introduces some vagueness, but that corresponds to the way *lecture* is used. Although necessarily defined in terms of what the teacher does, in practice it sets psychologically what the students are expected to do.

The PSI (personalized system of instruction), sometimes called the Keller Plan, uses five principles, four of them inherited from programmed learning as used in the 1960s: small steps, self-paced active learning, early feedback on performance (from discussion with student proctors), individual support with personal contact, and progress to the next unit of work being conditional on mastery of the previous one. A unit typically involves a week's assignment, including reading and practical work, but no lectures. Lectures are an occasional privilege for students who have reached a stage such that they can understand them. Methods I have classified as related to PSI have at least three of these characteristics and mostly four or all five. My inclusion of individualized instruction under this heading is the most contentious because authors' use of this term is often unclear. I have assumed it adopts at least the middle three principles.

Discussion occurs when students make a spoken contribution and get a response. The criterion would include a student's asking a question in a lecture and getting an answer. That may stretch the definition of *discussion* too much, but Chapter Five shows that such an incident has significant psychological effects on the attention of all students. We simply have to accept that teaching methods are continua. Any attempt to cut a line between them will be arbitrary in some respects.

"Inquiry" assumes that students have to obtain or seek information, but it cannot exclude their being presented with some too. It might be regarded as an element within independent study. It is presented as a separate method here only when experimenters have done so.

"Independent study" could include many psychologically different activities depending on the subject of study. For example, reading a history book is very different from doing mathematical calculations. I have assumed that the dominant activities are reading and writing. This is intended to exclude laboratory work and workshops.

The "Other" category mostly includes other methods of presenting information (for example, audio, television, computers). Strictly, computer-assisted learning is not a single method. Computers are tools that can be used in many ways.

[a]Includes only comparisons reported after 1976. Up to that time Kulik, Kulik, and Smith (1976) reviewed 39 comparisons with lectures; 38 favored PSI, 34 significantly. Ruskin and Hess (1974) reviewed 239 comparisons of PSI with traditional methods and most also favored PSI.

Table 1.1 probably underrepresents insignificant results. This issue has been the subject of more experimental observation in the United States than any other issue in the field of teaching methods in higher education. As long ago as 1963, McKeachie (who is probably better acquainted with the field than anyone else) said that a host of comparisons remain unpublished because there are no significant differences to report. The same is true today. A review of doctoral and masters theses in *Dissertation Abstracts* shows that postgraduate students continue to make similar comparisons (each no doubt with some previously untried variables), but the broad conclusion remains the same: when it comes to acquiring information, there's not much difference between lectures and other methods, except for PSI. I maintain this broad conclusion, but I recognize it is broad. Inevitably, there are reservations within that breadth. But they would cloud my message at this stage.

Dubin and Taveggia (1968) reviewed ninety-one studies comparing two or more teaching methods on one or more "measures" of course content (Table 1.2). Most of these assessments used "objective tests" of the multiple-choice, true-false, or sentence-completion type also used for course examinations. Most of these were tests of factual information, but not every report makes this clear. By using more than one criterion, one study may produce more than one comparison between methods. Thus the sum of the figures in the central column in Table 1.2 may exceed ninety-one. But since the learning of students assessed by more than one measure may be duplicated in these figures, Dubin and Taveggia eliminated this overlap by using only one figure per study. The figures in parentheses give this comparison.

However, it may rightly be objected to both Tables 1.1 and 1.2 that figures giving the total number of studies or comparisons do not prove anything if those favoring one method are highly significant and those favoring the other are not statistically significant at all. Accordingly, where possible, Dubin and Taveggia computed standardized scores from the standard deviations and the numbers of students reported to be involved. In all cases, they found no significant difference in effectiveness between any of the methods listed in Table 1.2.

There were a very large number of studies comparing lectures with television when video cameras first became widely available in the 1960s. I have not included them in Table 1.1, and Dubin and Taveggia did not consider them. Reference can be made to two reviews. Chu and Schramm (1967) summarized 202 comparisons at the college level; 22 favored TV, 152 showed no significant difference, and 28 favored the lecture. With adults, the figures were 7, 24, and 2 respectively. Dubin and Hedley (1969) reviewed 191 comparisons of television with traditional teaching, and although most of the differences were insignificant at the 5 percent level, they thought overall that there was a slight balance in favor of traditional teaching. Table 1.1 includes comparisons published since these early

TABLE 1.2. SUMMARY OF NINETY-ONE STUDIES COMPARING TEACHING METHODS.

Method 1	Percentage Favoring Method 1[a]	Number of Comparisons	Percentage Favoring Method 2[a]	Method 2
Lecture	54.7 (51.1)	201 (88)	44.8 (48.9)	Discussion
Lecture	45.8 (37.5)	59 (8)	51.5 (50)	Lecture and discussion
Lecture and discussion	31.2 (41.7)	16 (12)	50 (41.7)	Discussion
Lecture	52.8 (52)	72 (50)	47.2 (48)	Supervised reading
Lecture and discussion	50 (52.2)	34 (23)	50 (47.8)	Supervised reading
Lecture	40 (40)	20 (20)	60 (60)	Unsupervised reading
Face-to-face instruction[b]	50 (49.4)	116 (81)	50 (50.6)	Supervised reading
Face-to-face instruction[b]	41.9 (40)	31 (25)	58.1 (60)	Unsupervised reading

Note: The figures in parentheses give only one comparison from each experimental group.

[a]Both significantly and insignificantly.

[b]Lectures, discussion, and laboratory teaching.

Source: Dubin and Taveggia (1968).

reviews. They broadly confirm previous comparisons: there is not much difference in the effectiveness of lectures and other methods to teach information.

If there is no difference between the effectiveness of the lecture and other methods on tests of information, it seems reasonable to infer that the lecture is as effective as these methods in transmitting information.

However, if you are a thorough skeptic, you may retort that there is no difference between them because none of them teach anything at all! But there's an answer to that. By comparing results of tests before and after teaching, the experiments provide evidence that lectures and other methods do transmit information. Furthermore, the study by Fodor (1963) and two by Gulo (Gulo and Baron, 1965; Gulo and Nigro, 1966), where lectures were compared with irrelevant activity or no teaching at all, all found lectures to be superior. Moreover, in some comparative studies a control group with no teaching is also tested, and it

is clear that lectures result in greater gains. Consequently, available evidence suggests that lectures do teach at least some information.

Therefore, the lecture is one method of achieving the first kind of objective, and its use for this purpose is at least sometimes justifiable. But since the other methods are equally effective, this conclusion does not necessarily justify the frequent heavy reliance on the lecture method.

However, it is not recommended that discussion methods be used primarily to teach information. They are expensive in staff time, and the one significant comparison Dubin and Taveggia did obtain was that unsupervised reading is superior to discussion for the acquisition of information.

Most Lectures Are Not as Effective as Discussion Methods for the Promotion of Thought

Although there is not the same quantity of experimental evidence, I shall argue that the studies that have been made, common sense, and present psychological knowledge give a consistent picture in favor of this proposition; and that if lectures are to be used to promote thought, the technique to be used should be different from the descriptive style traditionally used to "survey an area of knowledge." For example, Corman (1957) found that a knowledge of the principles used in solving problems made no difference to the number of problems students could actually solve, and information on how to approach problems could only be applied by the most intelligent group. Knowledge is not enough. Students need practice in solving problems and applying principles.

