

Attention span during lectures: 8 seconds, 10 minutes, or more?

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Bradbury NA. Attention span during lectures: 8 seconds, 10 minutes, or more? *Adv Physiol Educ* 40: 509–513, 2016; doi:10.1152/advan.00109.2016.—In the current climate of curriculum reform, the traditional lecture has come under fire for its perceived lack of effectiveness. Indeed, several institutions have reduced their lectures to 15 min in length based upon the “common knowledge” and “consensus” that there is a decline in students’ attention 10–15 min into lectures. A review of the literature on this topic reveals many discussions referring to prior studies but scant few primary investigations. Alarming, the most often cited source for a rapid decline in student attention during a lecture barely discusses student attention at all. Of the studies that do attempt to measure attention, many suffer from methodological flaws and subjectivity in data collection. Thus, the available primary data do not support the concept of a 10- to 15-min attention limit. Interestingly, the most consistent finding from a literature review is that the greatest variability in student attention arises from differences between teachers and not from the teaching format itself. Certainly, even the most interesting material can be presented in a dull and dry fashion, and it is the job of the instructor to enhance their teaching skills to provide not only rich content but also a satisfying lecture experience for the students.

lecture; attention; note taking; clickers

TED and the Goldfish

THE ENORMOUSLY POPULAR TED talks are a series of talks in which speakers present their ideas on a wide range of topics from technology to biomedical research to culture. One key stipulation given to all speakers is that they have a maximum of 18 min to present their material. The rule dictating 18 min is based on the notion that 18 min is long enough to have a “serious” presentation but short enough to hold a person’s attention. With the broad spectrum of physiology teaching from undergraduate courses to health professional and graduate level courses, should a “TED” approach be widely implemented in physiology curricula? Since the founding of Western universities in the middle of the 11th century, the lecture has been the traditional means of passing on knowledge. Indeed, the 50-min lecture still holds sway at many institutions. Despite nearly a millennium of usage, the established lecture format has come under more and more scrutiny. It is criticized as being too long to hold a student’s attention based on several authors’ claims that a student’s attention span declines precipitously after 10–15 min. Such observations would support the TED approach of an 18-min limitation. If, as is contended, a student can mentally focus only in 15-min increments, it would seem not only unreasonable but also grossly inefficient to

subject students to a 50-min lecture. Thus many authors would make the case that a lecture session should last no more than 10–15 min to accommodate the biological set point of a student’s attention span. In 2015, a study commissioned by Microsoft and discussed in *Time* magazine found that the average attention span was in fact only 8 s. If indeed this is the case, then even participating in a 15-min lecture would be positively heroic. To place this in perspective, it was reported in the same *Time* article, that goldfish, of the piscine rather than snack variety, have an attention span of 9 s, one whole second greater than humans! It is perhaps rather premature to opt for an 8-s lecture format, as there are many caveats to the *Time* article, not the least of which is that no one knows how to actually measure a goldfish’s attention span. What has been measured is goldfish memory, which, according to researchers in the School of Psychology at the University of Plymouth, is actually quite good (7). Similarly the 8-s attention span for humans actually reflects the average time a person will spend on a web page before looking somewhere else. So thankfully, we can dispense with the 8-s lecture limit, but we are still left with the idea that a physiology curriculum should only entertain the concept of a 15-min attention span. However, despite the perceived and agreed upon wisdom of this time point, are there actually any data that would support such a thesis?

Genesis of the 10-Min Attention Span

The academic literature is replete with articles and books supporting and propagating the conclusion that lectures should adhere to the 10- to 15-min attention span that is characteristic of modern students. In the book *Tools for Teaching*, Davis (5) states that “...student attention during lectures tends to wane after approximately 10–15 minutes.” Similarly, Wankat (20) argues that “Although student attention is high at the start of a lecture, it has reached a low point after 10–15 minutes.” In essays honoring the psychologist Wilbert J. McKeachie, Benjamin (1) asserts that “When the lecture begins, most students are paying attention, and for most students that attention lasts for about 10 minutes.” Indeed, McKeachie (13), in *Teaching Tips (8th Ed.)*, has maintained that “Attention typically increases from the beginning of the lecture to 10 minutes into the lecture and decreases after that point,” a sentiment still echoed by this author more than 20 yr later in the 14th edition of the book (19). Several points are noteworthy regarding these publications. First, all of them agree on a quantitatively precise 10–15 min time course for a variable (attention) that is nebulous and never quantitatively defined. Second, evidentiary discussion for such a precise time span is negligible. Third, all of the above reports do not provide any primary data on attention but are content to all cite the same single initial report as the basis for the 10- to 15-min attention span assertion. For example, McKeachie (13) states that “Hartley and Davies’

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review of research on attention of students during lecture reports that attention typically increases from the beginning of the lecture to 10 minutes into the lecture and decreases after that point.” Thus, the propagated concept of a 10- to 15-min attention span ultimately appears to rely on a single key manuscript published in 1978 (10) describing the waning of attention during a lecture.

