Autism symptoms in children with Attention-Deficit/Hyperactivity Disorder: a community-based study.

Submitted by

Jessica Leigh Green BA (Hons)

Supervised by:

Professor Nicole Rinehart

Professor Vicki Anderson

Dr Emma Sciberras

A thesis submitted in partial fulfilment for the degree of

Doctor of Psychology (Clinical Psychology)

October 2015

Faculty of Medicine, Nursing and Health Sciences, School of Psychological Sciences
Monash University, Clayton Campus

- Dedication -

To my Mum and Dad, Gayle and Ern Green.
Thank you for nurturing my love of learning, investing in my education
and raising me to know Jesus, who I serve through my clinical work and research.
I hope you see this achievement as partly yours, too.

Abstract

Background

Attention-Deficit/Hyperactivity Disorder (ADHD) is the most common neurodevelopmental disorder in children (Polanczyk, Willcutt, Salum, Kieling, & Rohde, 2014) and is highly comorbid with Autism Spectrum Disorder (ASD) (Green et al., 2015; Kotte et al., 2013). Although it is well established that children with ADHD or ASD and their families experience poorer functioning including child and parent mental health problems, child peer problems, poorer family quality of life (FQoL) and parenting difficulties, it is unknown how comorbid ASD symptoms contribute to child and family functioning in children with ADHD. It is important to understand which comorbidities contribute to poorer child and family functioning to guide treatment planning.

Aims

This study aimed to examine the prevalence of ASD symptoms in children with ADHD and the association between ASD symptoms and child and family functioning across three connected studies. The specific aims of each study are outlined below.

Study 1. To examine the prevalence and type of ASD symptoms (social interaction, communication and stereotyped behaviour) in children with ADHD and non-ADHD controls. Within the ADHD group only, we also examined the relationship between ADHD subtype, hyperactive/impulsive and inattentive symptoms, ADHD symptom severity and child gender and ASD symptom severity.

Study 2. To examine the association between ASD symptoms and (a) social functioning; (b) mental health; (c) quality of life and (d) sleep, in children with and without ADHD.

Study 3. To examine the association between ASD symptoms (measured dimensionally) in children with and without ADHD and a broad range of family functioning variables and to examine differences between ADHD+ASD, ADHD and control groups on family functioning variables.

Methods

Participants were 6-10 year old children (164 ADHD; 198 non-ADHD control) attending 43 schools in Melbourne, Australia, who were participating in the Children's Attention Project. ADHD was assessed in two stages using the parent and teacher Conners' 3 ADHD index and the Diagnostic Interview Schedule for Children IV (DISC-IV). ASD symptoms were identified using the Social Communication Questionnaire (SCQ). Child functioning measures were social functioning (Strengths and Difficulties Questionnaire (SDQ), mental health (DISC-IV, SDQ), quality of life (QoL: Pediatric Quality of Life Inventory 4.0) and sleep problem severity. Family functioning outcome variables were parent mental health, family quality of life (FQoL), and scales assessing couple conflict, couple support and parenting behaviours. Unadjusted and adjusted linear and logistic regression examined continuous and categorical outcomes, respectively.

Results

Study 1. Children with ADHD had more ASD symptoms than non-ADHD controls (adjusted mean difference = 4.0, 95% confidence interval (CI) 2.8; 5.3, $p < 0.001$, effect size = 0.7). Boys with ADHD had greater ASD symptom severity than girls with ADHD (adjusted mean difference = 2.9, 95% CI 0.8; 5.2, $p = 0.01$, effect size = 0.4). Greater ADHD symptom severity was associated with greater ASD symptom severity (regression co-efficient = 1.6, 95% CI 1.2; 2.0, $p < 0.001$). No differences were observed by ADHD subtype. Greater hyperactive/impulsive symptoms were associated with greater ASD symptoms (regression coefficient = 1.0; 95% CI 0.0; 2.0, $p = 0.04$) however, this finding attenuated in adjusted analyses, which accounted for parent educational attainment, socioeconomic status, child internalising and externalising comorbidities ($p = 0.45$).

Study 2. Each standard deviation (SD) increase in SCQ scores was associated with a 6.7 unit reduction in QoL ($p < 0.001$) and greater parent and teacher-reported peer problems, emotional and conduct problems. For every SD increase in SCQ scores, internalising (OR = 1.8, 95% CI 1.3, 2.6, $p = 0.001$) and externalising disorders (OR = 1.5, 95% CI 1.1, 2.1, $p = 0.02$) increased, as did moderate/severe sleep problems (OR = 1.5, 95% CI 1.0, 2.2, $p = 0.04$). Most findings held in analyses adjusting for socio-demographic factors, ADHD symptom severity, and comorbidities (when not the outcome), with the exception of externalising disorders and sleep problems.

Study 3. In unadjusted dimensional analyses, higher ASD symptoms were associated with more couple conflict ($p = 0.04$) and poorer FQoL for all subscales ($p \leq 0.001$), with non-significant trends for less couple support ($R^2 = 0.10$, $p = 0.06$), more hostile parenting ($R^2 = 0.02$, $p = 0.06$) and poorer parent mental health ($R^2 = 0.02$, $p = 0.07$). In adjusted dimensional analyses, higher ASD symptoms were only associated with poorer FQoL, across all subscales only ($p \leq 0.01$). The trend association between ASD symptoms and parent mental health attenuated due to meaningful associations with comorbid internalising disorder ($p = 0.003$) and ADHD symptom severity ($p = 0.05$). The trend association between ASD symptoms and hostile parenting attenuated due to significant associations with comorbid externalising disorders ($p = 0.002$), lower parent education attainment ($p = 0.03$) and greater ADHD symptom severity ($p = 0.04$). Less couple support attenuated due to a significant association with socioeconomic status ($p = 0.004$).

In unadjusted categorical analyses, parents of children with ADHD+ASD reported more couple conflict ($p = 0.04$), less couple support ($p = 0.001$), poorer FQoL ($p < 0.001$) and a non-significant trend for greater mental health difficulties ($p = 0.07$), compared to the ADHD group. In adjusted categorical analyses, parents of children with ADHD+ASD had poorer parent self-efficacy ($p = 0.02$), poorer FQoL ($p < 0.05$) ($p < 0.05$) and a non-significant trend for less couple support ($p = 0.06$), compared to parents of children with ADHD.

In unadjusted categorical analyses, family functioning was significantly poorer for the ADHD and ADHD+ASD groups, compared to controls for most outcomes ($p < 0.001$). In adjusted categorical analyses, all findings attenuated except FQoL was significantly poorer for the ADHD and ADHD+ASD groups, compared to controls.

Conclusion

ASD symptoms are common, and associated with poorer functioning in children with ADHD. It is important for clinicians working with children with ADHD to identify and manage ASD symptoms, given that they exacerbate functional impairments in this already vulnerable group. The relationship between ASD symptoms and broader family functioning appears to be largely driven by internalising and externalising disorders, ADHD severity, and socioeconomic status. Poorer FQoL appears to be independently associated with ASD symptoms in children with ADHD.

Copyright notice

PART A: General Declaration

Monash University

Declaration for thesis based or partially based on conjointly published or unpublished work

General Declaration

In accordance with Monash University Doctorate Regulation 17.2 Doctor of Philosophy and Research Master's regulations the following declarations are made:

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes 1 original paper published in a peer reviewed journal and 2 unpublished publications. The core theme of the thesis is examining the association between autism spectrum disorders in children with ADHD and child/family functioning. The ideas, development and writing up of all the papers in the thesis were the principal responsibility of myself, the candidate, working within the Murdoch Childrens Research Institute under the supervision of Professor Nicole Rinehart, Professor Vicki Anderson and Dr Emma Sciberras.

The inclusion of co-authors reflects the fact that the work came from active collaboration between researchers and acknowledges input into team-based research.

In the case of Chapters 1 - 6 my contribution to the work involved the following:

Thesis chapter	Publication title	Publication status*	Nature and extent of candidate's contribution
1	Introduction	Unpublished	Literature review and writing of Introduction chapter
2	General Method	Unpublished	Writing of general method
3	Autism spectrum disorder symptoms in children with ADHD: A community-based study	Published	Literature review, subset of data collection, data analysis and writing of manuscript
4	Association between autism spectrum disorder symptoms and functioning in children with ADHD	Under review	Literature review, subset of data collection, data analysis and writing of manuscript
5	Association between autism spectrum disorder symptoms and family functioning in children with attention-deficit/hyperactivity disorder	Submitted	Literature review, subset of data collection, data analysis and writing of manuscript
6	General Discussion	Unpublished	Writing of general discussion

I have / have not (circle that which applies) renumbered sections of submitted or published papers in order to generate a consistent presentation within the thesis

Signed: [redacted]

Date: [redacted]

Preface

This thesis is based on data collected from the *Children's Attention Project* – the first Australian longitudinal cohort study of children with and without ADHD (NHMRC; project grant no. 1008522). This study was conducted at the Centre for Community Child Health at the Murdoch Childrens Research Institute, Melbourne, Australia.

The *Children's Attention Project* team was responsible for all aspects of running the broader project, including securing funding, designing the study, recruiting parents, teachers and children, and collecting data over a three-year period.

I established the three studies that are outlined in this thesis, which form a small part of the overarching *Children's Attention Project.* The novel aims for the three studies were developed under the guidance of my supervisory team: Professor Nicole Rinehart, Professor Vicki Anderson and Dr Emma Sciberras. I added the Social Communication Questionnaire (SCQ) to the broader CAP study. The research assistants from the Children's Attention Project collected SCQ data at interview for wave 1, whilst I was responsible for SCQ data collection over the phone, with the assistance of one other staff member, for wave 2. I also contributed to recruitment, data cleaning and participant retention tasks for the broader *Children's Attention Project.* I performed all statistical analyses presented in this thesis under the guidance of my supervisory team, in particular Dr Emma Sciberras.

Publications

During my candidature, the following peer-reviewed publications arose from my doctoral data. I drafted the initial manuscript and contributed to 70% of the work for publications 1 – 3, which address the aims of my thesis and appear in Chapters 3-5. Publications 4 and 5 are invited publications that are not directly related to my thesis thus, they appear in Appendix A – B.

Research Articles

1. **Green JL**, Rinehart N, Anderson V, Nicholson J, Jongeling B, Sciberras E. Autism spectrum disorder symptoms in children with ADHD: a community-based study. Manuscript accepted for publication in *Research in Developmental Disabilities,* In Press DOI: 10.1016/j.ridd.2015.09.016

2. **Green JL**, Sciberras E, Anderson V, Efron D, Nicholson J, Rinehart N. Autism spectrum disorder symptoms and functioning in children with ADHD: a community-based study (Under review) *Pediatrics,* submitted September 2015.

3. **Green JL,** Rinehart N, Anderson V, Efron D, Nicholson J, Jongeling B, Hazell P, Sciberras E. Autism spectrum disorder symptoms in children with ADHD: association with parent, couple and family functioning (Submitted). *European Journal of Child and Adolescent Psychiatry*, submitted October 2015.

Other Publications

4. **Green JL**, Sciberras E, Rinehart N (2015). Two years post DSM-5: the emerging picture of Attention Deficit Hyperactivity Disorder and Autism. *Belonging Journal.* Accepted for publication in August 2015.

5. **Green JL**, Sciberras, E., & Enticott, P. (2015). Conduct Disorder and Oppositional Defiant Disorder. In N. Rinehart, P. Enticott, & J. Bradshaw (Eds.), *Developmental Disorders of the Brain*. Melbourne: Psychology Press. Accepted for publication in October 2015.

National/State Conference Presentations

6. **Green JL,** Sciberras E, Anderson V, Efron D, Jongeling B, Nicholson J, Rinehart N. Autism spectrum disorder symptoms in children with Attention Deficit/Hyperactivity Disorder: A community-based study. Accepted for an Oral presentation at the ASfAR Conference, Melbourne, December 2014.

7. **Green JL,** Rinehart N, Anderson V, Efron D, Schilpzand E, Nicholson J, Jongeling B, Sciberras E. Social and communication difficulties in children with ADHD and non-ADHD controls: a community-based study. Poster presentation at the *Murdoch Childrens Research Institute Student Symposium,* August 2014.

8. **Green JL,** Rinehart N, Anderson V, Efron D, Schilpzand E, Nicholson J, Sciberras E, Jongeling B. Social and communication difficulties in children with ADHD and non-ADHD controls: a community-based study. Oral presentation at *The Royal Australian and New Zealand College of Psychiatrists, Faculty of Child and Adolescent Psychiatry 2014 Conference*, Perth May 2014.

9. **Green JL,** Rinehart N, Anderson V, Efron D, Schilpzand E, Nicholson J, Jongeling B, Sciberras E. Comorbid autism spectrum disorder symptoms in children with ADHD: support for DSM-V. Combined Symposium at *The Royal Australian and New Zealand College of Psychiatrists, Faculty of Child and Adolescent Psychiatry 2013 Conference*, Melbourne October 2013.

10. **Green JL,** Rinehart N, Anderson V, Efron D, Schilpzand E, Nicholson J, Jongeling B, Sciberras E. Social and communication difficulties in children with ADHD and non-ADHD controls: a community-based study. Poster presentation at the *International Congress of Pediatrics 2013 (ICP) - The 27th Congress of International Pediatric Association*, Melbourne August 2013.

International Conference Presentations

11. **Green JL,** Rinehart N, Anderson V, Efron D, Nicholson J, Hazell P, Sciberras E. Autism spectrum disorder symptoms in children with ADHD: association with parent, couple and family functioning. Poster presentation accepted 16th International European Society for Child and Adolescent Psychiatry Congress, Madrid, Spain 20-24 June 2015.

12. **Green JL**, Sciberras E, Anderson V, Efron D, Nicholson J, Rinehart N. Autism Spectrum Disorder Symptoms in Children with Attention Deficit/Hyperactivity Disorder: A Community-Based Study. New Research Poster at 61st Annual Meeting of the American Academy of Child and Adolescent Psychiatry, San Diego, October 2014.

Acknowledgements

During my undergraduate studies at the University of Melbourne, I dreamed of working at the Royal Children's. When I travelled past on the tram, I sensed that it was where I was meant to be and in 2011, I got a spot! Thank you to Vicki for taking time to meet with me, as an early career research assistant, and for connecting me with Emma, who mentored me and then invited me to be part of her exciting new project, the Children's Attention Project. How grateful I am for the opportunities I have had to learn here at MCRI.

I would like to thank the parents, children and teachers that contributed to my research – for answering my phone calls and giving me your time. I have tried my best to steward your investment well. I am also very thankful for the funding I received during my candidature from the Murdoch Childrens Research Institute and Monash University.

A big thank you to my wonderful supervisors. Nicole, thank you for your excellent knowledge in the area of neurodevelopmental disorders, for keeping me on track, and helping me to remember the 'bigger picture' and to not overthink things! Emma, thank you for always being there. For your exceptionally thorough feedback, your warmth and encouragement. I am a better researcher and writer because of your investment in me, both before and during my Doctorate. Vicki, thank you for your wisdom, career advice and guidance of my research. I hope to one-day lead as you do, with warmth, kindness and a commitment to nurturing the next generation. How blessed I have been to have three exceptional female leaders to show me the way.

To the amazing Childrens Attention Project team. To the CAP chief investigators, who were also co-authors on my papers, Jan, Daryl, Brad and Phil, thank you for contributing your time and ideas to this work. Liz, you clever whiz you! Thank you for all your help, with statistics or database dramas, you were always there. To Matt, I think we, and the rest of the office, have the symptoms of autism memorised now! Thank you for all your help, especially during the data collection stage. To Alisha, you were by my side when I was on the home stretch. Thank you for your kindness, pug pictures, coffee walks and enthusiasm. To all the CAP research assistants, who collected data that contributed to my doctorate during parent interviews, thank you.

I'd also like to thank the families I have worked with during my undergraduate years, who welcomed me into their homes, giving me a much better understanding of autism, cerebral palsy and Rett syndrome. To Michael, Viv, Benny, Megan and Zoë. To Carrie, Rob and Blakey. To Mandie, Paul, Tanealle, Caulee and Shanae. Thank you for encouraging me to become a psychologist and for inspiring this work.

Finally, to my family. To my Mum and Dad, Gayle and Ern, thank you for all that you have sacrificed and done for me. This thesis is dedicated to you. For making meals and doing my washing in the last few weeks of thesis writing, a special thanks Mum! To my sisters, Joanna and Kristen. Thanks for the hugs, prayers and encouraging bible verses when I needed them.

To my dear friends, particularly Viv, Liz and Jules, thank you for your encouragement and constant support, particularly in the unexpected challenges that have come my way this year. To my housemates, Meg, Bec, Justine, Claire and Alice, thank you for your patience and care.

Father God, all my work is yours. May your kingdom come, your will be done, on earth as it is in heaven (Matthew 6:10). To my church family at St Hilary's Anglican Church, thank you Erica and Kieran for mentoring me and encouraging me to keep my relationship with Jesus at the centre of my life. To my church small group and crafternooners, thank you for your prayers. To my goddaughter, Nellie. Thank you for the encouraging stickers you gave me as I wrote my thesis, for the pictures you drew that I pinned up at my desk – you are so thoughtful. This is what I've been busy doing. I promise to make your special summer dress now that my thesis is done!

Funding

All aspects of the *Children's Attention Project* were funded by a Project Grant from the Australian National Health and Medical Research Council (No. 1008522). MCRI is supported by the Victorian Government's Operational Infrastructure Support Program. I was funded by an Australian Postgraduate Award from Monash University and a Professor David Danks Scholarship from MCRI. The funding bodies had no involvement in our research.

TABLE OF CONTENTS

List of Tables

List of Figures

Abbreviations

Abbreviation	Definition
ADHD	Attention-Deficit/Hyperactivity Disorder
ASD	Autism Spectrum Disorder
CAP	Children's Attention Project
CI	Confidence interval
DISC-IV	Diagnostic Interview Schedule for Children Fourth Edition
FQoL	Family Quality of Life
MCRI	Murdoch Childrens Research Institute
NHMRC	National Health and Medical Research Council
OR	Odds Ratio
PedsQL	Pediatrics Quality of Life Index
QoL	Quality of Life
SCQ	Social Communication Questionnaire Lifetime Form
SD	Standard Deviation
SDQ	Strengths and Difficulties Questionnaire

A note on terminology.

This study was able to determine whether children met criteria for ADHD. However, we were not able to make a diagnosis of ASD, as the SCQ is a screening measure only. Given this, the term ASD symptoms is used throughout this thesis. For categorical analyses in Study 3, ADHD+ASD refers to children in the ADHD group, with a confirmed ADHD diagnosis, who also have clinically significant ASD symptoms, defined as an SCQ total score of 11 or more. The ADHD only group includes children with a confirmed diagnosis of ADHD who did not score in the clinical range for ASD symptoms (11 or more SCQ total score). The control group included children who did not meet criteria for ADHD, and who did not have clinically elevated ASD symptoms.

1. STUDY OVERVIEW

1.1 OVERALL STUDY AIMS

Given the limitations of previous research, the proposed community-based study aimed to (1) examine the prevalence and nature of ASD symptoms in children with ADHD, compared with non-ADHD controls and predictors of ASD symptoms in children with ADHD (2) examine the association between ASD symptoms and child functioning in children with ADHD and non-ADHD controls; and (3) examine the association between ASD symptoms and family functioning. These aims were thoroughly examined across three connected sub-studies as outlined below.

1.2 STUDY 1

AIM 1. To examine the prevalence and type of ASD symptoms in children with ADHD and non-ADHD controls.

AIM 2. Within the ADHD group only, to examine the relationship between ADHD subtype, hyperactive/impulsive and inattentive symptoms, ADHD symptom severity, child gender and ASD symptom severity.

HYPOTHESES. It was hypothesised that: (1) children with ADHD would have more ASD symptoms across all domains, compared to non-ADHD controls, (2) greater ADHD symptom severity would be associated with more ASD symptoms, (3) children with ADHD combined type would have more ASD symptoms compared to children with ADHD inattentive type; and (4) greater ASD symptom severity in girls with ADHD compared to boys with ADHD.

1.3 STUDY 2

AIM 1. To clarify the relationship between ASD symptoms and psychosocial functioning in a community sample of children with and without ADHD, through the use of rigorous measures and multi-informant assessments of a) peer problems and prosocial behaviours; b) mental health; and c) sleep.

AIM 2. To extend current knowledge by examining psychosocial quality of life (QoL), which encompasses social, emotional and school functioning, which to the best of our knowledge, has not been previously examined.

HYPOTHESES. It was hypothesised that: (1) Greater ASD symptom severity in children with and without ADHD would be associated with greater peer problems and less prosocial behaviours; (2) greater ASD symptom severity in children with and without ADHD would be associated with poorer child mental health; (3) greater ASD symptom severity in children with and without ADHD would be associated with moderate to large sleep problems and; (4) greater ASD symptom severity in children with and without ADHD would be associated with poorer psychosocial quality of life.

