Physiology & Behavior 162 (2016) 196–200

Contents lists available at ScienceDirect

Physiology & Behavior

journal homepage: www.elsevier.com/locate/phb

Review

2015 Distinguished career award Reflections on a career in science

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HIGHLIGHTS

- Some developments in a career happen less by good planning than by good fortune.
- Research projects should be worth the time, effort, and resources invested in them.
- To make progress in research you have to know everything that preceded your work.
- Study of ingestive behavior requires multidisciplinary approaches and perspectives.

ARTICLE INFO

Article history:
Received 29 August 2015
Accepted 28 September 2015
Available online 3 October 2015

Keywords:
SSIB
Career
Food and fluid ingestion

ABSTRACT

I was very pleased to receive the 2015 Distinguished Career Award from SSIB. This brief manuscript contains reminisces that might stir up pleasant memories in the older members of SSIB and also some general thoughts that I hope will be of value to the younger investigators who are closer to the beginning of their scientific careers. Although the organization has chosen to honor me with this special award, my own career was shaped by a great many people who have influenced my scientific career and I want to acknowledge them. They include Neal Miller, my doctoral mentor at Yale; Joe Holmes and Alan Epstein, my postdoctoral mentors; George Wolf and Reed Hainsworth, graduate student colleagues; John Brobeck, Paul Rozin, and Phil Teitelbaum, Michael Zigmond, Joe Verbalis, Jim Smith, and Alan Sved, faculty colleagues; Derek Denton, Paul McHugh, and James Fitzsimons, scientific role models; John Bruno, Steve Fluharty, and Linda Rinaman, post-doctoral trainees at Pitt; and Lori Flanagan, Kath Curtis, Michael Bushey, Mike Bykowski, Reza Manesh, Carrie Smith, Jennifer Vaughan, and Myriam Stricker, student trainees at Pitt. I thank them all and also my colleagues in SSIB not only for the honor of this award but for providing an abundant supply of insights and discoveries that have stimulated me throughout my adult life, in addition to being an attentive community in supporting my own work.

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I was very pleased to receive the 2015 Distinguished Career Award from SSIB. I want to thank the committee and its members for selecting me for this honor.

I spent a good many hours in my adult life paying attention to issues of relevance to the brain's control of ingestive behavior. I closed my research lab 7 years ago, and receiving this award and preparing my acceptance talk and this manuscript motivated me to reflect on my career in a way that I had not done recently. In doing so, I had several insights that I wanted to share with the seated audience then and with the reading audience now. This brief manuscript resembles the talk I presented at the SSIB meeting in Denver on 11 July 2015, containing reminisces that might stir up pleasant memories in the older members of the group and also some general thoughts that I hope will be of value to the younger investigators who are closer to the beginning of their scientific careers.

My first such thought is that although the organization has chosen to honor me with this special award, my own career was shaped by a great many people who have influenced my work and I want to acknowledge

http://dx.doi.org/10.1016/j.physbeh.2015.09.028
0031-9384/

them. The principle is, *credit should be given where credit is due, and they deserve a lot of credit for what I have done*. Thus, I want to mention who these people are and what I learned from them. The first person I want to acknowledge is my doctoral mentor at Yale, **Neal Miller**. I went to Yale in 1961 to pursue a doctorate in Chemistry, the subject I had studied as an undergraduate student at the University of Chicago. However, at Yale I soon realized that I did not want to have a career in Chemistry so I switched my focus to Psychology. I naïvely picked Psychology because my older brother had focused his attention on the subject and seemed to enjoy it, which led me to believe that I might enjoy it too. I had to submit a late application for admission into the Department, which I did, and I was accepted even though I had never taken a course in the subject. That's the basis of my second thought. A scientific career can be a long and twisting road, and many academics like to plan and control things every step of the way. I'm one of those people. *Yet some of the most important developments in a career sometime happen less by good planning than by good fortune.* Luckily for me at the time, an incoming graduate student had recently withdrawn from the Psychology Department and thus created an open fellowship; in addition, perhaps my background in Chemistry interested Dr. Miller, whose own work then included studies of chemical brain stimulation. In any case, I had the good fortune to be accepted by the Department, given that scholarship, and invited to join the lab of one of the most prominent psychologists of the 20th century.

I learned a tremendous amount in Dr. Miller's lab, which was especially important since I knew almost nothing when I began. I most recall learning four specific things, for which I have always been grateful. First, Dr. Miller seemed always to be focused on some work-related issue or another rather than engaged in something of casual interest. I had never met anyone like that, and I very much admired his work ethic and adopted it as best I could. Second, he had filled his lab with an unusual assortment of trainees, each pursuing something of great interest to them; it was not always apparent to me that their research was of great interest to Dr. Miller but it was always apparent that the trainee was of great interest to him. I found that element of research training to be admirable, as well. Third, Dr. Miller was wonderfully able to communicate basic elements of experimental design, such as having an adequate number of subjects in each study and the need for control groups. I learned from him these essential features of scientific investigations. Fourth, after a trainee's presentation we always anticipated his question about the significance of our work. His attitude was that *each research project should be worth the time, effort, and resources that were invested in it*. I agreed with that perspective and adopted it as well. In fact, former trainees of mine will recognize that Dr. Miller's question later morphed into the "So what?" question I asked after presentations throughout my own career.

