Dissociation of working memory impairments and attention-deficit/hyperactivity disorder in the brain

Aaron T. Mattfeld, Susan Whitfield-Gabrieli, Joseph Biederman, Thomas Spencer, Ariel Brown, Ronna Fried, John D.E. Gabrieli


Abstract
Prevailing neuropsychological models of attention-deficit/hyperactivity disorder (ADHD) propose that ADHD arises from deficits in executive functions such as working memory, but accumulating clinical evidence suggests a dissociation between ADHD and executive dysfunctions. This study examined whether ADHD and working memory capacity are behaviorally and neurobiologically separable using functional magnetic resonance imaging (fMRI). Participants diagnosed with ADHD in childhood who subsequently remitted or persisted in their diagnosis as adults were characterized at follow-up in adulthood as either impaired or unimpaired in spatial working memory relative to controls who never had ADHD. ADHD participants with impaired spatial working memory performed worse than controls and ADHD participants with unimpaired working memory during an n-back working memory task while being scanned. Both controls and ADHD participants with unimpaired working memory exhibited significant linearly increasing activation in the inferior frontal junction, precuneus, lingual gyrus, and cerebellum as a function of working-memory load, and these activations did not differ significantly between these groups. ADHD participants with impaired working memory exhibited significant hypoactivation in the same regions, which was significantly different than both control participants and ADHD participants with unimpaired working memory. These findings support both a behavioral and neurobiological dissociation between ADHD and working memory capacity.

Highlights
• ADHD and working memory deficits were behaviorally and neurally dissociable.
• Working memory performance was unrelated to the current ADHD diagnosis.
• Impaired working memory was associated with reduced brain activations.
• Working memory status was stable, while ADHD diagnostic status was more variable.