It is probably because the construction of questions is relatively difficult that there have been far fewer experimental studies comparing the effectiveness of teaching methods for the promotion of thought. Nevertheless, reference to Table 1.3 gives a very clear impression. Dubin and Taveggia did not compute standardized scores to answer the objection that mere quantity of studies does not prove a case if the minority group displays highly significant results. They didn't need to. I have only found two studies to suggest that lectures stimulate thought better than discussion methods.

Table 1.3 also shows that lectures are ineffective compared with "other methods" to promote thought. This is a surprise. However, most of those other methods involved more student activity than listening to lectures. PSI involves discussion, and it is hard to imagine that teachers using role plays, modeling, simulations, case presentations, and so on do not follow up with discussion of what has been observed by these methods.

TABLE 1.3. NUMBER OF EXPERIMENTAL COMPARISONS OF LECTURES WITH OTHER METHODS WHERE PROMOTION OF THOUGHT IS THE CRITERION.

Teaching Method	Lectures Less Effective	No Significant Difference	Lectures More Effective
Discussion	29	1	2
Reading and independent study	1	3	1
Inquiry	5	1	1
Other methods	12	17	0

I should be the first to accept that this is a broad generalization. To begin, there are many kinds of thinking. Cabral-Pini (1995) evaluated flexibility and creativity. Tillman (1993) was interested in students' seeing issues from many points of view and reserving their judgment. That might be called open-mindedness, although Fielding, Kameenui, and Gersten (1983) wanted students to form their own opinions. Gist (1989) was interested in the quantity and diversity of ideas, Lam (1984–1985) in the depth of questions asked. All these and many more are worthwhile educational objectives that lectures have been comparatively ineffective to teach.

Second, there are many kinds and contexts of discussion among these comparisons. For example, apart from methods simply described as discussion, Mohr (1996), Cabral-Pini (1995) and Smith (1995) used cooperative discussion; Hingorani (1996), Tillman (1993), and Self, Wolinsky, and Baldwin (1989) used case discussion in different contexts. Khoiny (1996) and Jensen (1996) are among those using problem-based discussion, and Sawyer and Sawyer (1981) used microcounseling.

Yet in spite of the variety, with few exceptions discussion is consistently more effective than lectures in getting students to think.

Why is this? Compared with discussion methods, the students' role in lectures is relatively passive. They sit listening; their activity usually consists of selecting information from what is said, possibly translating it into their own words or some form of shorthand, and then writing it down. Bloom (1953) replayed tape recordings of lectures and discussions to students and asked them at intervals to recall the thoughts they had in the original situation. Admittedly, the stimulated student recall was subjective, but the sample was large. It is difficult to suggest a better way of obtaining such data, and Siegel and others (1963) have since found the method "reasonably valid" when compared against independent measures of

students' learning. During lectures, 36.8 percent of the time was spent in "passive thoughts about the subject" and "thoughts evidencing simple comprehension," compared with 20.3 percent during discussion. Thirty-one percent of lectures were spent with irrelevant thoughts, compared with 14.5 percent during discussion. During discussions, the students spent 8.3 percent of the time attempting to solve problems and synthesize (interrelate) information, compared with 1.0 percent during lectures. All these comparisons were statistically significant and suggest that during discussion students are more attentive, active, and thoughtful than during lectures.

This has been known for a long time, but too many teachers seem to ignore it. When Hovland and Mandell (1952) demonstrated that students are more likely to accept a conclusion if the lecturer states it at the end of an argument than if all the same evidence is presented with the conclusion left unstated, they showed the inability of students to draw an inference during a lecture. Barnard (1942) and Dawson (1956) found that although a lecture-demonstration was superior for teaching specific information, problem-solving discussions were better on tests of problem solving and scientific attitude. When Asch (1951) and James, Johnson, and Venning (1956) used a nondirective form of discussion, usually known as free-group discussion, students displayed wider thinking and considered more solutions to problems than those who received traditional teaching. This may reflect flexibility and open-mindedness.

In effect, what is being said here is that if students are to learn to think, they must be placed in situations where they have to do so. The situations in which they are obliged to think are those in which they have to answer questions, because questions demand an active mental response. Although it could be modified to do so, the traditional expository lecture does not demand this (Taplin, 1969; Dunn, 1969; Elton, 1970; see Parts Three and Four of this book). The best way to learn to solve problems is to be given problems that have to be solved. The best way to "awaken critical skills" is to practice using the canons of criticism. The best way to develop powers of analysis is to keep analyzing situations and data. If this thesis seems obvious common sense, it should be remembered that some people place faith in their lectures to stimulate thought and expect thinking skills to be absorbed, like some mystical vapors, from an academic atmosphere. Psychologists are likely to wince at the imprecision of such a notion; learning to think is not an absorption process.

The commonsense view finds support from psychologists. Harlow (1949) described "learning to think" as the acquisition of learning sets. Monkeys and children were rewarded for selecting the odd item among three objects. They were trained to make progressively finer and more abstract discriminations and, more important, were able to apply the "odd man out" principle to problems they had

never seen before. Similarly, as problems became more complex, they seemed able to apply principles from previously experienced problem situations. Practice with basic simple problems improved, and made possible, the solutions to more complex ones. Gagne (1965) points out that when students are given a problem to solve, they may not only apply principles but also combine them to form new higher-order principles. This ability is essential to the development of a student's powers of thought. (Indeed, Gagne implies that the combination and application of principles is what "thinking" is.)

The important point here is that the essence of learning to think involves practice; that lectures do not normally provide opportunity for this, and still less do they provide an opportunity for the active expression and testing of thoughts.

The Gestalt school described problem solving as a process of achieving "insight" by (1) recognizing the problem, (2) gaining familiarity with its elements, such as the concepts involved, (3) constantly reorganizing the elements, (4) possibly incorporating a considerable period of irrelevant activity or overt inactivity, and (5) culminating in a flash of insight displayed by the sudden demonstration of the solution. For example, children taught to find the area of a rectangle by multiplying its height by its length may try various ways of rearranging a parallelogram before suddenly hitting on the idea of cutting off a right-angled triangle and replacing it on the other end to make a rectangle, so that they may use the rule they already know (Wertheimer, 1945). The first two stages may be achieved in lectures if the lecturer raises problems and discusses them from a variety of perspectives, but in the uninterrupted lecture the remaining stages are neither encouraged nor usually possible. There is little pressure on students to tackle the problems raised themselves. (They depend on the lecturer to do this, and they are rarely disappointed.) Nor are they given time to reorganize the sometimes unfamiliar concepts presented by the lecturer. Furthermore, the whole of a student's experience and expectations of the lecture method favor it as a period of "information input" rather than "information processing." The lecturer who wishes to promote thought by lecturing must overcome the conservatism arising from student experience!

I am not denying that thought may take place during lectures—although Bloom's study (1953) suggests that not much does. Obviously it may. Those students who become lecturers probably think more than most. I am suggesting that the traditional style of continuous exposition does not promote it in such a way as to justify lecturing to achieve this objective. Similarly, I am not denying that lectures can provide the necessary information for students to think about, once they get home; but the teacher must do something to make sure that they do think about it, and this requires something more than the traditional lecture.