1.4 STUDY 3

AIM 1. To examine the association between ASD symptoms (measured dimensionally) in children with and without ADHD and a broad range of family functioning variables.

AIM 2. This study also aimed to examine differences between ADHD+ASD, ADHD and control groups on family functioning variables.

HYPOTHESES. It was hypothesised that greater ASD symptoms in children with ADHD would be associated with 1) poorer parent mental health; 2) poorer family quality of life (FQoL); 3) more couple conflict; 4) less couple support; and 5) lower parent self-efficacy, less parenting consistency and warmth, and more hostile parenting. We hypothesised that the ADHD+ASD group would have poorer family functioning, across all domains, when compared to the ADHD or control groups.

Declaration for Thesis Chapter 1: Introduction

Monash University

Declaration by candidate

In the case of Chapter 1: Introduction, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Review of relevant literature and writing of literature review	70%

The following co-authors contributed to the work. If co-authors are students at Monash University, the extent of their contribution in percentage terms must be stated:

Name	Nature of contribution
Professor Nicole Rinehart	Input during final draft stage of manuscript
Professor Vicki Anderson	Input during final draft stage of manuscript
Dr Emma Sciberras	Input during final draft stage of manuscript

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work*.

Candidate's Signature	[redacted]	**Date** 28/10/2015
Main Supervisor's Signature	[redacted]	**Date** 20/10/2015

2. INTRODUCTION

2.1 OVERVIEW

ASD and ADHD are two of the most common neurodevelopmental disorders. DSM-5 now allows both conditions to be diagnosed simultaneously, in response to growing research evidence that these two neurodevelopmental disorders commonly co-occur. Around 50% of children with ASD have clinically significant symptoms of ADHD (Simonoff et al., 2008; Sinzig, Walter, & Doepfner, 2009) and up to a third of children with a primary diagnosis of ADHD show clinically elevated symptoms of ASD (Clark, Feehan, Tinline, & Vostanis, 1999; Grzadzinski et al., 2011; Reiersen, Constantino, Volk, & Todd, 2007). It is increasingly clear that ADHD and ASD overlap in terms of implicated genetics and brain regions involved. Christopher Gillberg has led the field in highlighting the complexity of comorbidity across neurodevelopmental conditions particularly ASD, ADHD, anxiety and mood disorders in his ESSENCE model, which argues that such comorbidity is the rule rather than the exception (Gillberg, 2010; Gillberg & Fernell, 2014). Gillberg and others have highlighted that it is often not the diagnosis alone that is associated with poor outcomes, but the type and nature of comorbidity (Gillberg et al, 2010). There is increasing concern within the research and clinical community that this comorbidity is not always detected. A recent paper found a three-year delay in the diagnosis of ASD for children diagnosed with ADHD first, compared to children who were diagnosed with ADHD and ASD at the same time, or ADHD after an initial ASD diagnosis (Miodovnik, Harstad, Sideridis, & Huntington, 2015). Children diagnosed with ADHD first were nearly 30 times more likely to receive their diagnosis of ASD after the age of 6, with implications for funding and intervention (Miodovnik et al., 2015). The diagnosis of ADHD can overshadow the comorbid diagnosis of ASD, and visa versa, which may result in these 'at risk' children not receiving treatments appropriately tailored to their presenting difficulties (Joshi et al., 2014).

2.2 ATTENTION-DEFICIT/HYPERACTIVITY DISORDER

2.2.1 OVERVIEW. ADHD is characterised by a persistent pattern of impulsivity, inattentiveness, and/or hyperactivity, which is developmentally inappropriate, and interferes with a child's functioning, at school and/or at home – see Table 1 for a summary of the diagnostic criteria. There are three ADHD subtypes or presentations, as termed in the DSM-5; predominantly inattentive subtype, predominantly hyperactive-impulsive subtype and combined type (American Psychiatric Association, 2013). ADHD affects approximately 5% of children (Polanczyk et al., 2014) worldwide and approximately 6.8% of Australian children between 6 and 17 years of age (Graetz, Sawyer, Hazell, Arney, & Baghurst, 2001). ADHD affects more males than females, at a ratio of 2:1 (APA, 2013).

Though ADHD symptoms decline with age, at least 50% of children with ADHD still experience impairing symptoms during adulthood (Booster, Dupaul, Eiraldi, & Power, 2012). Most children with ADHD (84%) meet diagnostic criteria for at least one other psychiatric disorder (Simonoff et al., 2008), such as oppositional defiant disorder (ODD; 45-65%), mood disorders (7-50%), anxiety disorders (27-33%) and conduct disorder (CD; 14-23%) (Biederman et al., 1996; Busch et al., 2002; Ghanizadeh, Mohammadi, & Moini, 2008; Wilens et al., 2002). Children with ADHD are also at elevated risk for language disorders (Emma Sciberras, Mueller, et al., 2014), sleep problems (Sung, Hiscock, Sciberras, & Efron, 2008) and difficulties with academic achievement (Efron et al., 2014b).

2.2.2 DIAGNOSTIC CRITERIA

Table 1. Diagnostic criteria for ADHD, according to DSM-5 (American Psychiatric Association, 2013)

A. A persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development, as characterized by (1) and/or (2)
1. Inattention: Six (or more) of the following symptoms have persisted for at least 6 months to a degree that is inconsistent with developmental level and that negatively

impacts directly on social and academic/occupational activities (For older adolescents/adults (age 17 and older), at least five symptom are required).

a. Often fails to give close attention to details or makes careless mistakes in schoolwork, at work, or during other activities (e.g., misses details, work is inaccurate).
b. Often has difficulty sustaining attention in tasks or play activities (e.g., has difficulty remaining focused during school, conversations, or lengthy reading).
c. Often does not seem to listen when spoken to directly (e.g., mind seems elsewhere, even in the absence of any obvious distraction).
d. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (e.g., starts tasks but quickly loses focus and is easily distracted).
e. Often has difficulty organizing tasks and activities (e.g., difficulty managing sequential tasks; difficulty keeping materials and belongings in order; messy, disorganized, work; has poor time management; fails to meet deadlines).
f. Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (e.g., schoolwork or homework; for older adolescents and adults, preparing reports, completing forms, reviewing lengthy papers).
g. Often loses things necessary for tasks or activities (e.g., school materials, pencils, books, tools, wallets, keys, paperwork, eyeglasses and mobile phones).
h. Is often easily distracted by extraneous stimuli (for older adolescents and adults, may include unrelated thoughts).
i. Is often forgetful in daily activities (e.g., doing chores, running errands; for older adolescents and adults, returning calls, paying bills, keeping appointments).

2. Hyperactivity and Impulsivity: Six (or more) of the following symptoms have persisted for at least 6 months to a degree that is inconsistent with developmental level and that negatively impacts directly on social and academic/occupational activities. (For older adolescents/adults [age 17 and older], at least five symptom are required).

a. Often fidgets with or taps hands or feet or squirms in seat.
b. Often leaves seat in situations when remaining seated is expected (e.g., leaves his or her place in the classroom, office or other workplace, or in other situations that require remaining in place).
c. Often runs about or climbs in situations where it is inappropriate. (In adolescents or adults, may be limited to feeling restless).
d. Often unable to play or engage in leisure activities quietly.
e. Is often "on the go," acting as if "driven by a motor" (e.g., is unable to be or uncomfortable being still for extended time, as in restaurants, meetings; may be experienced by others as being restless and difficult to keep up with).
f. Often talks excessively.
g. Often blurts out an answer before a question has been completed (e.g., completes people's sentences; cannot wait for turn in conversation).
h. Often has difficulty waiting his or her turn (e.g., while waiting in line).
i. Often interrupts or intrudes on others (e.g., butts into conversations, games, or activities; may start using other people's things without asking or receiving permission, adolescents or adults may intrude into or take over what others are doing).

B. Several inattentive or hyperactive-impulsive symptoms were present prior to age 12 years.

C. Several inattentive or hyperactive-impulsive symptoms are present in two or more settings (e.g., at home, school or work; with friends or relatives; in other activities).

D. There must be clear evidence that the symptoms interfere with or reduce the quality of social, academic, or occupational functioning.

E. The symptoms do not occur exclusively during the course of schizophrenia or another psychotic disorder and are not better explained by another mental disorder (e.g., mood disorder, anxiety disorder, dissociative disorder, personality disorder, substance intoxication or withdrawal).

Specify whether:

Combined Presentation: If both Criterion A1 (Inattention) and Criterion A2 (Hyperactivity-Impulsivity) are met for the past 6 months.

Predominantly Inattentive Presentation: If Criterion A1 (Inattention) is met but Criterion A2 (Hyperactivity-Impulsivity) is not met for the past 6 months.

Predominantly Hyperactive/Impulsive Presentation: If Criterion A2 (Hyperactivity-Impulsivity) is met and Criterion A1 (Inattention) is not met for the past 6 month

Specify current severity:

Mild, Moderate or Severe

2.2.3 AETIOLOGY. The aetiology of ADHD remains unclear however research suggests that there is a range of genetic, biological and environment factors involved. Imaging studies have suggested a number of function brain abnormalities in children with ADHD, particularly in the prefrontal cortex and striatum and the parietal cortex (Rubia, Alegria, & Brinson, 2014; Silk, Vance, Rinehart, & et al., 2005). Children with ADHD have decreased cerebral volumes and cortical thickness, compared to children without ADHD (Rubia et al., 2014). ADHD has also been found to be highly heritable, accounting for up to 80% of cases (Faraone, Perlis, & Doyle, 2005; Thapar, Cooper, Jefferies, & Stergiakouli, 2012). Williams et al. (2010) found that rare chromosomal deletions and duplications were higher in children with ADHD, however these abnormalities were common to children with other neurodevelopmental conditions including ASD. A range of environmental risk factors have been associated with the development of ADHD, particularly related to the pre and postnatal period (see Linnet et al. 2003 for a review). It is thought that many genetic and environment factors interact ot increase the risk of ADHD (Linnet et al., 2003).

2.2.4 TREATMENTS. Treatment guidelines recommend that management of ADHD should be multifaceted, with both pharmacological and non-pharmacological treatments considered (American Academy of Child and Adolescent Psychiatry, 2007; National Health and Medical Research Council, 2012). In practical terms, ADHD is typically managed using

psychostimulant medication including methylphenidate and amphetamine based stimulants (Feldman & Reiff, 2014), or with non-stimulants, such as atomoxetine and norepinephrine-reuptake inhibitor, which are used less commonly with poorer effects (Wolraich et al., 2011). The most rigorous trials have shown that overall outcomes are best for children who receive both medication and psychosocial interventions (Pfiffner et al., 2007; The MTA Cooperative Group, 1999). There is evidence that psychological therapies can be particularly helpful for improving functional outcomes for children with ADHD. Behavioural interventions have been found to increase positive parenting and reduce child conduct difficulties (Daley et al., 2014). Managing sleep difficulties is also a way to improve outcomes for children with ADHD. A recent randomised controlled trial reported that a two-session treatment program, targeting behavioural sleep problems, improved child sleep, quality of life and ADHD symptom severity (Hiscock et al., 2015).

2.3 AUTISM SPECTRUM DISORDER

2.3.1 OVERVIEW. ASD is a neurodevelopmental condition, which is first diagnosed in childhood, effecting approximately 1% of the population (APA, 2013; Elsabbagh et al., 2012). The condition is characterised by deficits in social reciprocity and communication, and patterns of restricted, repetitive and stereotyped behaviours (APA, 2013). Social communication impairments include lack of nonverbal social behaviours such as gestures, delayed or absent friendships, deficits in social or emotional reciprocity, delays in or lack of spoken language, difficulties initiating or maintaining a conversation, repetitive language, and deficits in spontaneous make-believe play (APA, 2013 – see Table 2). Patterns of restricted, repetitive and stereotyped behaviours and interests include preoccupation and intense focus on one or more interests or parts of objects, insistence on consistency of routines, and repetitive movements such as hand flapping (APA, 2013). It was previously thought that around a third

of children with ASD had high functioning autism, and 70% had a comorbid intellectual disability (Charman et al., 2011). We now know, from more recent research, that around 60% of individuals with ASD have normal intellectual functioning and around 40% will have a comorbid intellectual disability (Baio, 2012). More males are diagnosed with ASD, compared to females (4:3:1) (May, Cornish, & Rinehart, 2014). Comorbidity is common in ASD. A large population based study found that 70% of individuals with ASD had at least one additional comorbid condition, and 41% had two or more (Simonoff et al., 2008). Forty percent of young people with ASD are diagnosed with one or more anxiety disorders (Van Steensel, Bogels, & Perrin, 2011), 28% ODD (Simonoff et al., 2008) and 13.8% having chronic tic disorder or Tourette syndrome (Simonoff et al., 2008). ASD is associated with significant cost to society and families with an estimated $3 million spent by families of children with ASD beyond the ordinary costs of raising a child (Knapp, Romeo, & Beecham, 2009). Intervention can reduce the level of impairment faced by children with ASD, with the aim to start intervention as soon as difficulties are identified (Elberling et al., 2014).

2.3.2 DIAGNOSTIC CRITERIA

Table 2. Diagnostic criteria for ASD, according to DSM-5 (American Psychiatric Association, 2013)

A. Persistent deficits in social communication and social interactions across many contexts, manifested by the following either currently or by history (examples are for illustration and are not exhaustive):
1. Deficits in social-emotional reciprocity. These deficits may include: a) Abnormal approach in social situations b) An inability to engage in normal back and forth conversation c) Reduced sharing of interests, emotions or affect d) Failure to initiate or respond to others in social interactions
2. Deficits in nonverbal communicative behaviours used for social interaction. These deficits may include:

a) Poorly integrated verbal and nonverbal communication

b) Unusual eye contact and/or body language

c) Difficulties understanding or using gestures

d) Total lack of facial expression and nonverbal forms of communication.

3. Deficits in making, keeping and understanding relationships. For example ranging from:

a) Difficulties changing behaviour to suit different social situations

b) Difficulties engaging and in sharing imaginative play

c) Challenges making friends

d) No interest in peers

Specify current severity, based on social communication impairments and restricted, repetitive patterns of behaviour: Level 1: Requiring Support, Level 2: Requiring substantial support, Level 3: Requiring very substantial support.

B. Restricted, repetitive patterns of behaviour, interests and activities, as demonstrated by at least two of the following, currently or by history (examples are illustrative and not exhaustive):

1. **Stereotyped or repetitive motor movements, use of objects, or speech.** E.g. Greater interest in parts of object than using object as it was intended, lining up of toys, echolalia, making up odd or unusual phrases.
2. **Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behaviour.** E.g. Great distress at small changes in routine, need to take same route when travelling, insistence on eating the same foods each day.
3. **Very restricted and fixated interests that are abnormal in their intensity or focus.** E.g. Strong attachment to unusual objects, Interest that is unusual or peculiar in *focus* (e.g. timetables, electricity) or an interest that is usual for their age and peer group but the interest is abnormal in its *intensity.*
4. **Hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of the environment.** E.g. apparent indifference to pain or

temperature, adverse reaction to specific textures or sounds, excessive smelling and touching of objects, great interest in lights or movements.

Specify current severity, based on social communication impairments and restricted, repetitive patterns of behaviour: Level 1: Requiring Support, Level 2: Requiring substantial support, Level 3: Requiring very substantial support.

C. Symptoms need to be present in the early developmental period

D. Symptoms cause clinically significant impairment in social, occupational or other important areas of current functioning

E. Deficits are not better explained by intellectual disability or global developmental disability. To make comorbid diagnoses of ASD and intellectual disability, social communication should be below that expected for the general developmental level.

Note: Individuals with a well-established DSM-IV diagnosis of autistic disorder, Asperger's disorder, or pervasive developmental disorder not otherwise specified should be given the diagnosis of autism spectrum disorder. Individual with marked deficits in social communication, but whose symptoms do not otherwise meet criteria for autism spectrum disorder should be considered for a diagnosis of social communication disorder.

Specify whether:

With or without accompanying intellectual impairment

With or without accompanying language impairment

Associated with known medical or genetic condition or environment factor

Associated with another neurodevelopmental, mental or behavioural disorder

With catatonia

2.3.3 TREATMENTS. There is increasing evidence that parent-focused interventions that involve education and behaviour management can improve child adaptive behaviour and ASD symptoms (McConachie & Diggle, 2007), sleep difficulties (Papadopoulos et al., 2015) and parent mental health, particularly for those who have a child with an intellectual disability

(Tonge, Brereton, Kiomall, Mackinnon, & Rinehart, 2014). Psychopharmacology is widely used for ASD. While some medications have been shown to influence restricted or repetitive behaviours and comorbid difficulties such mood or anxiety (SSRIs, Risperidone and other antipsychotics), no medication has been proven to change the core symptoms of ASD. Biological therapies that are used to treat mental health difficulties, for example, transcranial magnetic stimulation, are also being explored as potential interventions for ASD (Enticott et al., 2014). Initial findings from therapeutic agents identified as promising in the animal literature, such as oxytocin, have been disappointing in showing clinical changes (Dadds et al., 2014). There is emerging work looking at effective treatments for children with comorbid ADHD and ASD, but more research is needed (Davis & Kollins, 2012)

2.4 COMORBIDITY OF ADHD AND ASD

2.4.1 GENETICS. Research of late has focused particularly on the genetic overlap and familial transmission of ADHD and ASD (Polderman, Hoekstra, Posthuma, & Larsson, 2014), with Musser et al. (2014) reporting that the offspring of mothers with ADHD are more likely to have an ASD, compared to offspring of typically developing mothers. Both ASD and ADHD are highly heritable conditions, with around 70-80% of the phenotypic variance for each disorder explained by genetic factors (Faraone et al., 2005; Lichtenstein, Carlström, Råstam, Gillberg, & Anckarsäter, 2010). Studies suggest that around 50-70% of the covariance of ASD and ADHD may be explained by common genetic influences (Mulligan et al. 2009; Rommelse, Franke, Geurts, Hartman, & Buitelaar, 2010; Ronald, Simonoff, Kuntsi, Asherson, & Plomin, 2008).

2.4.2 NEUROANATOMY. ADHD is associated with functional and structural abnormalities within the fronto-striatal, fronto-cerebellar and fronto-parieto-temporal networks, as well as reduced grey matter in the basal ganglia, and abnormal grey matter and cortical thickness in frontal, cerebellar and temporal regions (Krain & Castellanos, 2006; Rubia, Alegria, & Brinson, 2014). ASD has also been linked to disruption within the fronto-striatal system (Bradshaw & Sheppard, 2000), though more global abnormalities have been found, including increased cortical thickness of all four lobes, poorly organised white matter tracts, abnormal neuronal migration and myelination, and atypical functional connectivity (Anagnostou & Taylor, 2011). While ADHD has been associated with a delay in structural brain maturation (Rubia et al., 2014) and reduced grey matter in the right posterior cerebellum (Lim et al., 2015), ASD is characterised by abnormal development, including early brain overgrowth and lack of expected pruning (Anagnostou & Taylor, 2011; Stanfield et al., 2008).

Children with ADHD and ASD have been reported to share ADHD-like irregularities of the basal ganglia, which are not present in children with ASD alone (Di Martino et al., 2013). Both children with ADHD and ADHD+ASD have been found to have difficulties with inattention although the causes seem different: under-arousal in ADHD and abnormal neural connectivity in ADHD+ASD (Bink et al., 2015).

In summary, both ADHD and ASD are associated with structural and functional abnormalities of brain regions and networks. It seems that children with ADHD+ASD may have abnormalities associated with both disorders combined.

2.4.3 EXECUTIVE FUNCTIONING. Both ADHD and ASD are associated with deficits in executive function (Bradshaw & Sheppard, 2000). A recent review (Gargaro et al., 2011) suggests that specific executive functioning profiles may help to differentiate ADHD and ASD, with children who had ADHD and ASD having a combination of the executive functioning

profiles seen in each disorder individually (Reiersen, 2011). Executive functioning deficits that have been found to dissociate ADHD and ASD include reasoning, self-monitoring and organisation in ASD (Semrud-Clikeman, Walkowiak, Wilkinson, & Butcher, 2010), and sustained attention in ADHD (Johnson et al., 2007; Sinzig, Bruning, Morsch, & Lehmkuhl, 2008). Initial findings suggest that the additive effects of having both conditions (ADHD and ASD) would mean that children with ADHD+ASD would be more likely to have executive functioning deficits. Overall, studies examining executive functioning in children with ADHD+ASD suggest these children with the comorbid condition have a combination of many of the deficits associated with ADHD and ASD alone. This 'additive' phenomenon in executive dysfunction is very similar to the additive abnormalities found in brain imaging work (Di Martino et al., 2013).

