Are teenage brains really different?

March 28 2008

Many parents are convinced that the brains of their teenage offspring are different than those of children and adults. New data confirms that this is the case. An article by Jay N. Giedd, MD, of the National Institute of Mental Health (NIMH), published in the April 2008 issue of the *Journal of Adolescent Health* describes how brain changes in the adolescent brain impact cognition, emotion and behavior.

Dr. Giedd reviews the results from the NIMH Longitudinal Brain Imaging Project. This study and others indicate that gray matter increases in volume until approximately the early teens and then decreases until old age. Pinning down these differences in a rigorous way had been elusive until MRI was developed, offering the capacity to provide extremely accurate quantifications of brain anatomy and physiology without the use of ionizing radiation.

Writing in the article, Dr. Giedd comments, “Adolescence is a time of substantial neurobiological and behavioral change, but the teen brain is not a broken or defective adult brain. The adaptive potential of the overproduction/selective elimination process, increased connectivity and integration of disparate brain functions, changing reward systems and frontal/limbic balance, and the accompanying behaviors of separation from family of origin, increased risk taking, and increased sensation seeking have been highly adaptive in our past and may be so in our future. These changes and the enormous plasticity of the teen brain make adolescence a time of great risk and great opportunity.”

In an accompanying editorial, Elizabeth R. McAnarney MD, Department

of Pediatrics, University of Rochester Medical Center, comments, "Finally neuroscientists are able to go under the '…leathery membrane, surrounded by a protective moat of fluid, and completely encased in bone…' to provide new insights into brain development. Changes in the brain during childhood and adolescent development that are being documented through exquisite imaging by Giedd and others hold the promise for the development of hypotheses about the potential origins of behaviors that we have observed clinically for years…."

"Novelty seeking/sensation seeking and risk taking," Dr. McAnarney continues, "is the basis for considerable growth during adolescence, as well as for the seemingly reckless behavior of some adolescents. Novelty seeking/sensation seeking and risk taking are topics of growing interest as adolescent brain development is defined better and as morbidity from adolescent risk taking mounts….The implication of our growing knowledge of brain–behavior mechanisms of adolescent conditions should provide insights into the risk of particular adolescents for morbidity and mortality. Preliminary data are promising so that as we begin to understand the complexity of and specificity of each of these conditions, we shall be able to diagnose and treat conditions earlier."

The NIMH Longitudinal Brain Imaging Project began in 1989. Participants visit the NIMH at approximately two-year intervals for brain imaging, neuropsychological and behavioral assessment and collection of DNA. As of September 2007, approximately 5000 scans from 2000 subjects have been acquired. Of these, 387 subjects, aged 3 to 27 years, have remained free of any psychopathology and serve as the models for typical brain development.

Three themes have emerged from this and other studies in this new era of adolescent neuroscience. The first is functional and structural increases in connectivity and integrative processing as distributed brain modules become more and more integrated. Using a literary metaphor,

maturation would not be the addition of new letters but rather of combining earlier formed letters into words, and then words into sentences and then sentences into paragraphs.

The second is a general pattern of childhood peaks of gray matter (frontal lobe, parietal lobe, temporal lobe and occipital lobe) followed by adolescent declines. As parts of the brain are overdeveloped and then discarded, the structure of the brain becomes more refined.

The third theme is a changing balance between limbic/subcortical and frontal lobe functions that extends well into young adulthood as different cognitive and emotional systems mature at different rates. The cognitive and behavioral changes taking place during adolescence may be understood from the perspective of increased “executive” functioning, a term encompassing a broad array of abilities, including attention, response inhibition, regulation of emotion, organization and long-range planning.

Source: Elsevier