Note Taking

If all of the citations for a 10- to 15-min attention span originate with a 1978 article by Hartley and Davies (10), then a thorough examination of this article is clearly warranted. What is remarkable regarding this publication is that attention span is not actually the subject of the article; rather, the subject of the manuscript is in fact “note taking.” This article itself is also not a primary data source, but it reviews the literature up to that point regarding the taking of notes in class by students. Although this publication concerns note taking and not attention span, perhaps note taking is a reasonable surrogate marker for attention. Indeed, the review by Hartley and Davies (10) contends that the amount of notes taken declines over the course of a lecture, consistent with “attention” decline after the first 10–15 min of a lecture. Certainly, a review of prior literature, even work by Hartley and Cameron (9) and Maddox and Hoole (12), argued for a connection between a 10-min time point and a decline in note taking. Unfortunately the decline in note taking was observed during the last 10 min of the lecture and not the first (9, 12). Moreover, the decline in note taking at the end of the lecture was not caused by a lack of attention or mental exhaustion on the part of the student but rather reflected a drop in lecture content during the waning few minutes of the presentation (12). In fact, the rate of note taking appears to be relatively constant throughout the course of a lecture, and changes in note taking appear to reflect whether the lecturer is making key points rather than student fatigue. However, the question still remains: is note taking a good surrogate for attention? The answer appears to be no. Hartley and Davies (10) concede that there is a waxing and waning in attention span during a lecture but that measuring note taking was not an indicator of attention. Indeed, citing the author’s own work (9) and that of Maddox and Hoole (12), Hartley points out that note taking is not necessarily indicative of attention at all. So, note taking is not a good proxy for attention whatsoever, and even if it were, it does not support a 10- to 15-min limit on student engagement.

Personal Assessment

As discussed above, observations of students note taking has been imputed as a surrogate for student attention. Yet as we have seen, this is unreliable and not even supported by authors who were studying note taking. If note taking is not a useful metric, then what other approaches can be used to study student attention spans? A study by Stuart and Rutherford (18) attempted to discern attention of British medical students by asking the students themselves what their attention level was during a lecture. Every 5 min during a lecture, a buzzer would go off and the students would record their own perceived attention level on a 1 to 9 scale. The results showed that attention rose rapidly during the first 10–20 min and then slowly and steadily declined until the end of the 50-min

lecture. Attention span did decline after 20 min, but the decline was slow and never went below the initial attention level observed in the first few minutes of the lecture. Interestingly, although the attention level at the beginning of a lecture was not different between second- and fifth-year medical students, the attention level observed at the end of the lecture was significantly greater for fifth-year students compared with second-year students. Had senior medical students somehow learned to pay more attention in class? Were senior students acquiring new skills and techniques to enable them to be alert for longer periods of time than their junior colleagues? In reality, a review of the data shows that the entire difference between second- and fifth-year students was all due to the fact that one class for fifth-year students was taught by an experienced lecturer who did not present to second-year students. Thus, differences in attention appeared to be related to individual lecturers’ teaching styles and not related to the student’s individual abilities to remain attentive. A finding like this should be axiomatic. We have all experienced lectures where the lecture has been so awful and jejune that 10 min of lecture has been 10 min too long, yet for other lecturers 1 h seems wholly inadequate.

Direct Observation

Johnstone and Percival (11) attempted to evaluate attention span not by utilizing the student’s own evaluations but by employing two outside observers, whose job it was to watch the class and record the times of perceived attention drift. Out of 90 lectures given, the lectures “...were attended by at least one of us observers,” state the authors. Although gratifying that at least one of the authors usually turned up to observe the class, in fact observation by both authors occurred only 13% of the time, with 87% of all subjective data collected by a single observer. Johnstone and Percival (11) reported that attention dropped during the first 5 min of class, with another attention lapse 10–18 min into the class, a finding seemingly consistent with prior observations. However, there are several problems with the methodology that raise concerns about the validity of the findings. Although it is stated that when both authors observed the same lecture they were in agreement as to when attention lapses occurred, there was no definition as to what was an attention lapse. A person looking away from the teacher may be reflecting on the material and integrating it with prior work. A student fixedly staring at the teacher may be thinking about last night’s dinner.