2.5 ASD SYMPTOMS IN CHILDREN WITH ADHD

2.5.1 PREVALENCE. Prior to the release of the DSM-5, ADHD and ASD were not diagnosed simultaneously (APA, 2013). In response to a wave of clinical and research evidence supporting the overlap of these two conditions, DSM-5 now allows the dual diagnosis of ASD and ADHD. Research demonstrates that children with ADHD have higher levels of ASD symptoms than controls, with 18 - 50% of children with ADHD having clinically significant ASD symptoms (Green et al., 2015; Kochhar et al., 2011a; Kochhar et al., 2011b; Reiersen et al., 2007; Ronald et al., 2008; Van der Meer et al., 2012). Table 3 summarises the published papers examining the prevalence and type of ASD symptoms in children with ADHD, illustrating that there is great variability in the existing evidence of ASD prevalence in ADHD samples. The majority of studies include clinical samples (13 out of 18), which limits our understanding of children with broader ADHD population. Age ranges are broad, which makes it difficult to assess the prevalence of ASD symptoms in children with ADHD at particular developmental stages (e.g.

middle childhood, early adolescence, and early adulthood). Measures of ASD symptoms also vary, with some measures being researcher generated and thus not validated. Reiersen and colleague's paper (2007) is most similar to this study. Her sample included 946 population-based twins with ADHD, ranging from 8 – 25 years of age when comorbid ASD symptoms were assessed using the Social Responsiveness Scale (SRS). She found that 22% of children with ADHD had clinically significant ASD symptoms.

2.5.2 TYPE OF ASD SYMPTOMS. There are three core domains of ASD symptoms, based on the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition (DSM-IV-TR) criteria: social interaction, communication and repetitive behaviours. While some studies report that children with ADHD exhibit elevated ASD symptoms across the three main core domains of ASD (Clark et al., 1999; Hattori et al., 2006; Nijmeijer et al., 2009; Reiersen et al., 2007) others report elevation in the repetitive and stereotyped behaviour (Polderman et al., 2014) or communication domains alone (Kochhar et al., 2011b). These differences may be due to the age of the sample, as Polderman et al. (2014) only examined adults with ADHD and co-occurring ASD symptoms. Kochhar et al.'s (2011) examined children and adolescents (9 – 15 years), which is similar to the age range in this study however, this was a clinically derived sample, with a small sample size (n = 60). It is possible that Kochhar et al.'s study did not have sufficient power to detect differences between the ADHD and control group on all SCQ subscales (communication, social interaction and repetitive behaviours).

2.5.3 RELATIONSHIP BETWEEN ADHD SYMPTOMS AND ASD. In a longitudinal population-based birth cohort study (n = 5,383, age 4 -17 years), ASD symptoms were found to be generally stable, with ADHD symptoms declining over time (St. Pourcain, 2011). There is also evidence that children who have persistent ADHD symptoms are more likely to have persistent social communication difficulties (St Pourcain, 2011; Reiersen, 2011). Researchers

suggest that the presence of ASD symptoms in children with ADHD may be a risk factor for more persistent ADHD (St. Pourcain et al., 2011).

Children with ADHD combined type (Cooper, Martin, Langley, Hamshere, & Thapar, 2014; Grzadzinski et al., 2011; Reiersen et al., 2007) and inattentive type (Ronald, Larsson, Anckarsater, & Lichtenstein, 2014) have been documented to have greater ASD symptoms than hyperactive/impulsive subtype, suggesting that a diagnosis of ADHD combined subtype may be a risk factor for greater ASD symptoms. When examined dimensionally, greater ASD symptoms have been associated with greater inattentive symptoms (Ronald et al., 2014), more impulsive symptoms (Kroger et al., 2011; Ronald et al., 2014) and elevated hyperactivity (Kroger et al., 2011). There is mixed evidence as to whether greater ADHD symptom severity is associated with more ASD symptoms in children with ADHD. A small clinical study (n = 75) found that ASD symptoms were not associated with ADHD symptom severity in children with ADHD (Grzadzinski et al., 2011), while a recent larger clinical study (n = 711) found that greater ADHD symptom severity was associated with greater ASD symptoms in children with ADHD. Overall, it remains unclear whether it is the subtype of ADHD, the types of symptoms, or the ADHD symptom severity that is most associated with ASD symptoms in children with ADHD.

2.5.4 GENDER. The small body of research examining the relationship between gender and ASD symptoms in children with ADHD has produced mixed findings (Nijmeijer et al., 2009; Reiersen et al., 2007). A community-based study reported that boys with ADHD had more ASD symptoms than girls with ADHD (Reiersen et al., 2007). However, in the same study, a greater percentage of girls with ADHD combined type met clinical cut offs for ASD symptoms (75%) compared to boys with ADHD combined type (25%; Reiersen, 2007). Nijmeijer and colleagues (2009) have also reported that girls with ADHD had more ASD symptoms than

boys with ADHD. A clinical study using the Social Communication Questionnaire (SCQ) (Rutter, Bailey, & Lord, 2003) found that boys with ADHD had greater SCQ scores on the Social Interaction scale only, when compared with girls with ADHD (Martin, Hamshere, O'Donovan, Rutter, & Thapar, 2014).

2.6 SUMMARY. In summary, longitudinal research shows that ASD symptoms are more stable over time, compared to ADHD symptoms, which typically reduce with age. The presence of ASD symptoms in children with ADHD may be a risk factor for more persistent ADHD symptoms over time, but more research is needed. Children with ADHD combined or inattentive ADHD are more likely to have ASD symptoms, compared to children with an ADHD hyperactive-impulsive presentation. With regard to gender and ADHD symptom severity, research is mixed, with no clear association between gender or ADHD symptom severity and an increased likelihood of ASD symptoms in children with ADHD.

Table 3. Summary of papers relevant to Study 1

Lead Author (Year)	N	Age	Sample	Measure ASD	Prop ASD	Relevant key findings
Van der Meer (2014)	378	6 – 13 years	Population	AQ[a] SCQ[c]	30%	30% of children in the high ASD and high ADHD class were above the clinical SCQ cut off score.
Ronald (2014)	17,000	9 – 12 years	Population twins	Autism-Tics[b]	NR	ASD associated with more inattentive and impulsive symptoms
Martin (2014)	821	5 – 18 years	Clinical	SCQ[c]	NR	Boys with ASD symptoms scored higher than girls on social interaction SCQ subscale.
Cooper (2014)	711	5 – 18 years	Clinical	SCQ[c]	NR	ASD symptoms more likely in children with ADHD combined type or greater ADHD symptoms
Kotte (2013)	469	6 – 18 years	Clinical	CBCL[d]	18%	
Van der Meer (2012)	644	5 – 17 years	Clin/Pop	SCQ[c]	NR	
Mayes (2012)	1005	2 – 16 years	Clinical	CASD[e]	34%	
St Pourcain (2011)	5,383	4 -17 years	Population	SCDC[f]	NR	
Kroger (2011)	205	6 – 13 years	Clinical	SCQ[c]	NR	ASD associated with more hyperactive/impulsive symptoms
Kochhar (2011)	60	9 – 15 years	Clinical	SCQ[c]	28%	ADHD group not elevated on SCQ repetitive subscale
Grzadzinski (2011)	75	7 – 18 years	Clinical	SRS[g]	33%	ASD associated with ADHD combined type but not ADHD severity.
Rich (2009)	379	Mean 10.41	Community	SCQ[c] PDD screen[h]	15%	
Nijmeijer (2009)	256	5 – 19 years	Clinical	CSBQ[i]	NR	ADHD > Controls ASD symptoms, all subscales Elevated ASD symptoms in girls and boys ASD associated with ADHD combined type
Mulligan (2009)	821	5 - 12 years	Clinical	SCQ[c]	67%	
Reiersen (2007)	946	8 – 25 years	Population twins	SRS[g]	22%	ASD associated with ADHD combined type. Greater ASD symptoms for boys, but greater proportion of girls above ASD cut-off. ADHD > Controls ASD symptoms, all subscales.
Hattori (2006)	35	5 – 15 years	Clinical	ASSQ[j]	NR	ADHD > Controls ASD symptoms, all subscales.
Greene (2001)	267	NR	Clinical	CBCL[d] SAICA[k]	22%	
Clark (1999)	49	5 – 15 years	Clinical	ACC[k]	50%	ADHD > Controls ASD symptoms, all subscales.

Note: [a] Autism Quotient; [b] Autism–Tics, AD/HD, and other comorbidities parental interview inventory; [c] Social Communication Questionnaire; [d] Child Behaviour Checklist; [e] Checklist for Autism Spectrum Disorder; [f] Social Communication Disorder Checklist; [g] Social Responsiveness Scale; [h] Family history interview for PDD symptoms following the Family History Research method; [i] Children's Social Behaviour Questionnaire; [j] High-Functioning Autism Spectrum Screening Questionnaire; [k] Social Adjustment Inventory for Children and Adolescents; [l] Autism Criteria Checklist.

Table 4. Summary of papers relevant to Study 2

Lead Author (Year)	N	Age	Sample	Measure ASD	Measures Other	Relevant key findings
Thomas (2015)	392	5 -13 years	Clinical	Parent reported diagnosis	SDQ[e] PedsQL[f]	Children with ADHD+ASD poorer QoL, greater peer problems, emotional and conduct problems, compared to controls.
Van der Meer (2014)	378	6 – 13 years	Population	AQ[a] SCQ[b]	SWAN[g] CPRS-R:L[h]	High ASD+ADHD symptom class were the most oppositional, emotionally labile and anxious although, none in clinical range.
Cooper (2014)	711	5 – 18 years	Clinical	SCQ[b]	CTRS[i] CAPA[j]	Greater ASD symptoms associated with presence of externalising diagnoses (conduct & ODD), anxiety diagnosis and symptoms of depression, after adjusting for covariates.
Kotte (2013)	469	6 – 18 years	Clinical	CBCL[c]	KSADS[k] CBCL[c] SAICA[l]	ADHD+ASD group had a more severe emotional dysregulation profile, poorer social functioning, and more externalising and internalising disorders than the ADHD only group. Greater ASD symptoms were not associated with greater ADHD symptom severity, or specific ADHD symptoms.
Van der Meer (2012)	644	5 – 17 years	Clin/Pop	SCQ[b]	CPRS-R:L[h]	ASD symptoms associated with greater emotional lability and more peer problems.
Kroger (2011)	205	6 – 13 years	Clinical	SCQ[b]	Kinder DIPS interview	ASD symptoms were not associated with more externalising disorders.
Grzadzinski (2011)	75	7 – 18 years	Clinical	SRS[d]	CPRS-R:L[h] CBCL[c]	ASD symptoms associated with greater oppositional and withdrawn/depressed behaviours but not greater ADHD symptom severity or anxiety.
Mulligan (2009)	821	5 - 12 years	Clinical	SCQ[b]	CPRS-R:L[h] CTRS[i] SDQ[e]	ASD symptoms associated with greater externalising diagnoses.

Note: [a] Autism Quotient; [b] Social Communication Questionnaire [c] Child Behaviour Checklist; [d] Social Responsiveness Scale; [e] Strengths and Difficulties Questionnaire; [f]Pediatric Quality of Life Inventory; [g] The Strengths and Weaknesses of ADHD Symptoms and Normal Behaviour Scale; [h] Conners Parent Rating Scale Revised Long Version; [i] Conners Teacher Rating Scale [j] Child and Adolescent Psychiatric Assessment [k] Kiddie Schedule for Affective Disorders and Schizophrenia [l] Social Adjustment Inventory for Children and Adolescents

2.7 ASD SYMPTOMS AND CHILD FUNCTIONING IN ADHD.

Children with ADHD have greater internalising and externalising difficulties (Efron et al., 2014a; Sciberras, Lycett, et al., 2014), more peer problems (Efron et al., 2014a; Mrug et al., 2012; Nijmeijer et al., 2008), greater sleep difficulties (Lycett, Mensah, Hiscock, & Sciberras, 2014) and poorer QoL (Karande, 2012; Wehmeier, Schacht, & Barkley, 2010) compared to children without ADHD. However, the degree to which ASD symptoms contribute to, or compound, these difficulties remains unclear. Understanding whether ASD symptoms are related to functional difficulties in children with ADHD will enrich the assessment and treatment of children with ADHD (See Table 4 for a summary of relevant studies).

2.7.1 MENTAL HEALTH. There is conflicting evidence as to whether mental health and peer difficulties in children with ADHD are associated with comorbid ASD symptoms. The majority of studies suggest that ASD symptoms in children with ADHD are associated with greater conduct and oppositional defiant symptoms (Cooper et al., 2014; Grzadzinski et al., 2011; Kotte et al., 2013; Mulligan et al. 2009; Van der Meer et al., 2012), with only two not finding this association between ASD symptoms and externalising disorders in children with ADHD (Kroger et al., 2011; Van der Meer et al., 2014). There are few possibilities for these conflicting findings. Firstly, Kroger et al. used a unique clinical interview, that hasn't been used in previous studies. Secondly, the differences in findings depend on how they are reported by researchers. Van der Meer et al. (2014) report that no classes (e.g. ADHD only, ADHD+ASD) showed clinically elevated mental health difficulties. However, when the paper is examined more closely, it is reported that children with high ASD and ADHD symptoms were more oppositional, emotionally labile and anxious than any other group, albeit with scores in the non-clinical range. Given this ambiguity, future research needs to be clear about whether ASD symptoms are associated with greater mental health difficulties, and whether these are clinically elevated.

Research is also mixed as to whether ASD symptoms are associated with greater internalising symptoms (e.g. depression and anxiety) in children with ADHD. A large (n = 644) mixed clinical/population based study by Van der Meer et al. (2012) found that children with ADHD+ASD were more emotionally labile than children with ASD+ADHD, as measured by the Conners Long form. This study identified classes based on the dominant symptoms, with the ADHD+ASD having predominantly ADHD symptoms, with some ASD symptoms, and the reverse for the ASD+ADHD group. Similarly, Kotte et al. (2013) and Cooper et al. (2014) found that clinically referred children with ADHD+ASD were more likely to have a mood disorder or anxiety disorder, compared to children with ADHD alone. In contrast, Grzadzinski et al. (2011) found no difference between children with ADHD alone and children with ADHD+ASD on measures of anxiety (N = 75, clinical sample, ages 7 – 18 years). It is possible that Grzadzinski did not find increased rates of internalising difficulties, because her sample is the smallest of all studies, which may have led it be underpowered, or because her age range was very broad (7 – 18 years). The majority of evidence suggests that children with ADHD+ASD are more at risk of internalising symptoms, however this needs to be confirmed within a community-based sample.

2.7.2 PEER PROBLEMS. Two studies have shown a link between ASD symptoms in children with ADHD and greater peer problems (Kotte et al., 2013, Van der Meer et al., 2012). Van der Meer et al. (2012) examined social problems using the Conners Long Form, in a mixed population and clinical sample of young people (n = 644) ranging from 5 – 17 years of age. They found that children with ADHD+ASD had more social problems than children with ADHD alone. Kotte et al. (2013) examined social problems using the Social Adjustment Inventory in a clinical sample of 6 – 18 year olds (n = 242), finding significantly higher social impairment for children with ADHD+ASD, compared to ADHD only. Grzadzinski et al. (2011) findings contrasted to those previously reported. They found, in a clinical sample of 75

children, aged between 7 – 17 years, no difference between children with ADHD only and ADHD+ASD on the Conners social problems subscale. No studies have examined peer problems using teacher report. This is important, as teachers are likely to have unique insight into the quality of social relationships in the school setting. Given the mixed findings, and that all studies has been done using clinical only or mixed samples, future research needs to examine peer problems in community samples utilising teacher reports.

2.7.3 QUALITY OF LIFE. Quality of life (QoL) describes an individual's subjective perception of their position in life, as evidenced by their physical, psychological, and social functioning (Danckaerts et al., 2010b) We know that children with ADHD and ASD have poorer QoL than children without ADHD (Danckaerts et al., 2010a; Delahaye et al., 2014; Simone Thomas, Sciberras, Lycett, Papadopoulos, & Rinehart, 2015). In a large clinical based study of children aged 5 -13 years (N = 392), it was found that greater ASD symptoms in children with ADHD are associated with poorer QoL (Simone Thomas et al., 2015). However, this was a clinical based study, which relied on parent-reported ASD diagnosis, rather than a validated measure of ASD symptoms. Furthermore, quality of life was parent-reported. Using a validated measure of ASD symptoms would allow future research to more closely examine the association between ASD symptoms and poorer QoL.

2.7.4 SLEEP. Sleep problems are common in children with ASD and ADHD (Papadopoulos et al., 2015). Research suggests that sleep difficulties in children with ADHD are typically transient however; they are persistent in 10% of cases (Lycett et al., 2014). There is evidence that comorbid internalising and externalising disorders, as well as greater ADHD symptom severity, puts children at greater risk of persistent sleep problems (Lycett et al., 2014). There is increasing evidence that behavioural sleep interventions can improve sleep, child and family functioning in samples of children with ADHD (Emma Sciberras, Fulton, Efron, Oberklaid, &

Hiscock, 2011). Only one study has examined whether sleep problems are exacerbated by comorbid ASD in children with ADHD (Thomas, Lycett, Papadopoulos, Sciberras, & Rinehart, 2015). This study found that sleep problem severity did not differ between children with ADHD+ASD compared to ADHD alone (Thomas et al., 2015). Given this is the first study in this area, further research is needed to replicate the results.

2.8 ASD SYMPTOMS AND FAMILY FUNCTIONING IN ADHD

Although it is well established that parents of children with ADHD or ASD experience poorer family functioning including parent mental health problems, poorer family quality of life (FQoL) and parenting difficulties, it is unknown how comorbid ASD symptoms contribute to family functioning in children with ADHD. It is important to understand which comorbidities contribute to poorer family functioning to guide treatment planning.

There is an extensive literature examining the family functioning of children with ADHD (Johnston & Mash, 2001). Parents of children with ADHD have been found to use less consistent and more hostile parenting behaviours than parents of non-ADHD controls, in response to the stress of managing ADHD symptoms (Cussen et al., 2012; Johnston & Mash, 2001(Modesto-Lowe, Danforth, & Brooks, 2008). Parents of children with ADHD have higher rates of depression and anxiety than parents of children without ADHD and poorer FQoL (Cussen, Sciberras, Ukoumunne, & Efron, 2012; Pressman et al., 2006; van Steijn, Oerlemans, van Aken, Buitelaar, & Rommelse, 2014). Research is mixed regarding couple functioning, with recent studies finding no difference between couples who have a child with ADHD and couples without a child with ADHD on measures of couple conflict and couple support (Cussen et al., 2012; van Steijn, Oerlemans, van Aken, Buitelaar, & Rommelse, 2015). It appears that ADHD *plus an additional comorbidity* is a risk factor for more relationship difficulties for

couple who have a child with ADHD (Hurtig et al., 2007; Wymbs, Pelham, Gnagy, & Molina, 2008).

Similarly, parents of children with ASD have been found to have poorer family functioning, across multiple domains, including more depressive symptoms, compared to parents of children with ADHD or typically developing children (Jellett, Wood, Giallo, & Seymour, 2015; Sikora et al., 2013). Couples who have a child with ASD have less relationship satisfaction (Brobst, Clopton, & Hendrick, 2009; Meadan, Halle, & Ebata, 2010) and higher rates of divorce (Hartley et al., 2010) than couples without a child with ASD. These parents face specific challenges in parenting, given the social communication impairments at the core of ASD. Surprisingly little research has examined parenting in children with ASD. Initial findings suggests that parents of children with ASD largely parent in a similar way to parents of typically developing children, with negative parenting behaviours almost entirely accounted for by parental stress (Blacher, Baker, & Kaladjian, 2013; Boonen et al., 2015). This is important in growing our understanding of risk and modifiable outcomes that lead to better or poorer outcomes for children with ADHD. It is possible that families who have a child with ADHD+ASD are at particular risk for poorer family functioning, thus benefiting from targeted intervention.

In summary, it is well established that families of children with ADHD or ASD have poorer family functioning than families of typically developing children. It is less clear how family functioning is affected when a child has both ADHD and ASD symptoms. To the best of our knowledge, only one study (Kotte et al., 2013) has examined the association between ASD symptoms and family functioning in children with ADHD. This study included a clinical sample of youth with (n = 242) and without ADHD (n = 227) aged between 6 to 18 years. They found no differences in family functioning (expression, conflict and cohesion) when comparing families that had a child with ADHD (n = 198) to families with a child who had ADHD+ASD

(n = 44) (Kotte et al., 2013). However, couples that had a child with ADHD+ASD experienced significantly more conflict, and were more likely to be separated or divorced, than couples with a typically developing child (Kotte et al., 2013). One of the limitations of this study was the measurement of ASD symptoms. The measure of ASD symptoms was researcher generated using subscales of the CBCL, which is not a validated measure of ASD symptoms. Furthermore, the measure of family functioning describes difficulties, without making it clear the functional impact of these difficulties on family life. To advance the literature further, future research needs to examine the association between ASD symptoms and family functioning more broadly, using a validated measure of ASD symptoms. Research could build on Kotte's work by incorporating a measure of FQoL, which assesses the impact of child health and behaviours on family day to day life.

