

Introduction

- Effortful Control is one of three temperament constructs
 - Characterized by attentional focusing, low inhibitory control, low intensity pleasure, and perceptual sensitivity
- Past research in children suggest that areas of executive functioning support Effortful Control (e.g. Posner and Rothbart, 2000)
- However, the links between Effortful Control and its executive networks with the limbic system are relatively under investigated
- This is important to study during early childhood
 - The amygdala and ACC undergo rapid growth early in life (e.g. Tottenham, Hare, & Casey, 2009)
 - Research suggests age-related differences in Effortful Control during early childhood (e.g. Posner & Rothbart, 1998)

Purpose:

- Explore developmental differences in Effortful Control
- Investigate potential relations between amygdala and ACC with Effortful Control

Methods

Participants

- 111 children aged 3- to 7-years-old ($M = 4.69$, $SD = 1.47$, 54 female)
- Of these, 94 provided usable MRI data for Amygdala volumes and 76 for ACC cortical thickness and surface area

Child Behavior Questionnaire:

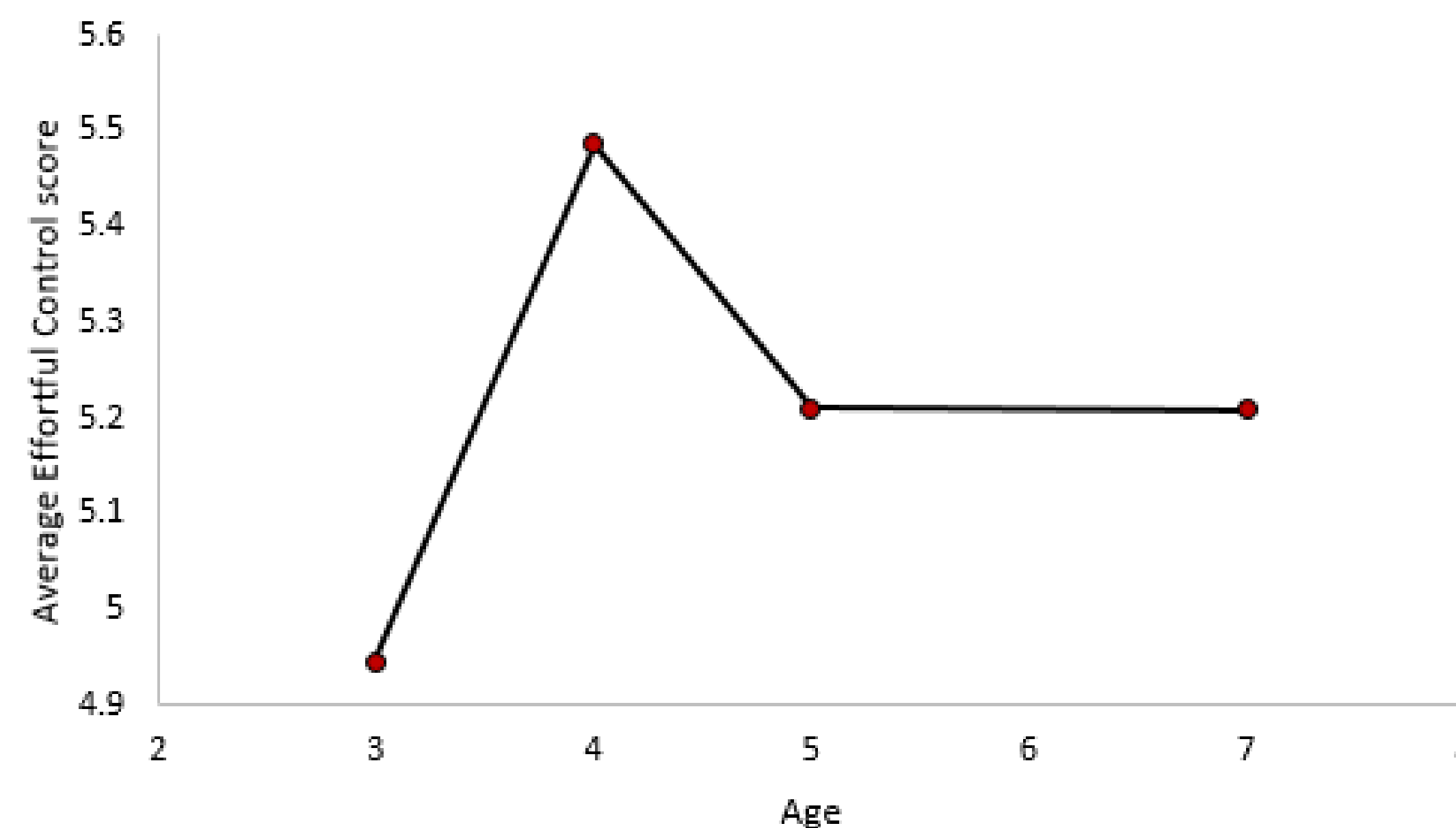
- Parents of child participants completed the CBQ – very short form
- CBQ assesses temperament in children ages 3-8 providing individual scores for factors: Surgency (Extraversion, Negative Affectivity, and Effortful Control (Rothbart et al., 1994)
- A higher score reflects greater expression of factors

Structural MRI Data

- A T1-weighted structural MRI scan (0.9 mm^3) was obtained using a Siemens 3T scanner with a 32-channel coil
- Amygdala volumes were extracted via Freesurfer v6.0 (Fischl, 2012) and adjusted using Automated Segmentation Adapter Tool (ASAT, Wang et al., 2011)
- ACC thickness and surface area were ???