Clickers and Attention

Recently, Bunce et al. (4), attempted to address the question of student attention using “clickers.” Nonchemistry majors taking chemistry classes were asked to self-report using three possibilities: with students asked to press *button no. 1* for attention lapses of ≤ 1 min, pressing *button no. 2* for attention lapses of 2–3 min duration, or pressing *button no. 3* for attention lapses > 5 min. The authors noted that students did not engage in consistent levels of attention but rather went between phases of attention and inattention throughout the entire lecture. Interestingly the examples the authors give for attention lapses argue not for deficits in attention but rather for attention directed toward things other than the lecture. As examples of the kinds of things that were classified as attention

lapses, the authors reported that *button no. 1* was pressed by students glancing at and paying attention to the clock, *button no. 2* was pressed by students paying attention to and responding to text messages, and *button no. 3* was pressed by students paying attention to homework from another class. All of these so-called attention lapses are extrinsic to whether a student is losing attention in the present lecture due to mental fatigue.

Recall and Retention

One of the arguments in favor of a 10- to 15-min lecture is that material covered in the lecture is not retained during lectures lasting >15 min. Data in support of this contention were presented by Johnstone and Percival (11), who attempted to test knowledge of material covered during an apparent “attention lapse” during subsequent tests. The authors report that students performed poorly on recall of material covered during an “attention lapse,” a finding that was “...statistically highly significant.” Yet what statistical analyses were performed, what method of data collection was utilized, and what the criterion for significance was were not elaborated upon in the article. McLeish’s report (15) of the work by Trenaman argued that there was an inverse relationship between the length of the lecture and the retention of the material covered in that lecture. In these studies, students listened to a recorded lecture (what would now be called a podcast) and were evaluated immediately following the lecture on their retention of the material. Trenaman found that students listening to only 15 min of lecture had immediate retention of almost 41% of the material compared with students listening to 40 min of material, who only retained 20% of the material. Although this study might seem to highlight the concept of diminishing returns, there are several flaws in the analysis that preclude any hard interpretation of the data. Clearly, more material is covered in a 40-min session compared with a 15-min session, so it is not surprising that retention percentage is reduced, and this can be fully accounted for by the number of testable items covered in the two sessions. Even if the outcome from this study does define an inverse relation between lecture length and material retention immediately following the lecture, is this in any way a meaningful analysis? No physiology course director would expect students to immediately take examinations on the material just covered in a lecture. No one can imagine that immediate testing following exposure to material would in any way be a reasonable assessment of learning and comprehension. Indeed, to do so would likely incite a minor revolt, or at least a robust complaint to the Dean. Attempts to replicate Trenaman’s data have not been satisfactory. McLeish (15), utilizing a live lecture format, rather than Trenaman’s recorded format, found that there was no difference nor decline in retention rates of material between live lectures of 25, 40, or 50 min. It is ironic that in today’s student preference for listening to recorded rather than live lectures, the most parsimonious solution to the difference between Trenaman and McLeish’s studies would argue that recorded material is inferior to live lecture in content retention.

This article started by looking at note taking and has meandered to material retention. Therefore, it would seem fitting, to ask whether there is a correlation between note taking and content recall. Fortunately, such an analysis was performed by Scerbo et al. (16) in 1992. Consistent with previous reports,

there was an observed decline in note taking during the length of a lecture. However, the decline in note taking had no impact on the retention of covered material during subsequent evaluation. That is not to say that note taking is not an important skill for students to acquire, but as would be expected, it is the quality of the notes being taken, not their quantity, that is important. One critical point made by Scerbo et al. (16), which should be taken into account by teachers, is that written cues are recorded more frequently and better retained than statements preceded by spoken cues. Whether using chalk boards or PowerPoint, the conclusion is clear, that key points should always be highlighted in writing as well as spoken.

