A prolegomenon to the study of graduate research training

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Academic physiologists are both teachers and researchers. As a teacher the physiologist has two main tasks, to teach courses and to supervise graduate student research. It is argued that these two tasks involve different pedagogic strategies and therefore should not be confounded with one another. The physiologist who acts as a teacher in a situation of research advising will be an inappropriate advisor and will provide the student with inappropriate research training. When performing the task of graduate advisor, the physiologist should maintain a liberal attitude that fosters the graduate student’s research education.

This will lead physiologists to a new frame of mind where truth and nontruth are clearly distinct. This is especially true for medical and veterinary physiologists, for whom the immediate needs of a patient must be taken care of irrespective of theoretical debates about the ultimate truth of a theory. However, it is also true for academic physiologists, whose job is to report not the polemical aspects of science but the findings that are considered correct and useful. One example among thousands of possible examples is the discussion of the central nervous system control of food intake in Ganong’s (3) classic Medical Physiology. As the author of a textbook, Ganong had to present facts, not conflicting hypotheses. Consequently, Ganong adopted the conception that the lateral hypothalamus was a feeding center (1), even though other researchers claimed that the lateral hypothalamic syndrome was a mere consequence of a general motiva
tional impairment (9) or a consequence of motor dys
tunction (2).

To not be misunderstood, I immediately point out the implications of the “absolutization” of scientific knowledge. It should be made clear to the reader that I am not criticizing colleagues who write textbooks. Nor am I criticizing the behavior of physiology teachers who un
intentionally present a simplified (and, most likely, in
complete) version of physiology to their students. Indeed, I cannot even see how else the contents of any science could be taught. The point I want to make is that teaching science is very different from doing science. As Merton (5) pointed out several decades ago, one of the basic requirements for doing science is the endorsement of organized skepticism. Those of us who conduct physiological research know very well that there are no absolute truths and that even the most obvious observations may be flawed. However, when we enter the classroom as teachers, we are not expected to question the validity of physiological research. It is our duty to give out facts and principles that can be useful to people who may never enter a research laboratory in their lives. We should not pretend to be God, but we must be assertive. Teaching requires an assertive attitude, including a sense of possessing the truth. Teaching requires also a sense of dominance, as the teacher must be seen as the one who has the knowledge and passes it on to the students. I am sure most professors have faced these issues some time during their careers. Teaching requires a teacher’s
attitude. It requires the belief that there is a clear set of facts to be taught and that this set of facts should be presented to a group of people (the students) who are ignorant regarding these facts. Undoubtedly, students can be encouraged to engage in critical thinking, but the acceptable level of criticism (i.e., of skepticism) is almost negligible when compared with the level required of a research student.

THE PHYSIOLOGIST AS A GRADUATE ADVISOR

The other educational role of academic physiologists is the supervision of graduate students. Rather than learning specific physiological facts, students are now expected to learn how to conduct independent research. This change in goals requires a change in the relationship between professor and student. When it comes to research, the professor no longer holds the unquestionable truth. Realistic physiologists know that what they believe to be true is not always what other physiologists believe to be true. An example among thousands of other examples refers to the organ responsible for the phenomenon of adaptive diet-induced thermogenesis: one group of researchers believes this organ is the liver (4), whereas another group believes it is brown adipose tissue (8). It would be very egocentric and erroneous to assume that your own group is correct and the other group is wrong. Most likely, both groups have a partial understanding of the phenomenon.

Not only do professors lose the status of truthkeeper when they play the role of advisor, they also lose the position of dominance. Indeed, research behavior cannot be properly described by a formal set of rules. The few rules that can be identified are more effectively transmitted in a course on research methods than in the interaction between graduate student and graduate advisor. Consequently, professors do not possess a body of knowledge that should be passed to students. Professors have the experience in research, and this is the reason why they are given the status of advisors, but they do not have something concrete to show. Naturally, if you do not know what it is that you own, you cannot be too proud of owning it. Therefore the position of dominance is not justified.

THE CONFLICT BETWEEN TEACHER AND ADVISOR

Graduate students usually identify two basic types of advisors, authoritarian advisors and liberal advisors. Authority advisors are the ones who know very well what they want to accomplish and insist that graduate students take specific courses and conduct the experiments that the advisor designed. Liberal advisors believe that students should learn on their own and only suggest courses and experimental ideas. These two types of advisors have traditionally been considered to result from different types of personal characteristics. This implies that they are both legitimate. Moreover, as there is always a quantitative continuum in personality traits, professors never think of themselves as being at either extreme. I believe this situation should be changed. It may be true that no one is at the extremes of the continuum, but I believe there is an objective criterion that allows a classification of graduate advisors. The criterion is the attainment of the ultimate goal of graduate advising: students should learn to conduct independent research.

We saw above that the best strategy for teaching (i.e., an attitude of possessing the truth and being its disseminator) is not the best strategy for advising (i.e., an attitude of scientific skepticism and modesty). Now, graduate advisors of the authoritarian type confound their double roles of teacher and advisor. By using a teacher strategy in an advisor situation, these people perform an inappropriate advising role. I do not believe that anyone would intentionally be an inappropriate advisor. However, because we do not learn how to be advisors at graduate school, it is not surprising that many of us end up being bad graduate advisors. The natural solution to the problem is to call the attention of our graduate students to the distinction between teaching and advising. As they become advisors themselves, they will be better prepared to advise new students.

My argument is, therefore, that graduate advisors should respect the distinction between teacher and advisor and that if they do not respect it, they will not be good advisors (and will not provide a good education for their graduate students). I believe the authoritarian type of advisor is much more likely to disrespect the distinction between teacher and advisor than the liberal advisor. Consequently, I condemn advisors of the authoritarian type. Research advisors who are dogmatic and directive are no better than teachers who present a lecture topic as a random gathering of inconsistent experimental findings. Physiologists must be able to maintain a dynamic balance between the pedagogic dogmatism that belongs in the classroom and the scientific skepticism that belongs in the laboratory.

In practical terms, the main issue is one of personal attitude. If physiologists have the attitude of liberal advisors, they will have a good chance of fostering the research education of their graduate students. Decisions will then be made based on some type of advisor’s common sense. For instance, even a very liberal advisor who has been working on topics in exercise physiology for many years would have to discourage a graduate student who wanted to do research on the molecular biology of *Escherichia coli* (assuming the student even had the means to conduct such research at the advisor’s laboratory). After all, a laboratory must preserve its identity, and advisors cannot become experts in a new field every time they accept a new graduate student. On the other hand, an advisor who is working on a project on ammonia excretion in fish should allow a graduate student to conduct an independent study on uric acid excretion in turtles if the student so wishes. If graduate students are in a laboratory to learn physiology (and not to serve as technicians for the advisor), they should be allowed to conduct their own supervised research. To prevent students from working on their own ideas is equivalent to preventing pupils from reading the textbook. Even when (actually, especially when) the ideas of students seem inappropriate at first, their attempts at independent research should be encouraged. The indiscriminate refusal of new ideas because they might be wrong is a
consequence of a paternalistic attitude that belongs in the classroom but not in the laboratory.

This essay was meant to be only a prolegomenon to the study of how graduate students should be trained in physiological research. Much research needs to be done on this important educational topic. I hope the ideas presented here will be helpful to those who undertake this invaluable enterprise.

REFERENCES