Genetic effects on the microstructure of the amygdala, fusiform and hippocampus in humans

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A model for understanding the genetic basis of social-cognition

Williams syndrome (WS): a neurodevelopmental condition caused by a deletion of ~26 genes on 7q11.23
Hypersociability in Williams syndrome

• Socially uninhibited or socially fearless (Deutsch et al., 2007; Gosch and Pankau, 1994).

• Greater use of emotionally provocative language (Jones et al 2000)

• Affinity towards attending to faces (Riby et al 2008)
The social-cognitive brain in Williams syndrome

Structure

- **Enlarged amygdala volume** (Reiss et al 2004, Martens et al 2009)

Function

- **Reduced amygdala response to fearful facial expressions** (Meyer-Landenberg et al 2005)
- **Increased amygdala response to happy facial expressions** (Haas et al 2009)
- **Enlarged functionally defined fusiform face area (FFA)** (Golarai et al 2010)
Diffusion Tensor Imaging (DTI)

- Measures the diffusion of water molecules

- DTI of the brain regions comprised of mixed tissue types
Abnormal diffusivity of the hippocampus in Alzheimer’s

Goals of current study

• Investigate the structural integrity of social-cognitive brain networks during childhood in WS

• Investigate the structural integrity of social-cognitive brain regions comprised of mixed tissue types in WS by using DTI
Methods

• **Sample:** 36 children
  (18 WS, 18 TD; mean age = 11.42 years)

• **DTI:** 23 non-collinear directions

• **Regions of Interest:**
  - White-matter pathways
    - Inferior fronto-occipital fasciculus (IFOF)
    - Uncinate fasciculus (UF)
  - Mixed tissue types ROIs
    - Fusiform gyrus
    - Amygdala
    - Hippocampus
    - Medial orbitofrontal gyrus

• **Analysis:** Between groups (WS vs. TD) and behavioral correlations with IQ and SRS social-cognition
White-matter pathways

A. Fractional anisotropy

B. Radial diffusivity

C. Axial diffusivity

IFOF: WS > TD  IFOF: TD > WS  UF: WS > TD  UF: TD > WS
Mixed tissue types ROIs

A. Left Regions of Interest: FA

B. Right Regions of Interest: FA

C. Right Regions of Interest: ADC

* $p < .025$
FA and social cognition in WS

![Graph showing the correlation between FA: R. Fusiform Gyrus and SRS: Social-cognition with an r value of 0.51 and p < 0.05.]

![Bar chart comparing FA in WS and TD groups.]

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<th>WS</th>
<th>TD</th>
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<td>FA</td>
<td>.30</td>
<td>.25</td>
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* Indicates statistical significance at p < 0.05.
Implications

- Evidence of abnormal structure of social cognitive networks during childhood development in WS
- Evidence of microstructural alterations in several brain regions that may be associated with the WS social phenotype
- Supports the efficacy of using DTI to elucidate brain structure – behavioral associations in brain regions other than pure white-matter
Future directions

• Combine DTI with functional connectivity analysis of fMRI data during social-cognitive processing

• Longitudinal studies to elucidate developmental trajectories of the social-cognitive brain in WS
Thank you !!

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- WS families

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