

# Verbal–spatial IQ discrepancies impact brain activation associated with the resolution of cognitive conflict in children and adolescents

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#### Funding information

National Institute of Mental Health, Grant/Award Number: R01MH090062; Klingenstein Foundation; The NVLD Project; Promise Project at Columbia; NIDA-AACAP, Grant/Award Number: 2K12DA000357-11

#### Abstract

Verbal–spatial discrepancies are common in healthy individuals and in those with neurodevelopmental disorders associated with cognitive control deficits including: Autism Spectrum Disorder, Non-Verbal Learning Disability, Fragile X, 22q11 deletion, and Turner Syndrome. Previous data from healthy individuals suggest that the magnitude of the difference between verbal IQ (VIQ) and performance IQ (PIQ) scores (the VIQ>PIQ discrepancy) is associated with reduced thickness in frontal and parietal cortices (inferior frontal, anterior cingulate, inferior parietal lobule, and supramarginal gyrus) that support cognitive control. Unknown is whether the VIQ>PIQ discrepancy is associated with functional deficits in these areas in healthy or ill children and adolescents. We assessed the effects of the VIQ>PIQ discrepancy on fMRI BOLD response during the resolution of cognitive conflict in 55 healthy children and adolescents during performance of a Simon Spatial Incompatibility task. As the magnitude of the VIQ>PIQ discrepancy increased, activation of fronto-striatal, limbic, and temporal regions decreased during conflict resolution ( $p < .05$ , corrected). In exploratory analyses, the VIQ>PIQ discrepancy was associated with reduced functional connectivity from right inferior frontal gyrus to right thalamus and increased functional connectivity to right supramarginal gyrus ( $ps < .03$ , uncorrected). The VIQ>PIQ discrepancy may be an important aspect of an individual's cognitive profile and likely contributes to, or is associated with, deficient cognitive control processes characteristic of many childhood disorders.

## RESEARCH HIGHLIGHTS

- Cognitive control deficits are present in childhood disorders characterized by verbal–spatial discrepancies, such as Autism Spectrum Disorders, Non-Verbal Learning Disability, Fragile X, 22q11 deletion, and Turner Syndrome.
- Previous data suggest that the magnitude of the verbal–spatial discrepancy is associated with reduced thickness in frontal and parietal cortices that support cognitive control.
- Current findings suggest that children and adolescents with greater verbal relative to spatial abilities under-engage fronto-striatal

regions and deactivate limbic regions during conflict resolution, one aspect of cognitive control.

- The VIQ>PIQ discrepancy is likely an important aspect of an individual's cognitive profile that may contribute to deficient cognitive control processes characteristic of many childhood disorders.

## 1 | INTRODUCTION

The capacity for cognitive control is critical for the successful development of social competence and school readiness (Diamond, Barnett,