
JOSEPH E. BOGEN: A REMEMBRANCE

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JOSEPH E. BOGEN

Born: Cincinnati, Ohio, July 13th 1926

Passed Away: Pasadena, California, April 22nd, 2005

Education

1943: Undergraduate, California Institute of Technology

1949: A.B., Whittier College

1951: Mathematics, UCLA

1956: MD, University of Southern California

Some academic appointments

1957: Assistant in surgery, Cornell Medical School

1958: Research Fellow in Neurophysiology, California Institute of Technology

1973-2005: Clinical Professor, University of Southern California

1984-2005: Adjunct Professor, UCLA

1995-1999: Visiting Professor, California Institute of Technology.

Some honors and awards

1976: President, Southern California Neurosurgical Society

1985: President, Los Angeles Society of Neurological Sciences

1988: Award of Merit, California Association of Neurological Surgeons

1996: Best of Show, Descanso Bonsai Society

Of Minds and Brains

First Encounter. I first got to know Joe in the summer of 1970. I had just recently joined Roger Sperry's Psychobiology lab in the division of Biology at Cal Tech as a graduate student. Sperry's lab was the ideal environment for learning about brain and behavior. There were at least four different teams that pursued research concurrently in the lab. One team worked on optic nerve regeneration and

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chemo-affinity in fish, continuing Sperry's groundbreaking work in Chicago. Another team worked on plasticity in the visual system of cats. Then there was the team that worked on hemispheric specialization and interhemispheric interaction in monkeys. And finally, the work on the human split-brain patients. Bogen was the neurosurgeon who, together with Phillip Vogel of the White Memorial Hospital, operated on these patients. (They practiced half a dozen times in the morgue until "the procedure seemed reasonably in hand".) We had weekly lab meetings on Fridays and they provided an opportunity to learn the latest in neuroanatomy, neurophysiology and behavioral neuroscience. Joe Bogen was usually present at the seminars and he was distinguished by his booming voice, large stature, and ever present tie and jacket. (Nobody else in the lab wore a tie and a jacket.) I was not shy to ask questions and express opinions in spite of my ignorance. Pretty soon, Joe and I were engaged in a loud and emotional argument, to the astonishment of the other new graduate students. One of them was heard to say afterwards: "You wouldn't believe what happened in the lab meeting today. These two guys were yelling at each other and at the end of the meeting, one of them turned to the other and said, 'How about continuing over dinner?'" That stormy encounter was to be paradigmatic of our relationship ever since. Many students were intimidated by Joe's authoritative manner. But I sensed at once that his bark was worse than his bite.

The foreigner and the cowboy. Joe always struck me as a study in contrasts. Americans often found his flamboyant style overbearing and somewhat foreign, continental to be exact. European scientists, on the contrary, saw him as the epitome of the American gunslinger, shooting from the hip. I found him to be an indispensable teacher, a consummate raconteur, an occasionally frustrating theoretical sparring partner, and a kind friend. Joe was the opposite of Sperry in many ways. Sperry, the reticent Yankee, preferred to think alone. He published the results of one experiment only when the next one was completed. Bogen, on the other hand, enjoyed the free exchange of ideas in argument. (His Jewish Talmudic genes, no doubt.) Both of them shared a modicum of paranoia and deep-rooted pessimism. But there was no question of the intensity and commitment that each felt for science. Together with then-graduate-student Mike Gazzaniga, they conceived and ushered in the modern split brain era. While Bogen would have preferred to think of his work with Sperry as a collaboration of peers, he reluctantly recognized it as a life-long teacher-student relationship.

A restless mind. Bogen's was an inquisitive mind, never at rest, always in pursuit of some new area of knowledge as hobby. First it was jazz. He considered becoming a jazz critic early in his career and knew some of "The Greats" personally. Then there was the guitar and folk singing. Later it was Opera. He would describe with some apparent pride how he became tearful during a particularly beautiful aria. Then it was wine. And finally cooking. Throughout, he was a master bonsai craftsman ("Better to take my aggression on the trees than on my patients"). And there were movies, of course. His favorites included **Some**

Like It Hot (“nobody’s perfect”) and **Hopscotch** (“not that Figaro, the other one”).