Similarly, students will think during lectures, insofar as they have time, if they already have a disposition to do so. The lecturer provides information to think

about. But that is different from the lecture method promoting thought. Marton and his disciples (Marton, Hounsell, and Entwistle, 1984) have contrasted students who have "deep" and "surface approaches" to learning. No doubt the former think more in lectures. Others have emphasized the personal context of learning (Ramsden, 1992). Alison King has shown the benefits of instructing students to generate their own questions during a lecture. Ausubel (1968) has argued that having a concept in mind in advance of a presentation (an "advance organizer," to be discussed in Chapter Five) can help students to reorganize the material. But saying that some students are predisposed to think in lectures is quite different from saying that lectures teach them to do so.

Changing Attitudes Should Not Normally Be the Major Objective of a Lecture

The personal nature of attitudes makes this argument more difficult to assert with the same confidence as used regarding information and thought. The assertions are necessarily generalizations. The general argument is that lectures are not as effective as more active methods for changing attitudes and the method should only be used when effective.

The three kinds of attitude objectives specified earlier were (1) the acquisition of values and attitudes associated with subject matter, (2) interest in the subject as a discipline, and (3) changes in personality and social adjustment. These need to be considered separately, because in some subjects there is a much stronger case for using the lecture method to achieve objective 1 than for 2 and 3.

1. Lectures Are Relatively Ineffective for Teaching Values Associated with Subject Matter

Party political speeches and broadcasts are not effective in changing people's voting habits, but they do help to confirm the preferences already held. Sermons rarely convince agnostics, but they give solidarity to the faithful. Similarly, lectures are ineffective in changing people's values, but they may reinforce those that are already accepted.

Elections dominated by television and other media presentations sometimes lead to disenchantment with politicians generally. There is a good reason for this. Presentations can produce doubt by giving negative information that is inconsistent with the values of the audience; but arousing positive enthusiasm requires something quite different. Enthusiasm, and motivation generally, cannot be *given* in presentations such as broadcasts and lectures. Motivation is an inner flame that

has to be there already. Passive reception of information will not fan the flame (unless there is an emotionally prepared mind). That requires energy and activity in the mind of the receiver. For example, Dresner (1989–1990) showed that students who already thought politicians can change things were more likely to change their behavior after a lesson on environmental issues.

The greater effectiveness of discussion in changing attitudes and values has been known by psychologists for a long time, and no one now spends much time trying to prove it. (See Table 1.4.) In a now-classic experiment, Lewin (1943) gave exactly the same information on the merits of eating whale meat to groups of housewives in lectures and discussions. The discussion groups were asked to indicate by a show of hands whether they would try the meat. When questioned some time later, 32 percent of the discussion groups had served it, compared with 3 percent of the lecture groups. In a similar study, Lewin (1943) found that group discussion and decision was more effective in persuading mothers to feed orange juice and cod liver oil to their babies than giving the same information individually. The relative importance of discussion in individual decision making has been disputed in the case of students (Bennett, 1955); but Pennington, Haravey, and Bass (1958) and Mitnick and McGinnies (1958) have found that when discussion shows some consensus, it has a greater long-term effect upon attitudes than lectures do. Judging from an experiment by Hovland, Janis, and Kelley (1953) with students as subjects, lecturers' effectiveness in achieving their objectives is more strongly influenced by their personalities than by their academic expertise. Assuming their influence is for the good, it seems reasonable to think that their personalities would be more effective in a teaching method using two-way interaction.

Other experiments are summarized in Table 1.4. Apart from a report by Gerberich and Warner (1936), there appears to be a strong case that discussion methods are more effective than lectures in changing attitudes. It is hardly

TABLE 1.4. NUMBER OF EXPERIMENTAL COMPARISONS OF LECTURES WITH OTHER METHODS WHERE CHANGE IN ATTITUDES AND VALUES ASSOCIATED WITH THE SUBJECT MATTER IS THE CRITERION.

Teaching Method	Lectures Less Effective	No Significant Difference	Lectures More Effective
Discussion	19	11	4
Other	9	13	3

surprising that lectures influence attitudes more than no teaching at all (Kipper and Ben-Ely, 1979). And in debates (Pederson, 1993), there is often pressure to persuade others and not be persuaded oneself. In the study by Benson (1996), the effect of discussion is diluted. The power of social conformity to influence attitudes in group situations (Asch, 1951; Sherif and Sherif, 1956; Cohen, 1964) is well known, and I shall not enlarge on it here. Zimbardo (1960) has shown that "a good group spirit" is an important variable affecting changes in students' attitudes, but in a lecture with minimal student interaction there is hardly a group at all in the accepted sense of the word (Abercrombie, 1978).

Both discussion and decision making involve the activity principle in learning. This may be taken further in simulations and role-play teaching methods. LeBlanc (1996) found that nurses who experienced simulations showed better attitudes toward the elderly in clinical practice eight weeks later, though they did not show significantly better on a questionnaire immediately after teaching. Dresner (1989–1990) found students changed their home heating habits after a simulation, but not after a lecture. Culbertson (1957) has demonstrated that subjects with unfavorable attitudes toward blacks changed most if forced to act the black role. Observer attitudes changed less, and controls changed least.

Similarly, King and Janis (1956) have shown a greater attitude change in students required to present the speech of another student who held the opposite view than those who only heard the speech. These and other experiments summarized in Table 1.4 show that active methods are more effective in producing changes in student attitudes than passive listening. The activity principle is important in many forms of professional training, such as teaching, medicine, and social work, where attitudes are important.

2. Lectures Are Relatively Ineffective for Inspiring Interest in a Subject

The inspirational function of lectures is asserted more often than it merits. Admittedly, most of us can remember a few lectures that stood out and influenced us as students, but they are usually few compared with the total number of lectures received. Also, the same lectures do not inspire everyone because not everyone has a mind prepared in the same way. Furthermore, in many cases the inspiration is short-lived and leads to little further action. For example, Hartley and Cameron (1967) found that only three out of twenty-two students who stated their intention to do further reading after a lecture had in fact done so one month later.

This is not to say that student motivation is not one objective of a lecture. It can and should be. My argument is that, as a generalization, lectures are not effective in generating enthusiasm in a subject and therefore student motivation should not normally be the major objective and purpose of using the method.

Admittedly, there are exceptional lecturers who may enthuse their audience with great regularity late on a Friday afternoon, but ordinary mortals who do not have a distinctive personality cannot achieve this excellence and should not try to copy them. There is another reason why I think this is normally impossible. The excellence of one lecturer often depends on contrast with others. The student's intellectual diet requires a variety of foods for well-rounded development.

Reference to Table 1.5 shows that there have been very few studies comparing lectures with other teaching methods, if we take students' attitudes toward their academic discipline as the criterion of effectiveness. Though the majority suggest that lecturing is less effective than other methods, the alternatives are not consistently of one type. Half involve some interpersonal responsiveness and elicitation of thoughts or feelings from the students, but compared with Table 1.4 a greater proportion are, like lectures, some kind of presentation method.

