

Lessons Learned From a Life in Science

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APS Past President Michael S. Gazzaniga's illustrious career as a researcher, an intellectual, and an advocate for science has led to his elections to the National Academy of Medicine and the National Academy of Sciences and appointment to the President's Council on Bioethics. Gazzaniga's groundbreaking investigations examining split-brain patients and his instrumental role in the genesis of the field of cognitive neuroscience establish him as a leader in the scientific quest to understand the relationship between brain and mind.

In his William James Fellow Award Address at the 2015 APS Annual Convention in New York City, Gazzaniga (University of California, Santa Barbara) discussed the evolution of his career over several decades and the lessons he learned along the way.

Lesson 1: Write the Letter

"I went to college to learn something, and to show you how much I needed to learn, I joined a fraternity called Alpha Delta Phi, also known as the Animal House," said Gazzaniga.

While the Animal House surely provided some amusement, the young Gazzaniga eventually concluded that there must be more for him than the Greek system. He had a burgeoning interest in science, but it was reading the late APS William James Fellow Roger Sperry's article on neurospecificity in *Scientific American* that ignited his desire to understand the brain. Gazzaniga's family home was close to the California Institute of Technology (Caltech) where Sperry worked, so he decided he would write to Sperry and ask about the possibility of a summer fellowship. Sperry wrote back, inviting Gazzaniga to "come on over," and the result was a 3-month fellowship that enabled the then-college student to conduct his own research with animals.

"It was so exciting," Gazzaniga remembered. "At that [point I] decided I did not want to go into medical school and wanted to go into basic research."

That one letter to Sperry served as the starting point for the rest of Gazzaniga's research career. Keeping that in mind, Gazzaniga advised young scientists, "When you think you want to do something, just write the letter and it just may happen."

Lesson 2: Find Your Community

Early experiences at Caltech led Gazzaniga to pursue a doctorate and subsequent postdoctoral fellowship at the university, again under the mentorship of Sperry. Sperry, in Gazzaniga's words, was "of course a genius," and Caltech seemed to have no shortage of geniuses wandering the hallways at that time. On the same floor as Gazzaniga's office one also would find the offices of geneticist and National Medal of Science winner A.H. Sturtevant, geneticist and Nobel Prize winner Edward Lewis, and chemist and

Nobel Prize winner Linus Pauling.

“These are the people you bumped into [in] the hallway, and it was at a time when people took an interest. It became a very rich community,” said Gazzaniga.

The prevailing norm at Caltech was to “do important things,” and this philosophy generated an intellectual environment that put professors, graduate students, and undergraduates on even ground.

“The minute you walked through the front door you were an equal with the famous professors — you were in discussions with them,” said Gazzaniga.

This community pushed the young Gazzaniga to continuously search for ways to design better experiments, a motivation that has served him well throughout his career.

Lesson 3: Pursue Diverse Interests

During his 5 years at Caltech, Gazzaniga and colleagues produced a series of papers that investigated various psychological functions — motor, somatosensory, visual, and linguistic — in split-brain patients. At the same time, Gazzaniga also was pursuing his interest in politics. An enterprising young graduate student, he enlisted the help of politician Barry Goldwater to organize a debate on President John F. Kennedy’s foreign policy featuring conservative commentator William F. Buckley and television host Steve Allen.

The event, held at the 3,000-seat Hollywood Palladium, sold out, and Gazzaniga ended up organizing two more debates. The debates eventually were published together as a book, contributing to the political dialogue at the time.

“But what it really did,” said Gazzaniga, “was get me sold on the notion of intellectual battles, of putting together people who really don’t think the same way.”

The early pursuit of intellectual stimulation outside the lab became a thread that would run throughout Gazzaniga’s career, culminating in his tenure on the President’s Council on Bioethics.

“It was an exhilarating 7 years — intellectually charged, lots of disagreement, but an incredible learning experience,” said Gazzaniga. The Council tackled topics that were ethically fraught and publicly controversial, including issues related to stem cells and the intersections among free will, determinism, and the law. Gazzaniga’s popular book *The Ethical Brain* is based on his thoughts about these issues.

“While you want to keep your day job, go ahead and do all the other things you also want to do,” Gazzaniga advised.

Lesson 4: Keep on Going

After several productive years on the West Coast, Gazzaniga returned east, where he continued his research at New York University and later at Cornell. He and collaborator Joseph LeDoux, also a 2015

APS William James Fellow, would drive around New England to visit split-brain patients and collect data, persisting even through the icy and treacherous winters.

That persistence paid off when Gazzaniga and colleagues experienced a light-bulb moment of sorts.

For 25 years, the typical procedure for testing split-brain patients involved presenting images to the patients and asking them to identify what they saw. For example, the patients might see a chicken on the right side of the screen and a snow scene on the left side, but they would say that they saw only the chicken. Verbally, they could only report the image that was presented to the right visual field and processed by the brain's left hemisphere, where language abilities typically are focused.

When asked to point at any items that related to what they saw, however, the patients would pick out both a chicken claw and a snow shovel.

This dissociation between what patients could report verbally and what they could show behaviorally became the hallmark of the classic "split-brain effect."

After 25 years of using this general procedure, the researchers decided to make a small addition: They would ask the participants *why* they pointed to the two different items.

When one patient was asked to explain his choices, he replied: "That's easy, chicken claw goes with the chicken and you need a shovel to clean out the chicken shed."

"We were sitting there just stunned," said Gazzaniga.

This surprising finding, confirmed in tests with many other patients, showed that the disconnected brain aggregated information across different systems, filling in information as necessary to provide a sense of perceptual and cognitive unity and produce a (seemingly) cohesive narrative.

That a slight change to a long-used procedure could yield such deep insight into the relationship between brain and mind reinforced the notion that there always are new discoveries to be made, even after 25 years of research in a specific area.

The importance of this kind of persistence is something Gazzaniga emphasized early in his talk as he looked out into the audience:

"I see many, many prospective awardees out there, so keep it up," he said.