INTERVIEW
Donald G. Stein: Pioneer in the Areas of Neuroplasticity and Recovery of Function

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Donald G. Stein is the Asa G. Candler Professor of Emergency Medicine at the Emory University School of Medicine. He received his BS and MA degrees at Michigan State University and his PhD degree at the University of Oregon. He did his postdoctoral training at Massachusetts Institute of Technology and started his teaching career at Clark University, where began his work in the area of recovery of function after brain injury.

At Clark, Stein gained notoriety as a strong proponent of neuronal plasticity and for his work on the serial lesion effect which directly challenged the doctrine of localization of function. In 1988, Stein became vice provost for research and dean of the Graduate School at Rutgers University, Newark and adjunct professor of neurology at the University of Medicine and Dentistry of New Jersey. In 1995, Stein became the vice provost for graduate studies, dean of the Graduate School of Arts and Sciences and interim vice president for research at Emory University for five years, before returning to full-time teaching and research. His recent work on the mechanisms underlying the therapeutic effects of progesterone on the injured brain had its origins in his work on the role of sex differences on recovery of function that he started at Clark University. Stein vigorously pursued this line of research at Rutgers and Emory. His groundbreaking work on the efficacy of progesterone therapy following brain injury has been translated into clinical trials. Meanwhile, his most recent laboratory work has focused on the use of progesterone as therapy in rodent models of stroke. Stein has authored more than 400 articles, book chapters, reviews, and papers and has co-authored or edited 16 books on recovery of function after brain injury. He is the recipient of numerous prestigious honors and awards. He was most recently honored with a Festschrift at the Association for Psychological Science annual meeting in San Francisco for his pioneering work in neuroplasticity and recovery of function. Although primarily known for his research, Stein has excelled as an outstanding teacher, educator, and mentor during his long and distinguished career. In this interview, he offers some useful insights into how his research has enriched his teaching and mentoring and offers some helpful advice for undergraduate neuroscience educators.

GD: When and how did you become interested in neuroscience?
DS: As a student at Michigan State University during the 1960's, when I was doing a clinical internship at Battle Creek Veterans Administration Hospital and, later, at Caro State Hospital, it became obvious to me that the treatments being used were not effective. Many of the patients at the VA hospital were veterans of World War II and the Korean Conflict who suffered traumatic brain injury and a variety of mental disorders. The options for treating these patients were extremely limited, mostly to keeping them sedated, and I became convinced that there had to be a better way. However, I knew that in order to develop better treatments, I needed to learn more about the brain.

GD: What sparked your interest in neuroplasticity and recovery of function?
DS: I was interested in the physiological basis for learning and memory and went to the University of Oregon to pursue a Ph.D. and work with Jim McGaugh. Although McGaugh subsequently took a position at University of California at Irvine, I was fortunate to be able to continue my work on hippocampus and memory consolidation with Dan Kimble, who had just finished his training with Bob

Isaacson and Karl Pribram and was just starting as a young assistant professor at Oregon. During my dissertation work I began to notice that about 25-35% of the animals receiving bilateral hippocampectomies had minimal impairments. Initially, I was worried that I messed up the surgery, but after analyzing the brains, I was stunned to find that, despite their relatively normal behaviors, these animals had perfectly fine hippocampal lesions. This piqued my interest and I really wanted to explore these individual differences to better understand the possible recovery mechanisms that could account for this anomaly. However, I followed Dan Kimble's advice to keep on track and focus on the original thesis of my project, so that I could obtain a Ph.D. in a reasonable period of time. Although my postdoctoral training at MIT allowed me to work with Steve Chorover and interact with Walle Nauta and F.O. Schmitt, at a time when the term "neuroscience" was conceived, the focus there was reductionistic, and antithetical to my true interest on recovery of function. It was during my years at Clark University that I gained the freedom to pursue the study of recovery mechanisms. The works of McGaugh's good friend, Lou Petrinovich and the very early work of Karl Lashley on slow growing lesions and functional recovery, first introduced to me by Jim McGaugh and Dan Kimble at Oregon, began to provide a basis for my thoughts on recovery mechanisms. Tamara Dembo, who was a faculty member in the Psychology Department at Clark and who had received her training with Kurt Goldstein and Alexander Luria, encouraged me to study recovery of function. However, it was the work of John Adametz on the serial lesion effect and the collaboration with my first graduate student, Jeff Rosen, which propelled my research into mechanisms of functional recovery.

