# THE GENERALIST'S CORNER

## Expanding Your Coverage of Neuroscience: An Interview With Michael Gazzaniga

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*Michael Gazzaniga, the David T. McLaughlin Distinguished University Professor at Dartmouth College, is a pioneer in the field of cognitive neuroscience. He received his PhD from California Institute of Technology in psychobiology, where he conducted his famous work with Roger Sperry on the split-brain phenomenon. His research has provided insights on functional lateralization and how the cerebral hemispheres communicate with one another. He has written more than 20 books, many for the lay audience, and has well over 100 publications, including book chapters, interviews, and monographs. Currently, he serves as Director for the Center of Cognitive Neuroscience at Dartmouth. He was elected president of the American Psychological Society in 2004. He manages a summer school program in cognitive neuroscience and conducts many visiting professor seminars.*

Rasmussen: When teachers of psychology, particularly those outside the field of cognitive neuroscience, see the name Michael Gazzaniga, they often think of the split-brain research you conducted in the late 1960s and early 1970s with Roger Sperry. Today, much of your research still involves the use of patients with special neurological conditions. Can you bring us up to date on some of the types of cases you have examined in recent years and what those cases mean in terms of what is known about involved neuroanatomical substrates?

Gazzaniga: After all these years, the split-brain patient continues to provide riveting insights into brain organization, particularly with respect to how cognitive processing is divided between the two hemispheres. With the advent of brain imaging, however, we can now see how the normally intact brain conveys information between the hemispheres, how people vary in this process, and what that entails for their behavior. For example, we can now relate individual differences in the structural integrity of the corpus callosum to patterns of laterality and interhemispheric communication speed. On a broader scale, studies of split-brain patients have raised important questions about the nature of human consciousness. When combined with information gleaned from other neurological cases with cortical lesions, such as those patients who suffer from neglect or blindsight,

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research with split-brain patients can help psychologists understand conscious versus unconscious processes.

Rasmussen: Can you explain how those with blindsight aid in the understanding of conscious processes?

Gazzaniga: Patients with so-called blindsight are patients who are blind in all or part of a visual field, but are not consciously aware of residual visual capacity they may still possess. The islands of cortex that remain following a large cortical lesion to the visual system may be capable of supporting form, color, brightness, and movement discriminations even though the patient claims to see nothing. This sort of finding can instruct us how the visual system is organized.

Rasmussen: You mentioned neglect and attention. What's happening there from a neurological perspective?

Gazzaniga: As for neglect and attention, we made the original observation years ago that information presented in a neglected field can often still influence perceptual decisions. These kinds of studies reveal how much of the information we process goes on outside of our conscious awareness.

Rasmussen: Do you have any quick-and-easy demonstrations that can be used in the classroom to illustrate these specific principles?

Gazzaniga: Well, I like to show Roger Sheperd's Turning Tables illusion. Try as one might to override it cognitively, it is impossible. Automatic processes take over, probably through the ventral stream of the visual system and demand we see something differently than what it is.

Rasmussen: I believe that is the demonstration in which two identical tables are shown side by side, except one is turned 90 degrees of the other. Because of the orientation, one table looks larger and longer than the other. I agree—it indeed is a compelling illusion, a take on the horizontal–vertical illusion. I have found that illusions are one of the most effective and fun (as students report, anyway) demonstrations to use in the classroom. Do you have other demonstrations besides illusions that work well in the classroom?

Gazzaniga: Oh, there are so many excellent demonstrations. Attentional research has produced compelling examples that show how poorly we grasp a full visual scene. In memory research there are numerous demonstrations that reveal various aspects of the processing stream and, indeed, it is difficult to remember some kinds of information.

Rasmussen: If you taught an introductory psychology course today, what issues might you tell undergraduate students about—which do or do not relate specifically to the field of cognitive neuroscience—that would probably not be found in their textbooks?

