Attention and Memory in Boys
with Predominantly Inattentive and Combined Subtypes of ADHD

Lisa Gomes

A thesis submitted for the degree of Doctor of Psychology (Clinical)
of the Australian National University
April 2011
Except where due acknowledgement is given, I affirm that this thesis is the result of my own research carried out under the supervision of Dr. Bernd Heubeck of the Department of Psychology at the Australian National University.

Lisa Gomes
1 April 2011
Acknowledgements

I would like to thank my supervisor, Dr Bernd Heubeck for his help in the development and support of this research project. I would also like to thank Dr Elizabeth Rieger and Dr Phillipa Butcher, who both very generously provided invaluable comments on this dissertation. Many thanks must also go to Caroline Twang for her help with the preparation of the manuscript and to Laura Clapham for her assistance with data collection for six children. A further note of thanks must be also extended to the principals, schools, teachers, parents and students who made this research possible. And also to those special children who early in my study of psychology ignited my passion for working with children.

Many thanks to my clinical psychology peers, especially Jodie B., Deb, Sarah, Tushara, Yan, Lian, Suzi and Sori, for their support and encouragement during times of stress. I would also like to thank my mum, dad and Anna for their constant love and support.

Finally I would like to especially thank my husband Roland for his constant love, support and belief in me.
Contents

Acknowledgements 3
List of Tables 7
List of Figures 8
Abstract 9

Chapter

1 Introduction 11

2 Defining ADHD 14
   Conceptualisations of ADHD
   The History of ADHD
   The Current Diagnostic Criteria for ADHD
   Evaluation of Current Diagnostic Criteria and Beyond
   Summary and Conclusions

3 Demographic Characteristics of the ADHD Subtypes 20
   Prevalence
   Age of Onset and Age of Referral
   Gender Differences
   Social Economic Status and Ethnicity
   Family Characteristics
   Summary and Conclusions

4 Psychosocial and Academic Differences between the ADHD Subtypes 24
   General Functioning
   Co-morbidity
   Internalising Symptoms and Disorders
   Externalising Symptoms and Disorders
   Social Functioning
   Intellectual and Academic Functioning
   Referral, Receipt and Response to Treatment
   Summary and Conclusions
<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Theoretical Conceptualisations of ADHD and its Subtypes</td>
</tr>
<tr>
<td></td>
<td>Executive Functions</td>
</tr>
<tr>
<td></td>
<td>Theories of ADHD</td>
</tr>
<tr>
<td></td>
<td>Summary and Conclusions</td>
</tr>
<tr>
<td>6</td>
<td>Attention Deficits in the ADHD Subtypes</td>
</tr>
<tr>
<td></td>
<td>Theoretical Models of Attention</td>
</tr>
<tr>
<td></td>
<td>Attention Deficits in ADHD Subtypes</td>
</tr>
<tr>
<td></td>
<td>Summary and Conclusions</td>
</tr>
<tr>
<td>7</td>
<td>Memory Deficits in ADHD Subtypes</td>
</tr>
<tr>
<td></td>
<td>Theoretical Models of Memory</td>
</tr>
<tr>
<td></td>
<td>Memory Deficits in ADHD Subtypes</td>
</tr>
<tr>
<td></td>
<td>Summary and Conclusions</td>
</tr>
<tr>
<td>8</td>
<td>Research Questions and Hypotheses</td>
</tr>
<tr>
<td></td>
<td>Research Question 1 – Psychosocial Functioning in the ADHD Subtypes</td>
</tr>
<tr>
<td></td>
<td>Research Question 2 – Attention in the ADHD Subtypes</td>
</tr>
<tr>
<td></td>
<td>Research Question 3 – Memory in the ADHD Subtypes</td>
</tr>
<tr>
<td></td>
<td>Research Question 4 – Using Attention and Memory Measures to Discriminate Between Groups</td>
</tr>
<tr>
<td>9</td>
<td>Method</td>
</tr>
<tr>
<td></td>
<td>Design</td>
</tr>
<tr>
<td></td>
<td>Recruitment and Selection</td>
</tr>
<tr>
<td></td>
<td>Participant Characteristics and Matching</td>
</tr>
<tr>
<td></td>
<td>Measures</td>
</tr>
<tr>
<td></td>
<td>Procedure</td>
</tr>
</tbody>
</table>
Results

Statistical Analyses
Research Question 1 – Psychosocial Functioning in the ADHD Subtypes
Research Question 2 – Attention in the ADHD Subtypes
Research Question 3 – Memory in the ADHD Subtypes
Research Question 4 – Using Attention and Memory Measures to Discriminate Between Groups

Discussion

Psychosocial Functioning
Attention
Memory
The Utility of Attention and Memory Tasks in Predicting Group Membership
Theoretical Implications
Clinical Implications
Limitations
Future Research
Conclusion

References

Appendix

A. Ethical Approval
B. Parental Information Statement and Consent Form
C. Diagnostic Questionnaire
D. Parent Questionnaire
E. Additional Statistical Analyses
F. Applied Clinical Research
List of Tables