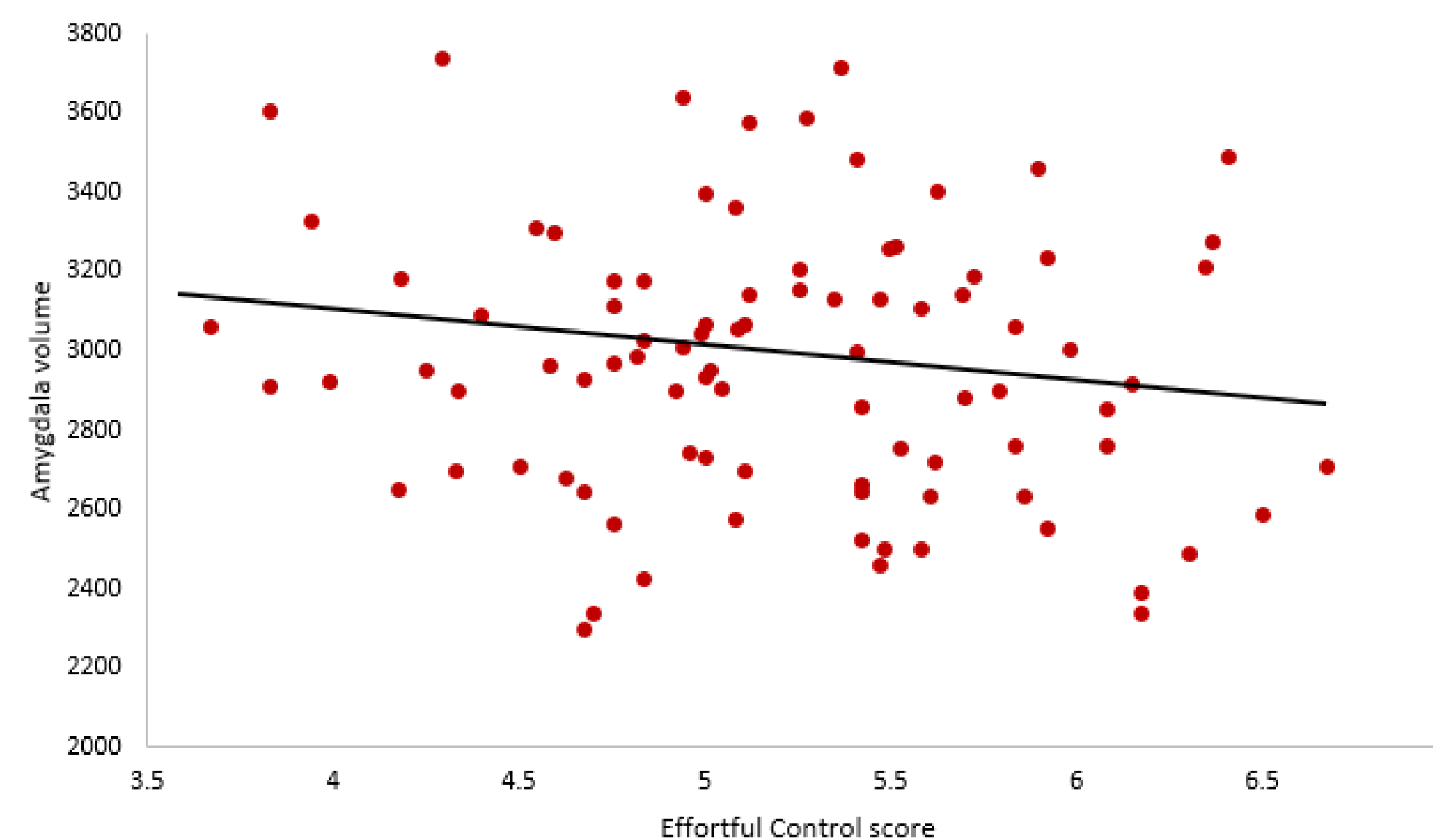
Results

Figure 1. Age differences related to Effortful Control score



- One-way ANOVA was used to find a significant interaction between age and Effortful Control, $p \leq 0.01$
- Gender was used as a covariate

Figure 2. Negative correlation between Effortful Control score and Amygdala volume



- Mild negative correlation was found between total volume of Amygdala and Effortful Control, correlation = -0.323 , $p \leq 0.05$
 - Specifically, negative correlation was found between volume of left amygdala (but not right amygdala) and Effortful Control, $p \leq 0.05$
 - Volumes were controlled for total intracranial volume, but volumes displayed in figure 2 are raw
- There were no significant findings associated with ACC

Discussion

- The results reinforce the idea that there are age-related differences in expression of Effortful Control
- Results suggest that regardless of age, the amygdala and Effortful Control have an inverse relationship
- Future analyses will incorporate longitudinal data to explore whether early temperamental functioning is a predictor for brain development
- Future directions can examine functional connectivity between executive and limbic systems in relation to Effortful Control

Take-Home Message

Effortful Control fluctuates in early childhood. The amygdala and executive functioning of Effortful Control seem inversely related.

Acknowledgements

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References

