ADHD in children and adolescents: examination of the contribution of irritability, sadness and anxiety to working memory problems  J Winther, N Hall, S Aggarwal, K Rennie, C Prakash, A Vance*

Developmental Neuropsychiatry Program/Academic Child Psychiatry Unit, Department of Paediatrics, University of Melbourne, Murdoch Childrens Research Institute, Royal Children’s Hospital, Parkville, Melbourne, Victoria, Australia; Correspondence: avance@unimelb.edu.au

Introduction
ADHD is the most prevalent child and adolescent psychiatric disorder seen in public child and adolescent mental health services in Australia and is known to be associated with verbal and visuospatial working memory deficits. These deficits have been linked to learning difficulties/academic underachievement and social relationship problems. Further, ADHD is known to be associated with increased symptoms of anxiety, irritability and sadness that can manifest as part of the disorder or as comorbid anxiety and depressive disorders, especially dysthyemic disorder. Currently, it is unknown whether these three common symptoms independently contribute to working memory problems aside from core ADHD symptoms.
Introduction (continued)
This is important to know because academic achievement and social skills are protective factors for young people with ADHD and WM deficits may limit the effectiveness of cognitively based treatment programs focussed on helping children with their academic achievement and with the acquisition of social skills. In this study, we examine whether parent reported anxiety, irritability and sadness/unhappiness in children and adolescents with ADHD contribute to spatial working memory problems along with core ADHD symptoms.

Method
ADHD defined by
(1)-parent semi-structured clinical interview;
(2)-parent and teacher dimensional report subscale scores - core symptom domains of ADHD - greater than 1.5 standard deviations above the mean for a given child’s age and gender
- medication and formal psychological treatment naïve -

N=1150
comorbid diagnoses of learning disorders (28%), DCD (11%), speech/ language disorders (15%), depressive disorders (10%), anxiety disorders (28%) and ODD (70%)/ conduct disorder (6%);  
ADHD children – 
consecutively referred for assessment because they were not responding to usual school psychological management approaches delivered at a community primary care level; met the inclusion criteria of living in a family home and attending normal primary schools. All IQs > 80; none had overt neurological disease or psychotic symptoms  
-Spatial working memory and its strategy and span components assessed using the Cambridge Neuropsychological Test Automated Battery (CANTAB). The Werry and Aman questionnaire used to define parent reported anxiety, irritability and sadness/unhappiness in children and adolescents with ADHD.  
-Standard multiple regression used to examine how well core ADHD, anxiety, irritability and sadness/unhappiness symptoms predicted spatial working memory and its strategy and span components.
### Results

Only core ADHD (3% of the variance) and sadness/unhappiness (2% of the variance) symptoms made independent significant contributions to the prediction of spatial working memory deficits (between search errors).

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<th>CGI</th>
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<th>IRR</th>
<th>SAD</th>
<th>B</th>
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p ≤ .0005 ***
p ≤ .067 #
Only core ADHD (1% of the variance) and irritability (1% of the variance) symptoms made independent significant contributions to the prediction of strategy deficits.
In contrast, core ADHD (4% of the variance), irritability (1% of the variance) and sadness/unhappiness (1% of the variance) symptoms made independent significant contributions to the prediction of spatial span deficits.

Importantly, core ADHD symptoms associated with worsening cognitive performance while irritability and sadness/unhappiness associated with better cognitive performance.

Anxiety - no independent contribution and there was no shared contribution of anxiety, irritability and sadness/unhappiness to the variance of cognitive performance.
Discussion – Research Implications

-These findings confirm the known association between core ADHD symptoms and working memory deficits. However, our understanding of the contribution of anxiety, sadness/unhappiness and irritability is extended: only sadness/unhappiness independently contributes to a better working memory performance in children and adolescents with ADHD. Indeed it appears to mediate the relationship between irritability, anxiety and working memory. Further, better spatial span performance is independently contributed to by irritability and sadness/unhappiness which together appear to mediate the relationship between anxiety and spatial span. In contrast, only irritability makes an independent contribution to better strategy performance and appears to mediate the relationship between anxiety, sadness/unhappiness and strategy performance.
Discussion – Research Implications

-[1] anxiety’s association with working memory performance is mediated by depressive symptoms;

-[2] sadness/unhappiness and irritability have qualitative similarities and quantitative differences in their protective effects on specific higher order cognitive functions such as spatial working memory;

-[3] the association of better spatial span and working memory performance associated with sadness/unhappiness and irritability can be understood via Marburg’s model of depression.
Discussion – Clinical Implications

- Early identification of anxiety and depressive symptoms imperative because they are common in patients with ADHD, an independent driver of ODD – a main driver for referral to public mental health services, increase the risk of MDD and self harm potential, yet they may aid working memory deficits that contribute to learning and social relationship difficulties

Hence these symptoms need to be managed without losing their protective benefits on cognition

- A specialist multi-disciplinary team needs to comprehensively assess anxiety and depressive symptoms and prioritise specific and targeted psychological and/or medication treatments.
Discussion – Clinical Implications

-Specific and targeted psychological and/or medication treatments need to be trialled and evaluated; eg mood and anxiety regulation skills training as part of comprehensive parent and teacher management training and child skills training run in conjunction,

-Further, the potential synergism between (1) medication treatments, for example, stimulant medication for inattentive symptoms and SSRI medication for anxiety and mood symptoms, and (2) the implemented psychological treatments needs to be assessed and maximised through RCTs