Table                                     Page
7.1  Studies that Investigated Working Memory in ADHD and its Subtypes  58
7.2  Studies that Investigated Explicit Memory in ADHD and its Subtypes  61
7.3  Studies that Investigated Implicit Memory in ADHD and its Subtypes  64
9.1  Socio-economic Characteristics of the ADHD-PI, ADHD-C and Control Groups  77
9.2  Inattention and Hyperactivity/Impulsivity Percentiles for the ADHD-PI, ADHD-C and Control Groups (means with standard deviations in parentheses)  78
9.3  Counterbalancing of Stimuli Sets for the Explicit and Implicit Memory Tasks  87
10.1 Mean, SD and Group Comparisons on the SDQ Subscales for the ADHD-PI, ADHD-C, and Control Groups.  93
10.2 Mean, SD and Group Comparisons on the TEA-Ch Subtests for the ADHD-PI, ADHD-C and Control Groups  97
10.3 Mean, SD and Group Comparisons on the Memory Tasks for the ADHD-PI, ADHD-C and Control Groups  101
10.4 Coefficients of each of the Attention and Memory Tasks on the Two Discriminant Functions  104
10.5 Discriminant Function Classifications for the ADHD-PI, ADHD-C and Control Groups  104
## List of Figures

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>DSM-IV-Revised Criteria for Attention-Deficit/Hyperactivity Disorder (APA, 2000)</td>
<td>17</td>
</tr>
<tr>
<td>5.1</td>
<td>Barkley’s (1997) Hybrid Neuropsychological Model of Executive Functions</td>
<td>33</td>
</tr>
<tr>
<td>5.3</td>
<td>Sonuga-Barke’s (2002) Dual Pathway Model of ADHD</td>
<td>37</td>
</tr>
<tr>
<td>10.1</td>
<td>Plot of the Centroids of the ADHD-PI, ADHD-C and Control Groups on the Two Discriminant Functions</td>
<td>103</td>
</tr>
</tbody>
</table>
Abstract

Attention-Deficit/Hyperactivity Disorder (ADHD) is a common disorder in childhood which can have a significant impact upon many facets of a child’s life. The ADHD-Predominantly Inattentive (ADHD-PI) and ADHD-Combined (ADHD-C) subtypes share clinically significant problems of inattention, but differ from one another in the presence of clinically significant levels of hyperactivity-impulsivity for the latter subtype. Important differences between the ADHD-PI and ADHD-C subtypes have emerged in the ADHD literature pertaining to demographic and family characteristics, and psychosocial functioning. In addition, some theoretical conceptualisations of ADHD (e.g., Barkley, 1997; Sonuga-Barke, 2002) have distinguished between the subtypes, with Milich, Balentine, and Lynam’s (2001) having further asserted that the ADHD-PI and ADHD-C are distinct and unrelated disorders.

In the school context, children with either ADHD subtype have been found to display marked problems with their learning. Studies that have investigated the nature of the fundamental building blocks of learning – attention and memory – in ADHD have found mixed results pertaining to differences between the subtypes. At present, consensus has not been reached in the literature regarding the precise nature of attention and memory deficits for the ADHD-PI versus the ADHD-C subtypes.

The current study examined the nature of and differences in attention and memory between ADHD-PI, ADHD-C and Control groups. Differences in psychosocial functioning between groups were also explored as such functioning can have some impact upon a child’s learning at school. Twenty boys with ADHD-PI were matched on age, intelligence, and current medication status with 20 boys with ADHD-C and 20 control children. Different patterns in psychosocial functioning, as assessed by parent and child ratings on the Strengths and Difficulties Questionnaire, were found between groups.

Participants were administered the Test of Everyday Attention for Children, a battery of tests that assess different types of attention – selective attention, sustained attention and attentional control/switching. Different types of memory – working memory, explicit memory, and implicit memory – were assessed using the Digit Span Forward and Backward tasks, a Category Cued Recall task, and a Category Exemplar Generation
task. On attention tests, the ADHD-PI and ADHD-C subtypes performed comparably and were impaired relative to controls on sustained attention and attentional control/switching, with some additional selective attention impairments for the ADHD-C group. No differences on memory measures were found between groups, with the exception of the ADHD-PI subtype scoring higher on Digits Forward than the ADHD-C group. A discriminant analysis based on attention and memory test performance found attentional control/switching measures to best discriminate the ADHD groups from controls and a trend for selective attention measures to separate the ADHD subtypes. Sixty-seven percent of participants were correctly classified by the discriminant analysis which indicated that there was considerable heterogeneity in attention and memory profiles within groups.

The results of the present study suggest that the nature of attention and memory in the ADHD groups was more similar than dissimilar. The heterogeneous nature of these fundamental building blocks of learning within each ADHD subtype has clinical implications and points to the need for individualised assessment and treatment for children with ADHD.