Gazzaniga: I would try to show how understanding the brain can provide students with insights into their own lives, such as why is it we humans must have some kind of moral compass. New brain imaging studies reveal this phenomenon, and with luck the penny will drop that perhaps the reason why we, by and large as a species, don't go around killing people is because we are built that way, not because someone told us not to kill. I also would take a "levels of analysis" approach that makes it clear that a full understanding of any psychological question requires addressing it at several different levels of analysis, from gene expression to cultural and social forces. Much of the work going on in psychology and neuroscience raises ethical questions and sometimes these are difficult to get into a textbook.

Rasmussen: Your new book, *The Ethical Brain* (2005), takes on some of these issues, correct?

Gazzaniga: Yes. Today's students should be aware of the long-term ethical implications of such things as enhancement drugs for memory, mood, and sex.

Rasmussen: What kinds of implications did you write about in *The Ethical Brain* in terms of using enhancement drugs?

Gazzaniga: In brief, I try to make a distinction between enhancing drugs that target the body versus the brain. There are good reasons to oppose somatic drugs because their safety is questionable. At the same time, I don't think we will ever condone them because they represent a form of cheating and we don't like cheaters. I am less concerned about drugs used to help with ailing memory or even enhancing mental performance. These sorts of drugs seem to be repairing our mental infrastructure and that is fine with me.

Rasmussen: You mentioned earlier the "levels of analysis" matter, which seems like a very important one to address. Can you give offer an example of an issue that you walk the students through, in terms of the various levels?

Gazzaniga: First, there are many excellent examples of the levels approach: aggression is good (from genes, brain regions, neurochemistry, individual differences, sex effects, culture). Sexual behavior is also excellent. Eating also involves everything from gene processes (obesity) to physiology to cultural cuisine.

Let me give you an example directly from our introductory text (Gazzaniga & Heatherton, 2003, p. 42). To understand how different types of psychological scientists work at each of these levels, consider the study of music. For example, what type of music do you like? The enjoyment of music is a fascinating aspect of human life. Music is present in many aspects of daily life and is clearly important to most people. There are many questions to be asked about the musical experience, such as how preferences vary across individuals and across cultures, how music affects emotional state and thought processes, and even how the brain perceives sound as music rather than noise. For instance, suppose you wanted to know how often people listen to music. One survey of 2,465 English adolescents found they re-

ported listening to 2.45 hours of music each day, and they said that they did so because it allowed them to project a desired "image" to the world and helped them to satisfy emotional needs (North, Hargreaves, & O'Neil, 2000).

What effect does listening to music have on people? Researchers have used laboratory experiments to study the effects of music at the cognitive level of analysis on mood, memory, decision making, and a variety of other mental processes (Krumhansl, 2003). For instance, "Russia under the Mongolian Yoke" from Prokofiev's Field of the Dead, played at half speed, reliably puts people into negative moods. Not only may the tempo of the music affect mood, but also whether it is in major or minor mode. These mood effects can even change how people behave.

Researchers can also examine music at a brain-systems level of analysis. Does perceiving music use the same brain circuits as, say, perceiving the sound of automobiles or spoken language? It turns out that the processing of musical information operates in a similar fashion to general auditory processing, but it likely also uses different brain mechanisms. Case reports of patients with certain types of brain injury indicate that some people lose the ability to hear tones and melody but not speech or environmental sounds.

Finally, some researchers have examined aspects of music from the genetic level of analysis. One study of attitudes in 800 British twins revealed that about half the variability in the liking of jazz music is determined by genetic influence (Martin et al., 1986).

As these examples demonstrate, researchers are crossing different levels of analysis to gain a greater understanding about music. Throughout the history of psychology, this strategy has been the favored approach. It is only relatively recently, though, that an explanation of a behavior is more commonly reported in terms of several levels of analysis. It is this crossing of the levels of analysis that many modern-day psychological scientists find so captivating because it helps provide a more complete picture than ever of important behavioral and mental processes.

Rasmussen: You mentioned you would talk about ethics in an introductory psychology course. It seems that ethics would certainly stem from a "levels of analysis" perspective (considering, for example, stem cell research).