2.9 LIMITATIONS OF PREVIOUS RESEARCH

Examining ASD symptoms in children with ADHD is an emerging area of research focus, considering the recent release of the DSM-5, which will allow the joint diagnosis of an ASD and ADHD. The majority of previous studies are limited by referral bias, with participants drawn from clinical samples more likely to have higher levels of symptomatology (see Table 3, list is not exhaustive). To assess the generalisability of findings, relating to the prevalence, nature and functioning correlates of ASD symptoms in children with ADHD, it is important for research to be community-based, and include children from a range of socio-economic backgrounds. Likely due to a preponderance of clinical samples, studies examining the overlap between ADHD and ASD predominantly include male samples (male only or greater than 80%), only include children with ADHD combined type, and examine individuals over a broad age range, typically greater than five years. There is evidence that girls are at least as affected by ASD symptoms as boys (Reiersen et al., 2007). It is therefore important to better understand

if there are any differences in the presentation of ASD symptoms in girls with ADHD. Also, research that looks at children at specific ages would be important to ascertain how these social and communication difficulties may change across development.

Secondly, a number of studies allocate participants to ADHD groups on the basis of clinician diagnosis, questionnaires, or file review, without follow up using a structured diagnostic interview alone (Clark et al., 1999; Gadow, DeVincent, & Schneider, 2009; Ghaziuddin, Welch, Mohiuddin, Lagrou, & Ghaziuddin, 2010; Hattori et al., 2006; Kanne, Christ, & Reiersen, 2009; Luteijn et al., 2000; Mayes, Calhoun, Mayes, & Molitoris, 2012; Nijmeijer et al., 2009; Reiersen et al, 2008; Van der Meer et al., 2012). Confirming ADHD diagnosis is important, as being clearly aware of the characteristics and severity of study samples, is central to determining the application of the results. As suggested by Grzadzinski (2011), it would also be helpful to view ASD traits in ADHD from a dimensional spectrum perspective, not just looking at cut-offs but also sub-threshold ASD symptoms. Lowering the autism measure cut-offs to, for example 11 on the SCQ, as proposed by Kroger (2011) may better identify sub-threshold ASD symptoms, common in children with high functioning autism or Asperger's, and more likely to be seen at this level in children with ADHD.

Thirdly, Reiersen's population-based study examining ASD symptoms in children with ADHD has advanced our understanding of the comorbidity of these two conditions (Reiersen et al., 2007). However, there were some limitations. Participants (n = 946) ranged from 8 to 25 years of age when ASD symptoms were measured, which was up to 5 years after information was collected about ADHD symptoms, and the study included a small sample of girls with ADHD (n = 19) (Reiersen et al., 2007).

Fourthly, the wide variety of parent-report measures used to identify ASD symptoms in children with ADHD is a potential limitation of research at present. This heterogeneity makes

comparison between studies difficult. More recent studies have relied on clinician diagnosis of ADHD and ASD only (Musser et al., 2014) or measures that are not well validated (e.g., self-report checklist of 12 items based on DSM-5 criteria (Polderman et al., 2014) and the Autism, Tics, AD/HD and other comorbidities telephone interview (A-TAC) (Ronald et al., 2014). Future research should use parent-report ASD screening measures, which are based on well-established ASD diagnostic interviews, such as the SCQ and the Social Responsiveness Scale (SRS). Further, as suggested by Reiersen (2011), findings of previous studies need to be replicated with alternative measures of ASD and ADHD symptoms.

Lastly, research to date has, rightly, focused on disentangling the relationship between ADHD and ASD, in an attempt to establish if the two are different manifestations of an overall disorder. More research is needed that examines that the association between ASD symptoms in children with ADHD and child and family functioning.

3. THE PRESENT STUDY

3.1 RATIONALE AND OVERALL AIMS

Given the limitations of previous research, the proposed community-based study aimed to (1) examine the prevalence and nature of ASD symptoms in children with ADHD, compared with non-ADHD controls and predictors of ASD symptoms in children with ADHD (2) examine the association between ASD symptoms and child functioning in children with ADHD and non-ADHD controls; and (3) examine the association between ASD symptoms and family functioning. These aims were thoroughly examined across three connected sub-studies as outlined below.

3.2 STUDY 1 AIMS AND HYPOTHESES

AIM 1. To examine the prevalence and type of ASD symptoms in children with ADHD and non-ADHD controls.

AIM 2. Within the ADHD group only, to examine the relationship between ADHD subtype, hyperactive/impulsive and inattentive symptoms, ADHD symptom severity, child gender and ASD symptom severity.

HYPOTHESES. It was hypothesised that: (1) children with ADHD would have more ASD symptoms across all domains, compared to non-ADHD controls, (2) greater ADHD symptom severity would be associated with more ASD symptoms, (3) children with ADHD combined type would have more ASD symptoms compared to children with ADHD inattentive type; and (4) greater ASD symptom severity in girls with ADHD compared to boys with ADHD.

3.3 STUDY 2 AIMS AND HYPOTHESES

AIM 1. To clarify the relationship between ASD symptoms and psychosocial functioning in a community sample of children with and without ADHD, through the use of rigorous measures and multi-informant assessments of a) peer problems and prosocial behaviours; b) mental health; and c) sleep.

AIM 2. To extend current knowledge by examining psychosocial quality of life (QoL), which encompasses social, emotional and school functioning, which to the best of our knowledge, has not been previously examined.

HYPOTHESES. It was hypothesised that: (1) Greater ASD symptom severity in children with and without ADHD would be associated with greater peer problems and less prosocial behaviours; (2) greater ASD symptom severity in children with and without ADHD would be associated with poorer child mental health; (3) greater ASD symptom severity in children with and without ADHD would be associated with moderate to large sleep problems and; (4) greater ASD symptom severity in children with and without ADHD would be associated with poorer psychosocial quality of life.

3.4 STUDY 3 AIMS AND HYPOTHESES

AIM 1. To examine the association between ASD symptoms (measured dimensionally) in children with and without ADHD and a broad range of family functioning variables.

AIM 2. This study also aimed to examine differences between ADHD+ASD, ADHD and control groups on family functioning variables.

HYPOTHESES. It was hypothesised that greater ASD symptoms in children with ADHD would be associated with 1) poorer parent mental health; 2) poorer family quality of life (FQoL); 3) more couple conflict; 4) less couple support; and 5) lower parent self-efficacy, less parenting consistency and warmth, and more hostile parenting. We hypothesised that the ADHD+ASD group would have poorer family functioning, across all domains, when compared to the ADHD or control groups.

Declaration for Thesis Chapter 2: General Method

Monash University

Declaration by candidate

In the case of Chapter 2: General Method, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Project design, attainment of ethics approval, recruitment and assessment of a sub-set of research participants and writing of manuscript	70%

The following co-authors contributed to the work. If co-authors are students at Monash University, the extent of their contribution in percentage terms must be stated:

Name	Nature of contribution
Professor Nicole Rinehart	Contributed to project design and provided input during final draft stage of manuscript
Professor Vicki Anderson	Contributed to project design and provided input during final draft stage of manuscript
Dr Emma Sciberras	Contributed to project design and provided input during final draft stage of manuscript

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work*.

Candidate's Signature	[redacted]	**Date** 28/10/2015
Main Supervisor's Signature	[redacted]	**Date** 20/10/2015

4. METHOD

4.1 THE CHILDREN'S ATTENTION PROJECT (CAP)

The three studies outlined in this thesis are part of the broader Children's Attention Project (CAP), which is the first Australian prospective cohort study of a community-based sample of primary school aged children with a confirmed diagnosis of ADHD and non-ADHD controls (Emma Sciberras et al., 2013). The project commenced in 2011 and is funded by the National Health and Medical Research Council of Australia (NHMRC) until 2015 (Project grant number: 1008522). This funding allowed for baseline data collection and two follow ups, 18 months and three years post baseline for two cohorts. Children were in Grade 1 (6 - 7 years of age) at baseline. The CAP study aims to:

1. Describe ADHD symptoms over the early years of school;
2. Evaluate the extent to which a community sample of children with ADHD has elevated risks for poor mental health, academic & social outcomes compared to non-ADHD controls
3. Evaluate the extent to which families of a community sample of children with ADHD have elevated risks for poor parent mental health & quality of life compared to non-ADHD controls; and
4. Assess the influence of ADHD subtype and other child, family, socioeconomic and school factors on children's mental health, academic and social outcomes.

4.2 DESIGN

All three sub-studies had a cross-sectional, community based design.

4.3 SETTING AND LOCATION

Participants were Grade 1 students recruited from 43 eligible state primary schools in five school networks in the East and West of Melbourne, selected for their socioeconomic mix,

using the Index of Community Socioeconomic Advantage. Children are recruited in two consecutive cohorts: Cohort 1 recruited in 2011 and Cohort 2 in 2012 (see Figure 1).

4.4 PARTICIPANTS

Children in their second year of formal schooling (6-8 years of age) were screened for ADHD. Children with an intellectual disability (IQ < 70) were excluded, as were those whose parents lacked sufficient English to complete study questionnaires. Children were also excluded if they had a serious medical condition (e.g., diabetes), genetic disorder (e.g., Down's Syndrome), moderate-severe sensory impairment (e.g., blind, deaf) or neurological problems (e.g., cerebral palsy, epilepsy). All other Grade 1 children will be eligible for study participation.

4.5 ETHICS

Ethics approval was obtained from The Royal Children's Hospital (#31056), the Victorian Department of Education and Early Childhood Development (#2011_001095) and Monash University (#CF12/4044 - 2012001944) Melbourne, Australia.

4.6 MEASURES

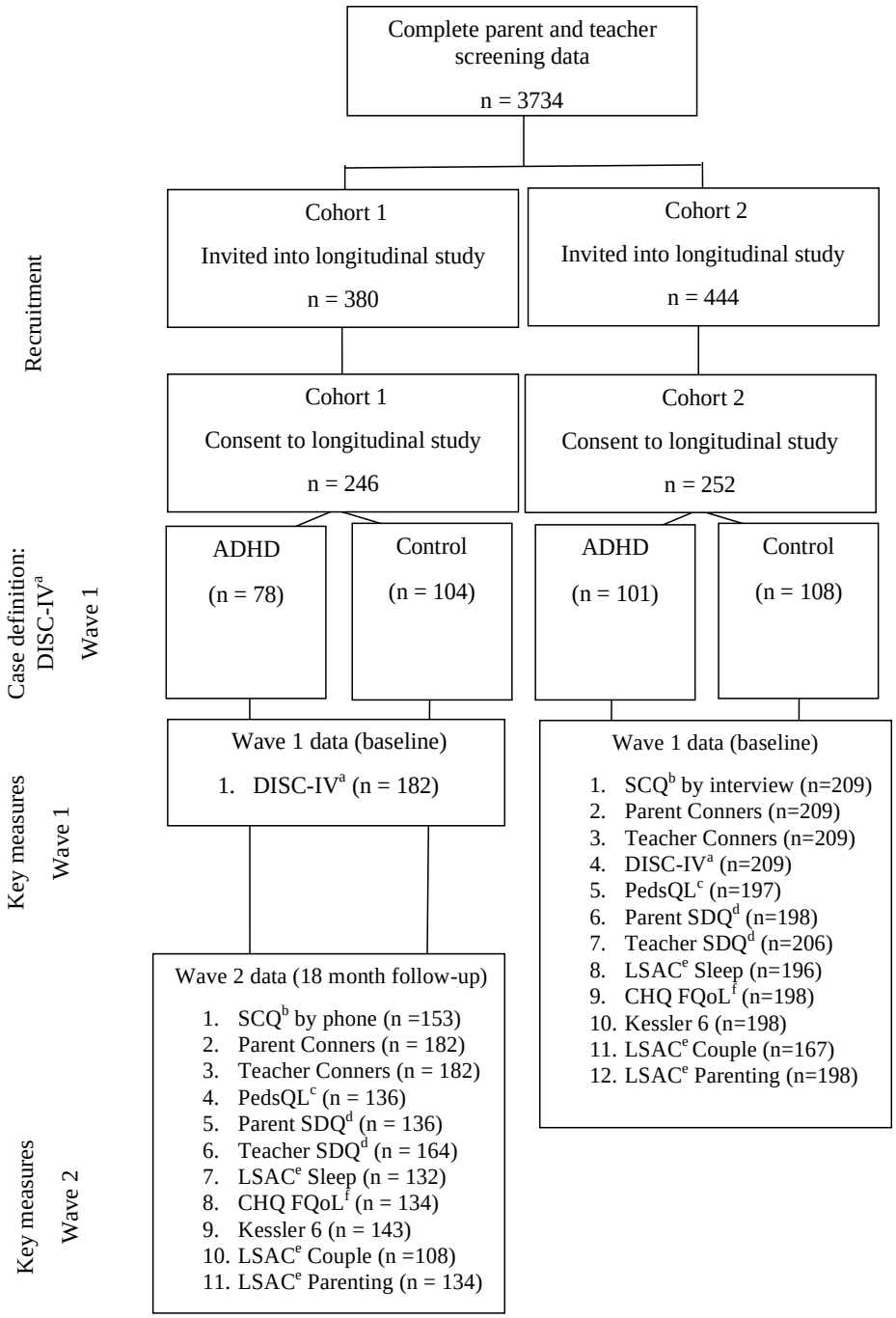
4.6.1 DETERMINING GROUP MEMBERSHIP

ADHD diagnosis and subtype. These diagnoses were assessed using the DISC-IV (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000), collected at Wave 1 only (see Figure 1). This parent-completed interview assesses mental health conditions using DSM-IV-TR criteria (see Table 5 for a summary of study measures). The measure has good diagnostic reliability and validity (Shaffer et al., 2000). Impairment thresholds and DSM-IV symptoms

(Version N, April 2007, algorithms) were used to confirm presence and subtype of ADHD. Interviewers were blind to the child's ADHD screening status.

ASD symptoms. Child ASD symptoms were assessed using the Social Communication Questionnaire Lifetime form (SCQ; Rutter et al., 2003). The SCQ is a 40-item, parent-report screening measure, which measures symptomatology associated with ASD. Items are in a yes/no format (see Appendix C). The SCQ was originally designed to accompany the *Autism Diagnostic Interview Revised* (ADI-R), with the SCQ content coverage being parallel to this interview, only much briefer. It is the most researched ASD screening measure, with eleven studies examining the validity and reliability in a range of samples (Norris, 2010). It has been validated in children between six and ten years. An overall Total Score is derived, and is then interpreted with reference to cut-off scores, indicating the likelihood that the individual has an ASD. A cut-off of 15 or greater on the Lifetime form indicates possible ASD (Rutter et al., 2003). Recent research has suggested that a cut-off of 11 on the Lifetime form is more appropriate for identifying children with mild to moderate ASD, who do not have an accompanying intellectual disability (Eaves, Wingert, & Ho, 2006; M. Norris & Lecavalier, 2010).In addition, three subscales can be obtained; Qualitative Abnormalities in Reciprocal Social Interaction, Qualitative Abnormalities in Communication; and Restricted, Repetitive and Stereotyped Patterns of Behaviour. The Lifetime Form was used in this research, as this form assesses behaviour that has occurred throughout the child's lifetime. The measure takes approximately 10 minutes to complete for each participant. The total SCQ was used in Papers 1 to 3, however, the subscale scores were examined in Paper 1 only.

Figure 1. Overall participant flow chart



[a]Diagnostic Interview Schedule for Children Version 4, [b]Social Communication Questionnaire Lifetime form, [c] Pediatric Quality of Life Scale, [d]Strengths and Difficulties Questionnaire, [e]Longitudinal Study of Australian Children, [f]Child Health Questionnaire Family Quality of Life.

With regard to validity, there is high agreement between the SCQ and the ADI-R at both the Total Score and domain score level, with this agreement being unaffected by age, gender, language level, and performance IQ (Rutter et al., 2003). Discriminant validity of the SCQ for ASD versus non-ASD was, respectively, 0.88 and 0.87 (Chandler et al., 2007; Tony Charman et al., 2007). All three sub-scores showed satisfactory differentiation of ASD from other diagnoses, with ROC curve scores ranging from 0.79 to 0.83 and 0.90 for the Total Score (Rutter et al., 2003). Sensitivity was 0.85 and specificity was 0.75. The cut-off of 15 or more gave sensitivity of .96 and a specificity of 0.80 for autism versus other diagnoses (Rutter et al., 2003).

4.6.2 OUTCOME MEASURES: STUDY 1

ADHD symptom severity. This construct was measured using the 10-item parent and teacher-reported Conners 3 ADHD Index (C. Conners, 2008) collected at Waves 1 and 2 (see Figure 1). Parents and teachers rated the child's symptoms in the last month, on a 4-point scale from 'not true at all' to 'very much true'. The measure has strong psychometric properties (C. Conners, 2008), particularly the revised parent and teacher versions (C. K. Conners, Sitarenios, Parker, & Epstein, 1998a, 1998b).

4.6.3 OUTCOME MEASURES: STUDY 2

Internalising and externalising disorders. The presence of an internalising or externalising disorder, was were assessed using the DISC-IV (Shaffer et al., 2000) at Wave 1 and defined as meeting diagnostic criteria for at least one internalising (e.g., generalized anxiety disorder, social phobia, specific phobia, panic disorder, obsessive compulsive disorder, post-traumatic stress disorder, tic disorder, separation anxiety disorder, major depressive disorder and dysthymic disorder) or externalising disorder (e.g., ADHD, oppositional defiant disorder, conduct disorder) in the year prior to assessment.

Peer problems, prosocial behaviour, emotional and conduct problems. These outcomes were assessed using the Strengths and Difficulties Questionnaire (SDQ) (Goodman, 1997) parent and teacher report for the following subscales, which each have 5 items: peer problems (e.g. "rather solitary, prefers to play alone), prosocial behaviour (e.g. Helpful if someone is hurt, upset or feeling ill), emotional problems (e.g. has many worries) and conduct problems (e.g. often lies or cheats). Parents and teachers were asked to rate on a three point Likert scale from not true, somewhat true to certainly true, the child's behaviour over the previous 6 months. Higher scores on problems subscales indicate poorer functioning whereas higher scores on the prosocial behavior scale indicate better functioning. Continuous scores were used in this study. The measure has strong psychometric properties, particularly the teacher version, for identifying behavioural difficulties in children aged 4 -12 years (Stone, Otten, Engels, Vermulst, & Janssens, 2010).

Child quality of life (QoL). QoL was assessed using the Pediatric Quality of Life Inventory 4.0 (PedsQL) (Limbers, Ripperger-Suhler, Boutton, Ransom, & Varni, 2011), which was completed by parents. The PedsQL physical, emotional, school and social QoL subscales were used (5 items each, with 7 items for the physical subscale), the Psychosocial Health Summary Score (15 items), which summarises scores on the emotional, social and school subscales, and a Total Scale Score, which summarises all subscale scores (22 items). The PedsQL has been shown to have good internal consistency ($\alpha = .92$ for parent-reported total scale QoL; (Varni, Burwinkle, Seid, & Skarr, 2003). Scores range from 0 to 100 with higher scores indicating better QoL.

Sleep problems. Moderate to large sleep problems were assessed using the following parent-reported item "*How much is your child's sleeping pattern or habits a problem for you?*"(Quach, Hiscock, Canterford, & Wake, 2009; Sung et al., 2008) from the Longitudinal

Study for Australian Children (LSAC) questionnaire. Responses were dichotomized into 'no problem at all/small problem' versus 'moderate problem/large problem' (Quach et al., 2009; Sung et al., 2008). This item has been used to measure sleep in children with and without ADHD (Quach et al., 2009; Sung et al., 2008) to dichotomize children into distinct sleep problem groups: no/mild versus moderate/severe (Hiscock, Canterford, Ukoumunne, & Wake, 2007; Quach et al., 2009; Sung et al., 2008). The measure corresponds well with the Children's Sleep Habits Questionnaire, a well-validated 33-item measure of child sleep difficulties (Lycett, Mensah, Hiscock, & Sciberras, 2015).

4.6.4 OUTCOME MEASURES: STUDY 3

Family quality of life (FQoL). FQoL was assessed using The Child Health Questionnaire Parent Form (CHQ-PF50) (Landgraf & Abetz, 1996). Family Impact Scale, which includes 10 items. This scale assesses the emotional impact, family impact and time impact of the child's health or behaviour. It is a reliable and validated measure of health-related QoL in children with ADHD (Rentz, Matza, Secnik, Swensen, & Revicki, 2005). The CHQ-PF50 has good to very good internal consistency on emotional impact ($\alpha = 0.68$), time impact ($\alpha = 0.75$) and family activities ($\alpha = 0.87$) scales (Waters, Salmon, & Wake, 2000). The emotional impact subscale assesses the degree of worry or concern caused by a child's wellbeing, behaviour, attention or learning difficulties on the parent (two items, rated from 1 'None' to 5 'A lot'). The family impact subscale examines the impact of the child's health or behaviour on family activities (e.g. ability to make spontaneous plans, impact on parent work, cause of conflict; six items, rated from 1 'Very often' to 5 'Never'). The time impact scale asks how often parents' time for their own personal needs was limited by their child's health, behaviour, attention or learning difficulties (two items, rated from 1 'Yes, limited me a lot' to 4 'No, did not limit me'). The scale is scored as the mean of the items (score between 1 and 5)

and converted to a score out of 100. The first section is reverse-coded, thus higher scores in all three scales represent a higher level of family functioning. The scale is scored as the mean of the items (score between 1 and 5) and converted to a score out of 100. All three subscales, family impact, time impact and emotional impact, will be used in this study.

