INCREASED RATE OF THINNING IN FRONTO-PARIETAL AND TEMPORAL CORTICES ASSOCIATED WITH NOVELTY SEEKING IN TYPICALLY DEVELOPING YOUTHS

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Introduction

•The temperament trait of novelty seeking (NS) is typified by impulsivity, thrill-seeking, and disregard for rules.

•Prior research indicates an association between this trait and Attention Deficit Hyperactivity Disorder (ADHD). Specifically, it has been reported that ADHD symptoms and NS may be underpinned by shared genetic factors.

•In the present study, utilizing a longitudinal sample of healthy youths, we investigated the cerebral cortical correlates of NS.

Sample

•The NIH MRI Study of Normal Brain Development is a multi-site project that provides a normative database to study relations between healthy brain maturation and behavior (Evans, 2006).

•Subjects were recruited throughout the United States utilizing a population-based sampling method aimed at minimizing selection bias (Waber et al., 2007).

•The Objective 1 database used in this study included 431 children from 4:6 to 18:3 years who underwent extensive cognitive, neuropsychological and behavioral testing along with three MRI brain scans (two years between each visit).

•Quality controlled thickness data and JTCI data were available for 235 youths (131 females, 104 males; 391 MRIs).

Measures

Parent Junior Temperament and Character Inventory (JTCI)

•The temperament trait, NS, was assessed using the parent version of the Junior Temperament Character Inventory (JTCI) (Luby et al., 1999). This instrument is a downward extension of the Temperament and Charter Inventory (TCI) which is a widely used temperament assessment measure with good psychometric properties.

Automated Image Processing

•Quality controlled native MR images were processed through the CIVET automated pipeline (version 1.1.9, 2006).

•This pipeline includes the CLASP algorithm for generating cortical thickness measurements at 40,962 vertices per hemisphere (Ad-Dab'bagh et al., 2006; Collins, Holmes, Peters, & Evans, 1995; Kim et al., 2005; Lyttelton, Boucher, Robbins, & Evans, 2007; MacDonald, Kabani, Avis, & Evans, 2000).

	Visit 1	Visit 2	Visit 3
Age	10.2 ± 0.23 (4.8-14.9)	10.6 ± 0.19 (6.4-15.0)	11.6 ± 0.19 (8.4-14.9)
Gender	Males = 72 (46.8%) Females = 82 (53.2%)	Males = 63 (42.6%) Females = 85 (57.4%)	Males = 37 (41.6%) Females = 52 (58.4%)
JTCI NS Score	7.00 ± 0.22 (1-15)	7.18 ± 0.23 (1-14)	7.67 ± 0.32 (1-15)

TABLE 1: Demographic information for each visit (± standard error of the mean, with range in between parentheses).

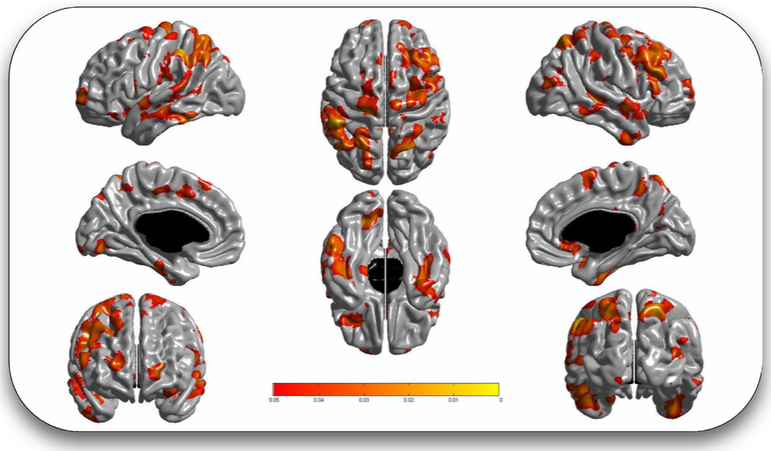

FIGURE 1: Brain areas where local cortical thickness is associated with the "JTCI NS Age" interaction (n = 235; 391 MRIs). The figure is shown at q ≤ 0.05 with a false discovery rate correction. Controlled for age, gender, cerebral volume proxy (total brain volume minus cortical volume), and scanner.

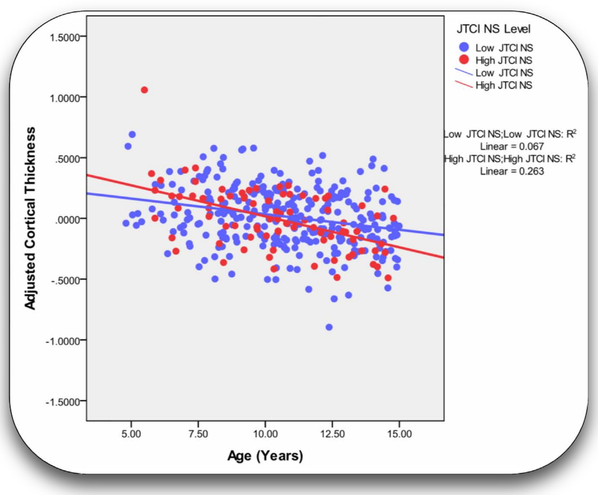

FIGURE 2: Scatter plot depicting the relation between cortical thickness (in peak region, left inferior parietal lobule) and age for youths high (scores of 10 and above) and low (scores of less than 10) on JTCI NS. Thickness values have been adjusted for gender and cerebral volume proxy (total brain volume minus cortical volume). Note: residual values appear on the Y axis.

Analyses

•Statistical analyses were implemented using SurfStat, a toolbox created for MATLAB 7 (The MathWorks, Inc.) by Dr. Keith Worsley (http://wiki.bic.mni.mcgill.ca/index.php/SurfStat).

•To account for within-person dependence, mixed-effects models were utilized and subject ID was entered as a random effect.

•First, cortical thickness was regressed against NS scores on the Parent Junior Temperament and Character Inventory.

•Next, we tested for an "JTCI NS Age" interaction on cortical thickness.

•Age, gender, cerebral volume proxy (total brain volume minus cortical volume), and scanner were controlled for in each analysis.

Results

•No main association between cortical thickness and JTCI NS was found.

•The "JTCI NS Age" interaction term was associated with thickness in a number of regions including bilateral dorsolateral prefrontal, parietal, and temporal cortices (Figure 1).

•Follow-up analysis revealed that youths with higher JTCI NS scores demonstrated an increased rate of thinning in these regions (Figure 2).

Conclusions

•Our results suggest that NS is related to cortical maturation in healthy youths, with increased thinning rates in fronto-parietal regions being associated with higher levels of NS.

•Interestingly, some of the regions evidencing an increased thinning rate in high NS youth have been implicated in the pathophysiology of ADHD.

•It is noteworthy that higher levels of NS in this healthy sample of youths was related to an increased rate of thinning, whereas attention problems (in both clinically and typically developing samples) have been associated with a decreased rate of thinning.

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