

Austin H. Riesen (1913-1996) Sensory Deprivation Pioneer

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The uncommonly kind and gentle manner of Austin Herbert Riesen seemed almost a contradiction to the force and influence that he and his pioneering work in sensory deprivation and brain function exerted on the entire field of developmental psychology. His perceptive and innovative experimentation, particularly with visual impairment, opened entirely new pathways and vistas in the quest to understand the relationship between behavior and physiology. Yet with all his formidable presence in the field, he remained always, as colleague after colleague attests, the quintessence of what it means to be a scholar and a gentleman.

Riesen, professor emeritus of psychology at the University of California-Riverside, died of pneumonia September 15, 1996, at his home in Riverside, California. He was 83, born July 1, 1913, in Newton, Kansas. Riesen was honored as a University of California Outstanding Emeritus Faculty Member in 1992 and was elected to the National Academy of Sciences in 1995 (see March 1996 *Observer*) in recognition of the monumental impact of his research into how early visual experience, or the lack of it, affects vision, visually guided actions and learning, and brain anatomy and function. He is recognized as having virtually created the paradigm of sensory deprivation which led to profound discoveries about the relationship between early experience and later development. His studies generated research worldwide on topics such as deprivation versus enrichment of the early environment, critical periods of sensory and behavioral development, and effects of early experience on the central nervous system, for example.

His approach was both comparative and developmental—studying and comparing the sensory capacities and sensory development within a wide range of animal species, including chimpanzees, monkeys, cats, rabbits, rats, chickens, and others.

It was the strange and awkward experience of humans following removal of congenital cataracts that motivated Riesen's creation of controlled sensory deprivation experiments in animals. He became fascinated in the late 1940s by reports that humans whose vision was incapacitated from birth by cataracts had great difficulty recognizing and interacting with forms such as circles, squares, and triangles when removal of the cataracts enabled them to see.

Riesen investigated the phenomena by devising experiments with animals to determine the effects of sight deprivation. Using newborn chimpanzees at first—since the species is in many respects similar to humans—Riesen raised them in full darkness, using bandages or otherwise keeping them in the dark. After about two years, the animals were tested in light conditions and were found to be visually blind though not organically blind. In essence, they could see but could not comprehend. As with humans whose cataracts were removed, Riesen found the animals to be visually naive, unable to interact normally in recognizing or interacting with forms or patterns, as when objects are approaching or receding. When a hand approached the eye, for instance, they did not blink. The brain had not wired-in the need for such reaction. His research and that of his colleagues and students proved that many motor and mental functions are not innate but are developed through environmental, especially visual,

experience. The brain requires visual experience to organize patterns and forms. Conversely, sight deprivation in older animals, after they had experienced normal vision early in life, did not have deleterious effects. Once the brain had enough early experience, it was not impaired by later deprivation in contrast to deprivation at birth or early thereafter. After confirming that vision requires experience for the brain to recognize patterns and forms, Riesen then examined the period in an animal's development in which visual experience was most critical. He found that the experience needed for the brain to organize discrimination had to occur very early in life. And, to sort out exactly what aspect of the deprivation was producing what kind of adverse developmental outcome, Riesen refined the paradigm in various ways, such as raising animals with a diffuse, unstructured light, so the retina would be illuminated but with varying degrees of pattern stimulation. With each variation the pattern of deficits was found to be different.

Riesen further discovered that even if animals had patterned light experience, but were kept immobile and tightly confined as opposed to freely running around in a large area, they would have motor and coordination deficits when released from confinement. In experiments with animals moving in the light, he established that the brain must learn to interact with small and large images, yielding perception of distance and perspective. Such skill has to be organized in the brain through experience with patterns, such as approaching, receding, oblique movement, and changing attitude. It is not simply patterned light per se that is critical, but the interchange with the pattern as the organism moves about. In later years, Riesen began to investigate organic aspects of the brain, using the Golgi stain method, which silhouettes whole neurons in the visual cortex. He found that in visually deprived animals the branches in the silhouette were less expansive, like a bush deprived of nutrients, suggesting a relationship between experience and development of the brain. He then extended studies to the somatic sensory system, analyzing animals deprived of extensive motor activity but not of vision. He discovered that neuron processes—proliferation and complexity of dendritic fingers that receive information from other neurons—were significantly less expansive in monkeys raised in confined spaces compared to animals that had moved about freely during development.

Riesen's studies revealed that the brain is not completely structured genetically but only partly so, and that its structure changes depending upon experience. This suggests that neuronal development in the brain of a child raised in a sensorially impoverished environment (deprived, for instance, of toys and enriching experiences) will not be as mature or complex as in a child with rich experiences. The work reveals how critical experience in early childhood is to the development of every individual.

Riesen's pioneering research on early visual deprivation began with studies of chimpanzees while he was an assistant professor of psychobiology at the Yerkes Laboratory of Primate Biology in Florida. His tenure at Yerkes from 1939 to 1949 was interrupted by World War II and service as a captain and aviation physiologist in the US Army Air Corps between 1943 and 1946. He joined the faculty at the University of Chicago in 1949, continuing his research there until 1962. He published his first book, *Postural Development of Infant Chimpanzees*, in 1952 (Yale University Press, New Haven) and became professor of psychology in 1956. Riesen left the University of Chicago in 1962 to organize the graduate program in psychology at the University of California-Riverside (UCR). Serving as chair of the Department of Psychology from 1962 to 1968, he served at UCR until his retirement in 1980. It was in 1975 that he authored and edited the landmark book, *The Developmental Neuropsychology of Sensory Deprivation* (Academic Press). In the 1970s he made two films, *A Survey of the Primates*, and *Primate Growth and Development*, detailing studies of a gorilla's first year. He was editor of the journal

Advances in Psychobiology from 1972 to 1976.

Riesen graduated from Tucson High School in Arizona in 1931, then received his bachelor's degree from the University of Arizona in 1935, was inducted into Phi Beta Kappa, and received his doctorate from Yale University in 1939, the same year he married his wife, Helen. They were married 57 years. He was a member of Sigma Xi and Phi Kappa Phi. He wrote numerous articles on visual and brain development, lectured nationally and in Japan, Australia, and Switzerland, and received numerous awards including an honorary doctor of science degree from the University of Arizona. He was the University of California-Riverside Faculty Research Lecturer in 1974, lecturing on Brain Development After Use and Disuse.

Riesen also was a visiting research professor at the University of Rochester from 1951 to 1953 and a Sigma Xi research lecturer at the University of Arizona in 1961 and UCR in 1975. He was a Fellow of the American Psychological Society, and a member of the Society for Neuroscience, the International Society of Developmental Psychobiology, and the International Brain Research Organization. He also gave service on the Memory Vision Research Committee of the National Institutes of Health. A renaissance man, he enjoyed music, played the clarinet, and sang for those in convalescent and rest homes. As a Congregationalist, he sang in his church choir for more than 20 years. In addition to his reputation as an intellectual giant, Riesen is remembered for his kind, deferential treatment of and concern for others. Said one longtime colleague, "I never once saw him lose his temper or exchange angry words with another person." He is survived by his wife Helen, of Riverside, California; a daughter, Carol Riesen Nelson of Houston, Texas; and a son, Kent Murdoch Riesen of Eureka, California.