Development and genetics of brain temporal stability related to attention problems in adolescent twins.

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Abstract

The brain continuously develops and reorganizes to support an expanding repertoire of behaviors and increasingly complex cognition. These processes may, however, also result in the appearance or disappearance of specific neurodevelopmental disorders such as attention problems. To investigate whether brain activity changed during adolescence, how genetics shape this change, and how these changes were related to attention problems, we measured EEG activity in 759 twins and siblings, assessed longitudinally in four waves (12, 14, 16, and 18 years of age). Attention problems were assessed with the SWAN at waves 12, 14, and 16. To characterize functional brain development, we used a measure of temporal stability (TS) of brain oscillations over the recording time of 5 min reflecting the tendency of a brain to maintain the same oscillatory state for longer or shorter periods. Increased TS may reflect the brain's tendency to maintain stability, achieve focused attention, and thus reduce "mind wandering" and attention problems. The results indicate that brain TS is increased across the scalp from 12 to 18. TS showed large individual differences that were heritable. Change in TS (alpha oscillations) was heritable between 12 and 14 and between 14 and 16 for the frontal brain areas. Absolute levels of brain TS at each wave were positively correlated with attention problems but not significantly. High and low attention problems subjects showed different developmental trajectories in TS, which was significant in a cluster of frontal leads. These results indicate that trajectories in brain TS development are a biomarker for the developing brain. TS in brain oscillations is highly heritable, and age-related change in TS is also heritable in selected brain areas. These results suggest that high and low attention problems subjects are at different stages of brain development.