GD: What was it like when you first started teaching at Clark University and are there any lessons you learned or helpful hints that you might give to junior faculty members who are at the beginning of their teaching careers?

DS: Under the leadership of Seymour Wapner, the Psychology Department at Clark had regained the stature it had attained in the early 1900s when G. Stanley Hall was its President and when Willard S. Small became the first scientist to run a rat through a maze. However, I was only 26 years old when I started teaching at Clark, and ironically, I was the first and the last person to teach physiological psychology there. Back in 1965, only about 15 people in the country received their doctorates in physiological psychology and there were only about four journals on the subject and only two textbooks, one by Clifford T. Morgan and one by Richard Thompson. *Neuroscience* was in its infancy, or to put this into a context that *JUNE* readers will clearly understand--my Society for Neuroscience membership number is 000000035. Because it was a new area for Clark University, I was responsible for developing the entire curriculum in physiological psychology. From doing this, I learned more about the subject during the first year I taught at Clark than all four years of graduate school. However, it was exciting, because I had developed a love of teaching from Jim McGaugh and Dan Kimble, a passion that has lasted throughout my career. In terms of advice for faculty members who are starting their teaching careers, I would encourage them to make sure they are given adequate time and resources to develop their courses and that their teaching load and infrastructure support is in proportion to the research expectations of their college or university. Teaching and research are a faculty member's primary mission, but adequate time and start-up funds are critically important during the first few years.

GD: Why have you always involved undergraduate students in your research and why have you continually emphasized the conceptual over the technical aspects of your research as a critical part of their laboratory experience?

DS: Undergraduate students represent our future and teaching them is fundamental to the mission of science. Undergraduate teaching is a noble profession. I say categorically that anyone who denigrates undergraduate teaching and its importance to our country has no vision of the future. Involving undergraduates in research has been a tremendously fulfilling part of my life. The emphasis on the history of ideas and concepts is critical. The notion of recovery of function has driven my work for 40 years and continues to be the foundation of my research. Although techniques are valuable tools, they really are not what drive meaningful, programmatic research. Virtually none of the tools that I used when I originally started this research are being used now, but the concepts still remain vitally important.

GD: In what ways do you feel that your research has enriched your teaching?

DS: My interest in recovery of function was sparked by the research I was doing, and the fact that the animals were not behaving as they should after receiving brain injury set the future direction of my life's work, including the courses and curricula I developed. It provided the basis for the book "Brain Damage and Recovery" that I wrote with Stan Finger and the book "Brain Repair" that I wrote with Bruno Will and Simon Brailowsky. My research has always supported my teaching, and my teaching, in turn, has informed my research.

GD: What do you consider to be the highlights of your career?

DS: I would have to consider the Festschrift at this year's Association for Psychological Science's meeting as one of the most significant highlights. It was a wonderful event and it was tremendously gratifying to be honored by former students and life-long colleagues as part of a terrific scientific program. Another highlight was being invited to the Vatican to speak and to participate in a weeklong meeting organized by the Pontifical Academy of Sciences, founded by Leonardo Da Vinci. Serving as an AAAS Congressional Fellow in the US Senate was also a great honor and a tremendous learning experience. Clearly, one of the most personally satisfying highlights is the NIH

providing support for a Phase III multi-center national trial to test the clinical efficacy of progesterone treatment following traumatic brain injury.