Parent mental health. This construct was measured using the Kessler 6 (Furukawa, Kessler, Slade, & Andrews, 2003), a brief 6-item measure of psychological distress. The scale has good validity and reliability (Furukawa et al., 2003; Kessler et al., 2010). A recent study found Cronbach's alpha's to be 0.88 for the K6, with an optimal cut off of 14 (Cornelius, Groothoff, van der Klink, & Brouwer, 2013). The measure assesses the frequency of symptoms of depression and anxiety in the previous four weeks, with each item rated on a 5-point scale from none of the time (1) to all of the time (5). Higher scores indicate greater psychological distress. The measure assesses the frequency of symptoms of depression and anxiety in the previous four weeks, with each item rated on a 5-point scale from none of the time (1) to all of the time (5). Higher scores indicate greater psychological distress.

Parenting behaviours. These behaviours were assessed using scales from the Longitudinal Study of Australian Children (LSAC) (Zubrick, Lucas, Westrupp, & Nicholson, 2013). Parenting behavior subscales included hostile parenting (4-items), parental consistency (7-items), parental warmth (6-items) and parental self-efficacy (1-tem), which have been shown to have an important impact on child health and development (Zubrick et al., 2013). Higher scores indicated more of these specific domains for hostile parenting, parental warmth and parental self-efficacy. Lower scores on the consistent parenting scale indicated more consistent parenting. The hostile parenting subscale asked questions about parent behaviours like limited praise, talk that disapproves the child's behaviour, punishing the child when angry and parental difficulties managing their child. The parental consistency subscale asks questions

about the degree to which parents follow through on consequences (e.g. How often is your child able to get out of punishment if he/she really sets his/her mind to it?). The parental warmth subscale asks questions like 'How often do you hug or hold your child for no apparent reason?' and 'How often do you enjoy listening to your child and doing things with him/her?'. The parental self-efficacy item assesses parenting confidence by asking 'Overall, as a parent, do you feel that you are…?' with the options from 1 (Not very good as a parent) to 5 (A very good parent). For other scales, most items were scored on a five-point scale from 1 (Never/Almost Never) to 5 (Almost always/All the time, wording dependent on scale). The *couple support* scale from LSAC includes three items, with lower scores indicating less support (e.g. 'How often is your partner a resource and support to you in raising your child?'). The *couple conflict* scale from LSAC includes four items, with higher scores indicating more conflict (e.g. 'How often do you and your partner argue?' and, 'How often is there anger or hostility between you and your partner?'). Items are scored on a five-point scale from 1 (Never) to 5 (Always). Both scales have been shown to have good to very good reliability and validity (Zubrick et al., 2013).

4.6.5 CONFOUNDING VARIABLES (STUDY 1, 2 AND 3)

Demographic, child and family characteristics were identified *a-prioiri* that may be related to the associations of interest. The choice of variables was done carefully, to ensure that variables that may be on the causal pathway were not included. In adjusted models, we included child gender and age, recruitment cohort, parent high school completion (yes/no), neighbourhood socioeconomic status was measured by the census-based Socio-Economic Indexes for Areas Disadvantage Index, based on the child's residential postcode (SEIFA, mean of 1000, SD 100; higher scores reflect less disadvantage)(Australian Bureau of Statistics, 2013), and internalising diagnosis in the past year (yes/no: DISC-IV) and externalising diagnosis in the past year (yes/no: DISC-IV) and school clustering (Study 1 and 2 only). See Table 5 for a

summary of measures.

4.7 PROCEDURE

ADHD was screened using parent and teacher Conners 3 ADHD Indices, together with parent report of previous ADHD diagnosis (see Figure 1). Completed parent and teacher screening surveys were received for 63% of potential participants, with no differences between responders and non-responders for child age and gender; however, responders were from more socially advantaged areas. Children screened positive for ADHD if they had a prior diagnosis of ADHD, and/or if their scores on both parent and teacher ADHD indices were $\geq 75^{th}$ percentile for boys, and $\geq 80^{th}$ percentile for girls. Children screened negative if they did not have a prior diagnosis of ADHD and their scores on both the parent and teacher ADHD indices were $< 75^{th}$ percentile for boys and $< 80^{th}$ percentile for girls. Children who screened positive for ADHD (n = 412) were randomly matched, based on gender and school, with a child who screened negative for ADHD (n = 412).

At Wave 1, of the 412 children who screened positive for ADHD, 267 were eligible and participated in the longitudinal study (response rate: 65%), with 179 confirmed as meeting ADHD criteria on the DISC-IV making the ADHD group (see Figure 1). Of the 412 children who screened negative, 231 were eligible and participated (response rate: 56%), with 212 not meeting criteria for ADHD on the DISC-IV comprising the non-ADHD control group - see Efron et al. (2014a) for further details. The DISC-IV was completed via clinical interview with the child's parents, and other outcome measures were collected by parent and teacher questionnaires. Families were followed-up at 18 months post-recruitment (Wave 2) to assess medium-term outcomes

Table 5 Summary of study measures

Construct	Measure	Source
Core measures for Study 1 (Chapter 3- Profile)		
ASD Symptoms	Social Communication Questionnaire (SCQ) Lifetime Version (Rutter et al., 2003)	P
ADHD symptom severity	Conners' 3 ADHD index (C. Conners, 2008)	P, T
ADHD subtype	NIMH Diagnostic Interview Schedule for Children (DISC-IV) Fourth Edition (Shaffer et al., 2000)	P
Internalising and externalising comorbidities		
Core measures for Study 2 (Chapter 4- Child Functioning)		
Behavioural functioning	Strengths & Difficulties Questionnaire (SDQ; (Goodman, 1997) Prosocial behaviour, Peer problems, conduct and emotional problems subscales	P, T
QoL	Pediatric Quality of Life Inventory (PedsQL) – Version 4 (Limbers et al., 2011) Total score, Psychosocial Health Summary score, Physical, emotional, social and school quality of life subscales.	P
Moderate/severe sleep problems	Longitudinal Study for Australian Children (LSAC) (Quach et al., 2009; Sung et al., 2008) parent reported item.	P
Core measures for Study 3 (Chapter 5 – Family Functioning)		
Parent mental health	Kessler 6 (K6) (Furukawa et al., 2003)	P
Family quality of life (FQoL)	The Child Health Questionnaire (CHQ-PF50) (Landgraf & Abetz, 1996) – Parent Version, Family Impact Scale . Emotional impact, family impact and time impact subscales	P
Parenting behaviours	Longitudinal Study for Australian Children (LSAC) (Zubrick et al., 2013) Parental consistency, parental warmth, parental self-efficacy and angry parenting subscales	P
Couple relationship quality	Longitudinal Study for Australian Children (LSAC) (Zubrick et al., 2013) Couple support and couple conflict subscales	P

Note. P = parent report, T = teacher report.

For Cohort 1, blinded assessors completed the SCQ during a telephone at Wave 2 (18 month follow-up; see Table 6). For cohort 2, blinded assessors completed the SCQ during a face-to-face assessment at Wave 1 (baseline; see Table 6). The research assistant read the instructions and questions to parents, and recorded their responses. A standardised protocol was developed, with further clarification of items, should parents require further explanation (see Appendix D). SCQ data collection protocols were identical between the cohorts, apart from the mode of assessment. We report on Wave 1 child and family functioning variables for Cohort 2 participants and Wave 2 variables for Cohort 1, to harmonize with SCQ data collection.

Table 6. Data collection schedule.

	2011	**2012**	**2013**
Cohort 1	Wave 1 (Age 6-7) Diagnostic Interview Child Assessment		Wave 2 (Age 8-9) + SCQ (by phone) Parent Questionnaire Teacher Questionnaire
Cohort 2		Wave 1 (Age 6-7) + SCQ (at interview) Diagnostic Interview Child Assessment Parent Questionnaire Teacher Questionnaire	

4.8 STATISTICAL METHODS

4.8.1 OVERVIEW

This section describes the statistical methods employed, including strategies used to minimise missing data, ensure data accuracy and deal with outliers. It also describes the techniques used to consider normality and calculate effect sizes.

4.8.2 MISSING DATA

When surveys were received, they were visually inspected for missing data. If a section appeared to have been simply overlooked, the respondent was contacted and asked whether they would be willing to complete the section over the phone. Imputation was not used for

missing data. Therefore, there are some variables with more missing data. The total N ranges for each outcome are summarised in footnotes under each results table.

4.8.3 OUTLIERS

An outlier is an extreme value, which can unduly influence summary measures in its direction. Histogram, box and whisker plots were generated in Stata to examine the distribution of each outcome in order to identify outliers. There were no outliers identified by inspection, or as indicated by Cook's *d* values greater than 1.

4.8.4 NORMALITY

Normality refers to the degree to which the spread of data follows a normal bell shaped distribution. The chosen analytic approaches rely on assumptions of normality, thus it is essential to examine the spread of each outcome variable. Inspection of the normal probability plot of standardised residuals and the scatterplot of standardised residuals against standardised predicted values indicated the assumptions of normality, linearity and homoscedasticity of residuals were mostly met, with some exceptions outlined below.

There was some evidence that the residuals, for peer problems by teacher report, sleep problems, emotional problems by teacher report and conduct problems by teacher report, were somewhat non-linear and homogenous, as indicated by a p value of less of 0.05.Similarly, there was some evidence of homogenous residuals for K10, FQoL, parental consistency, parental warmth and couple outcome variables. However, given our large sample size, data is robust to the violation of these assumptions. Tests indicated that multicollinearity was not a concern for any outcome measures, with no outcome variables scoring higher than 10, which indicates a high level of multicollinearity.

4.8.5 POWER CALCULATION

In adjusted analyses, the study had 80% power to detect a 0.38-0.42 SD difference between ADHD and controls, .43-.50 SD difference between ADHD+ASD and controls, and .48-.56 SD difference between ADHD+ASD and ADHD. For all comparisons, an alpha level of 0.05 was used and exact *p* values and effect sizes are reported where appropriate. Although a number of statistical tests were performed, which may contribute to Type I error, Howell (2002) argues that correction for multiple comparisons is not warranted where *a priori* predictions are made. However, results should be interpreted conservatively.

4.9 ANALYSIS PLAN

4.9.1 STUDY 1 ANALYSES.

This study aimed to: 1) examine the prevalence and type of ASD symptoms in children with ADHD and non-ADHD controls; and 2) Within the ADHD group only, to examine the relationship between ADHD subtype, hyperactive/impulsive and inattentive symptoms, ADHD symptom severity, child gender and ASD symptom severity.

Chi-square and t-tests were used to examine differences between the ADHD and non-ADHD control group based on demographic variables. As noted earlier, the measure that was most proximal to SCQ data collection was used in analyses: Wave 1 SCQ and DISC-IV for Cohort 2; Wave 2 SCQ and Wave 1 DISC-IV data (collected 18 months earlier) for Cohort 1. Unadjusted and adjusted linear regression was used to examine differences in SCQ total and subscale scores between children with and without ADHD (Aim 1). Confounding variables were determined *a priori.* Adjusted binary logistic regression was used to compare the proportion of children with clinically significant (≥ 15: clinical cut off; ≥ 11: at risk range) SCQ Total Scores.

For children with ADHD only, unadjusted and adjusted linear regression was used to examine the relationship between total SCQ score and a) ADHD symptom severity b) inattentive symptoms, and hyperactive-impulsive symptoms and c) child gender (Aims 2, 3 and d) ADHD subtype. ADHD symptom severity scores, inattentive symptoms, and hyperactive-impulsive symptoms were converted into standard deviation units to facilitate meaningful interpretation. Effect sizes (Cohen's *d*) were calculated with effect sizes of 0.20, 0.50 and 0.80 indicating small, medium and large effect sizes respectively (Cohen, 1992). A sensitivity analysis was conducted which excluded children with a pre-existing ASD diagnosis to allow comparison to previous literature. All models controlled for school clustering, to take into account common school characteristics, given that children were recruited within school contexts. Adjusted analyses included the following potential confounding variables identified a priori: child gender, child age, recruitment cohort ADHD symptom severity, parent high school education completion (yes/no), socioeconomic status (SEIFA), criteria for at least one internalising disorder met in past year (yes/no) and criteria for at least one externalising disorder met in past year (yes/no). Analyses were conducted using Stata 13.0.

4.9.2 STUDY 2 ANALYSES.

This study aimed to 1) examine the association between ASD symptoms and a) peer problems and prosocial behaviours; b) mental health; c) quality of life; and d) sleep in children with and without ADHD.

Unadjusted and adjusted linear regression were used to examine, in children with and without ADHD, associations between: a) SCQ score and parent and teacher reported peer problems (SDQ), b) SCQ score and child QoL (Peds-QL) and c) SCQ score and parent and teacher-reported emotional and conduct problems (SDQ). In children with and without ADHD, unadjusted and adjusted logistic regression was used to examine the association between SCQ

score and the presence of an internalising and/or externalising disorder (DISC-IV) and moderate/severe sleep problems. Adjusted analyses controlled for child age, child gender, ADHD symptom severity, parent education, socioeconomic status, school clustering, and recruitment cohort. Analyses for peer problems, sleep problems and child QoL were also adjusted for the presence of an internalising or externalising disorder (met criteria for at least one in the past year). SCQ total score was used in analyses, with this score converted into standard deviation units. Analyses were conducted using Stata 13.0.

4.9.3 STUDY 3 ANALYSES.

This study aimed to 1) examine the association between ASD symptoms, measured continuously, in children with and without ADHD and a broad range of family functioning variables and; 2) examine differences between ADHD+ASD, ADHD and control groups on family functioning variables.

Unadjusted and adjusted linear regressions were used to examine the association between ASD symptoms and family functioning in children with ADHD. Adjusted analyses controlled for child (age, sex, internalising disorder, externalising disorder, recruitment cohort, ADHD symptom severity) and family factors (parent high school completion, Socio-Economic Indexes for Areas Disadvantage Index and school clustering). Total SCQ total score was used in analyses and converted into standard deviation units to assist interpretation. A series of linear regressions were used to examine differences in family functioning between children with ADHD+ASD (defined as SCQ score of 11+), ADHD only and controls, firstly comparing ADHD and ADHD+ASD groups to controls and subsequently comparing ADHD+ASD to ADHD. Analyses were conducted using Stata 13.0.

Declaration for Thesis Chapter: Results

Monash University

Declaration by candidate

In the case of the Results Chapter, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Statistical analyses and writing of manuscript	70%

The following co-authors contributed to the work. If co-authors are students at Monash University, the extent of their contribution in percentage terms must be stated:

Name	Nature of contribution
Professor Nicole Rinehart	Input during final draft stage of manuscript
Professor Vicki Anderson	Input during final draft stage of manuscript
Dr Emma Sciberras	Input during final draft stage of manuscript

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work*.

Candidate's Signature	[redacted]	**Date** 29/10/2015
Main Supervisor's Signature	[redacted]	**Date** 29/10/2015

5. RESULTS

5.1 OVERVIEW. Details results are presented by sub-study in the following chapters. In summary, there were 198 participants in the control group and 164 participants in the ADHD group (see Table 7).

Table 7. Demographic characteristics for children with ADHD and controls

	Control ***n = 198[a]***	**ADHD** ***n = 164[b]***	**P value**
Child Characteristics			
Child age in years, mean (SD)	8.1 (1.1)	7.9 (1.1)	0.13
Male, n (%)	128 (64.7)	114 (69.5)	0.30
Existing Autism Spectrum Disorder diagnosis, n (%)	3 (1.6)	35 (21.3)	<0.001
ADHD subtype, n (%)			-
ADHD-Combined		83 (50.6)	
ADHD-Inattentive		62 (37.8)	
ADHD-Hyperactive/Impulsive		19 (11.6)	
ADHD symptom severity[c] – parent report, mean (SD)	1.4 (2.4)	13.1 (4.6)	<0.001
ADHD symptom severity[c] – teacher report, mean (SD)	0.8 (2.4)	11.5 (5.9)	<0.001
Internalising comorbidity[d] in past year, n (%)	9 (4.5)	43 (26.2)	<0.001
Externalising comorbidity[d] in past year, n (%)	14 (7.1)	87 (53.1)	<0.001
Medication use (any), n (%)	1 (0.6)	27 (19.2)	<0.001
Primary caregiver/family characteristics			
Parent completed high school, n (%)	156 (81.3)	97 (62.2)	<0.001
SEIFA, mean (SD)	1014.9 (46.0)	1012.1 (42.9)	0.55

[a] Control children with SCQ data available - n ranges between 183 – 198; [b a] ADHD children with SCQ data available - n ranges between 144 - 164; [c] Conners 3 ADHD Index (Collected at Wave 1 for Cohort 2 and Wave 2 for Cohort 1); [d] DISC-IV (Collected at Wave 1 for Cohort 1 and Cohort 2).

5.2 SAMPLE CHARACTERISTICS. Children with ADHD were more likely to have a primary caregiver who had not completed high school, and more likely to have had a pre-existing diagnosis of ASD compared to non-ADHD controls (see Table 7). Children with ADHD also had higher rates of internalising and externalising disorders, poorer quality of life, more peer and sleep problems, fewer prosocial behaviours, and more emotional and conduct problems than non-ADHD controls. Parents of children with ADHD reported poorer family functioning across all domains, compared to non-ADHD controls.

Declaration for Thesis Chapter 3: Profile Paper

Monash University

Declaration by candidate

In the case of Chapter 3, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Project design, review of relevant literature, attainment of ethics approval, recruitment and assessment of a sub-set of research participants, data analysis and writing of manuscript	70%

The following co-authors contributed to the work. If co-authors are students at Monash University, the extent of their contribution in percentage terms must be stated:

Name	Nature of contribution
Professor Nicole Rinehart	Contributed to project design and provided input during final draft stage of manuscript
Professor Vicki Anderson	Contributed to project design and provided input during final draft stage of manuscript
Dr Emma Sciberras	Contributed to project design and provided input during final draft stage of manuscript
Professor Jan Nicholson	Provided input during final draft stage of manuscript
Dr Brad Jongeling	Provided input during final draft stage of manuscript

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work*.

Candidate's Signature	[redacted]	**Date** 28/10/15
Main Supervisor's Signature	[redacted]	**Date** 20/10/2015

6. STUDY 1

6.1 STUDY 1 OVERVIEW. This chapter includes a published paper titled "Autism spectrum disorder symptoms in children with ADHD: a community-based study", which was published in *Research in Developmental Disabilities*. The aim of this study was to firstly examine the prevalence and type of ASD symptoms in children with ADHD and non-ADHD controls. The second aim was to examine the relationship between ADHD subtype, hyperactive/impulsive and inattentive symptoms, ADHD symptom severity, child gender and ASD symptom severity in the ADHD group only.

6.2 STUDY 1 HYPOTHESES It was hypothesised that: (1) children with ADHD would have more ASD symptoms across all domains, compared to non-ADHD controls, (2) greater ADHD symptom severity would be associated with more ASD symptoms, (3) children with ADHD combined type would have more ASD symptoms compared to children with ADHD inattentive type; and in the absence of strong evidence regarding gender differences, we predicted: (4) greater ASD symptom severity in girls with ADHD compared to boys with ADHD.

6.3 STUDY 1 PAPER.

Research in Developmental Disabilities 47 (2015) 175–184

Contents lists available at ScienceDirect

Research in Developmental Disabilities

Autism spectrum disorder symptoms in children with ADHD: A community-based study

Jessica Leigh Green [a,b,*], Nicole Rinehart [b,c], Vicki Anderson [b,d,e], Jan M. Nicholson [b,f], Brad Jongeling [g,h], Emma Sciberras [b,d,e]

[a] School of Psychological Sciences, Monash University, VIC, Australia
[b] Murdoch Childrens Research Institute, Parkville, VIC, Australia
[c] School of Psychology, Deakin University, Burwood, VIC, Australia
[d] The Royal Children's Hospital, Parkville, VIC, Australia
[e] The University of Melbourne, Parkville, VIC, Australia
[f] Judith Lumley Centre, LaTrobe University, Melbourne, VIC, Australia
[g] Child Development Service, Joondalup, WA, Australia
[h] The University of Western Australia, Perth, WA, Australia

ARTICLE INFO

Article history:
Received 18 December 2014
Received in revised form 16 September 2015
Accepted 17 September 2015
Available online

Keywords:
Attention-deficit hyperactivity disorder
Autism spectrum disorder

ABSTRACT

This study examined the prevalence of autism spectrum disorder (ASD) symptoms in a community-based sample of children with attention-deficit/hyperactivity disorder (ADHD) and non-ADHD controls. We also examined the relationship between ASD symptoms and ADHD subtype, ADHD symptom severity and child gender. Participants were 6–10-year-old children (164 ADHD; 198 non-ADHD control) attending 43 schools in Melbourne, Australia, who were participating in the Children's Attention Project. ADHD was assessed in two stages using the parent and teacher Conners' 3 ADHD index and the Diagnostic Interview Schedule for Children IV (DISC-IV). ASD symptoms were identified using the Social Communication Questionnaire (SCQ). Unadjusted and adjusted linear and logistic regression examined continuous and categorical outcomes, respectively. Children with ADHD had more ASD symptoms than non-ADHD controls (adjusted mean difference = 4.0, 95% confidence interval (CI) 2.8; 5.3, $p < 0.001$, effect size = 0.7). Boys with ADHD had greater ASD symptom severity than girls with ADHD (adjusted mean difference = 2.9, 95% CI 0.8; 5.2, $p = 0.01$, effect size = 0.4). Greater ADHD symptom severity was associated with greater ASD symptom severity (regression co-efficient = 1.6, 95% CI 1.2; 2.0, $p < 0.001$). No differences were observed by ADHD subtype. Greater hyperactive/impulsive symptoms were associated with greater ASD symptoms (regression coefficient = 1.0; 95% CI 0.0; 2.0, $p = 0.04$) however, this finding attenuated in adjusted analyses ($p = 0.45$). ASD symptoms are common in children with ADHD. It is important for clinicians to assess for ASD symptoms to ensure appropriate intervention.