Consequently, although Table 1.5 supports my contention that the inspirational role of lectures is often grossly overstated, on its own it does not strongly suggest an explanation for this fact. Effective teaching to change attitudes and values is usually best achieved by their elicitation in discussion, followed by their rational consideration. A possible explanation is that the alternative presentation methods had some novelty value compared with lectures; but this assumes that attitudes toward the teaching method influence attitudes toward the subject.

This raises another criterion relevant to the inspirational role of lectures: their popularity (see Table 1.6). It seems unlikely that students will feel inspired and enthusiastic about their subject as a result of the lectures they hear, and at the same time either wish to have fewer lectures or disapprove of the method. "Lectures are interesting; we wish we had fewer of them" seems to be an inconsistent remark. (I admit there could be circumstances in which students might reasonably assert both propositions. Perhaps they are so inspired that they want more private study time to follow the enthusiasm of the moment. But I see little evidence of such all-consuming enthusiasm.)

TABLE 1.5. NUMBER OF EXPERIMENTAL COMPARISONS OF LECTURES WITH OTHER METHODS WHERE INCREASED INTEREST IN SUBJECT MATTER IS THE CRITERION.

Teaching Method	Lectures Less Effective	No Significant Difference	Lectures More Effective
Discussion	5	4	1
Other	11	7	3

TABLE 1.6. NUMBER OF EXPERIMENTAL COMPARISONS OF LECTURES WITH OTHER METHODS WHERE STUDENTS' PREFERENCE FOR THE METHOD IS THE CRITERION.

Teaching Method	Lectures Less Preferred	No Significant Difference	Lectures More Preferred
PSI	12	5	3
Discussion	17	3	1
Other	18	11	10

There can be little doubt about the unpopularity of the lecture system among students. Remembering that PSI includes discussion with student proctors, Table 1.6 shows students' preference for discussion methods. In a survey of eight colleges and universities by students (Saunders and others, 1969), there was a consistent desire for more seminars and fewer lectures (except in art colleges, where students spent thirty hours per week in studio work). In another survey of 1,052 students in twelve teachers' colleges, more than half preferred seminars to lectures and rated them superior for "inspiring ideas" and "developing standards of judgment," while lectures were rated highest for obtaining information (Stones, 1970). McLeish (1970) obtained ratings of teaching methods from ten teachers' colleges and several universities. There was a marked preference for seminars and tutorials, and relative distaste for lectures, in all groups. Interestingly, the students' distaste for lectures was exceeded by all five groups of lecturers who were questioned; one wonders how much enthusiasm for their subject the lecturers engendered in these circumstances. The Hale Report (Hale, 1964) also shows the students' disenchantment with the lecture method, but a more favorable attitude from university teachers. Similarly, in considering seven teaching methods students of English, education, and dentistry ranked lectures seventh for efficiency and fifth for enjoyment, but easily first for their frequency (Flood Page, 1970).

However, it is to be expected that there are differences between groups of students. Observations in adult education together with reports by Reid-Smith (1969) and Gauvain (1968) suggest that this unpopularity may not be true with older students. In an inquiry by Woolford (1969), although in general students were more satisfied the more they were able to participate, those who were more able, less emotionally stable, or less extroverted preferred participation to be restricted. There were no differences between those from different social backgrounds.

Most students in the inquiry by students themselves (Saunders and others, 1969) thought "the acquisition of information" to be the most important kind of

objective of lectures, although 41 percent thought lectures should stimulate independent work. (The four most popular objectives were "to impart information," 76 percent; "to provide a framework," 75 percent; "to indicate methods of approaching the subject," 64 percent; and "indicate sources of reference," 47 percent.)

In particular, arts and humanities students seek stimulating ideas. Since lectures are criticized for poor preparation and presentation, or as repetition of standard textbooks, perhaps the lack of stimulation is the fault of the lecturers who commit these errors rather than the lecture method itself. Students desire stimulation, but they do not get it. If that is the case, lecturers must attend to this aspect of their technique, for unless they can surpass their average colleague my conclusion will remain the same: stimulating student interest in a subject might be one objective of a lecture, but it should not normally be the major objective because the method is relatively ineffective for this purpose.

3. Lectures Are Relatively Ineffective for Personal and Social Adjustment

An individual's personality consists of relatively permanent characteristics. Therefore, almost by definition, we should not expect any teaching method to have immediate effects. In particular, lectures are situations in which students are expected to be relatively passive. They are not situations in which students are expected to "socialize" or in which we might expect their personalities to develop by being expressed. The focus of attention is on lecturers and what they say, not on the students. Consequently, to use the lecture method to develop students' personalities, social responsiveness, or self-awareness is to make the same kind of mistake as to expect prisoners to adjust to society by putting them in solitary confinement.

With this in mind, the balance of studies in Table 1.7 might at first seem surprising. We might expect many nonsignificant findings, and none at all in which lectures were more effective than other methods. However, closer inspection of the research reports shows Erlich's finding (1979) is the only real surprise. Nonsignificant findings are often not reported. A few constructive words from a

TABLE 1.7. NUMBER OF EXPERIMENTAL COMPARISONS OF LECTURES WITH OTHER METHODS WHERE PERSONAL AND SOCIAL ADJUSTMENT IS THE CRITERION.

Teaching Method	Lectures Less Effective	No Significant Difference	Lectures More Effective
All methods	14	8	4

lecturer (Tuohimaa, Tamminen, and Fabrin, 1993) before medical students have to dissect their first human corpse are more likely to reduce anxiety than nothing at all. And not only was the lecture in the Yorde and Witmer (1988) study coupled with discussion but the relationship between psychological stress and muscular tension in the face, as measured by their electromyographs (EMGs), is far from established.

More pertinent is the fact that all the methods more effective than the lecture are relatively active and expressive with immediate feedback, usually from peers. Accordingly, I am confident in my conclusion that changes in personality and social adjustment should not normally be the major objective of a lecture. Teachers of clinical medicine, management, social work, education, and other fields where these things are important will need to use other, more active and expressive methods.

Lectures Are Relatively Ineffective for Teaching Behavioral Skills

If you want to teach a behavioral skill, at some stage the student should practice it. If you are training athletes to run 100 meters, at some point in that training they should practice running 100 meters. If you want to teach carpentry, by all means talk about safety in using chisels and demonstrate how to use them; but at some stage it will be necessary to let the students practice using a saw, plane, chisel, and all the other tools. If I am to undergo surgery, I want the surgeons to have practiced the operation before; their being lectured about it is not enough.

You might think this principle is obvious. And so it is, to ordinary people. But it is quite beyond some of the most intelligent people our educational system has produced. They want their students to do well in examinations, but they never give practice in doing them. They want their students to use the library effectively and they lecture them as they show them around, but they don't design practical exercises in using it. A professor who wanted to teach us surveying gave us a lecture; but we never handled the equipment or tried to survey a field. Verbal presentations present words, and words are what students get from them. If you want them to be able to do something, put them in a situation where they practice doing it.

Table 1.8 shows the operation of this principle. Studies only show lectures to be more effective if the other methods compared are presentation methods or no teaching at all. The fact that two studies show lectures and no teaching at all to be equally effective does not inspire confidence in lectures for this purpose. Most of the methods showing no significant difference from lectures are discussion or presentation methods. They don't give relevant skills practice; but most of the methods that are more effective than lectures do.