Bogen’s work, like his personality, was fraught with dualities. The most pervasive one was perhaps the uneasy tension between his self-image as a clinician and as a scientist. He often iterated that subsequent to 1963 and a failed NIH grant application, he never applied for, or received any funds for research. His main occupation was surgery and science was a luxury, a hobby, if an all consuming one. I suspect this provided a defense against imagined scientific criticism, not that a defense was necessary or hard to provide. His experiments and scientific presentations often shied away from detailed new data, sometimes to the detriment of the take-home message. But whether clinician or scientist, he was always the accomplished artist, writing in his own unique style, telling his captivating stories, recruiting converts to his “religion” of “mental dualism,” aka “hemispheric independence.” In this view, each cerebral hemisphere is an independent and different cognitive system with its own sensations, perceptions, memories, even language. Each has its own personality and consciousness. The two hemispheres can work simultaneously and independently, not only in the split brain but in the normal brain as well.

Anti-localization? Here is yet another contrast. Bogen believed that modularity of mind is wrong. He did not believe in strict localization of higher functions but felt more comfortable with “gradient localizations” (Goldberg & Costa, 1981). And yet he was willing to locate a separate mind in each hemisphere. Nay, localize the consciousness of each hemisphere in the intralaminar nucleus of the thalamus on that side. His work on hemispherectomized cats showed essentially complete recovery, thus demonstrating plasticity. But instead, he emphasized the localizing fact that one hemisphere is sufficient to control the whole gamut of the behavioral repertoire.

The Diagram Makers. Bogen's greatest ire was reserved for box-and-arrow modelers who described behavior without reference to brain anatomy or physiology. It was not sufficient that the behavioral data came from brain damaged patients. It had to incorporate brain structure and function explicitly. He believed that Tim Shallice’s influential book, *From Neuropsychology to Mental Structure*, was misguided. The proof was simply the absence of the term “inhibition” from the table of contents and the absence of even a single picture of brain from the whole book. He wrote: "A fundamental insufficiency in [the book] is of neuroanatomy. Neglected aspects include, besides the minimal appeal to anatomy: reorganization as an inevitable consequence of lesions, the momentum of lesions, the appearance of symptoms as the result of release from inhibition, the loss of performance from loss of facilitation, studies of experimental animals (15 references in a total of nearly 1000), a poorly informed discussion of the split-brain and an essentially total neglect of the hemispherectomy literature" (Zaidel, E. & Bogen, J.E. (1997). From hemispheres to mental structure, or, Being smart is not enough. Unfinished

manuscript). For Bogen, the dictum “function depends on its structure,” became a religious belief.

We agreed on the thesis of hemispheric independence. We saw eye to eye on the relationship between mind and brain. But what was for him a deep conviction and an article of faith was for me merely a useful heuristic. That made me a “nonbeliever” and consequently a target of intermittent anger. Herein lies yet another duality in Bogen’s scientific persona. The scientist as preacher and the scientist as experimentalist. Bogen divided the world into believers and nonbelievers and he welcomed the former and scorned the latter. On the contrary, I find it more rewarding to exchange ideas with scientists whose opinions and views differ from mine. He considered me perverse for focusing my work on language of the disconnected, minor, right hemisphere of the split brain patient. He said, “Why are you wasting your time on what is at best a minor development? You should focus instead on what the right hemisphere is specialized for, such as spatial perception.” My defense was that language processes the right hemisphere cannot perform are the innate and essential components of human communication. Bogen did not resonate to this Popperian view. He would rather explore what he believed than rule out what he did not. For him, emotional commitment was part and parcel of a theoretical stance, necessary for developing and promoting it. Of course, this did not mean that he ignored data that did not support his position. Ultimately he was a true scientist, committed to verified fact, flexible enough to accommodate his theory to it. Bogen was always aware of the tension between emotional commitment and rational belief. His mother was a psychoanalytic psychiatrist and a biochemist and her example colored his career choices for the rest of his life. Though a fan of psychoanalytic concepts, he considered the theory flawed because of its divorce from brain.

As a teacher, Joe Bogen was again complex and multifaceted. He possessed, demanded, and respected detailed knowledge of traditional human neuroanatomy. At the same time, he was ever the iconoclast, reveling in challenging established dogma and reinterpreting old facts in a new light (Bogen & Bogen, 1976). This placed him in the no-man’s-land between the clinical and the basic scientific camps, an uneasy clinician and a part time scientist. And that was his tragic flaw, not being and feeling fully accepted by either. He would sometimes prepare at great length for talks, only to miss the intended final impact. Was this the result of paranoia? Of over planning and an illusion of control? Or was it a fear of being pinned down, of being found wrong?