Gazzaniga: I am after framing up what issues will look like from a neuroethical point of view. As I noted in *The Ethicial Brain* (2005),

> I would define neuroethics as looking at how we want to deal with the social issues of disease, normality, mortality, lifestyle, and the philosophy of living, *informed by our understanding of underlying brain mechanisms*. It is not a discipline that seeks resources for medical cure, but one that rests personal responsibility in the broadest social context. It is—or should be—an effort to come up with a brain-based philosophy of life. (p. xv)

Rasmussen: What would you say to convince students that this philosophy would apply to their day-to-day lives?

Gazzaniga: Again, we all make moral judgments every day. Why do we not kill? Why do we dislike cheaters? How come we are horrified at the idea of incest? My bet is that at some point, neurobiology will show that we have special circuits in our brain that react against those moral challenges. If so, the students should want to know about it.

Rasmussen: Indeed. It seems that a "levels of analysis" approach requires a broad understanding of a topic. Such an approach may require a teacher of psychology to be well versed in many areas of psychology—a generalist, if you will. Academic lore suggests that one is more likely to find a generalist at a liberal arts college than at a research institution. However, lore also suggests that the seasoned researcher was more likely trained by the generalist model compared to a recently graduated PhD. To you, what is a generalist, and do you regard yourself as one?

Gazzaniga: Oh, sure I am. Details are necessary but today's psychological scientist absolutely has to keep abreast of research that spans many areas, from how genes are expressed, to how the brain enables the mind, to how cultural forces shape how people behave. It takes time to gain such a perspective and it is hard and an anxiety-filling assignment to speak to students, or for that matter, anyone, about the general issues that span psychology. One always worries about "empty talk"—talking in such generalities that nothing is really getting said. Yet, when taken seriously, a general talk can provide light and direction to a field.

Rasmussen: How so?

Gazzaniga: People worry about lots of things in our modern life. They worry, for example, that if one places human neuronal stem cells into a mouse, they might create some kind of human conscious agent within the mouse. That is crazy, and one can show it is crazy without getting too technical.

Rasmussen: You seem to have done an enormous amount of communicating to different audiences both within and outside your field. You've given dozens upon dozens of talks at prestigious institutions. You've been involved with promoting understanding of the brain through PBS and the BBC. You've written also over 20 books, some more focused on your research (e.g., *Integrated Mind*, 1978, with Joseph Ledoux) and others on topics that span a wider range (e.g., *Nature's Mind,* 1992). Do you see yourself as an ambassador for the field of cognitive neuroscience, and even more broadly, for the field of psychology?

Gazzaniga: I would call myself an enthusiast for cognitive neuroscience. I actually see that field tackling more and

more social issues. I do believe our species has a moral compass, or a built-in capacity to know right from wrong. One can talk about this idea as a simple belief, but I think we are going to see a shift in the cognitive neurosciences to develop a set of new questions that will address these sorts of issues head on.

Rasmussen: Do you believe your ability to switch from a "details" person to a generalist has allowed you to be an effective communicator to such a wide variety of audiences?

Gazzaniga: Who knows? I do believe there is a need to speak plainly about research issues. We all can get lost in the jargon and specifics of our field. It is a constant battle to remember to rise above that!

Rasmussen: Do you have any advice for how teachers of psychology can introduce their students to psychology, specifically neuroscience, without getting bogged down in jargon?

Gazzaniga: My experience is that students love knowing about the brain if the material is presented in an accessible way that doesn't just throw a bunch of terms at them. To make contact with students you have to do two things. First, you need to focus on what students really need to know to be informed about psychological science. My colleague Todd Heatherton and I thought about this a lot when we were making decisions for our introductory text—for example, do students really need to know this information at the introductory level? If the answer was no, then it doesn't make sense to bombard students with neuroanatomic detail. Second, you need to connect brain structures to behavior, which means taking a very functional approach. It is important to know about this brain region because it does X or Y, and if you damage that region, you can't do X or Y. This point of the discussion is where vivid case studies of brain patients really enliven a lecture. I like to include lots of case studies, such as showing one of my split-brain patients using both hemispheres at the same time, and then having him describe what his mind seems like to him. This material is fascinating stuff and students love to learn it. That is how to inspire students to learn neuroscience.

Rasmussen: Thank you very much.

Gazzaniga: You're very welcome.

## Resources


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