* Corresponding author at: Murdoch Childrens Research Institute, Royal Children's Hospital, Flemington Road, Parkville 3052, Australia.
E-mail address: jessica.l.green@monash.edu (J.L. Green).

http://dx.doi.org/10.1016/j.ridd.2015.09.016
0891-4222/

What this paper adds:

This study builds on the limited existing body of research examining ASD symptoms in community samples of children with ADHD. We found strong evidence that children with ADHD had elevated ASD symptoms across all symptom domains, compared to non-ADHD controls. There was little evidence of a relationship between ADHD subtype and ASD symptom severity although ADHD symptom severity was associated with greater ASD symptoms. Boys with ADHD had significantly greater ASD symptoms than girls with ADHD, particularly within the stereotyped behaviors domain. All results held when excluding children with a pre-existing ASD diagnosis.

1. Introduction

The comorbidity between autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) is topical, given the release of the DSM-5, which now allows for these conditions to be diagnosed simultaneously (Konst, Matson, Goldin, & Rieske, 2014; Reiersen, 2011). Research of late has focused particularly on the genetic overlap and familial transmission of ADHD and ASD (Polderman, Hoekstra, Posthuma, & Larsson, 2014), with Musser et al. (2014) recently finding that the offspring of mothers with ADHD were more likely to have an ASD, compared to offspring of typically developing mothers. Young children with ADHD present with multiple functional impairments including higher rates of internalizing and externalizing disorders, peer relationship problems, language and academic difficulties, when compared to children without ADHD (Efron, Hazell, & Anderson, 2011; Sciberras, Fulton, Efron, Oberklaid, & Hiscock, 2011; Sciberras, Lycett, Efron, Mensah, Gerner, & Hiscock, 2014; Sciberras, Mueller, et al., 2014; Sciberras, Roos, & Efron, 2009). These difficulties may be, in part, related to comorbidity with other disorders including ASD (Grzadzinski et al., 2011). It appears that more children with ADHD show features of ASD than complete comorbidity (Ronald, Larsson, Anckarsater, & Lichtenstein, 2014), suggesting that examining symptom co-occurrence, rather than complete comorbidity, may be helpful in research and clinical work (Reiersen, 2011). This paper examines comorbid ASD symptoms in a large community-based sample of children with ADHD and non-ADHD controls. A more thorough understanding of the type and prevalence of ASD symptoms in children with ADHD may assist in early identification and treatment of ASD symptoms in this group of children (Davis & Kollins, 2012).

Children with ADHD have significantly higher scores on measures of ASD symptoms compared to children without ADHD (Kochhar et al., 2011b; Kroger et al., 2011; Reiersen, Constantino, Volk, & Todd, 2007). Studies have reported that 18% to 50% of children with ADHD present with clinical levels of ASD symptoms (Kochhar et al., 2011a, 2011b; Ronald, Simonoff, Kuntsi, Asherson, & Plomin, 2008; Van der Meer et al., 2012). While some studies report that children with ADHD exhibit elevated ASD symptoms across the three main core domains of ASD (based on the *Diagnostic and statistical manual of mental disorders*, 4th ed. (DSM-IV-TR) criteria: social interaction, communication and repetitive behaviors; Nijmeijer et al., 2009), others report elevation in the social interaction (Clark, Feehan, Tinline, & Vostanis, 1999), repetitive and stereotyped behavior (Polderman et al., 2014) or communication domains alone (Kochhar et al., 2011b). ADHD symptom severity and ADHD combined subtype have been associated with the presence and severity of ASD symptoms (Reiersen et al., 2007; Van der Meer et al., 2012). Recent research has shown that children with persistent ADHD symptoms tend to also have persistent ASD symptoms, suggesting that the presence of social and communication difficulties may contribute to greater stability of ADHD symptoms over time (St. Pourcain et al., 2011). It also appears that children with ADHD and social communication difficulties are also at risk for other psychological comorbidities (Jang et al., 2013; Reiersen, 2011).

The small body of research examining the relationship between gender and ASD symptoms in children with ADHD has produced mixed findings (Nijmeijer et al., 2009; Reiersen et al., 2007). A community-based study found that boys with ADHD had more ASD symptoms than girls with ADHD (Reiersen et al., 2007), but that there were a greater proportion of girls with ADHD who had ASD symptoms in the clinical range (75%), compared to boys with ADHD (25%) (Reiersen et al., 2007). Nijmeijer et al. (2009) reported that girls with ADHD had more ASD symptoms than boys with ADHD. However, research in this area has focused on predominantly male samples.

Despite the recent increase in research examining the overlap between ADHD and ASD, existing studies have some key limitations. Of note, most studies examining the relationship between ADHD and ASD have focused on clinical samples (St. Pourcain et al., 2011). It is well known that clinical samples of children with ADHD are more likely to include boys and those presenting with more severe symptoms and comorbidities, which consequently may inflate the comorbidity observed between ADHD and ASD observed in these samples. Reiersen's population-based study examining ASD symptoms in children with ADHD has advanced our understanding of the comorbidity of these two conditions (Reiersen et al., 2007). However, there were some limitations. Participants ($n = 946$) ranged from 8 to 25 years of age when ASD symptoms were measured, which was up to 5 years after information was collected about ADHD symptoms, and the study included a small sample of girls with ADHD ($n = 19$) (Reiersen et al., 2007). More recent studies have relied on clinician diagnosis of ADHD and ASD only, which has not been confirmed by the research team (Musser et al., 2014), or measures of autism spectrum disorder symptoms that are not well validated (e.g. self-report checklist of 12 items based on DSM-5 criteria (Polderman et al., 2014) and the Autism, Tics, AD/HD and other comorbidities telephone interview (A-TAC) (Ronald et al., 2014). Far less research has

rigorously examined the types of ASD symptoms present in children with ADHD, and key predictors of these ASD symptoms, which may help with early identification.

In order to overcome the limitations of prior research, this study employed a large community-based sample to examine the prevalence and type of ASD symptoms (social interaction, communication and stereotyped behavior) in children with ADHD and non-ADHD controls. Within the ADHD group only, we also examined the relationship between ADHD subtype, hyperactive/impulsive and inattentive symptoms, ADHD symptom severity and child gender and ASD symptom severity. We hypothesized that: (1) children with ADHD would have more ASD symptoms across all domains, compared to non-ADHD controls; (2) greater ADHD symptom severity would be associated with more ASD symptoms; (3) children with ADHD combined type would have more ASD symptoms, compared to children with ADHD inattentive type; and in the absence of strong evidence regarding gender differences, we predicted: (4) greater ASD symptom severity in girls with ADHD compared to boys with ADHD.

2. Methods

2.1. Design

Data were collected as part of the Children's Attention Project (CAP), a longitudinal cohort study of children with and without ADHD (Sciberras et al., 2013). Ethics approval was obtained from The Royal Children's Hospital (#31056), the Victorian Department of Education and Early Childhood Development (#2011_001095) and Monash University (#CF12/4044 – 2012001944), Melbourne, Australia.

2.2. Participants

All children in their first year of school (6–8 years) were screened for ADHD across 43 primary schools in Melbourne, Australia (see Fig. A.1 for a detailed flow chart of recruitment). Children with an intellectual disability or a serious medical condition were excluded, as were those whose parents lacked sufficient English to complete study questionnaires. Participants were recruited in two cohorts, with Cohort 1 recruited in 2011 and Cohort 2 in 2012.

ADHD was initially screened using the parent and teacher Conners 3 ADHD Index, together with parent report of previous ADHD diagnosis. Completed parent and teacher screening surveys were received for 63% of the children. There were no differences between responders and non-responders on child age and gender however, responders were from more socially advantaged areas. Children were deemed to screen positive for ADHD if they had a prior diagnosis of ADHD, and/or if their scores on both the parent and teacher ADHD indices were $\geq$75th percentile for boys, and $\geq$80th percentile for girls. Children were deemed a negative screen if they did not have a prior diagnosis of ADHD and if their scores on both the parent and teacher ADHD indices were $<$75th percentile for boys and $<$80th percentile for girls. We used a higher cut-point for girls, as our pilot data showed that this resulted in better correspondence with diagnostic confirmation. Children who screened positive for ADHD ($n = 412$) were randomly matched, based on gender and school, with a child who screened negative for ADHD ($n = 412$).

At Wave 1, of the 412 children who screening screened positive for ADHD, 267 were eligible and participated in the longitudinal study (response rate: 65%), with 179 confirmed as meeting ADHD criteria on the Diagnostic Interview Schedule for Children IV (DISC-IV): making the ADHD group. Of the 412 children who screened negative, 231 were eligible and participated (response rate: 56%), with 212 confirmed as not meeting criteria for ADHD on the DISC-IV, making the non-ADHD control group – see Efron et al. (2014) for further details regarding recruitment and consent rates. Families were followed-up at 18 months post-recruitment (Wave 2) to assess medium-term outcomes.

2.3. Measures

ASD symptoms were identified using the Social Communication Questionnaire (SCQ) Lifetime Form (Rutter, Bailey, & Lord, 2003), a 40-item, parent-report screening measure assessing ASD symptoms. The SCQ produces a total score and three subscale scores: (1) reciprocal social interaction; (2) communication; and (3) restricted, repetitive and stereotyped patterns of behavior (Wiggins, Bakeman, Adamson, & Robins, 2007). For the current paper we refer to scores $\geq$15 as above the clinical cut-off and $\geq$11 as in the at-risk range. SCQ scores have good validity with demonstrated high agreement with the gold standard Autism Diagnostic Interview Revised (ADI-R) and high discriminant validity of 0.88 and 0.87 for ASD versus non-ASD respectively (Rutter et al., 2003). The SCQ was administered by telephone by blinded assessors at Wave 2 (18 month follow-up) for Cohort 1 children, and face-to-face during the Wave 1 (baseline) parent interview for Cohort 2 children.

ADHD, internalizing and externalizing disorders was assessed using the DISC-IV (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000), collected at Wave 1 only. This parent-completed interview assesses mental health conditions using DSM-IV-TR criteria. The measure has good diagnostic reliability and validity (Shaffer et al., 2000). Impairment thresholds and DSM-IV symptoms (Version N, April 2007, algorithms) were used to confirm presence and subtype of ADHD. The presence of an internalizing or externalizing disorder, was defined as meeting diagnostic criteria for at least one internalizing (e.g., generalized anxiety disorder, social phobia, specific phobia, panic disorder, obsessive compulsive disorder, post-traumatic stress disorder, tic disorder, separation anxiety disorder, major depressive disorder and dysthymic disorder) or externalizing disorder (e.g., ADHD, oppositional defiant disorder, conduct disorder) in the year prior to assessment. Interviewers were blind to the child's ADHD screening status.

ADHD symptom severity was measured using the 10-item parent and teacher-reported Conners 3 ADHD Index (Conners, 2008) collected at Waves 1 and 2. Parents and teachers rated the child's symptoms in the last month, on a 4-point scale from 'not true at all' to 'very much true'. The measure has strong psychometric properties (Conners, 2008). We report on Wave 1 scores for Cohort 2 participants and Wave 2 scores for Cohort 1, to harmonize with SCQ data collection.

Socio-demographic characteristics which might act as confounding variables included child gender and age, recruitment cohort, parent high school completion (yes/no), socioeconomic status as measured by the census-based Socio-Economic Indexes for Areas Disadvantage Index, based on the child's residential postcode (SEIFA), and internalizing comorbidity (yes/no: DISC-IV) and externalizing comorbidity (yes/no: DISC-IV).

2.4. Analyses

Chi-square and *t*-tests were used to examine differences between the ADHD and non-ADHD control group based on demographic variables. The measure that was most proximal to SCQ data collection was used in analyses: Wave 1 SCQ and DISC-IV for Cohort 2; Wave 2 SCQ and Wave 1 DISC-IV data (collected 18 months earlier) for Cohort 1. Unadjusted and adjusted linear regression was used to examine differences in SCQ total and subscale scores between children with and without ADHD (Aim 1). Binary logistic regression was used to compare the proportion of children with clinically significant (≥15: clinical cut-off; ≥11: at risk range) SCQ Total Scores (Aim 1).

For children with ADHD only, unadjusted and adjusted linear regression was used to examine the relationship between total SCQ score and (a) ADHD symptom severity (b) ADHD subtype, inattentive symptoms, and hyperactive-impulsive symptoms and (c) child gender (Aims 2, 3 and 4). ADHD symptom severity scores, inattentive symptoms, and hyperactive-impulsive symptoms were converted into one standard deviation units to facilitate meaningful interpretation. Effect sizes (Cohen's *d*) were calculated with effect sizes of 0.20, 0.50, and 0.80 indicating small, medium and large effect sizes respectively (Cohen, 1992). A sensitivity analysis was conducted which excluded children with a pre-existing ASD diagnosis to allow comparison to previous literature. All models controlled for school clustering. Analyses were conducted using Stata 13.0.

3. Results

3.1. Sample characteristics

Compared to non-ADHD controls, children with ADHD were more likely to be male, have a pre-existing diagnosis of ASD, have higher rates of internalizing and externalizing disorders, and were more likely to have a primary caregiver who had not completed high school (Table A.1). Of the children with ADHD, 51% had combined type, 38% inattentive type, and 11% hyperactive/impulsive type (95% CI 1.2; 2.0, $p < 0.001$).

3.2. Prevalence of social and communication difficulties

SCQ data were available for 362 children: 153 children (84.1%) for Cohort 1 and 209 (100%) for Cohort 2. For those children who had a pre-existing diagnosis of ASD ($n = 35$), 92% had an SCQ total score in the at-risk range (≥11); and 72% in the clinical range (≥15). A significantly higher proportion of children with ADHD compared to non-ADHD controls scored in the clinical range. Twenty-three percent ($n = 38$) of children with ADHD had an SCQ total score ≥15, compared to 3% ($n = 6$) of non-ADHD controls (odds ratio = 10.5; 95% CI 4.2; 26.3, $p < 0.001$). Forty percent of children with ADHD had an SCQ score ≥11, compared to 9% of non-ADHD controls (odds ratio = 7.5; 95% CI 4.0; 14.1, $p < 0.001$). Similarly, children with ADHD had significantly higher SCQ total and SCQ subscale scores, compared to non-ADHD controls, with large effect sizes observed (Table A.2). These differences remained significant in adjusted analyses. The most frequently endorsed ASD symptoms in the ADHD group were cannot have a to and fro conversation ($n = 90$, 55%), limited gesture use ($n = 89$, 54%), uses stereotyped utterances ($n = 85$, 52%), reverses pronouns ($n = 76$, 46%) and does not have particular friends or a best friend ($n = 73$, 45%).

3.3. Association between ASD symptoms and ADHD subtype, ADHD symptom severity and gender

In unadjusted and adjusted analyses, ADHD subtype was not significantly associated with SCQ total score in children with ADHD when inattentive type was compared to either combined type (regression coefficient = 1.2; 95% CI −1.1; 3.5, $p = 0.29$) or hyperactive/impulsive type (regression coefficient = 1.2; 95% CI −2.3; 4.8, $p = 0.50$) or when hyperactive/impulsive and combined type were compared (regression coefficient = 0.01; 95% CI −3.5; 3.5, $p = 0.99$). ADHD subtype was also not associated with SCQ Subscale scores. There was little evidence of an association between inattentive symptoms, measured continuously in children with ADHD, and total ASD symptoms (regression coefficient = 0.3; 95% CI −0.8; 1.3, $p = 0.60$). Inattentive symptoms were also not associated with SCQ subscale scores. However, hyperactive/impulsive symptoms were associated with total ASD symptoms in children with ADHD (regression coefficient = 1.0; 95% CI 0.0; 2.0, $p = 0.04$) but this attenuated in adjusted analyses ($p = 0.45$). No association between hyperactive/impulsive symptoms and SCQ subscales scores was found in unadjusted or adjusted analyses.

For children in the control group, there was evidence of an association between inattentive symptoms and total ASD symptoms (regression coefficient = 0.7; 95% CI 0.2; 1.3, $p = 0.01$) which remained significant in adjusted analyses ($p = 0.002$).

Inattentive symptoms in children without ADHD was associated with the communication ($p = 0.03$) and restricted, repetitive and stereotyped patterns of behavior SCQ subscales ($p = 0.001$), with both remaining significant in adjusted analyses ($p = 0.018$ for communication and $p = 0.007$ for restricted, repetitive and stereotyped patterns of behavior). There was little evidence of an association between hyperactive/impulsive symptoms and total ASD symptoms in children without ADHD ($p = 0.51$). However, there was a significant association between hyperactive/impulsive symptoms and restricted, repetitive and stereotyped patterns of behavior in children without ADHD, which remained significant in adjusted analyses (unadjusted $p = 0.002$; adjusted $p = 0.005$). When analyzed all together (ADHD and control group), greater ASD symptoms were associated with greater hyperactive/impulsive symptoms (regression coefficient = 2.3; 95% CI 1.7; 2.8, $p < 0.001$) and more inattentive symptoms (regression coefficient = 2.3; 95% CI 1.7; 2.9, $p < 0.001$). Both findings remained significant in adjusted analyses ($p < 0.001$).

Parent- and teacher-reported ADHD symptom severity was significantly associated with SCQ Total and SCQ Subscale scores, and remained significant after controlling for confounding variables, with one exception; teacher-reported ADHD symptoms were not significantly associated with SCQ Communication Subscale scores (Table A.3).

In unadjusted analyses, there was some evidence that boys with ADHD had more ASD symptoms than girls with ADHD ($p = 0.08$) (Table A.4). After adjusting for confounding variables, this difference became statistically significant, with boys with ADHD having more ASD symptoms than girls with ADHD (effect size = 0.4, $p = 0.01$). In both the unadjusted and adjusted analyses, boys with ADHD had more stereotyped behaviors than girls with ADHD; there were no gender differences on the Social Interaction and Communication subscales. Although boys with ADHD had a higher prevalence of ASD scores in the clinical (26% versus 16%) and at risk range (40% versus 30%) than girls with ADHD, these differences were not statistically significant (both $p = 0.10$).

3.4. Sensitivity analysis excluding those who have a previous ASD diagnosis

We re-ran our analyses for Aim 1 excluding children with a pre-existing diagnosis of ASD ($n = 35$). Children with ADHD ($n = 111$) continued to have higher SCQ total scores, compared to children without ADHD ($n = 180$) (mean difference = 2.7; 95% CI 1.8, 3.6, $p < 0.001$, effect size: 0.4). They had 14-fold increased odds of having an SCQ score of ≥15 (odds ratio = 14.1; 95% CI 1.7–115.9, $p < 0.001$) and 5.7 increased odds of having an SCQ score ≥11 or above (odds ratio = 5.7, 95% CI 2.5–13.4, $p < 0.001$), compared to non-ADHD controls. Children with ADHD without a prior diagnosis of ASD continued to have higher scores across all SCQ subscales, than non-ADHD controls; social interaction (mean difference = 0.5; 95% CI 0.1, 0.9, $p < 0.05$, effect size: 0.2), communication (mean difference = 0.8; 95% CI 0.4, 1.3, $p < 0.001$, effect size: 0.4) and stereotyped behavior (mean difference = 0.9, 95% CI 0.6, 1.2, $p < 0.001$, effect size: 0.5). All findings remained significant in the adjusted analyses.

4. Discussion

This study builds on the limited existing body of research examining ASD symptoms in community samples of children with ADHD. We found strong evidence that children with ADHD had elevated ASD symptoms across all symptom domains, compared to non-ADHD controls. There was little evidence of a relationship between ADHD subtype and ASD symptom severity although ADHD symptom severity was associated with greater ASD symptoms. Greater hyperactive/impulsive symptoms were associated with greater ASD symptoms in children with ADHD, but this finding attenuated in adjusted analyses. Greater inattentive symptoms were associated with greater ASD symptoms in children without ADHD. Boys with ADHD had significantly greater ASD symptoms than girls with ADHD, particularly within the stereotyped behaviors domain. All results held when excluding children with a pre-existing ASD diagnosis.

