Working memory demands do not disrupt emotion recognition in children with ADHD

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**Introduction**

- Social problems are well-documented in pediatric ADHD (de Boo & Prins, 2007; Huang-Pollock et al., 2009).
- The etiology of social deficits is unclear.
- Are there impairments in basic facial affect perception?
  - Findings are mixed:
    - Some studies have found that children with ADHD perform worse than controls on emotion recognition tasks (Da Fonseca et al., 2009; Sinzig et al., 2008).
    - Others have not found such problems (Downs & Smith, 2004; Greenbaum et al., 2009).
- The current study examines two potential explanations for discrepant findings in studies on emotion/affect recognition:
  1. Tasks that require cognitive processes implicated in ADHD beyond emotion recognition (e.g., choice-decision processes; Kofler et al., 2013; Shaw et al., 2016)
  2. Executive functioning deficits that may impair successful execution of basic facial affect recognition (Rapport et al., 2008; Kofler et al., 2011)
- The current study addresses these hypotheses via 4 counterbalanced tasks:
  1. Emotion recognition yes/no
  2. Concurrent dual-processing demands yes/no

**Participants**

- 8- to 13-year-old children with ADHD (N= 29) referred to a children’s learning clinic (CLC) by various community resources
- ADHD group:
  1. Diagnosis by the directing clinical psychologist using DSM-5 criteria for ADHD based on K-SADS interviews and parent/teacher ratings of at least 1.5 SDs above the mean on the Attention Problems and/or Hyperactivity scales of the BASC-II or
  2. Exceeding the criterion score for the parent version of the ADHD Inattentive and/or ADHD-Hyperactive/Impulsive subscales of the CSI-IV
- Non-ADHD group:
  1. Neurotypical children and
  2. Clinical diagnoses other than ADHD
- ADHD and Non-ADHD groups did not differ in the proportion of children diagnosed with a clinical disorder other than ADHD ($\chi^2[1]=1.58, p=.21$).

**Tasks**

<table>
<thead>
<tr>
<th>Emotion (Affect) Recognition</th>
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<tbody>
<tr>
<td>Pictures of children demonstrating six basic emotions</td>
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<tr>
<td>True/False statements alternated with picture stimuli</td>
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<tr>
<td>Low working memory demands</td>
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</tbody>
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<table>
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<tr>
<th>Animal Recognition</th>
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<tr>
<td>Pictures of six different types of animals</td>
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<tr>
<td>True/False statements alternated with picture stimuli</td>
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<td>Low working memory demands</td>
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</tbody>
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**Results**

- Preliminary analyses: ADHD group demonstrated impaired working memory ($d=0.56, p<.03$) based on recall of stimuli in correct serial position.
- Tier 1: Effects of Increasing Working Memory Demands on Affect Recognition Accuracy
  - Recognition accuracy = identification of correct emotion or animal
    - 2 (group: ADHD, Non-ADHD) x 2 (condition: Animal, Emotion) ANOVA: significant main effect of group ($p<.0005$)
    - No significant effects of group (p>.17) or working memory (p=.76)
    - All interaction effects non-significant (all p>.32)
  - Tier 2: Effects of Increasing Working Memory Demands on Affect Recognition Speed
    - Recognition speed = reaction time (ms) when clicking emotion or animal
    - 2 (group: ADHD, Non-ADHD) x 2 (condition: Animal, Emotion) x 2 (working memory: Low, High) mixed-design ANOVA: significant main effect of group ($p<.02$), condition ($p=.0005$), and working memory ($p=.0005$)
    - Significant condition x working memory interaction ($p=.009$)
    - Group x working memory interaction failed to reach significance ($p=.07$)
    - No evidence to indicate effects of group x condition ($p=.38$) or group x condition x working memory ($p=.37$)

**Discussion**

- ADHD group recalled fewer stimuli in correct serial order in the high working memory tasks ($d=0.56, p<.03$).
- Recognition Accuracy
  - Increasing working memory demands from low (recognition only) to high (complex span) did not differentially disrupt emotion/affect recognition for the ADHD group. (see graphs)
  - Both groups performed significantly worse on recognition of affective stimuli v. recognition of animal stimuli, with and without high working memory demands.
- Reaction Time
  - Both groups were slower at recognizing emotions than animals.
  - Both groups were slower at recognizing stimuli when working memory demands were high.
  - The ADHD group was slower overall than the non-ADHD group.
  - Adding working memory demands differentially disrupted emotion recognition speed for both groups (condition x working memory interaction).
- These results indicate that working memory is important for quickly recognizing emotions, with similar effects for both ADHD and Non-ADHD children.
- Additional studies are needed to tease apart emotion detection more broadly and investigate etiological factors associated with social problems in ADHD.

**Participants**

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- ADHD group:
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