My doctoral thesis concerned the apparent stimulus for thirst caused by a drop in blood volume [1]. Because thirst and vasopressin serve complementary roles in achieving water balance, and hypovolemia already was known to stimulate vasopressin secretion, I guessed that the same signal might also stimulate thirst, which turned out to be true. Those findings held little or no interest to Dr. Miller but they were of great interest to members of what would become the SSIB community. The success of that research project taught me many useful things. For example, I learned that *an argument by analogy together with the principle of parsimony provide useful insights into organismal function*. I also learned that body fluid homeostasis was the most interesting subject I had ever encountered and was what I wanted to study in the future. Inasmuch as homeostasis was achieved by behavioral and physiological actions, and I did not know enough about either subject, I concluded that I needed postdoctoral training. Such training was not as commonplace then as it is now. I selected for my postdoctoral mentor **Joe Holmes**, who was located in the University of Colorado Medical Center in Denver. Dr. Holmes had been a well-known contributor to the scientific literature on thirst and was a former student of Magnus Gregersen, another prominent scientist who had been perhaps the most successful student of Walter Cannon, who was one of the godfathers of homeostasis. Impressed as much by his pedigree as by his published work, I asked Dr. Holmes if he would accept me as a trainee and he agreed. In retrospect, his decision may have been more an act of kindness than a result of an interest in my work because, unknown to me at the time, he had switched the focus of his research to a different subject. Be that as it may, 50 years ago (i.e., in July 1965) I first came to Denver and joined his lab. I was surprised to discover that no one there was interested in the biological bases of thirst, and in fact my conversations about thirst with Dr. Holmes were very brief and infrequent. Although I was largely left alone, I spent a very productive year in Denver. Each day, virtually 7 days a week, I would go into the lab at 8:30 a.m., inject animals, and from 9 a.m. to 5 p.m. I went to the medical library and read all the articles I could find on body fluid homeostasis. I then returned to the lab, spent an hour collecting data on drinking behavior, and went home. I can tell you that a great many research articles can be read when you spend 8 h a day doing so for 350+ days.

> *I believe that if you really want to make progress in a field of research you have to know everything that preceded your work — all the experiments, all the data, and all the ideas. It's a never-ending task, of course, but there is no satisfactory alternative to reading the scientific literature thoroughly. After all, many good people have invested considerable time and thought over the years to the same problems that I wanted to understand, and if ultimately I was going to gain further insight into those issues I recognized that I had to see their published data and read everything they wrote.*

At the end of the year in Denver, I felt (mistakenly) that I had read everything that had been published on fluid homeostasis and I wanted to refine my ideas by participating in an academic community of scientists who were interested in ingestive behavior. Therefore, I applied to do a second postdoctoral stint, with **Alan Epstein** at the University of Pennsylvania, who accepted me into his lab. Alan was one of the most prominent scientists in the field of ingestive behaviors and he was my first mentor who seemed to have an interest in my work. Although we disagreed on many issues concerning how the brain worked to control water and food intake, I learned a tremendous amount during the year I spent at Penn from him and from his faculty colleagues there. One of those colleagues was **John Brobeck**, the chair of the Physiology Department, who allowed me to attend the medical course in physiology and supervise students in the associated laboratory. I recall that I once asked him to sponsor a manuscript for publication in the journal, *Proceedings of the Society for Experimental Biology and Medicine*, because he was a member of that society and sponsorship by a member was necessary. The manuscript I gave him was covered in red ink when it was returned to me. I thought I had written it well but I learned that there was considerable room for improvement. I apologized for asking John to do so much work but he graciously said that the paper was worth it. It was published later that year [2] but more importantly I learned another lesson: *contrary to popular opinion, data do not speak for themselves. They have to be communicated in well-written manuscripts that are clear and succinct, and hard work is needed to prepare such articles. Put another way, I learned that much more time is spent editing a manuscript than writing an initial draft of it.*

Another significant role model for me at Penn was **Paul Rozin**, then a young assistant professor in the Psychology Department. Coincidentally Paul had been a good friend of my older brother when the two were at college together, and he has been a valued friend to me for almost 50 years. By now he is well-known for his work on human food intake and his ability to think creatively in designing and interpreting his experiments, but I think that the lesson I learned best all those years ago (and since) has been his concern about *the need to teach well in addition to doing research well*. Not surprisingly, Paul has been a legendary teacher at Penn.