Complementary hemispheric specialization. As late as the 1930’s, it was generally believed in neuroscientific circles that the left hemisphere of right-handed people is dominant for language as well as for all other cognitive functions. This was in spite of prescient observations by the likes of the influential neurologist Hughlings Jackson at the end of the 19th century, that the right hemisphere has an important role in representing and controlling higher brain functions. Beginning in the 1940’s and 1950’s, neuropsychological studies of

patients with unilateral cerebral damage showed that right brain damage can result in selective cognitive deficits and suggested that the two hemispheres have complementary functional specializations. The split-brain work of Sperry, Bogen, and Gazzaniga recast that thesis in a more dramatic and direct form, showing complementary competence rather than complementary deficits.

Hemisphericity. Bogen soon extended the concept of complementary specialization from "task hemisphericity" to "individual hemisphericity," in which one hemispheric mode dominates the behavior of the individual as a whole. This was then extended to groups of individuals or "cultural hemisphericity" (e.g., artists are right hemispheric, accountants are left hemispheric). The concept was next applied to different cultural groups (e.g., South Pacific fisherman have well developed right hemispheric spatial navigation skills whereas Western lawyers have well developed left hemispheric verbal skills). Bogen operationalized cultural hemisphericity as the ratio between the scores on the Block Design (right hemisphere) and the Vocabulary (left hemisphere) subtests on the Wechsler Adult Intelligence Scale. This intuitive but controversial view was influential (Bogen, 1975), gave rise to some misapplications, and has returned to vogue under the guise of Jerre Levy's concept of "hemispheric arousal" (Levy et al., 1983).

In the summer of 1969, Bogen accompanied Sperry to a plenary symposium on cerebral dominance at the International Neurological Congress in New York organized by Harvard Professor of Neurology, Derek Denny-Brown. The other prominent participants were Oliver Zangwill from Cambridge, Henri Hecaen from Paris, as well as Wilder Penfield and Brenda Milner from the Montreal Neurological Institute. Bogen believed that this symposium changed neurologist's views of hemispheric specialization and created a paradigm shift overnight. The reason was that the split-brain data provided dramatic positive evidence consistent with cognitive deficits following hemispheric lesions. I personally doubt that the sociological impact of the symposium was that far-reaching. Work by Zangwill, McFie, Piercy and others in the 1940's and 50's highlighted selective cognitive deficits following right hemisphere damage and prepared the ground for the concept of complementary hemispheric specialization.

Three elements were critical for the singular impact of the Cal Tech split brain series on subsequent research in hemispheric specialization and interaction. First, the Cal Tech experiments were based on the rigorous split brain animal experiments of Sperry and Meyers in Chicago. Second, the surgery, unaided by a microscope, involved a complete section of the corpus callosum, anterior commissure and hippocampal commissure. This was verified later by MRI (Bogen et al., 1988). Third, the split-brain patients operated on by Vogel and Bogen were relatively intact cognitively. This made it uniquely possible to compare higher cognitive functions in the two disconnected cerebral hemispheres.

Hemispheric Independence. The split brain cats that Bogen observed in Sperry's lab in 1955 made a particularly profound impression on him. They represented what was for him personally the most influential scientific experiment

he had ever seen or heard of, before or since. "It set the course of my life. It rarely left my thoughts", he wrote much later (Bogen, 2006). In 1962, soon after Geschwind and Kaplan published their famous case of disconnection due to a stroke, Bogen suggested to Sperry that together they follow up the post-operative course of a patient who was to undergo cerebral commissurotomy for otherwise intractable epilepsy. The idea that each hemisphere is a separate cognitive system, complete with consciousness was first expressed by Sperry (Sperry et al., 1969), elaborated by Bogen (1990), and extended systematically to the normal population by me (Zaidel et al., 1990). This idea suggests that each hemisphere has its own attentional networks that orchestrate its own behavior. At the same time, this organizational principle calls for a control mechanism that coordinates the activities of the two hemispheres, resolves conflict, and unifies behavior between the two sides. That is the topic of much current research in hemispheric relations (cf. Zaidel & Iacoboni, 2003).

Bogen's metaphor for hemispheric independence was "two horses pulling a sleigh, such that if one is removed, the remaining member of the pair can still pull the sleigh." For him, the metaphor of runners on a sleigh, such that if one is damaged or removed the sleigh cannot go, was wrong.