Objective Assessment of Attention Span

As discussed, the concept of attention is somewhat nebulous and the working description for student attention ill-defined. Given the subjective nature of many publications on attention assessment, there appears to be clear need for an objective determination of student attention, but what physiological variables are amenable to easy and minimally invasive data collection? At least two factors can be associated with attention: arousal and motivation. Arousal refers to a general level of activity and a measure of nonspecific stimulation of a student’s cerebral cortex. Heart rate is one indication of arousal that is fairly easy to collect. Bligh (2) monitored 16 students’ heart rates every 5 s during a lecture using a pulsemeter. Heart rates steadily declined by ~14% from the start to end of the lecture, with a modest rise toward the end of the lecture. Initially, such data would seem to confirm the notion of a steady decline in attention during a lecture. However, Bligh (2) found the same decline in heart rate when the teaching format was a discussion class, and not a lecture. If heart rate is indeed a relevant measure of attention, these studies would imply that a drop in attention during so-called passive learning sessions, such as a lecture, is no worse than the drop in attention during active learning sessions, such as group discussions. In addition, Bligh (2) was unable to find any overall correlation between declining heart rate and retention of covered material. What little correlation did exist showed that student retention of material (as measured by immediate testing) was highest during the last 20 min of the lecture, when arousal (at least as determined by heart rates) was supposedly at its lowest. The observation that material covered during the latter half of a lecture is more readily retained is a finding previously noted by Giles et al. (8). In a study of medical student retention, Giles et al. (8) found that information presented between the 15- and 30-min time segments was recalled best, whereas material presented during the first 15 min had the worst retention. Interestingly, the seating position of the student in the lecture hall had as much impact on material retention as the placement of material within the lecture. Students sitting at the front, middle, and back of the lecture hall scored 80, 71.6, and 68.1%, respectively, on tests given immediately following the lecture. However, these findings likely reflect motivational factors (another component of attention) that determine where a student sits, rather than the seating position by itself.

Factors Affecting Attention during Lectures

In the book *What’s the Use of Lectures?*, Bligh (2) outlines several factors affecting attention. The author argues that there

is no reason that lectures should be “solo performances,” with paired faculty dialogues or group presentations being equally valid. As part of the physiology curriculum in gastrointestinal physiology at our medical school, one section is devoted to pathophysiology. This section is taught in clinical vignettes by four faculty all in attendance during the lecture session, each presenting a clinical case in rotation. This seems to be appreciated by the students and also serves as role modeling for how faculty interacts with each other in a professional manner. Similarly, there is no reason why students attending a lecture cannot be part of the lecture. This is probably best exemplified by the use of “clickers” that allow the students to answer questions posed by the teacher. This can give a lecturer immediate feedback on how well the students are comprehending the material. Of course, such two-way dialogue does not have to rely on electronic devices but can be achieved by verbal responses from the students. Stimulation can also come from auditory and visual cues. One eminently useful aspect of the internet is access to incredible graphics and videos. Teachers are no longer consigned to devising their own crayon or pencil drawings of tissues or organs but can avail themselves of great images (subject to appropriate copyright usage) to illustrate dynamic physiological processes. Despite it being an old adage, it is nonetheless still true that a picture is worth a thousand words. Students quickly pick up on the idea that if faculty are unwilling to take the time to provide the best possible graphics for their lectures, then students are unwilling to devote attention and time to that lecture; and who can blame them? Attention by students can also be seriously hampered by teachers merely reading long tracts of projected text. To the extent that lectures are a performance in front of an audience, teachers should actively take measures to alter rates of speech, cadence, and style. In this regard, watching videos of motivational speakers can be very illustrative. Equally if not more illuminating is watching videos of one’s own lectures. This allows a teacher to see the lecture from a student’s viewpoint and can be a great guide for improvements. Although all of the above aspects of attention and how teachers can impact that attention are discussed by Bligh (2), it is curious that Bligh (2) omits mentioning student motivation as a critical aspect of attention.

Has the Sun Set on the Day of the Lecture?

Many arguments have been raised against the utility of the lecture format, although many seem to be straw men, rather than reasoning based on findings. Clearly, the notion that lectures should be dismissed because students have only a 10- to 15-min attention span is erroneous and has little if any data to support it. The lecture format has been deemed a “passive” learning experience, with the current trend in “active” learning being focused on activities such as “flipped teaching” and “small problem-solving groups. A further argument against the lecture approach is that the lecture represents a form of educational Luddism, which is not student-centered and focusses on the “sage-on-the-stage”. It is informative to look at the definition of a sage. Merriam Webster’s dictionary defines sage as “wise through reflection and experience, or characterized by wisdom, prudence and good judgement.” It is surprising that such qualities are deemed unworthy or passé in a good teacher. In fact, recent studies show that the lecture can be an effective

way to help students acquire new knowledge. Perhaps this comes to the heart of the issue and requires an answer to the fundamental question of what is the purpose of a lecture? Certainly, one aspect is the conveyance of information, for which the lecture is an effective method (2). There are manifold online sources for information from which the student can collect; however, determining which sources are reliable or just plain wrong or discerning what information is salient vs. minutiae still requires a sage. The quoted dichotomy of “sage-on-the-stage” vs. “guide-by-the-side” is often used to disparage the lecture format. In reality, this contrast is nothing more than a sophomoric debating sleight, displaying the fallacy of the false choice. The construct implies that these are the only two options available, yet a minimal amount of thought reveals that this is clearly not the case.