GD: What more would you like to accomplish in your career?
DS: I would like to see our work on progesterone in a stroke model translate into clinical trials in the near future. We have received NIH support for our studies, and our findings, thus far, look very promising.

GD: Your book, "Buying In Or Selling Out" provides some interesting challenges to academic researchers who are under increasing pressure to pursue patents and accept support from private industries which may have a vested interest in the outcome of the research. Do you have any advice for young investigators who face these pressures?
DS: This is a huge issue in today's academic environment. I want to disclose that we have a license with a company that makes progesterone so that if the trials are successful, we can then assure of getting the treatment to the patients. The emergence of private industry into academia was inevitable, given that most of the universities were either unable or unwilling to provide the necessary support for their research and scholarly mission. Now, the genie is out of the bottle, and there is no getting it back in. Nonetheless, I would advise any young investigator to be true to their primary mission—to teach and disseminate information. When entering any agreement with a private company, faculty members must never jeopardize their primary mission of seeking intellectual and scholarly independence and they must always publicly disclose all aspects of the agreements they make with private companies. They should try to retain as much autonomy as possible and never give up their right to publish their results. It is also critical to develop as much independent research, through NIH or other not-for-profit sources, in order to ensure a high degree of autonomy from corporate pressures.

GD: For a long time you have been sensitive to the concern that we may be educating too many neuroscientists, relative to the number of projected job openings. What is your current perspective on this situation?
DS: There is no question that one has to be very concerned about flooding the market. However, my position on this has been modified in the last few years, primarily because there appear to be fewer and fewer American students who are pursuing careers in the academic sciences. It seems that most of the young scientists in the U.S. are here on foreign visas, while most American students are pursuing medical or business degrees. As such, I think it is important for the future of our country to make sure the pipeline of young scientists remains open, and I encourage our best students to pursue careers in science.

GD: What changes would you like to see in the way we educate neuroscience students?
DS: I am deeply concerned about the early specialization that seems to pervade our current approach to neuroscience education and science education, in general. I would like to see more students obtain a broader background, and prefer to have curricula that require more, not less, course work. Personally, I think I benefited greatly by taking courses in clinical, social psychology and developmental psychology as well as the philosophy of science and other courses in the humanities. These courses provided me with a broader perspective on critical aspects of brain functioning. Currently, there seems to be too much emphasis on methods and techniques, with many programs that are overly technique-driven, and with persistent emphasis on ultramolecular and genomic reductionism. I think this approach to education deprives students of formulating original ideas and putting together a broader perspective of brain functioning.

GD: What advice would you offer an undergraduate student who is considering a neuroscience major?
DS: I would advise them to take a broad spectrum of courses because they won't get this chance once they enter professional or graduate school. It may be their last chance to receive a liberal arts education, to contemplate the "big thoughts", and to engage in creative problem solving. The undergraduate years, unfortunately, may be a student's last chance to be a creative thinker before they focus on learning facts and techniques required by most medical and graduate schools.

GD: What advice do you have for a new faculty member who is just starting his or her career?
DS: Make sure you have enough time and support to think. Make sure you have the infrastructure that will allow you to perform effectively in that domain. Some places have unrealistic demands of new faculty. It is also important to develop a good teaching portfolio and to find an appropriate balance between your teaching and research responsibilities. And don't forget also that you need to "have a life", despite what your Chairperson might think or expect

GD: Are there any additional comments or insights that you might like to share with our readers?
DS: Yes. Always treat your students with respect. Never, never denigrate your students or postdocs. Mentor and nurture them—don't just see or use them as technicians. It's not just another academic chore or obligation---it's the essence of what you do as a professor. The students and postdocs I have worked with throughout my career were the keys to the successes I have had. They made all the difference to me.

GD: Thank you for taking the time for this interview and for your helpful advice and insights.

Donald Stein served as his advisor and mentor when Gary Dunbar received his Ph.D. at Clark University.

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