Working Memory Function in Typically Developing Children and Children with Autism, Focal Lesions, Williams Syndrome, and Specific Language Impairment

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Introduction

Working memory links lower level sensory perception and high level cognitive functions. Previous studies of working memory have found age-related changes in the efficiency and speed of performance and the degree of activation in networks subserving working memory during typical brain development. This study is part of an on-going multi-disciplinary program project in which the goal is to investigate hierarchical levels of neural processing and cognition in order to identify the specific underpinnings of cognitive deficits in children with development disorders. The study examines the role of working memory in typical and atypical development of language and social communication.

Participants in this ongoing study include typically developing children (TD) and children with high-functioning autism (HFA), low-functioning autism (LFA), specific language impairment (SLI), Williams syndrome (WS), and focial lesions (FL). Preliminary results are presented with an emphasis on individuals with autism spectrum disorder and typically developing (TD) children.

Methods

Four N-Back Working Memory Tasks were administered in a preset order:
- auditory identity
- visual identity
- visual spatial
- spatially-distributed visual identity

Participants responded with a button press to:
- a pre-specified stimulus (0-back)
- a stimulus identical to the previous stimulus (1-back)
- a stimulus identical to the stimulus two-back (2-back)
- All stimuli were difficult to verbalize. Inter-trial intervals were 1800 msec.

Auditory stimuli were computer-generated sounds controlled for loudness and were presented via speakers located immediately to the right and left of the monitor. Sound durations were 601 to 771 msec.

Visual stimuli for the identity task were presented centrally. Stimuli for the spatial and spatially-distributed visual identity were presented at 6 locations 6° from the center. Picture durations were 250 msec.

Conclusions

High-functioning children with autism do not differ from age- and IQ-matched typically developing children in auditory, visual, or spatial working memory using comparable task paradigms across modalities.

In both HFA and TD children, all four working memory tasks correlate with both receptive and expressive language despite the use of stimuli that are not easily verbalized. This suggests a modality-independent role of working memory in language development.

Low-functioning children with autism perform worse than HFA children despite having similar scores on a measure of autism symptoms, suggesting that working memory deficits in this group are related to more global impairments in functioning.

We thank the participants and their families for the time they so generously volunteered to our research.

Funded by NIH P50-NS22343