TABLE 1.8. NUMBER OF EXPERIMENTAL COMPARISONS OF LECTURES WITH OTHER METHODS WHERE THE DEVELOPMENT OF BEHAVIORAL SKILLS IS THE CRITERION.

Teaching Method	Lectures Less Effective	No Significant Difference	Lectures More Effective
Practice of the skill	13	8	0
Observation (e.g., demos)	5	12	2
Other methods	9	10	5

The truth, it seems, is that the principle is not obvious when the consequences of the behavioral skills are not so physically observable. The criteria in the studies in Table 1.8 are nearly all interpersonal skills. The effects of a chisel, a saw, and a plane are obviously different. Perhaps that is why no one has done experiments to test the effects of lectures on carpentry skills. The effects of lectures, discussions, and role plays are not so obvious—at least not immediately.

However, before we condemn lectures completely for this purpose, it is worth reflecting that most physical skills have an information component. "Knowing how" often includes some "knowing that," and lectures are as effective as other methods for teaching that information. Thus we should expect a presentation (such as a lecture) before behavioral practice to be an effective combination. Most students get lectures before dissecting a cadaver or filling a tooth; but such instruction is not so extensive before learning to swim or drive.

Conclusion with Reservations

I hold that a great deal of evidence supports the four generalizations stated at the beginning of this chapter, provided they are taken for what they are—generalizations. I must admit to several reservations, but I don't think they are sufficient to damage these four broad conclusions.

First, although the categories of the criteria of teaching effectiveness are logically distinct, they are very broad. There are many different kinds of information, thought, attitudes, and behavior.

Furthermore, where experiments use course grades, the criteria are impure. Although research shows that over 70 percent of marks for course grades can be obtained for memory of information even in subjects like medicine and physics (McGuire, 1963; Beard and Pole, 1971; Black, 1968), the remaining marks could influence experimental results.

Third, definitions of teaching methods are not precise. There are innumerable variables. How long does a contribution in discussion have to be before you classify it as a mini-lecture? Each teaching method comprises many techniques, but experimenters give few details about them. To compensate for uncontrolled variables, I have tried to review as much evidence as possible so that random variables even out.

Finally, people who carry comparative experiments are sometimes enthusiasts for one of the methods, and it is not usually the lecture. Could this unfairly bias against the lecture?

Notwithstanding these reservations, I still think the balance of evidence favors the conclusion. *Use lectures to teach information. Do not rely on them to promote thought, change attitudes, or develop behavioral skills if you can help it.*

CHAPTER THREE

FACTORS AFFECTING STUDENTS' ATTENTION

The effects of arousal.

Factors affecting student arousal.

1. Variations in stimulation in the learning situation.
2. Students' arousal regimes during periods of teaching.
3. Students' daily work and rest regimes.
4. Students' physical environment and bodily condition.

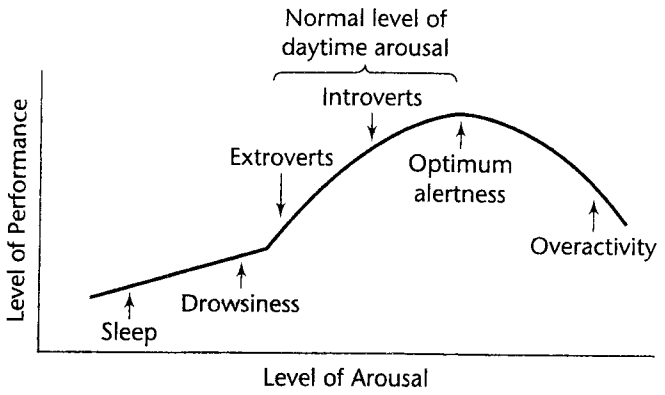
Although there are many meanings of *attention* (Treisman, 1966), in this context we are concerned with the students' ability to concentrate. The problems for teachers are, first, what factors affect student concentration, and second, how we can use our knowledge of these factors to help them.

There are two broad factors: arousal and motivation. Both refer to the amount of energy a student has. *Arousal* refers to a general level of activity; it is a measure of nonspecific stimulation of a student's cerebral cortex, which facilitates the transmission of nerve impulses from one part of the brain to another. *Motivation* is the energy directed toward a specific kind of activity or goal. (These are intended as nontechnical explanations of the terms, not definitions.) The research into student arousal and motivation is not particularly new, and its findings may seem fairly commonsense if you think about them. The trouble is, many lecturers don't think about them, so I offer no apology for presenting them here.

The Effects of Arousal

At what level of arousal should a teacher aim to keep students? The graph in Figure 3.1 (sometimes known as the "inverted U curve") shows a typical level of

FIGURE 3.1. THE INVERTED U CURVE.

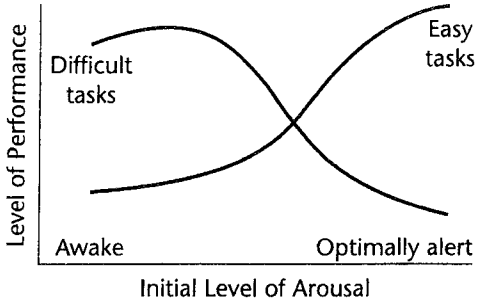


performance in relation to arousal. Students in lectures, it seems, can be conceived as varying from a state of deep coma to berserk anxiety!

It will be seen that at the extremes of relaxation and overactivity, the level of performance at, say, a learning or manual task is poor. But between these extremes there is an optimum level. We live most of our lives on the left-hand side of the optimum level. If we are stimulated, our level of arousal increases. We can be overstimulated, but the more common fault of lecturers is not to be stimulating enough. Arousal varies with personality factors. Extroverts require more stimulation than introverts to reach their optimum level. Using Cattell's 16 Personality Factor Test, Boreham reports that inattention in lectures is related to self-reports of "untroubled adequacy" (Boreham, 1984; Boreham and Lilley, 1978).

So long as they are not too relaxed, students generally perform better at difficult tasks if they start at a lower level of arousal. This is because the effort required raises the level of arousal to the optimum. Conversely, with simple tasks there is a temptation for students to take it too easy, and make silly mistakes. Consequently a higher initial level of arousal favors good performance at easy tasks. This generalization that lower initial arousal produces better performance at difficult tasks, depicted in Figure 3.2, is known as the "Yerkes-Dodson Law." It probably applies within the normal range of wakefulness and aids understanding of experiments such as the work of Thorson and Lang (1992). Using televised talking-head lectures, the insertion of videographics produced an orienting response with increased arousal (measured physiologically). In other words, arousal shifted from left to right in Figures 3.1 and 3.2. The learning of difficult and unfamiliar

FIGURE 3.2. DIAGRAMMATIC REPRESENTATION OF THE YERKES-DODSON LAW.



material suffered, while retention of easier and more familiar material presented at these times was enhanced.

It may be concluded that a teacher must aim to keep students at the level of arousal appropriate to the task. This usually means finding ways to increase or maintain it.