Almost one in four (23%) children with ADHD in our sample had an SCQ total score of above the clinical cut-off, and 40% had an SCQ total score in the at-risk range. This is largely consistent with Reiersen et al.'s (Reiersen et al., 2007) population-based study findings that 22% of children with ADHD had a Social Responsiveness Scale (SRS) total score in the clinical range. Our study extends prior findings using a larger sample of girls with ADHD ($n = 50$ compared to $n = 19$). Our results are also consistent with Kochhar et al.'s (2011b) finding that 28% of clinically referred children with ADHD ($n = 30$) had an SCQ total score above the clinical cut-off. These results confirm that children with ADHD from community-based samples have greater ASD symptoms than non-ADHD controls, consistent with previous findings in clinical samples (Nijmeijer, Hoekstra et al., 2009; Nijmeijer, Minderra, et al., 2008).

In contrast to expectations and previous research, we found no relationship between ADHD subtype and ASD symptoms (Reiersen et al., 2007). We did find a significant relationship between hyperactive/impulsive symptoms and total ASD symptoms in children with ADHD, as has been found previously (Kroger et al., 2011), although this association attenuated in adjusted analyses. No association between hyperactive/impulsive symptoms and SCQ subscales was identified. We found no relationship between inattentive symptoms and total ASD symptoms, or SCQ subscales, in children with ADHD. Past studies have found more ASD symptoms in children with combined or inattentive subtypes (Reiersen et al., 2007; Van der Meer et al., 2012) than children with hyperactive/impulsive type (Ronald et al., 2014). It should be noted that Van der Meer et al's (2012) study also included children with ASD only, ADHD only and ASD + ADHD, in contrast to this study. Given that we did not find an association between ASD symptoms and specific ADHD symptoms (inattentive or hyperactive/impulsive), this may suggest that ASD symptoms are associated with greater ADHD symptoms overall, rather than being related to a specific type of ADHD symptoms. This may explain previous findings that children with ADHD Combined type have more ASD symptoms than children with other ADHD subtypes. Interestingly, the pattern of association was different in the control group, with

greater inattentive symptoms associated with greater ASD symptoms for children without ADHD, and hyperactive/impulsive symptoms only associated with the Restricted, Repetitive and Stereotyped subscale of the SCQ. In contrast to previous studies (Nijmeijer et al., 2009; Reiersen et al., 2007), we did not find an association between inattention and ASD symptoms in children with ADHD group. We suspect this may be due to our measure of inattention symptoms, a symptom count variable from the DISC-IV, which meant that our ADHD sample had little variability in inattention scores. The association between inattention symptoms and ASD symptoms in the control group may be due to greater variability in inattention scores, compared to the ADHD group. Using a more in-depth measure of inattentive and hyperactive/impulsive symptoms may help clarify this association in future research.

We did find the largest effect size (unadjusted = 0.8; adjusted = 0.7) when comparing children with ADHD to children without ADHD for the SCQ subscale examining repetitive and stereotyped behaviors. This is consistent with Polderman's (2014) finding that repetitive and stereotyped behaviors were most associated with inattentive, hyperactive and impulsive behaviors, compared to social interaction and communication. Polderman argued that closer examination of the role of restricted, repetitive and stereotyped patterns of behavior, interests and activities may be important in better understand the co-occurrence of ASD and ADHD. Furthermore, we did find that ASD symptoms increased with greater ADHD symptom severity, consistent with previous findings by Van der Meer et al. (2012) in a mixed population-based clinical sample of children with ADHD, between 5 and 17 years. This finding is aligned with the argument that comorbid ASD symptoms may act as a marker of ADHD severity, and vice versa (St. Pourcain et al., 2011).

Consistent with Reiersen's (2007) population-based study, we found that boys with ADHD had more ASD symptoms, when measured dimensionally, than girls with ADHD, particularly in the stereotyped behavior domain. This also aligned with Gargaro et al. (2014) who found that boys with ASD had more ADHD symptoms, compared to girls with ASD. However, in contrast Reiersen found that girls with combined type ADHD (75%) were more likely to have ASD scores in the clinical range, compared to boys with ADHD (32%). In our sample, there was no significant difference in the proportion of boys or girls with ADHD who had a total SCQ score in the clinical or at-risk range. The difference in findings may be due to a more representative, larger sample of girls included in our study ($n = 50$ versus $n = 19$ in Reiersen's study), narrower age range, and differences in ASD measurement (SCQ versus SRS). There is evidence that Reiersen's (2007) sample of girls was more impaired than our sample, when comparing ASD symptom clinical cut-offs. Overall, seven out of 19 girls with ADHD (37%) were above the sex-specific cut-off for clinically significant ASD symptoms on the social responsiveness scale (SRS), compared to 16% of girls in our sample. It must be acknowledged that these are different measures of ASD symptoms, which may impact on this comparison.

Strengths of this study include: a community-based, rather than clinical, sample, which includes a larger sample of girls than previous studies, and children with all three ADHD types. This study confirmed ADHD and other comorbidities using a structured diagnostic interview, and a rigorous measure of ASD symptoms was also employed. The breadth of data collected also allowed us to control for potential confounding variables.

This study did have limitations. The DISC-IV data were not collected at the same time as the SCQ data for Cohort 1. Whilst the most proximal measure was used wherever possible, there is a possibility that a child's presentation (e.g., internalizing and externalizing comorbidities and ADHD symptom severity) may have changed during the 18-month period. Secondly, there were only 19 children in the ADHD-Hyperactive/Impulsive group. Thirdly, the SCQ is a screening measure, which indicates autism spectrum disorder symptoms, but cannot be used to diagnose an autism spectrum disorder. Future research could replicate our findings using the Autism Diagnostic Observation Schedule (ADOS) and the Autism Diagnostic Interview Revised (ADI-R), which is the gold standard for autism spectrum disorder assessment. This measure would have allowed us to gather helpful information about the specificity of the SCQ (e.g. how many children with clinically significant ASD symptoms meet criteria for an Autism Spectrum Disorder based on the ADOS assessment?). Fourthly, stereotyped and repetitive behaviors are not pathognomonic of ASD and thus may be indicative of other neurological or neurodevelopmental conditions. Lastly, it is acknowledged that the confidence interval for children with ADHD having a SCQ score of ≥ 15 compared to non-ADHD controls, excluding those with a pre-existing ASD diagnosis, is very high (1.7–115.9) suggesting a low level of precision.

5. Conclusions

Our findings show that ASD symptoms are common in children with ADHD. We found equivalent prevalence in our community-based sample to previous clinical based samples. This research highlights the importance of taking a multidimensional approach to assessing children with ADHD, which incorporates an assessment of children's ASD symptoms. This is particularly pertinent for boys with ADHD, and children with more severe ADHD symptoms. These findings are consistent with the new DSM-5 approach that allows comorbid diagnoses of ASD and ADHD. Future research needs to ascertain whether ASD symptoms in children with ADHD are associated with poorer functioning, which would guide whether intervention is necessary for these children. Future research needs to examine whether evidence-based interventions designed for children with ASD are effective in treating children with ADHD and clinically significant ASD symptoms, leading to improvements in their functioning.

Acknowledgments

The authors declare that they have no conflicts of interest. This study is funded by the Australian National Health and Medical Research Council (NHMRC; project grant no. 1008522) and the Murdoch Childrens Research Institute. Ms. Green's research work is funded by Monash University Australian Postgraduate Scholarship (APA; 2012–2015) and a MCRI Professor David Danks Top Up Scholarship (2013–2015). Dr Sciberras' position is funded by an NHMRC Early Career Fellowship in Population Health 1037159 (2012–2015). Professor Anderson is funded by an NHMRC Practitioner Fellowship 607333 (2010–2014). Professor Nicholson is funded by the Roberta Holmes Chair for the Transition to Contemporary Parenthood Program. This research was supported by the Victorian Government's Operational Infrastructure Support Program to the MCRI.

We would like to acknowledge all research staff, students and interns who contributed to data collection for this project. We would also like to thank the participating families, teachers and schools.

Appendix A. Appendix

See Fig. A.1
See Tables A.1–A.4

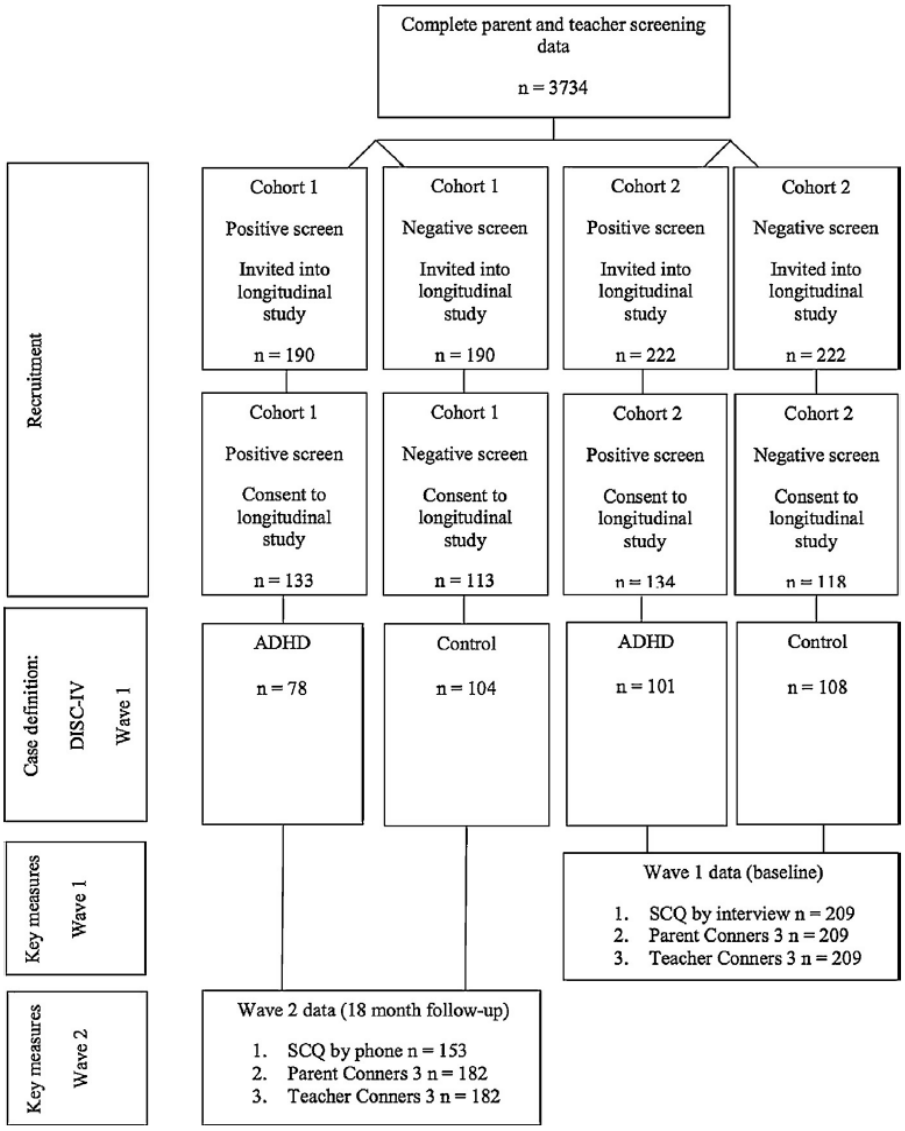


Fig. A.1. Participant flow chart.

Table A.1
Demographic characteristics for children with ADHD and controls.

	Control (n = 198[a])	ADHD (n = 164[b])	p Value
Child characteristics			
Child age in years, mean (SD)	8.1 (1.1)	7.9 (1.1)	0.13
Male, n (%)	128 (64.7)	114 (69.5)	0.30
Existing autism spectrum disorder diagnosis, n (%)	3 (1.6)	35 (21.3)	<0.001
ADHD subtype, n (%)			–
ADHD-combined		83 (50.6)	
ADHD-inattentive		62 (37.8)	
ADHD-hyperactive/impulsive		19 (11.6)	
ADHD symptom severity[c] – parent report, mean (SD)	1.4 (2.4)	13.1 (4.6)	<0.001
ADHD symptom severity[c] – teacher report, mean (SD)	0.8 (2.4)	11.5 (5.9)	<0.001
Internalizing comorbidity[d] in past year, n (%)	9 (4.5)	43 (26.2)	<0.001
Externalizing comorbidity[d] in past year, n (%)	14 (7.1)	87 (53.1)	<0.001
Medication use (any), n (%)	1 (0.6)	27 (19.2)	<0.001
Primary caregiver/family characteristics			
Parent completed high school, n (%)	156 (81.3)	97 (62.2)	<0.001
SEIFA, mean (SD)	1014.9 (46.0)	1012.1 (42.9)	0.55

[a] Control children with SCQ data available – n ranges between 183 and 198.
[b] ADHD children with SCQ data available – n ranges between 144 and 164.
[c] Conners 3 ADHD Index (collected at Wave 1 for Cohort 2 and Wave 2 for Cohort 1).
[d] DISC-IV (collected at Wave 1 for Cohort 1 and Cohort 2).

Table A.2
Mean differences in autism spectrum disorder symptoms[a] between children with ADHD and non-ADHD controls[a]

			Unadjusted[b]			Adjusted[c]		
	Control, n = 198 M (SD)	ADHD, n = 164 M (SD)	Mean difference (95% CI)	Effect size	p	Mean difference (95% CI)	Effect size	p
SCQ[a] total score	5.3 (4.0)	10.3 (7.2)	5.0 (3.8,6.2)	0.8	<0.001	4.0 (2.8, 5.3)	0.7	<0.001
SCQ[a] social interaction	1.7 (1.8)	3.2 (3.1)	1.4 (0.9, 2.0)	0.5	<0.001	1.1 (0.6, 1.7)	0.4	<0.001
SCQ[a] communication	2.8 (2.0)	4.1 (2.4)	1.4 (0.9, 1.8)	0.6	<0.001	1.1 (0.6, 1.6)	0.5	<0.001
SCQ[a] stereotyped behavior	0.7 (1.1)	2.3 (2.3)	1.6 (1.2, 1.9)	0.8	<0.001	1.3 (0.9, 1.7)	0.7	<0.001

[a] Measured using the Social Communication Questionnaire – lifetime form.
[b] Unadjusted models accounted for school clustering.
[c] Adjusted for child (age, sex, internalizing disorder, externalizing disorder, and recruitment cohort), family factors (parent high school completion, socio-economic indexes for areas disadvantage index (SEIFA)) and school clustering.

Table A.3
Linear regression of ADHD symptom severity[a] and autism spectrum disorder symptoms[b]

Outcome	Unadjusted	Adjusted[e]		
	B[c,d]	B[c]	95% CI	p
ADHD symptom severity – parent report				
SCQ total score	1.8	1.6	1.2, 2.0	<0.001
SCQ social interaction	0.5	0.4	0.2, 0.6	<0.001
SCQ communication	0.5	0.4	0.2, 0.6	<0.001
SCQ stereotyped behavior	0.6	0.6	0.4, 0.7	<0.001
ADHD symptom severity – teacher report				
SCQ total score	1.3	0.9	0.4, 1.4	0.001
SCQ social interaction	0.4	0.3	0.0, 0.5	0.020
SCQ communication	0.3	0.2	0.0, 0.4	0.078
SCQ stereotyped behavior	0.4	0.3	0.0, 0.5	0.003

[a] Measured by the Conners 3 ADHD index.
[b] Measured by the Social Communication Questionnaire – lifetime form.
[c] Regression co-efficient. Regression co-efficients should be interpreted as a mean increase in SCQ score for each standard deviation increase in ADHD severity score.
[d] Accounted for school clustering only.
[e] Adjusted for child (age, sex, internalizing disorder, externalizing disorder, and recruitment cohort), family factors (parent high school completion, socio-economic indexes for areas disadvantage index (SEIFA)), and school clustering

Table A.4
Association between gender and autism spectrum disorder symptoms[a] in children with ADHD.

	Mean (SD)		Mean difference (95% CI)					
	Girls with ADHD ($n = 50$)	Boys with ADHD ($n = 114$)	Unadjusted[c]	Effect size	p	Adjusted[d]	Effect size	p
SCQ[b] total score	9.0 (6.3)	10.9 (7.4)	2.1 (−0.3, 4.5)	0.3	0.080	2.9 (0.8, 5.2)	0.4	0.010
SCQ[b] social interaction	2.8 (2.7)	3.3 (3.2)	0.5 (−0.5, 1.5)	0.2	0.400	0.8 (−0.3, 1.8)	0.2	0.143
SCQ[b] communication	4.0 (2.5)	4.2 (2.3)	0.2 (−0.6, 1.0)	0.3	0.600	0.5 (−0.2, 1.2)	0.4	0.178
SCQ[b] stereotyped behavior	1.6 (1.8)	2.6 (2.4)	1.1 (0.4, 1.8)	0.3	0.004	1.3 (0.6, 2.0)	0.4	<0.001

[a] Measured by the Social Communication Questionnaire – lifetime form.
[b] Social Communication Questionnaire – lifetime form.
[c] Accounted for school clustering.
[d] Adjusted for child (age, sex, internalizing disorder, externalizing disorder, and recruitment cohort) and family factors (parent high school completion, socio-economic indexes for areas disadvantage index), and school clustering.

References

Clark, T., Feehan, C., Tinline, C., & Vostanis, P. (1999). Autistic symptoms in children with attention deficit-hyperactivity disorder. *European Child and Adolescent Psychiatry, 8*(1), 50–55.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155–159.

Conners, C. (2008). *Conners* (3rd ed.). Toronto Multi-Health Systems.

Davis, N. O., & Kollins, S. H. (2012). Treatment for co-occurring attention deficit/hyperactivity disorder and autism spectrum disorder. *Neurotherapeutics, 9*(3), 518–530. http://dx.doi.org/10.1007/s13311-012-0126-9

Efron, D., Hazell, P., & Anderson, V. (2011). Update on attention deficit hyperactivity disorder. *Journal of Paediatrics and Child Health, 47*(10), 682–689. http://dx.doi.org/10.1111/j.1440-1754.2010.01928.x

Efron, D., Sciberras, E., Anderson, V., Hazell, P., Ukoumunne, O., Jongeling, B., Schilpzand, E. J., Bisset, M., & Nicholson, J. M. (2014). A controlled community study of functional status in Attention-Deficit/Hyperactivity Disorder at age 6–8. *Pediatrics, 134*, e992–e1000.

Gargaro, B. A., May, T., Tonge, B. J., Sheppard, D. M., Bradshaw, J. L., & Rinehart, N. J. (2014). Using the DBC-P hyperactivity index to screen for ADHD in young people with autism and ADHD: A pilot study. *Research in Autism Spectrum Disorders, 8*(9), 1008–1015. http://dx.doi.org/10.1016/j.rasd.2014.05.004

Grzadzinski, R., Di Martino, A., Brady, E., Mairena, M. A., O'Neale, M., Petkova, E., et al. (2011). Examining autistic traits in children with ADHD: Does the autism spectrum extend to ADHD? *Journal of Autism and Developmental Disorders, 41*(9), 1178–1191.

Jang, J., Matson, J. L., Williams, L. W., Tureck, K., Goldin, R. L., & Cervantes, P. E. (2013). Rates of comorbid symptoms in children with ASD, ADHD, and comorbid ASD and ADHD. *Research in Developmental Disabilities, 34*(8), 2369–2378. http://dx.doi.org/10.1016/j.ridd.2013.04.021

Kochhar, P., Batty, M., Liddle, E., Groom, M., Scerif, G., Liddle, P., et al. (2011). Autistic spectrum disorder traits in children with attention deficit hyperactivity disorder. *Child: Care, Health and Development, 37*(1), 103–110. http://dx.doi.org/10.1111/j.1365-2214.2010.01123.x

Kochhar, P., Batty, M. J., Liddle, E. B., Groom, M. J., Scerif, G., Liddle, P. F., et al. (2011). Autistic spectrum disorder traits in children with attention deficit hyperactivity disorder. *Child: Care, Health and Development, 37*(1), 103–110. http://dx.doi.org/10.1111/j.1365-2214.2010.01123.x

Konst, M. J., Matson, J. L., Goldin, R., & Rieske, R. (2014). How does ASD symptomology correlate with ADHD presentations? *Research in Developmental Disabilities, 35*(9), 2252–2259. http://dx.doi.org/10.1016/j.ridd.2014.05.017

Kroger, A., Hanig, S., Seitz, C., Palmason, H., Meyer, J., & Freitag, C. M. (2011). Risk factors of autistic symptoms in children with ADHD. *European Child and Adolescent Psychiatry, 20*(11–12), 561–570. http://dx.doi.org/10.1007/s00787-011-0221-1

Musser, E. D., Hawkey, E., Kachan-Liu, S. S., Lees, P., Roullet, J. B., Goddard, K., et al. (2014). Shared familial transmission of autism spectrum and attention-deficit/hyperactivity disorders. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 55*(7), 819–827. http://dx.doi.org/10.1111/jcpp.12201

Nijmeijer, J., Hoekstra, P. J., Minderaa, R. B., Buitelaar, J. K., Altink, M. E., Buschgens, C. J. M., et al. (2009). PDD symptoms in ADHD, an independent familial trait? *Journal of Abnormal Child Psychology, 37*(3), 443–453.

