Editorial

Obituary
BELA JULESZ

Bela Julesz died on December 31, 2003. Bela served on the Editorial Advisory Board of *Spatial Vision* since the journal was established. In the first issue of *Spatial Vision* he published the article 'Cooperative and non-cooperative processes of apparent movement of random-dot cinematograms', co-authored with Jih Jie Chang. Julesz is well known for his invention of the random-dot stereogram but his interests, and intellect, covered a much larger universe of knowledge, so well exposed in his groundbreaking book *Foundations of Cyclopean Perception* (University of Chicago Press, 1971) which is considered among the most influential publications of the 20th century for cognitive science. Julesz studied the perception of depth, movement and texture, fields which he revolutionized, and developed methods to diagnose stereoblindness in strabismic infants. He was intrigued by the similarity between the visual and auditory perceptual systems and showed a particular interest in finding the neural correlates of the perceptual phenomena he studied. He was a pioneer of the interdisciplinary study of vision, combining psychophysics, computation, and physiology in a principled way.
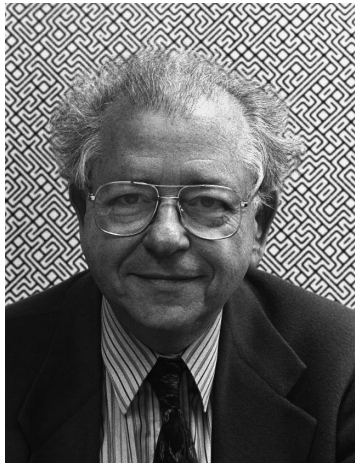
[*]Photo by Nick Romanenko, Rutgers Photo Services.

Julesz was born in Budapest, Hungary, on February 19, 1928. His childhood experiences included the havoc of World War II. In 1950 he received a Diploma in Electrical Engineering from the Technological University of Budapest, and in 1956 he received his doctorate at the Hungarian Academy of Sciences (thesis: 'Study of TV Signals with Correlation Methods'). He taught and conducted research in network theory, microwave systems and the encoding of television signals in Budapest until 1956. In 1956, during the Hungarian Revolution, Julesz and his wife Margit immigrated to the United States where he joined Bell Laboratories. There he continued his research in analyzing and processing pictorial information, and his interest turned to physiological psychology. At Bell Laboratories, he headed the Sensory and Perceptual Processes Department (1964–1982), and the Visual Perception Research Department (1983–1989). In 1989, he retired from AT&T Bell Laboratories and became a State of New Jersey Professor of Psychology and Director of the newly established Laboratory of Vision Research at Rutgers University until 1999, when he retired from Rutgers as Professor Emeritus.

Julesz is the originator of the random-dot stereoimage technique. The method enabled the isolation of a pure eye-disparity based neuronal network, proving that depth perception can be achieved without monocular form recognition. This result set the stage for a new era in vision sciences, with extensive research carried out under the heading of 'early vision'. The Julesz technique of random-dot stereograms and cinematograms is now widely used in many areas of depth and motion perception, allowing for an infallible test of stereopsis in human infants and monkeys. His finding of hysteresis in binocular depth and monocular movement perception led to several cooperative models of depth and movement perception. Julesz is the originator of a method to study textures having identical second-order statistics, which led to many insights in preattentive vision, particularly in texture discrimination. Using sophisticated mathematical methods to create well controlled, statistically defined stimuli he explored the limits of vision without semantics. He believed that early vision is mostly bottom-up, except for focal attention. Julesz was also among the first to show the role of spatial frequency channels in suprathreshold vision (with L. D. Harmon, 1973) and in binocular vision' (with J. E. Miller, 1975). In addition to his two books he has written several influential review articles: 'Visual and auditory perception — an essay of comparison' (with I. J. Hirsh, 1972); 'Global Stereopsis: Cooperative Phenomena in Stereoscopic Depth Perception' (*Handbook of Sensory Physiology VIII*, 1978); 'Spatial frequency channels in one-, two-, and three-dimensional vision: variations on an auditory theme by Békésy' (1980); 'Early Visual Perception' (with R. A. Schumer, in *Ann. Rev. Psychol.*, 1981); 'Textons, the elements of texture perception and their interactions' (*Nature* 1981); 'Stereoscopic vision' (in the Silver Jubilee issue of *Vision Research*, 1986); and is author of over 140 papers. He has published several papers and essays in auditory perception as well, including some original contributions such as echoic memory and spatial chords. He holds four US Patents (two of considerable significance in quality inspection of VLSI components). During his Rutgers period, Julesz

published his second book, *Dialogues on Perception* (The Bradford/MIT Press, 1995), a personal account of his scientific life where he examines his achievements with a critical view.

In 1969 he was Visiting Professor of experimental psychology at MIT (where his lectures served as a basis for 'Foundations' that was published in 1971), and in 1973 at the University of Western Australia. He spent the 1975–1976 year as Visiting Professor at ETH and the Neurology Dept. of the University of Zurich, teaching an advanced course in experimental psychology, developing a methodology (with D. Lehmann) to diagnose human infants for stereopsis. In 1983 he was Regents Lecturer at U.C.-Berkeley. He had a long standing association with Caltech. For three consecutive winter semesters (1977–1979) he was a Fairchild Distinguished Scholar at Caltech, doing research in Derek Fender's laboratory under binocular retinal stabilization and with John Allman on visually evoked potentials in monkeys, using random-dot correlograms. He taught graduate courses in visual and auditory perception in the winter semesters of 1985, 1986, and 1988 as Continuing Visiting Professor and in 1987 as a Fairchild Distinguished Scholar (for the second time). He held a grant together with Prof. David Van Essen, on linking neurophysiology of the monkey's visual cortex with human psychophysics of visual perception, and had a psychophysical laboratory established with a postdoctoral position.

In 1983 he won the prestigious MacArthur Fellow 'Genius' Award, and was cited as the 'first experimental psychologist and artificial intelligence researcher selected'. In 1980 he was elected a Fellow of the American Academy of Arts and Sciences, and in 1982 a corresponding member of the Goettingen Academy of Sciences. In 1982 he was elected a Neurosciences Associate of the Neurosciences Research Program at Rockefeller University. In 1983 he was elected Honorary Member of the Hungarian Academy of Sciences, the same institution which he graduated 27 years earlier. In 1985, he was awarded the Dr. H. P. Heineken Prize by the Royal Netherlands Academy of Arts and Sciences. In 1987 he was elected member of the National Academy of Sciences. In 1989 he received the Karl Spencer Lashley Award by the American Philosophical Society and was elected Fellow of the Society of Experimental Psychologists. In 1995 he was elected member of the American Philosophical Society. He was on the advisory board of the Santa Fe Institute.

He is survived by his wife Margit and by the many students and post-docs he trained and inspired. He had only one post doc at a time, maybe a dozen over the years, carefully selected and fully attended. Many of them have made highly significant independent contributions to science, all acknowledged in his 'Dialogues'. 'Dialogues' is an exciting book to read, and to learn about Bela the scientist and the person. For him, science was an exciting adventure, a passion he planned to convey to us in the new book he was working on before his untimely death, 'The Enjoyment of Vision by Eye and Intellect'.