The Onset of the Adolescent Delta Power Decline Occurs after Age 11 Years: A Comment on Tarokh and Carskadon

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WE THANK DRS. TAROKH AND CARSKADON FOR THEIR GENEROUS ACKNOWLEDGMENT OF OUR WORK IN THEIR RECENT PAPER.[1] HOWEVER, WE do wish to clarify a point of disagreement regarding the age at which the delta EEG power begins its adolescent decline. Tarokh and Carskadon report a significant decline in NREM delta power in 14 subjects between their first recording at 9 or 10 years of age and their second at age 11 to 13 years. They state that this decline contradicts our finding that NREM delta power does not change between ages 9 and 11 years.[2] They conclude that we "missed" a decline that occurs over this age range, perhaps because our subjects were studied at home on their habitual sleep schedules and were becoming increasingly sleep deprived. A homeostatic response to such deprivation might have "masked" declining delta power.

In fact, Tarokh and Carskadon's data are entirely consistent with our published age curves.[3] Their data cannot contradict our finding that delta power does not change between 9 and 11 years because they did not study this age range. They compared subjects studied at mean age 10.1 years vs. 12.3 years. The decrease in delta power found in their second recording agrees with our published finding demonstrating that delta power starts to decline by age 12 years.

To evaluate this issue further, we examined delta power in our 30 subjects over 5 semiannual recordings between mean age 10.4 and 12.4 years, closely approximating the mean ages (10.1 and 12.3) of Tarokh and Carskadon's 14 Ss at their first and second recordings. Over this age range, delta power indeed shows the significant ($F_{1,108}$ = 11.4, P = 0.001) decline predicted by our age curves. We next examined delta power in these same subjects over 4 semiannual recordings between mean age 9.3 and 10.9 years. Confirming our previous report, delta power showed *no decline* ($F_{1,84}$ = 1.06, P = 0.31). Finally, Tarokh and Carskadon's speculation that our subjects were becoming increasingly sleep deprived between 9 and 11 years is not supported by our data. Total sleep times did not change ($F_{1,83}$ = 1.35, P = 0.25) in the four semiannual recordings between ages 9.3 and 10.9 years, the same age range when delta power remained stable.

We emphasize these points because our discovery that the rapid delta power decline of adolescence starts between ages 11 and 12 years[3] is one of the major findings of our longitudinal study. We hypothesized that the onset of this decline signals the onset of brain adolescence. It is now recognized that the human brain undergoes a profound reorganization during adolescence characterized by massive, parallel declines in cerebral metabolic rate, synaptic density and delta wave amplitude.[4] Our longitudinal data show further that this rapid decline slows sharply between 16.5 and 17 years of age.[3] We believe that this deceleration signals the termination of brain adolescence, although the delta decline continues at a very slow rate well into adulthood. We have hypothesized that the brain reorganization of adolescence underlies the emergence of adult cognitive power and that errors in this normal maturational process can cause mental illness, notably schizophrenia.[5] It should be of particular interest to the readers of this journal that this profoundly important aspect of brain development can be followed noninvasively and inexpensively with sleep EEG recordings.

ACKNOWLEDGMENT

Work performed at UC Davis.

DISCLOSURE STATEMENT

The authors have indicated no financial conflicts of interest.

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Submitted for publication March, 2010
Accepted for publication March, 2010
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