Factors Affecting Student Arousal

We shall consider these four factors:

1. Variations in stimulation in the learning situation
2. The students' arousal regimes during periods of teaching
3. The students' daily work and rest regimes
4. The students' physical environment and bodily condition

1. Variations in Stimulation in the Learning Situation

Broadly speaking, variations in stimulation increase arousal and hence increase the students' attention. It seems reasonable to expect from this that lectures and audiotapes will be particularly poor teaching methods for maintaining students' attention unless a special effort is made to prevent their minds from wandering. In the lecture situation, the students maintain roughly the same posture, listen to the same human voice, and look at the same visual field.

a. Auditory Stimulation. As a lecturer, you should always ask yourself, *How can I vary my presentation?* One of the unwritten worldwide assumptions about lecturing is that lectures are solo performances. But why should they be? Betts and Walton (1970) provided auditory variation in university physics lectures to nearly four hundred students by alternately presenting differing points of view as a dialogue. One gave the logical organization of the subject, while the other interposed questions and gave illustrations or demonstrations. Comedians have long known that they can hold their audience far longer when there are two of them performing. Television companies know viewers will switch channels if the speaker does not change frequently, even in news programs. The same has been shown in psychological experiments. For example, Gruber (1964) demonstrated that alternation between auditory and visual presentations will raise levels of attention to a vigilance task. The same goes for lecturing; without varied stimulation, students mentally switch off.

Variations in auditory stimulation can also be introduced in lectures if there are frequent opportunities for questions and discussion. Therefore buzz groups and controlled discussion are important techniques for the teacher, especially in large classes where loss of student attention is frequent and can easily go unnoticed. The provision of occasional silence for the rapid revision of notes gives students an opportunity to frame questions in addition to a change in stimulation.

b. Visual Stimulation. Visual illustrations have an arousing effect whether or not they provide necessary information. I have found that students' heart rates will rise ten beats per minute in the six seconds after switching an overhead projector on or off. Human vision has an orienting reflex toward movement, such that some lecturers find they can draw attention to important points by using hand movements. Others overuse such gestures. At the secondary school level, Wyckoff (1973) found that increases in stimulus variation as measured by teacher mobility, gesturing, and pausing increased students' recall of factual information from lectures. The opposite was the case at the elementary school level, where perhaps the pupils were already near optimum arousal.

College decor should also not be ignored on the mistaken assumption that it is irrelevant to student learning. Drab buildings will produce a lower standing level of arousal; the use of color in slides or overhead projector transparencies will be particularly alerting.

c. Posture. Members of an audience will be more alert if their spines are upright. It is difficult for the lecturer to provide variations in postural position for the student, but opportunities to gather around the lecturer's bench for a demonstration,

or to move to a short discussion group, should not be rejected as too much trouble if they also can achieve course objectives.

d. Novel Stimulation. The essential requirement is for the teacher to provide novel stimulation (at intervals, if not continuously) throughout a lecture.

This point cannot be emphasized too strongly. The idea that lecturers should use the lecture method and no other for fifty minutes on end is absurd; yet it is quite a common practice. The remarkable tolerance of students for this diet is all the more surprising when one considers that the effect of monotonous stimulation is common knowledge and does not require verification by psychological experiment. MacManaway (1970) reports that 84 percent of his students said twenty to thirty minutes was the maximum length of lecturing to which they could attend.

Television is thought to be a medium that holds attention, but Mills (1966) and Wood and Hedley (1968) found long ago that fifteen to twenty minutes was the optimum viewing time if the material had to be learned. Barrington (1965) reports an optimum of about twenty-five minutes. Smith and Wyllie (1965) found that over half the students benefited when TV and conventional methods were mixed.

Discussion is less prone to lack of concentration partly because of the variety of voices that the student hears, and partly because there is self-stimulation if the students themselves are actively involved. This latter case is more effective than external stimulation.

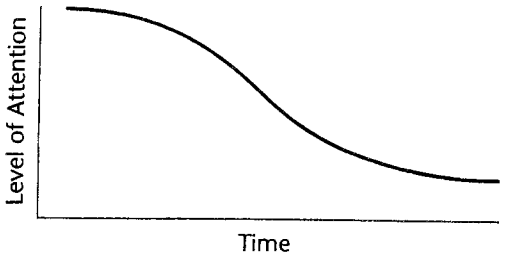
Many students always occupy the same seats in the library for private study. Superficially, it would seem that if the book to be studied is the only novel item in the environment, the students are likely to concentrate on it. In practice, the monotony of the rest of the environment has a more powerful de-arousing effect. Thus it is better for students to vary their place of work.

e. Intensity of Stimulation. Variations in the intensity of stimulation are also arousing. A sudden loud noise will make a person jump. Similarly, it is a well-known trick that the sudden lowering of a lecturer's voice can emphasize a point because it attracts attention. On the other hand, a continuous or repeated loud noise has a deadening effect. Buck (1963) has shown that a railway accident may be caused by habituation to the loud sound of an alarm bell two feet from the driver's ear if this stimulation is persistent.

2. Students' Arousal Regimes During Periods of Teaching

a. Attention Decrement. Figure 3.3. shows the typical decrement curve for a person's attention to a single task over a period of time. With more difficult tasks, extroverts show a greater decline after the first half hour than introverts (Bakan,

FIGURE 3.3. DECREMENT IN ATTENTION.

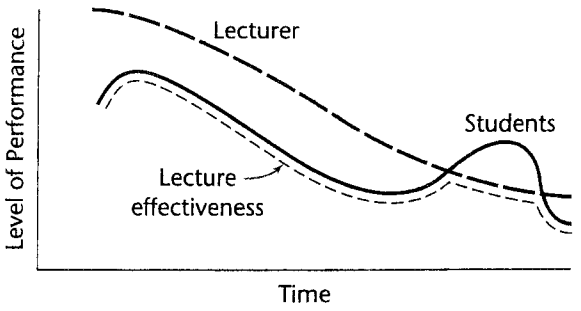


1959). This pattern is normally displayed in the level of performance of both students and their teachers in their respective work situations. In addition, it has been suggested (McLeish, 1968; Lloyd, 1968) that student attention takes five minutes to settle down at first, and it rises and falls during the last five or ten minutes of a fifty-five-minute lecture. Lloyd hypothesizes that the lecturer's level of performance conforms to Figure 3.3. Since the effectiveness of a lecture depends on both the lecturer and the students, it will conform to the lower of the two levels shown in Figure 3.4. The lecturer's level is normally higher owing to greater self-stimulation. Lloyd confirmed his hypothesis with reference to the number of notes students took. It may be objected that subject matter is not equally noteworthy throughout a lecture. Perhaps the rise at the end of the lecture would occur if the lecturer said, "To sum up, . . ." and all hitherto somnolent students immediately grabbed their pens to make amends for their earlier indolence.

What is needed is either a measure of arousal independent of the subject matter, or measures of learning in experiments that control for it. Both have been attempted.

Heart rate is one indication of arousal, but it is not a definitive measure of it, nor is the relation to learning a direct one. I took students' heart rates every six seconds throughout lectures and at first found the pattern confirmed Lloyd's hypothesis, including the rise at the end. Indeed, on one occasion when, at the end of normal time, the lecturer asked to continue for an extra ten minutes, there was a double rise in heart rate at the end! There is no obvious explanation for this rise. Even disregarding the student intervention, Figure 3.5 seems to show it in both lecture and discussion (see also Figure 17.1); but it does not always appear (Figure 3.6). Figure 3.6 shows separate regression lines for the first half hour and the second part of four lectures. They suggest that these two periods in lectures are quite distinct.