Is this article meant to imply that the 50-min lecture is the preeminent or only means of conveying information? Certainly not. Multiple approaches can and should be used to help students not only to remember material but also to have a deep comprehension of physiological processes and mechanisms and be able to utilize such knowledge in various applications. However, part of an overall balanced portfolio of instructional tools can include the lecture. Indeed, recent studies show that the lecture can be an effective way to help students acquire new knowledge and may have benefits over flipped or small group learning (17). In the book *Teaching Naked*, Bowen (3) articulates aspects of teaching suited particularly for lectures. Lectures are useful for introducing students to content. A quick search on Google for “gastrointestinal physiology,” for example, generates 1,400,000 hits. Which of these sites provides accurate information, which of them are relevant to undergraduate students with a minor in physiology, and which of them are relevant to medical students? It is unlikely that a student can adequately assess these options for themselves (at least initially). Lectures provide a good entry into a topic; they provide context and the level of detail and comprehension that are required for a particular class. These aspects are things that rely on a teacher’s accumulated experience and wisdom or, dare one say it, on the teacher being a sage.

If a student can get the identical learning experience viewing a YouTube video in bed just as they can attending a lecture in person, why is this assumption not evident in other aspects of life? We all have access to virtually unlimited recordings of music; we are able to watch shows on television when it is convenient for our schedule. If a virtual experience is indeed identical to a real experience, then no one need go to a live music concert, no one need to go to watch a live play or musical, no one need go to hear a distinguished speaker give a talk, and no one need attend a football or baseball game at a stadium. Yet such venues are often quickly sold out. What is different between a live and recorded event is the emotional buy-in. Certainly books, or even videos, can be excellent media for conveying content, but a live teacher can inspire a student to think more about a subject and delve deeper into content than can be achieved by passive media alone. Motivational speakers know this very well, and many make a remarkably good living by giving live presentations. Certainly charisma helps in generating excitement about a subject in students, but probably the biggest aspect of inspiring students is passion for the subject on the part of the teacher. Lectures are one place where a teacher can model intellectual, personal, and moral

values. They are usually one of the few places where students meet faculty in person, allowing students to interact with teachers and pose questions; it is critical that faculty acknowledge when they don't know the answers. In this way, faculty can provide a broader education in terms of modeling respect and care for students. Indeed, Dr. Martin Luther King stated that "...intelligence plus character – that is the goal of true education." Lectures can also be used as a platform to allow questions to be raised that can focus attention on areas of physiology that are not well worked out. Textbooks by their very nature are considerably out of date by the time they are published, and although many things remain true (e.g., the heart pumps blood, the pancreas secretes hormones and enzymes), the mechanistic understanding of these processes is continuously evolving. Thus, a lecture can be a good launching point for discussions on what is not known about physiological processes or areas in which there is considerable disagreement about mechanism. We tend to think of lectures as only passing on fixed content, but they can be a valuable tool in showing uncertainty and developing the intellectual processes for handling disagreements. Fortunately, there are now many sources to help teachers improve the quality of lectures and move the lecture beyond merely conveying information but also to inspire, motivate, and open doors to new ways of thinking. In this regard, there are many books that help faculty encourage critical thinking by their students, even within a lecture format (3, 6, 14).

Conclusion

As scientists and physiologists, we are called on to provide evidence for our research and data backing up our assertions. Yet when it comes to attention span, an unsubstantiated mantra of 15 min is chanted, with no support other than "That's what I've been told." With the current educational trends of "life-long learning" and "evidence-based teaching," if we insist on dogmatically applying a 10- to 15-min limit on lectures, we are implying that we really don't care about evidence. Beyond that, it still behooves teachers in physiology classes to do as much as possible to increase student motivation by showing the relevance of material and providing a context for what is taught as well as eagerly displaying a passion for the subject. Physiology is a wonderful science, and students should expect nothing less than having physiology taught with passion and enthusiasm. What could be better for the future of the discipline of physiology than to have students wanting to be in class and eager to spend as much time as they possibly can in the subject?

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