

Amygdala anisotropy correlates with aggression and impulsivity

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Purpose: Brain structural alterations have been implicated in aggression and impulsivity.¹ The diffusion characteristics of the amygdala, a region clinically associated with violent behavior, have not been studied for relationships to these personality traits. In this investigation, diffusion tensor imaging (DTI) measurements, including fractional anisotropy (FA) and mean diffusivity (MD), were compared in subjects classified as impulsive aggressive and in control subjects. DTI measurements were also evaluated for patterns of relationship to individual differences in the personality traits of aggression and impulsivity, as determined with behavioral measures.

Methods: 14 impulsive aggressive (mean age: 46.6; 10 males, 4 females) and 13 control subjects (mean age: 44.2; 9 males, 4 females). Groups did not differ in age or education. Subjects classified as impulsive aggressive met criteria for Intermittent Explosive Disorder after completion of the Mini International Neuropsychiatric Interview.² Individual differences in the personality traits of aggression and impulsivity were measured using the Life History of Impulsive Behaviors (LHIB)³ and the Buss-Perry Aggression Questionnaire assessing total aggression, physical aggression, verbal aggression, anger, and hostility (BPAQ).⁴ MR scanning was conducted using a GE Signa system, 1.5-tesla scanner. A b = 0 reference image was acquired, along with 6 images using a b value of 1000 s/mm² from each slice. Regions of interest (ROIs) were drawn manually on the b = 0 reference image in the amygdala according to validated neuroanatomical atlases (Figure 1). DTI measures for MD and FA were obtained in the amygdala. All statistical tests were conducted in SPSS (release 12.0; Chicago, IL) and were two-tailed using a significance level of 0.05.

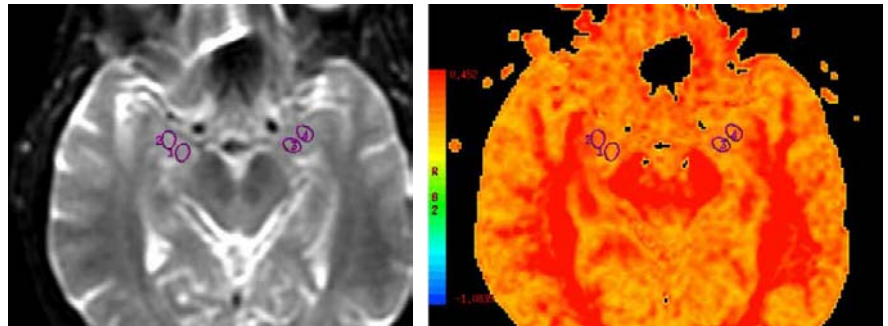


Figure 1. (left) b=0 image with amygdala ROIs. (right) FA map with amygdala ROIs.

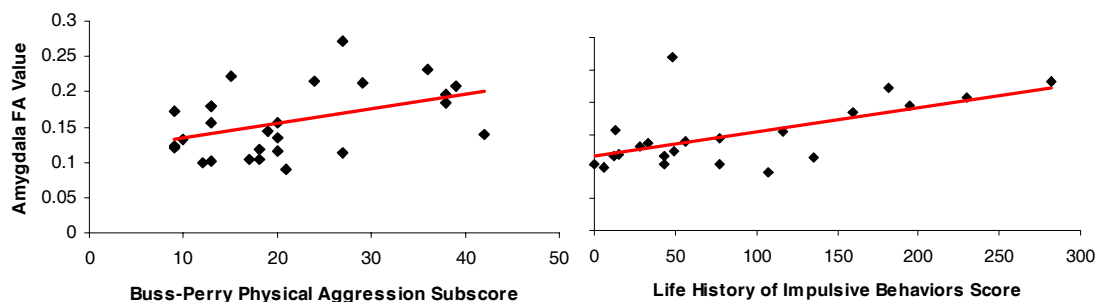


Figure 2. Positive correlation of amygdala FA with physical aggression ($r=0.44$) and impulsivity ($r=.57$).

Results: FA values in the amygdala were significantly increased in the impulsive aggressive (.17 (.05) vs. control group (.14 (0.03)). Increased amygdala FA values were significantly correlated with higher ratings of physical aggression ($r=.44$; $p=0.02$) and impulsivity ($r=.57$; $p=0.004$) (Figure 2).

Conclusion: In this investigation, FA values for amygdala were significantly increased in subjects classified as impulsive aggressive. Moreover, elevated FA values in amygdala were significantly correlated with individual differences in behavioral measures of physical aggression and impulsivity. The results of this study are consistent with volumetric findings of reduced brain parenchyma volumes in subjects diagnosed with Intermittent Explosive Disorder.⁵ DTI studies of impulsivity and aggression in schizophrenic patients have also identified relationships with diffusion abnormalities^{6,7} and volumetric studies in these patients indicate a relationship between abnormal brain morphology and aggression.⁸ Findings from this investigation indicate an association between the personality traits of aggression and impulsivity and anisotropy alterations in the amygdala. Normal myelination and region-specific white matter development occur over an extended period from childhood into early adult life.⁹ The relationship observed between anisotropy alterations in the amygdala with aggression and impulsivity may reflect neurodevelopmental or other factors that influence the integrity of white matter in this region.

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