FIGURE 3.4. LEVEL OF PERFORMANCE DURING A LECTURE.



Source: Adapted from Lloyd (1968).

FIGURE 3.5. STUDENTS' HEART RATES IN CLASS.

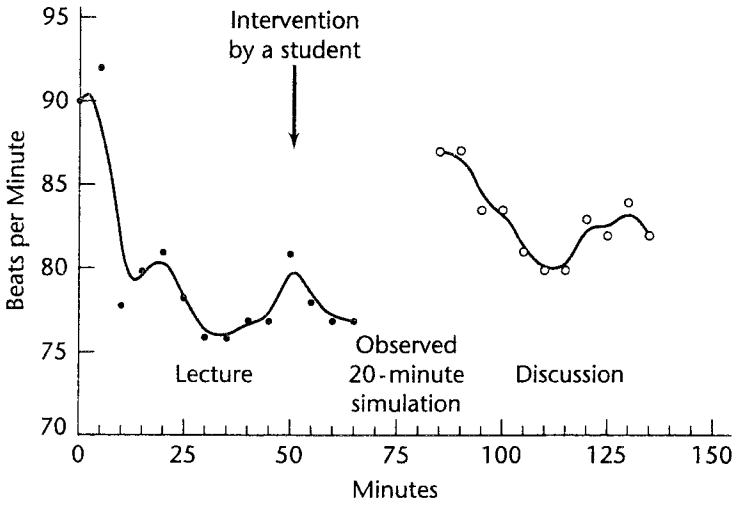
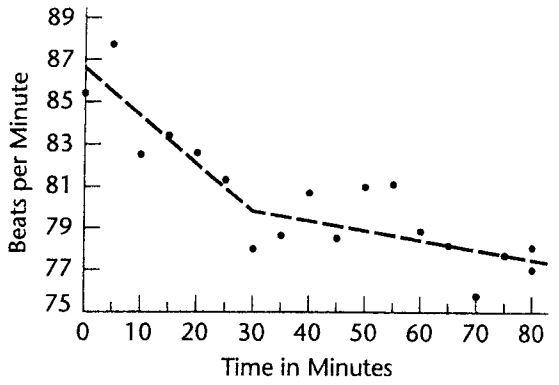


FIGURE 3.6. STUDENTS' HEART RATES IN UNINTERRUPTED LECTURES.



Note: The data are for sixteen students in four lectures with measures taken every five seconds. Thus each dot is the mean of 960 readings in a five-minute period. Heart rates stabilized before teaching began. Each lecture was eighty minutes (longer than most). Separate first-order regressions are presented for the first thirty minutes and the remainder to suggest that the arousal characteristics of the two periods are different. The first six means are as high as, or higher than, any that follow.

Confirming Lloyd's observation using other measures, Scerbo, Warm, Dember, and Grasha (1992) report that students take notes less and less as the lecture proceeds; but immediate recall does not show the same decrement. I have also been unable to confirm the decrement in attention using objective measures of students' learning during periods of lecturing lasting forty minutes. The four quarters of each of four lectures given in four different orders to four groups failed to show a decrement in learning according to their position in the order of presentation. On the contrary, in using an immediate test, learning in the last twenty minutes seemed superior, which suggests the importance of recency when the test is immediately after the lecture. We have already seen that arousal is by no means the only factor influencing learning. In any case, the threat of a test immediately after the lectures may have "concentrated the mind most wonderfully." So this experiment is not sufficient grounds to say that psychological conditions affecting attention are fundamentally different in lecture situations from those studied by psychologists. Furthermore, Giles and others (1982) did find that learning was greatest in the second fifteen minutes of a sixty-minute lecture.

Following Lloyd, Maddox and Hoole (1975) monitored the "information units" noted by students at five-minute intervals through a fifty-minute lecture as

a proportion of what the lecturer considered ideal; but the number spoken by the lecturer confirmed Lloyd's pattern. He slowed down. Consequently, the proportion noted by students was relatively constant, while the number decreased. In short, the efficiency of lecturer and students decreased together, much as Lloyd describes.

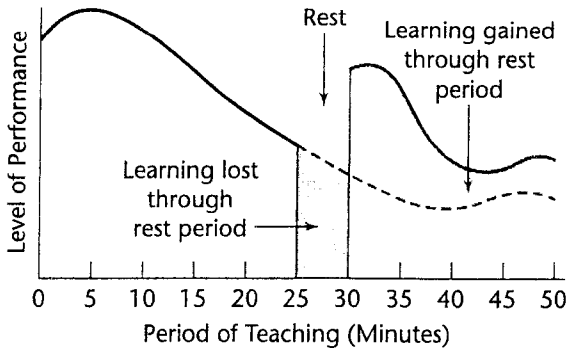
What can we conclude about the attention decrement? To generalize is difficult. On a subjective level, it is common experience that concentration for a full hour is not easy. There is reason to think that a lecture of twenty to thirty minutes is long enough unless there is varied stimulation. Note taking does decrease during a lecture, but evidence on the temporal pattern of learning during lectures is equivocal as judged by immediate tests. However, the results of immediate tests have a strong short-term memory component. Neither life nor examinations are immediate tests using short-term memory. They use long-term memories. We shall see in Chapter Nine that the opportunity to review notes strongly improves scores on delayed tests. Hence the decrement in note taking will reduce knowledge in the long run, and it is the long run that matters.

b. The Effect of a Short Break. A short break will allow the level of attention to recover, though later decrements will be quicker than the first. Mackworth (1950) has shown that performance on a vigilance task, requiring attention to a dial, will return nearly to its starting level after a short rest period. Adams (1955) found a marked improvement in attention to a manual skill after a brief rest; but improvement was not so great when the rest period was spent watching others do the same thing as when it was a complete change. A change is nearly as good as a rest. Wilkinson (1959) has reported an improvement for up to thirty minutes following a break of twenty-five seconds. If these experimental findings are applicable to teaching, there is a strong case for short breaks and changes in teaching method in each period of teaching (see Figure 3.5).

If Mackworth's, Adams's, and Wilkinson's findings are relevant and are applied to McLeish's and Lloyd's model (Figure 3.4), we may obtain Figure 3.7, which implies a gain as a result of rest. A three-minute buzz group could have a similar effect because it would provide a variation in stimulation. The rate of decrement shown is arbitrary and is steeper with more boring subject matter. Students may be bored because the subject matter is too easy, incomprehensibly difficult, or not personally interesting. The more bored the students, the more frequent the variations in teaching methods should be. Consequently, it is not suggested that the number of rest or buzz periods should always be limited to one.

These ideas are an extrapolation from psychological evidence from specific vigilance situations. They are confirmed by common teaching experience and by controlled experiments in teaching. Notice that the pauses may be quite brief. Weaver and Cotrell (1985) reported more student involvement, understanding,

FIGURE 3.7. HYPOTHESIZED PATTERN OF PERFORMANCE DURING A LECTURE WITH A BREAK.



thought, and feedback as a result of specific mental exercises in the middle of a lecture (for example, "Tear out half a sheet of paper and write your reactions to the lecture so far"). In an important experiment, Ruhl and Suritsky (1995) compared the effectiveness of lectures with three two-minute pauses, the provision of a lecture outline, and a combination of these two procedures. The pause procedure alone resulted in better free recall of lecture ideas and more complete lecture notes. This result could reflect the opportunity to fill in gaps in notes and to revise and rehearse what had been said rather than, or in addition to, superior levels of attention.

