

TELEVISION: NEUROSCIENCE

Wider Than the Sky

Arriving early for a major event may often be a wise decision, but entering the world three months ahead of schedule presents a unique set of challenges, particularly for the developing brain. This observation begins the first episode of a five-part television series *The Secret Life of the Brain*, which documents the extraordinary changes that the brain undergoes from conception until death. Produced by Emmy award-winner David Grubin, the series debuts 22 January on the Public Broadcasting System. Four years in the making, it is well worth the wait and the watch. Combining elegant computer animations, discussions with patients and their families, and interviews with neuroscientists and psychologists, Grubin provides a vivid exploration of that vast neuronal "telephone exchange" that enables us to compose music, write poetry, and design scientific experiments.

The most compelling episodes are the first and last, which explore the brain during fetal development and old age, respectively. It is in these episodes that the breadth and excitement of neuroscience research is most clearly conveyed. A companion book, authored by neurologist and neuropsychiatrist Richard Restak, mirrors the organization of the series while providing valuable additional details and thoughtful sketches that should fully engage the left hemisphere of the reader's brain.

Episode one unfolds with neuroscientists Susan McConnell and Carla Schatz explaining, with the help of computer animation and

videomicroscopy, the staggering demands placed on the developing fetal brain. Every minute, 500,000 new neurons are produced that must migrate to the correct location and form connections with their neighbors at the rate of two million per second. This extraordinary feat is, no doubt, why Grubin selected Emily Dickinson's poem *The brain is wider than the sky* to introduce the series. The brain's trump card, however, is its ability to respond to the endless barrage of information from the outside world by resculpting itself in a life-long task of pruning old connections and forming new ones. Indeed, the remarkable plasticity of the brain during development and, indeed, throughout life is the unifying theme of this series.

Later in the first episode, we witness the surgical removal of a cataract from a two-week-old infant, which enables the clouded eye to receive light signals that the brain's visual cortex desperately needs to ensure formation of the correct connections. If the cataract is not removed soon after birth, the baby will become permanently blind in that eye. Given the sensitivity of the brain to sensory stimuli, it is no surprise that the brain of an infant born three months prematurely—accustomed to the liquid warmth and darkness of the womb—is ill-prepared for the glaring lights and deafening buzz of a neonatal intensive care unit. Developmental psychologist Heidelise Als believes that creating intensive care units that mimic the quiet darkness of the womb could prevent violent overstimulation of the premature brain and avert learning problems later in childhood.

The next three episodes explore the brain during childhood, adolescence, and adulthood. Child psychologists in episode two explain language development in children. Episode three examines the last major phase of brain development: the maturation of

the prefrontal cortex (the seat of self-control and judgment) during adolescence. The stresses of growing up can lead to diseases such as schizophrenia and drug addiction, the seeds of which may have been sown years before by abnormal wiring during fetal brain development. Interviews with recovering teenage drug addicts help us to learn how addictive drugs hijack the brain's own molecular machinery. We also watch these teenagers struggle to regain control of their lives. One recovering cocaine addict showed remarkable insight when he discovered that the muscle relaxant prescribed for him (baclofen) quelled his craving for cocaine. This drug is now being tested as a possible treatment for drug addiction. Episode four views humans as feeling machines that think. Disorders such as post-traumatic stress syndrome and depression result when the amygdala, which controls emotion, overrides the cerebral cortex, which controls thinking.

Stan Kunitz, America's 95-year-old former poet laureate (shown below), is living proof of the brain's resilience and resourcefulness in old age, the subject of the series' final episode. In one of his poems he writes, "I am not done with my changes," arguably the perfect mantra for the aging brain. Even after the death of neurons in a stroke, the brain can be coaxed to commandeer neighboring neuronal circuits, enabling stroke victims to regain mobility of a paralyzed limb. A leading proponent of the rehabilitative therapy that produces this success, psychologist Edward Taub describes the brain as a muscle: the more it is exer-



cised the stronger it gets. Exercise itself is touted as a panacea for old age; doubtless, the mental agility of two exercise-happy nonagenarians will prompt scores of viewers to don running shoes and head for the hills.

But the brain's natural plasticity cannot stop the relentless neuronal loss that characterizes diseases of old age such as Parkinson's and Alzheimer's (AD). Alzheimer's researcher Dennis Selkoe explains how the proteins amyloid and tau form plaques and tangles in the AD brain. These aberrant build-ups result in the destruction of brain areas that control memory and cognition. A beta-amyloid vaccine, still under development, may bring good news for Alzheimer's patients. Currently in clinical trials, the vaccine stimulates clearance of amyloid plaques, offering hope for an effective treatment. Another surprising discovery, the existence of neural stem cells that produce new neurons in certain parts of the adult brain, may eventually benefit patients suffering from AD and other neurodegenerative diseases.

During the final credits, Kunitz offers this advice for life's so-called twilight years, "Care about life, care about others, remain active." Kunitz, like this inspiring series, attests to the wondrous plasticity of the brain.

—ORLA SMITH

The Secret Life of the Brain

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The Secret Life of the Brain

by Richard Restak

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