The alien/anarchic hand. Bogen's influential reviews of the callosal syndrome in the first, second and third editions of Heilman and Valenstein's *Clinical Neuropsychology* (1979, 1985 and 1993, respectively) introduced the disconnection account of the "anarchic hand" and "intermanual conflict". His use of the term "alien hand" to characterize the syndrome was however ill advised because the patient need not have had a feeling of disownership of the hand acting at cross purposes to "verbal intent". Instead, Bogen later suggested the use of the term "anarchic hand". Here, the (usually nondominant) hand appears to execute complex, well-planned, meaningful and goal-directed actions that are against the patient's will and cannot be inhibited voluntarily. When both hands act meaningfully at cross-purposes, there occurs "intermanual conflict", a condition that is sometimes observed in the acute disconnection syndrome. Although frontal models of intermanual conflict exist which do not involve the corpus callosum (e.g., Marchetti & Della Sala, 1998), the callosal account remains classic. The anarchic hand is sometimes associated with anterior lesions to the corpus callosum and the contralateral supplementary motor area, whereas the alien hand is associated with posterior lesions of the corpus callosum, encroaching on the parietal cortex (Marchetti & Della Sala, 1998).

Creativity and the corpus callosum. Bogen's manifesto, "The other side of the brain" (Parts I-IV, Bogen, 1969a,b; Bogen & Bogen, 1969; Bogen et al., 1972) was written in his unique style. In it, he foreshadowed recent views on cortico-cortical connectivity as being implicated in creativity (Bogen & Bogen, 1969; Bogen, 1999). In particular, he emphasized the role of the corpus callosum in enabling creative combinations of disparate representations and re-representations. These papers were also partly responsible for the enormous popularity of

hemispheric duality as an explanation for all manners of contrasts, ranging from “analytic-synthetic” to “yin and yang”. The ensuing overpopularization of concepts of complementary hemispheric specialization was responsible for a major sentiment against hemispheric specialization as a viable scientific topic in academic circles. However, recent observations of ubiquitous bilateral activations during the performance of many tasks using fMRI brain monitoring measures have refocused the interest of the scientific community on hemispheric relations.

Consciousness. It was a straightforward corollary of the thesis of hemispheric independence in the intact brain that each hemisphere is separately conscious. Consciousness is therefore dual. Not single, not triple, dual. Uncharacteristically, Bogen proceeded to elaborate an anatomical model of consciousness, locating it in the intralaminar nuclei of the thalamus (Bogen, 1995 a,b). That location has some desirable properties. It has access to sensations via projections from directly ascending pathways, it has awareness of cortical activity via widespread afference from cortex, and its role in volition is enabled by its heavy projection to the striatum. Indeed, bilateral epileptic foci in that location result in momentary losses of consciousness or “absence attacks”. Importantly, consciousness need not depend on language and is demonstrably present in the disconnected right hemisphere.

Cooking lessons with Joe. We worked well together for many years. We read and criticized each other’s papers, we discussed ideas endlessly. More often than not, he would lecture and I would go along, playing the obedient student. As his hearing deteriorated, our discussions turned into “Bogenese” monologues punctuated by my screams of assent or grunts of disagreements. We both loved philosophy. I taught him logic and he taught me neuroscience. We wrote encyclopedia papers and review chapters together (Zaidel et al., 1990, 1996, 1999, 2003) and we drank wine together. He taught me all that I know about wine (“I know what it tastes like even if I don’t have a word for it”), often comparing brands or vintages from covered bottles in blind tasting, scientific style. In recent years, he undertook teaching me how to cook. (This was an excuse for the two of us to get together without our wives, both accomplished cooks.) In January 2005 when he was ailing, he became intensely interested in Persian rugs. “I have got the rug bug and now think about hardly anything else. Do you know about rugs? (I mean carpets like from places such as Isfahan),” he e-mailed me on January 16th. I e-mailed back, “From consciousness to Persian rugs? Seems like a step down from analysis to classification. Or is it a shift from theory of mind to aesthetics?”- “Correct on both counts,” he replied. “An increase, with shift, of passion, together with a less demanding stream of thought,” he added.

Like all of us, Joe Bogen wrestled his whole life with the question of immortality. He taught me that the road to immortality is the trip itself not the destination. He has long since achieved it. Through his ideas, through his writing, through his students.

On April 21st, Joe was to deliver the psychology department colloquium at

UCLA. The title was "A few facts and questions about consciousness from an anatomico-physiological point of view". This was a big deal because it was intended for the general campus. As early as February he was fussing about preparing a new slide for the talk. He was hospitalized with peritonitis at the Huntington Memorial Hospital and passed away a few days later on April 22nd, one day after his scheduled colloquium.

I can hear Joe commenting with dry humor on my garrulousness. I see him, tie, jacket and all, surrounded by an admiring crowd following his talk, basking in the limelight, feeling in his element. And there I stand, wondering which side of his head he is coming from. Undoubtedly both, with heavy cross-callosal traffic.

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