Whatever your psychological interpretation, the educational advantages of short breaks remain. Johnstone and Percival (1976) observed students' inattention in ninety fifty-minute chemistry lectures given by twelve lecturers. After initial inattention when settling down, the next lapse typically occurred between ten and eighteen minutes; lapses became more frequent, reaching a point just before the end at which students could not attend for more than three or four minutes at a time. Attention was very much worse in a TV overflow room. Attention varied with the difficulty of the subject, the rate of delivery, the legibility of blackboard writing, and the lecturers' personalities. Yet—a most powerful point—inattention could be postponed, or even eliminated altogether, by short buzz-group discussions.

3. Students' Daily Work and Rest Regimes

The same decrement in attention, with consequent need of variation in teaching methods, occurs through the day as within a lecture. Some people reach their optimum level of performance during the morning, others at midday; but very few

people indeed are at their best in the afternoon. In a series of experiments using identical lectures, I found that students scored better on immediate tests at eight cognitive levels after lectures starting at 9:30 A.M. than 11:15 A.M., and better at 11:15 A.M. than 2:00 P.M. (Bligh, 1975). Likewise comparing students with themselves on different occasions, or with each other on the same test items, Holloway (1966) found scores better at 9:00 A.M. than 4:30 P.M.

Similarly, most people are more alert on Monday and Tuesday than on Friday. Yet these facts are commonly ignored by both teachers and those who organize their timetables. Since attention to lectures is more difficult in the afternoon and evening, lectures should be shorter, more varied, and more stimulating, or give way completely to small-group teaching or other active methods of learning, at that time.

After reviewing studies of drivers and others after some hours of activity, Jane Mackworth (1970) concludes that "prolonged performance in a monotonous task may interfere with the ability to make decisions at a fairly high cortical level, but not with automatic activity" (p. 35). This is consistent with the mirthful comment that lectures are periods of time during which the notes of the lecturer are transferred to the notebook of the students without going through the brains of either.

When the level of arousal is lower, either because of the time of day or because of loss of sleep, knowledge of results of the performance arouses the cortex, with consequent improvement (Wilkinson, 1961; Mackworth, 1970). Discussion of problems in small groups provides the student with this knowledge of results in a way that lectures or other presentation methods never can. Therefore, lecturers facing a class on "the morning after the students' night before" or on the day after the "Rag Ball" will be well advised to use discussion methods. Apart from some Russian work, there is little evidence in favor of sleep learning; practice of the art during lectures is not recommended!

Readers of advertisements for a well-known bedtime drink will know that "research has shown that there are many different levels of sleep." The inverted U curve shows that the same might be said of wakefulness.

The important point is that the level of arousal is continuously fluctuating, and even during apparent wakefulness there will be brief moments of sleep, known as "microsleeps" (Oswald, 1966). Contrary to what one might at first expect, students' heart rates fluctuate more toward the end of lectures when students seem more tired. Microsleeps are more frequent among sleep-deprived or tired students, but in between microsleeps normal mental capacity is not greatly impaired. Thus, a student will work more slowly, but not necessarily less profoundly, when tired. The microsleeps are frequently characterized by the dream state of sleep. Thus, we might say that a person's mind wandered for the moment. The overly conscientious or anxious student may often be detected by wary ob-

servation of frequent microsleeps during lectures or tutorials. This could be a useful advance warning that gentle student counseling may be necessary.

From the point of view of the student, a lecture is a paced situation, and Wilkinson (1963b) has shown that those suffering sleep deprivation work slower, but not less accurately, at mental tasks. In this case, the lecturers must either lecture at a slower speed and risk being dreary, or place the students in self-paced situations such as discussions or practical work. If they lecture at their normal speed, their students may miss vital information during microsleeps. The work of Pepler (1959) and Wilkinson (1963a, 1963b) suggests that the marked decrease in the speed of work over twenty to thirty minutes can be averted by short breaks every five minutes. Although their subjects were more sleep deprived than most students, the principle of short breaks should not be ignored when the need arises.

Some students claim that they work better against a background of noise. There is some evidence (Wilkinson, 1963b) that sleep-deprived subjects work better where noise has an arousing effect, but this effect wears off after half an hour. Those who have slept normally work better under quiet conditions, but their work will not greatly deteriorate in noisy conditions during the first thirty minutes. These two findings suggest that twenty to thirty minutes' noise is enough. If students have a lower level of arousal later in the day, these findings may be relevant to teaching at that time.

It must be frankly admitted that in this discussion I have taken big steps in reasoning from the precisely specified conditions used by experimental psychologists to the variable and uncontrolled conditions in which teachers work. Only further investigation can show whether the inferences are correct. There is a great deal we simply do not know about normal teaching situations. To some extent, the onus is on my critics to say why teachers and students should be different. The evidence available suggests that when students are tired, when teaching later in the day, or when subject matter is difficult, varied teaching methods, including the use of discussion techniques, are most likely to be effective.

4. Students' Physical Environment and Bodily Condition

The effect upon attention of variations in blood chemistry, especially following the use of drugs, has received much recent publicity and study. But for our purposes concerned with effective teaching, the important physical factors are common knowledge and will therefore be mentioned summarily. A modern, centrally overheated and humid lecture room induces student drowsiness. The fact is well known, but it is easily overlooked when lecturers are more concerned with their subject than their students, or when, being in an active role themselves, the room condition has little effect on them personally. The sharp contrast with the air outside

may result in objections if a window is opened more than a little. One solution is to open the door, for moving air may have an arousing effect without lowering the temperature.

The need for varied posture has been mentioned. The distracting effect of uncomfortable chairs in lectures is well known, but it is rare for lecturers to take countermeasures. If the effect is made clear to the students, a break of two minutes during which they are expected to stretch their legs may be unconventional, but it pays dividends. The best position is probably an erect but relaxed spine. The effect of using deep armchairs in small-group teaching is less obvious. The students may contribute as frequently as usual, but owing to their posture they may not note points or references that they otherwise would, and their lower intermittent arousal would not favor memory of the material.

A large lunch and a small quantity of alcohol will increase the somnolent effect, while tea or coffee may overcome it. Hunger may be arousing at first, but then a distraction. For those who are overly studious, the lack of physical exercise that was enforced during earlier schooling may result in a monotonous environment and an increase in weight with a consequent decline in arousal.

Conclusion

In Chapter Two, we saw that consolidation of memories may take up to half an hour. Lectures longer than that are therefore likely to interfere with the consolidation process. In this chapter, we see evidence once again to suppose that lectures should not be longer than twenty to thirty minutes—at least without techniques to vary stimulation.

Admittedly, the evidence is mostly indirect, and more research could be done. But a combination of psychological and physiological studies using a range of criteria, together with common experience, are beginning to form a composite picture that the first twenty to thirty minutes of a lecture are different from the remainder. The remainder is probably less effective and less efficient.

Part Four of this book describes and recommends some ways to vary student activity and maintain attention.