



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 discrepancies in studies on emotion/affect recognition:
 - Tasks that require cognitive processes implicated in ADHD *beyond* emotion recognition (e.g., choice-decision processes; Kofler et al., 2013; Shaw et al., 2016)
 - 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.
- The tasks were identical except for demands placed on our primary DVs:
 - Emotion recognition yes/no
 - Concurrent dual-processing demands yes/no

Participants

- 8- to 13-year-old children with ($N=32$) and without ADHD ($N=29$) referred to a children's learning clinic (CLC) by various community resources
- ADHD group:
 - Diagnosis by the directing clinical psychologist using DSM-5 criteria for ADHD based on K-SADS interviews *and*
 - Parent and teacher ratings of at least 1.5 *SDs* above the mean on the Attention Problems and/or Hyperactivity scales of the BASC-2 *or*
 - 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:
 - Neurotypical children *and*
 - 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

Emotion (Affect) Recognition

- Pictures of children demonstrating six basic emotions
- True/False statements alternated with picture stimuli
- Low working memory demands

Animal Recognition

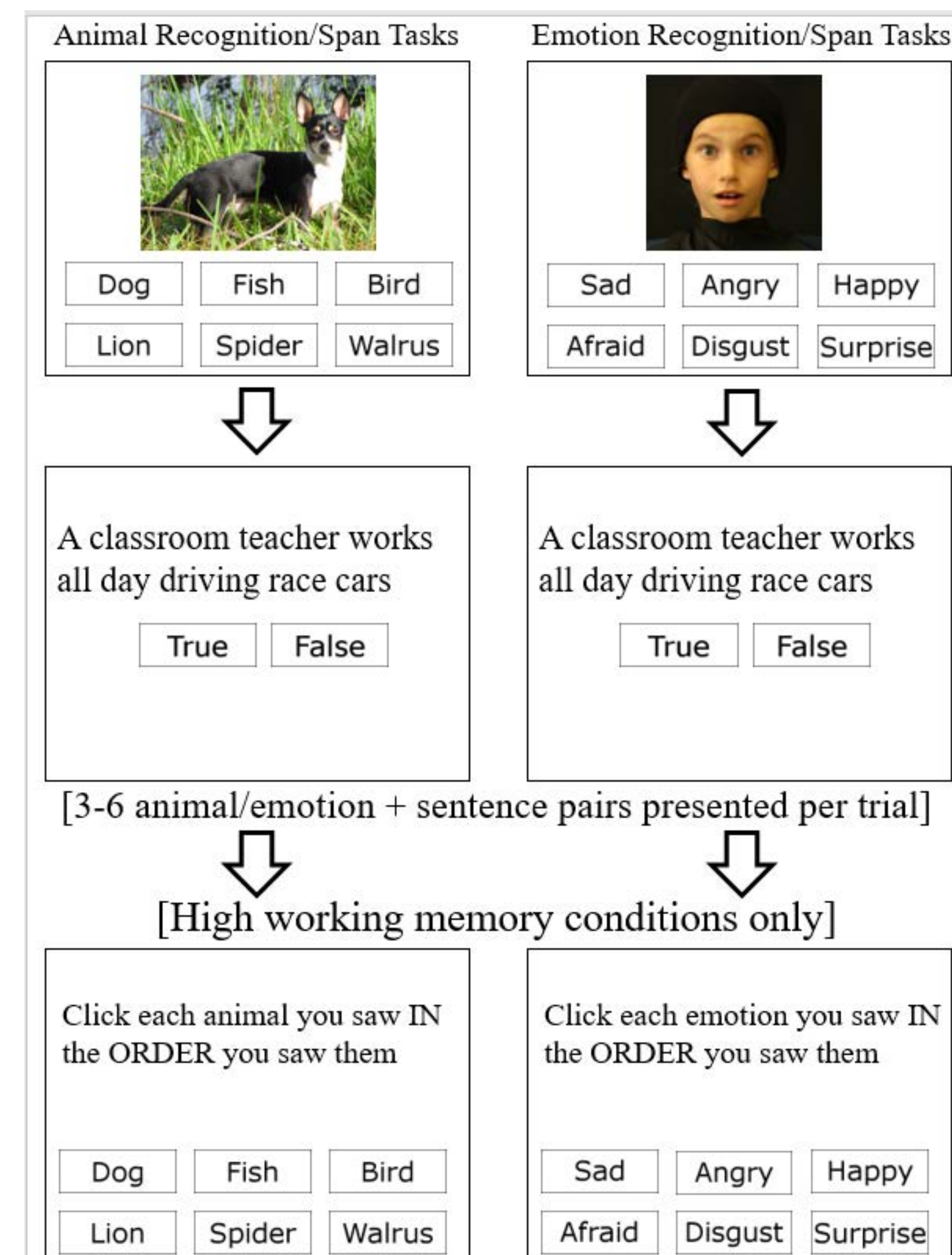
- Pictures of six different types of animals
- True/False statements alternated with picture stimuli
- Low working memory demands

