Is two better than one? Examining auditory, visual, and dual encoding processes on phonological working memory performance in children with ADHD

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Introduction

- ADHD is associated with working memory difficulties and variable performance (1, 2).
- In children with ADHD, phonological WM deficits are large, predicting many learning-related outcomes (3).
- Most studies of phonological WM performance in ADHD use tasks requiring that to-be-recalled material be encoded via auditory input, most commonly using digit span tasks (1).
- However, because material may also be encoded into phonological WM through visual encoding or dual (simultaneous auditory + visual input) encoding inputs, the impact of these different encoding presentations may impact phonological WM.

Present Study

- The current study is the first to examine the extent to which different encoding modalities (auditory, visual, or their combination) influence ADHD-related PHWM performance and performance variability.

Method

Participants

- N = 22 aged 8-13 years
- Children (10 female, 15 male) with diagnosis of ADHD based on:
  - Independent diagnostic using K-SADS semi-structured interview with parent
  - Parent and teacher ratings ≥ 1 SDs on BASC-2 Attention Problems and/or Hyperactivity Scale OR
  - Excluding parent/teacher criterion score on Child Symptoms Inventory-IV
- ADHD Presentations (14 Combined, 8 Inattentive, & 3 Hyperactive / Impulsive)
- Exclusion: Neurological impairment, seizures, psychosis, or WASI VCI IQ < 85 (Table 1)

Primary Measures

- Three conditions of a phonological WM task similar to the WISC-IV Letter-Number Sequencing. All tasks were counterbalanced. Stimuli presented at 1 sec intervals. All conditions identical except encoding presentation.
  - 1) Auditory Encoding: Stimuli presented auditorily using pre-encoded stimuli
  - 2) Visual Encoding: Stimuli presented as alpha-numeric numbers in center of screen
  - 3) Dual Encoding: Stimuli presented from Auditory and Visual encoding conditions simultaneously
- Conditions administered at four set sizes (3, 4, 5, 6). Each set size included 12 trials presented in ascending order.
- Tasks administered at 4 unique set sizes (3, 4, 5, 6) for a total of 48 trials.

Dependent Variables

- Phonological working memory performance
  - Number of stimuli correctly recalled per trial
- Phonological working memory performance variability

Analyses

- Preliminary analyses
  - Repeated-measures ANOVAs with LSD-post hoc
  - Effect size contrasts (See Tables 2 and 3)

Results

- Variability in phonological working memory performance as a function of encoding modality and set size

Discussion

- Presentation of encoding modality impacts phonological working memory performance in ADHD.
- Auditory encoding associated with poorest WM performance, particularly at high cognitive loads.
- Visual and Dual encoding show similar performance patterns, but Dual presentation decreases variability in phonological WM performance.
- Has implications for assessing phonological WM and treatment recommendations focused on decreasing performance variability.

References