Emotion (Affect) Span

- Same presentation of stimuli as described above
- Manipulation: set sizes of 3, 4, 5, or 6 faces to **recall** in serial order
- Complex span working memory task (high WM demands)

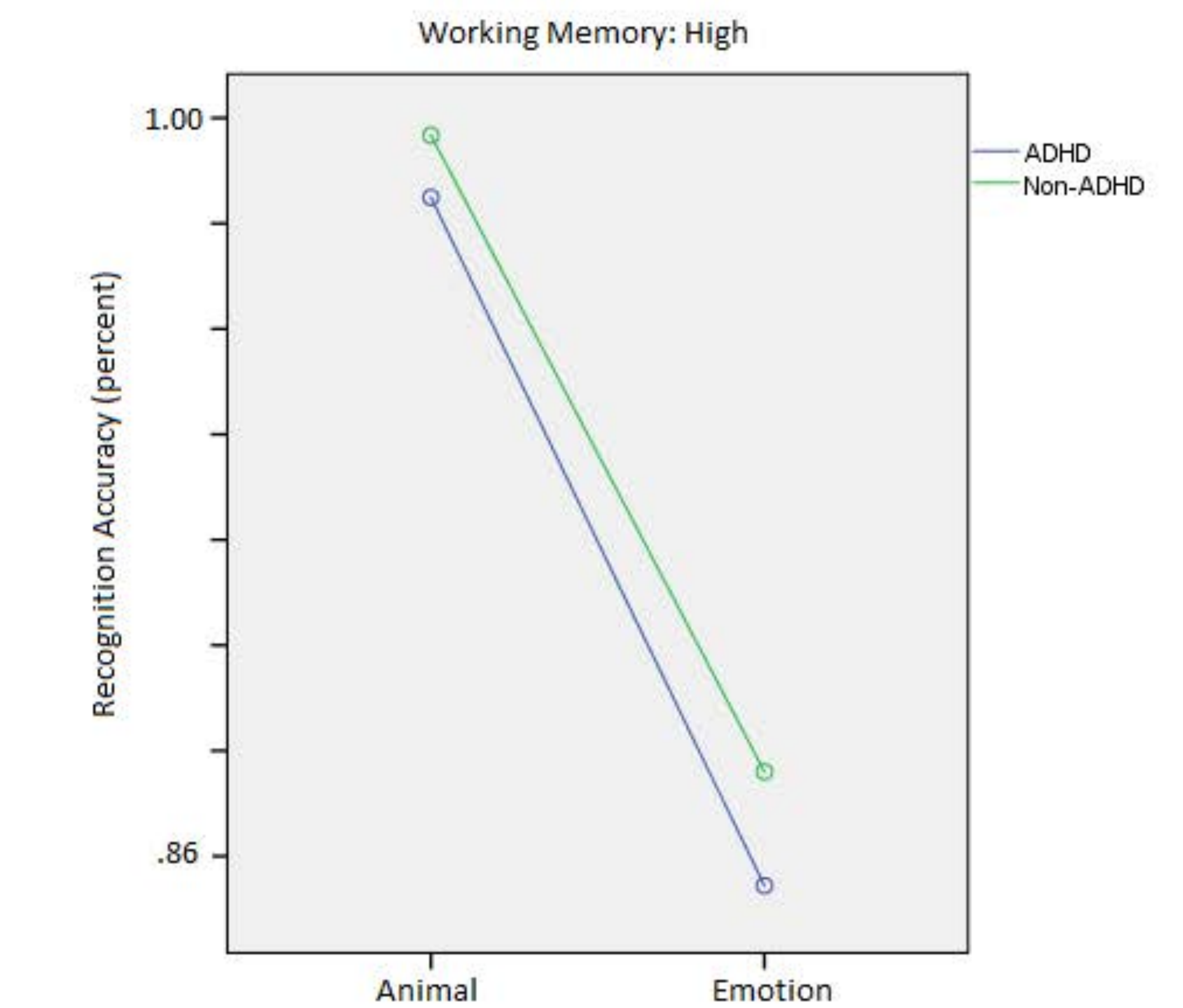
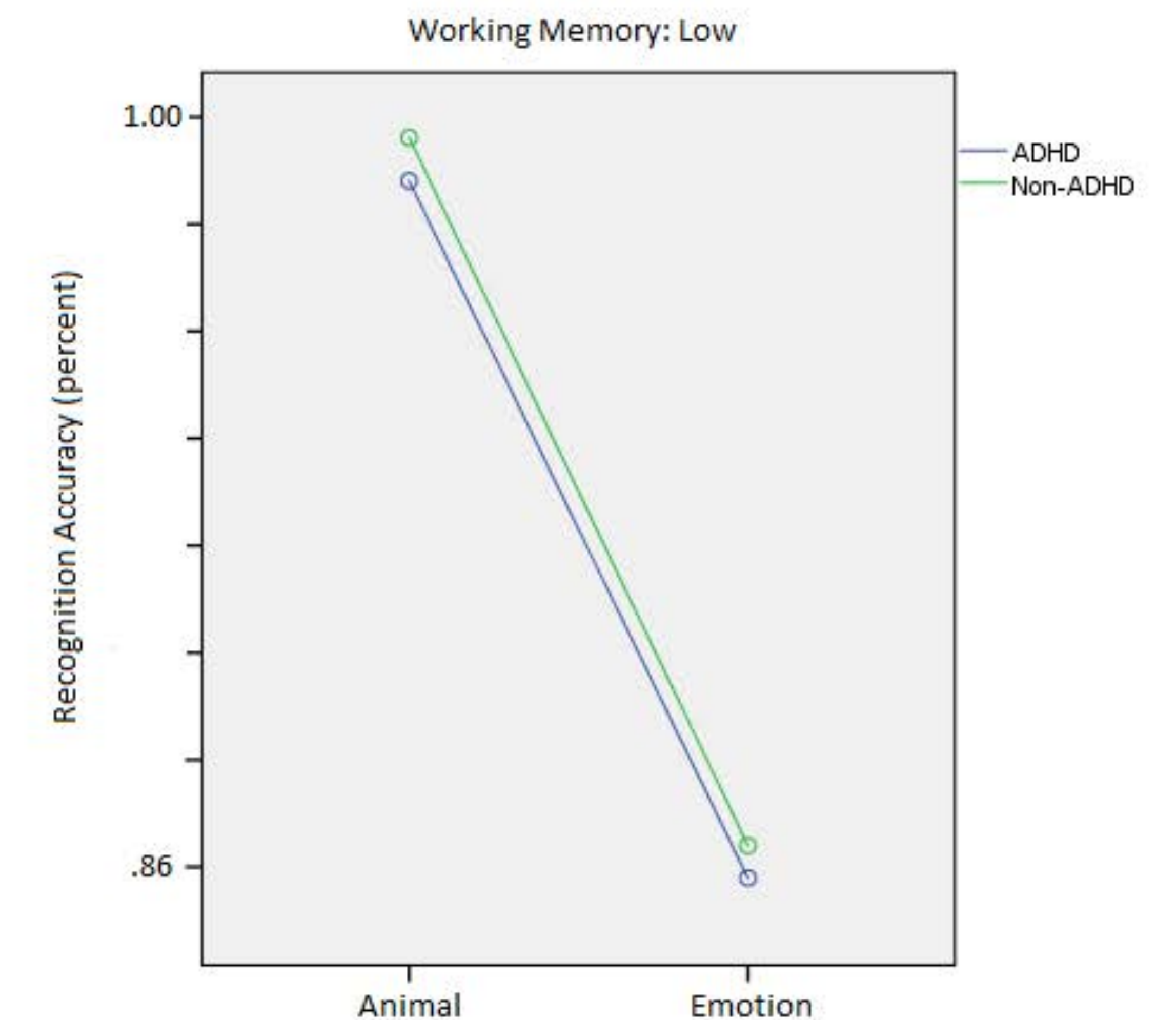
Animal Span

- Same presentation of stimuli as described above
- Manipulation: set sizes of 3, 4, 5, or 6 animals to **recall** in serial order
- Complex span working memory task (high WM demands)



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) x 2 (working memory: Low, High) mixed-design ANOVA: significant main effect of condition ($p<.0005$)
 - 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 effects 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 (Emotion Span and Animal Span; $d=0.56, p=.03$).
- 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.