Nijmeijer, J., Minderaa, R. B., Buitelaar, J. K., Mulligan, A., Hartman, C. A., & Hoekstra, P. J. (2008). Attention-deficit/hyperactivity disorder and social dysfunctioning. *Clinical Psychology Review, 28*(4), 692–708. http://dx.doi.org/10.1016/j.cpr.2007.10.003

Polderman, T. J. C., Hoekstra, R. A., Posthuma, D., & Larsson, H. (2014). The co-occurrence of autistic and ADHD dimensions in adults: an etiological study in 17770 twins. *Translational Psychiatry, 4*, e435. http://dx.doi.org/10.1038/tp.2014.84

Reiersen, A. M. (2011). Links between autism spectrum disorder and ADHD symptom trajectories: Important findings and unanswered questions. *Journal of the American Academy of Child and Adolescent Psychiatry, 50*(9), 857–859. http://dx.doi.org/10.1016/j.jaac.2011.06.012

Reiersen, A. M., Constantino, J. N., Volk, H. E., & Todd, R. D. (2007). Autistic traits in a population-based ADHD twin sample. *Journal of Child Psychology and Psychiatry, 48*(5), 464–472. http://dx.doi.org/10.1111/j.1469-7610.2006.01720.x

Ronald, A., Larsson, H., Anckarsater, H., & Lichtenstein, P. (2014). Symptoms of autism and ADHD: A Swedish twin study examining their overlap. *Journal of Abnormal Psychology, 123*(2), 440–451.

Ronald, A., Simonoff, E., Kuntsi, J., Asherson, P., & Plomin, R. (2008). Evidence for overlapping genetic influences on autistic and ADHD behaviours in a community twin sample. *Journal of Child Psychology and Psychiatry, 49*(5), 535–542. http://dx.doi.org/10.1111/j.1469-7610.2007.01857.x

Rutter, M., Bailey, A., & Lord, C. (2003). *Social Communication Questionnaire*. Los Angeles, CA: Western Psychological Services (WPS).

Sciberras, E., Efron, D., Schilpzand, E., Anderson, V., Jongeling, B., Hazell, P., et al. (2013). The Children's Attention Project: A community-based longitudinal study of children with ADHD and non-ADHD controls. *BMC Psychiatry, 13*(1), 18.

Sciberras, E., Fulton, M., Efron, D., Oberklaid, F., & Hiscock, H. (2011). Managing sleep problems in school aged children with ADHD: A pilot randomised controlled trial. *Sleep Medicine, 12*(9), 932–935. http://dx.doi.org/10.1016/j.sleep.2011.02.006

Sciberras, E., Lycett, K., Efron, D., Mensah, F., Gerner, B., & Hiscock, H. (2014). Anxiety in children with Attention-Deficit/Hyperactivity Disorder. *Pediatrics, 133*(5), 801–808.

Sciberras, E., Mueller, K. L., Efron, D., et al. (2014). Language problems in children with ADHD: a community-based study. *Pediatrics, 133*(5), 793–800.

Sciberras, E., Roos, L., & Efron, D. (2009). Review of prospective longitudinal studies of children with ADHD: Mental health, educational, and social outcomes. *Current Attention Disorders Reports, 1*(4), 171–177. http://dx.doi.org/10.1007/s12618-009-0024-1

Shaffer, D., Fisher, P., Lucas, C. P., Dulcan, M. K., & Schwab-Stone, M. E. (2000). NIMH Diagnostic Interview Schedule for Children Version IV (NIMH DISC-IV): Description, differences from previous versions, and reliability of some common diagnoses. *Journal of the American Academy of Child and Adolescent Psychiatry, 39*(1), 28–38. http://dx.doi.org/10.1097/00004583-200001000-00014

St. Pourcain, B., Mandy, W. P., Heron, J., Golding, J., Smith, G. D., & Skuse, D. H. (2011). Links between co-occurring social-communication and hyperactive-inattentive trait trajectories. *Journal of the American Academy of Child and Adolescent Psychiatry, 50*(9), 892–902. http://dx.doi.org/10.1016/j.jaac.2011.05.015

Van der Meer, J. M. J., Oerlemans, A. M., van Steijn, D. J., Lappenschaar, M. G. A., de Sonneville, L. M. J., Buitelaar, J. K., et al. (2012). Are autism spectrum disorder and attention-deficit/hyperactivity disorder different manifestations of one overarching disorder?. Cognitive and symptom evidence from a clinical and population-based sample. *Journal of the American Academy of Child and Adolescent Psychiatry*, *51*(11).. 1160-1172.e1163.

Wiggins, L. D., Bakeman, R., Adamson, L. B., & Robins, D. L. (2007). The utility of the Social Communication Questionnaire in screening for autism in children referred for early intervention. *Focus on Autism and Other Developmental Disabilities*, *22*(1), 33–38. http://dx.doi.org/10.1177/10883576070220010401

Declaration for Thesis Chapter 4: Child Functioning Paper

Monash University

Declaration by candidate

In the case of Chapter 4, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Project design, review of relevant literature, attainment of ethics approval, recruitment and assessment of a sub-set of research participants, data analysis and writing of manuscript	70%

The following co-authors contributed to the work. If co-authors are students at Monash University, the extent of their contribution in percentage terms must be stated:

Name	Nature of contribution
Professor Nicole Rinehart	Contributed to project design and provided input during final draft stage of manuscript
Professor Vicki Anderson	Contributed to project design and provided input during final draft stage of manuscript
Dr Emma Sciberras	Contributed to project design and provided input during final draft stage of manuscript
Dr Daryl Efron	Provided input during final draft stage of manuscript

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work*.

Candidate's Signature	[redacted]	**Date** 28/10/15
Main Supervisor's Signature	[redacted]	**Date** 20/10/2015

7. STUDY 2

7.1 STUDY 2 OVERVIEW. This chapter includes an empirical paper titled "The relationship between autism spectrum disorder symptoms and functioning in children with ADHD and controls: a community-based study". This paper is under review in *Pediatrics*. The aim of this paper is to examine the relationship between autism spectrum disorder symptoms and peer relationship problems, mental health and child quality of life.

7.2 STUDY 2 HYPOTHESES. It was hypothesised that: (1) Greater ASD symptom severity in children with and without ADHD would be associated with greater peer problems and less prosocial behaviours; (2) greater ASD symptom severity in children with and without ADHD would be associated with poorer child mental health; (3) greater ASD symptom severity in children with and without ADHD would be associated with moderate to large sleep problems and; (4) greater ASD symptom severity in children with and without ADHD would be associated with poorer psychosocial quality of life.

7.3 STUDY 2 PAPER.

Title: Association between autism spectrum disorder symptoms and functioning in children with ADHD: a community-based study.

Jessica Leigh Green[1,2], BA (Hons), Emma Sciberras[2,3,5], DPsych, Vicki Anderson[2,3,4], PhD, Daryl Efron[2,3,4], MD, FRACP, Nicole Rinehart[2,5], PhD.

Affiliations: [1] School of Psychological Sciences, Monash University, Clayton, VIC Australia; [2] Murdoch Childrens Research Institute, Parkville, VIC Australia; [3]The Royal Children's Hospital, Parkville, VIC Australia; [4]The University of Melbourne, Parkville, VIC Australia; [5]School of Psychology, Deakin University, Burwood, VIC Australia.

Address correspondence to: Ms. Jessica Leigh Green

Murdoch Childrens Research Institute, Royal Children's Hospital

Flemington Road, Parkville 3052 AUSTRALIA

[redacted]

Running head: Autism spectrum symptoms and child functioning.

Abbreviations: ADHD: Attention-Deficit/Hyperactivity Disorder; ASD: Autism Spectrum Disorder; DISC-IV: Diagnostic Interview Schedule for Children IV; DSM-IV-TR: Diagnostic and Statistical Manual of Mental Disorders Fourth Edition Text Revised; MD: Mean Difference; OR: Odds Ratio; SEIFA: Socio-Economic Indexes for Areas.

Key words: attention-deficit hyperactivity disorder, autism spectrum disorder, mental health, peer relations, quality of life.

Funding source: This study is funded by the Australian National Health and Medical Research Council (NHMRC; project grant no. 1008522) and the Murdoch Childrens Research Institute. Ms. Green's research work is funded by Monash University Australian Postgraduate Scholarship (APA; 2012 – 2015) and a MCRI Professor David Danks Top Up Scholarship

(2013-2015). Dr Sciberras' position is funded by an NHMRC Early Career Fellowship in Population Health 1037159 (2012-2015). Professor Anderson is funded by an NHMRC Senior Practitioner Fellowship 607333 (2010-2019). Dr Efron is funded by a Career Development Fellowship from the Murdoch Childrens Research Institute. This research was supported by the Victorian Government's Operational Infrastructure Support Program to the MCRI.

Financial disclosure: All authors have no financial disclosures relevant to this article.

Conflicts of interest: All authors have no conflicts of interest relevant to this article.

Word count: 2999

Abstract word count: 249

What's known on this subject: Although clinically elevated autism spectrum disorder (ASD) symptoms affect up to 25% of children with Attention Deficit Hyperactivity Disorder (ADHD), little research has examined how comorbid ASD symptoms impact on child functioning in this group.

What this study adds: Concurrent ASD symptoms contribute to poorer quality of life, greater peer problems, and increased mental health difficulties in children with ADHD. Future research needs to examine whether treating ASD symptoms improves functional outcomes for children with ADHD.

Contributor's statement

Jessica Leigh Green: Ms. Green conceptualized and designed the study specific to this paper, carried out the analyses, drafted the initial manuscript, revised the manuscript, and approved the final manuscript as submitted.

Emma Sciberras: Dr Sciberras contributed to the conception and design of the study, reviewed and revised the manuscript, provided critical input, and approved the final manuscript as submitted.

Vicki Anderson: Professor Anderson contributed to the conception and design of the study, reviewed and revised the manuscript, provided critical input, and approved the final manuscript as submitted.

Daryl Efron: Dr Efron reviewed and revised the manuscript, provided critical input, and approved the final manuscript as submitted.

Nicole Rinehart: Professor Rinehart contributed to the conception and design of the study, reviewed and revised the manuscript, provided critical input, and approved the final manuscript as submitted.

ABSTRACT

Objectives: To examine the association between autism spectrum disorder (ASD) symptoms and (a) social functioning; (b) mental health; (c) quality of life and (d) sleep, in children with and without Attention-Deficit/Hyperactivity Disorder (ADHD).

Methods: Participants were 6-10 year old children with ADHD (N=164) and without ADHD (N=198). ADHD was assessed via community-based screening (Wave 1) and case-confirmation using the Diagnostic Interview Schedule for Children IV (DISC-IV) (Wave 2). ASD symptoms were identified using the Social Communication Questionnaire (SCQ). Outcome measures were social functioning (Strengths and Difficulties Questionnaire (SDQ)), mental health (DISC-IV, SDQ), quality of life (QoL, Pediatric Quality of Life Inventory 4.0) and sleep problem severity.

Results: Each standard deviation (SD) increase in SCQ scores was associated with a 6.7 unit reduction in QoL ($p < 0.001$) and greater parent and teacher-reported peer problems, emotional and conduct problems. For every SD increase in SCQ scores, internalizing (OR = 1.8, 95% CI 1.3, 2.6, $p = 0.001$) and externalizing disorders (OR = 1.5, 95% CI 1.1, 2.1, $p = 0.02$) increased, as did moderate/severe sleep problems (OR = 1.5, 95% CI 1.0, 2.2, $p = 0.04$). Most findings held in analyses adjusting for socio-demographic factors, ADHD symptom severity, and comorbidities (when not the outcome), with the exception of externalizing disorders and sleep problems.

Conclusions: ASD symptoms are associated with poorer functioning in children with ADHD. It is important to identify and potentially manage ASD symptoms in children with ADHD given that they exacerbate functional impairments in this already vulnerable group.

INTRODUCTION

Up to 25% of children with Attention Deficit Hyperactivity Disorder (ADHD) have clinically elevated Autism Spectrum Disorder (ASD) symptoms.[1-4] ASD shares familial transmission with ADHD,[5] with the DRD4 7-repeat allele, thought to increase the risk for clinically elevated autistic symptoms in young people with ADHD.[6] Children with ADHD have greater internalizing and externalizing difficulties,[7,8] more peer problems,[8-10] greater sleep difficulties,[11] and poorer quality of life[12,13] compared to children without ADHD. However, the degree to which ASD symptoms contribute to, or compound, these difficulties remains unclear. Understanding whether ASD symptoms are related to functional difficulties in children with ADHD will enrich the assessment and treatment of children with ADHD.

There is conflicting evidence as to whether mental health and peer difficulties in children with ADHD are associated with comorbid ASD symptoms. In some studies, ASD symptoms in children with ADHD have been linked to greater externalizing[14-17,18] and internalizing difficulties (e.g., emotional lability,[16] anxiety,[17,18] and depressive symptoms[6,18]), while others have not found these relationships.[1, 19] Further, some studies have reported a link between ASD symptoms in children with ADHD and elevated peer problems,[16,18] while one study reported that children with ADHD+ASD symptoms had equivalent peer difficulties to children with ADHD only.[20] Most previous research has used parent reports of mental health and peer difficulties. Only one study[21] has included teacher reports of externalizing symptoms, finding that greater ASD symptoms was associated with more externalizing symptoms, and no

studies have included teacher ratings of internalizing symptoms or peer problems. Teachers may be better able to rate peer, emotional and conduct problems, as well as prosocial behavior, given they regularly observe children within a social context of same aged peers. Only one study has examined whether sleep problems are exacerbated by comorbid ASD in children with ADHD.[22] This study found that sleep problem severity did not differ between children with ADHD+ASD compared to ADHD alone.[22]

This study aimed to clarify the relationship between ASD symptoms and psychosocial functioning in a community sample of children with ADHD and without ADHD, through use of rigorous measures and multi-informant assessments of a) peer problems and prosocial behavior; b) mental health; and c) sleep. We also aimed to extend current knowledge by examining psychosocial quality of life (QoL), which encompasses social, emotional and school functioning, which to the best of our knowledge, have not been previously examined. It was hypothesized that greater ASD symptom severity in children with ADHD would be associated with poor functioning across all domains.

PATIENTS AND METHODS

Design and setting

Participants were 6-10 year old children attending 43 schools in Melbourne, Australia, who were participating in a longitudinal cohort study.[23] We report on data for 164 children with confirmed ADHD and 198 non-ADHD controls.

Measures

The Social Communication Questionnaire (SCQ) Lifetime Form,[24] a 40-item, parent-report screening measure was used to assess *child ASD symptoms*. The SCQ total score comprises items assessing reciprocal social interaction, communication, and restricted, repetitive and stereotyped patterns of behavior.[25] The SCQ corresponds well with the gold standard Autism Diagnostic Interview Revised and has high discriminant validity between children with and without ASD.[24] (See Table 11 for a summary of measures)

The Strengths and Difficulties Questionnaire (SDQ)[26] was used to assess parent and teacher reported child functioning using the following scales: *peer problems, prosocial behaviour, emotional problems and conduct problems* subscales. Higher scores on problems subscales indicate poorer functioning whereas higher scores on the prosocial behavior scale indicates better functioning.

The Diagnostic Interview Schedule for Children, Version 4 (DISC-IV)[27] is a parent-completed interview used to assess *ADHD including subtype* and identify *internalizing or externalizing disorders,* defined as meeting diagnostic criteria for at least one internalizing (e.g. Generalized Anxiety Disorder) or externalizing disorder (e.g. Conduct Disorder) in the year prior to assessment. The measure has good diagnostic reliability and validity.[27] The Conners 3 ADHD Index[28] was used to assess *ADHD symptom severity.* This measure has robust validity, and reliability.[28]

The Pediatric Quality of Life Inventory 4.0 (PedsQL)[29] was completed by parents to assess *child QoL*. The PedsQL physical, emotional, school and social QoL subscales were used, the Psychosocial Health Summary Score, which summarizes scores on the emotional, social and school subscales, and a Total Scale Score, which summarizes all subscale scores.

Sleep problems were assessed using the following parent-reported item "*How much is your child's sleeping pattern or habits a problem for you?*"[30,31] from the Longitudinal Study for Australian Children questionnaire. Responses were dichotomized into 'no problem at all/small problem' versus 'moderate problem/large problem'.[30,31] This item has been used to measure sleep in children with and without ADHD[30,31] to dichotomize children into distinct sleep problem groups: no/mild versus moderate/severe.[30-32] The measure corresponds well with the Children's Sleep Habits Questionnaire, a well-validated 33-item measure of child sleep difficulties.[33]

Procedure

Data were collected as part of the Children's Attention Project (CAP), a longitudinal cohort study of children with and without ADHD.[23] Ethics approval was obtained from The Royal Children's Hospital (#31056), the Victorian Department of Education and Early Childhood Development (#2011_001095) and Monash University (#CF12/4044 - 2012001944) Melbourne, Australia.

Children in their second year of formal schooling (6-8 years of age) were screened for ADHD. Participants were recruited in two cohorts: Cohort 1 recruited in 2011 and Cohort 2 in 2012 (see Figure 2). Children with serious medical conditions or intellectual disability were excluded, as were those whose parents lacked sufficient English to complete study questionnaires.

ADHD was screened using parent and teacher Conners 3 ADHD Indices, together with parent report of previous ADHD diagnosis. Completed parent and teacher screening surveys were received for 63% of potential participants, with no differences between responders and non-responders for child age and gender, however, responders were from more socially advantaged areas. Children screened positive for ADHD if they had a prior diagnosis of ADHD, and/or if their scores on both parent and teacher ADHD indices were $\geq 75^{th}$ percentile for boys, and $\geq 80^{th}$ percentile for girls. Children screened negative if they did not have a prior diagnosis of ADHD and their scores on both the parent and teacher ADHD indices were $< 75^{th}$ percentile for boys and $< 80^{th}$ percentile for girls. Children who screened positive for ADHD (n = 412) were randomly matched, based on gender and school, with a child who screened negative for ADHD (n = 412).

At Wave 1, of the 412 children who screened positive for ADHD, 267 were eligible and participated in the longitudinal study (response rate: 65%), with 179 confirmed as meeting ADHD criteria on the DISC-IV making the ADHD group. Of the 412 children who screened negative, 231 were eligible and participated (response rate: 56%), with 212 not meeting criteria

for ADHD on the DISC-IV comprising the non-ADHD control group - see Efron et. al[8] for further details. The DISC-IV was completed via clinical interview with the child's parents, and other outcome measures were collected by parent and teacher questionnaires. Families were followed-up at 18 months post-recruitment (Wave 2) to assess medium-term outcomes. For Cohort 1, the SCQ was completed during a telephone at Wave 2 (18 month follow-up). For cohort 2, the SCQ was completed during a face-to-face assessment at Wave 1 (baseline). SCQ data collection protocols were identical between the cohorts, apart from the mode of assessment. We report on Wave 1 child functioning variables for Cohort 2 participants and Wave 2 variables for Cohort 1, to harmonize with SCQ data collection.

Children with ADHD were more likely to have a primary caregiver who had not completed high school, and more likely to have had a pre-existing diagnosis of ASD compared to non-ADHD controls (Table 8). Children with ADHD also had higher rates of internalizing and externalizing disorders, poorer quality of life, more peer and sleep problems, fewer prosocial behaviors, and more emotional and conduct problems than non-ADHD controls.

Analyses

Unadjusted and adjusted linear regression, and r-squared for an effect size estimate, was used to examine, in children with and without ADHD, associations between: a) SCQ score and parent and teacher reported peer problems (SDQ), b) SCQ score and child QoL (Peds-QL) and c) SCQ score and parent and teacher-reported emotional and conduct problems (SDQ). In

children with and without ADHD, unadjusted and adjusted logistic regression was used to examine the association between SCQ score and the presence of an internalizing and/or externalizing disorder (DISC-IV) and moderate/severe sleep problems. Adjusted analyses controlled for child age, child gender, ADHD symptom severity, parent education, socioeconomic status, school clustering, and recruitment cohort. Analyses for peer problems, sleep problems and child QoL were also adjusted for the presence of an internalizing or externalizing disorder. SCQ total score was used in analyses, with this score converted into standard deviation units.

RESULTS

Peer problems and prosocial behavior. Higher SCQ scores in children with ADHD were associated with greater peer problems, as reported by parents ($R^2 = 0.24$, b= 1.1, $p < 0.001$; see Table 9) and teachers ($R^2 = 0.07$, b= 0.7, $p < 0.001$, see Table 9). For prosocial behavior, every standard deviation increase in SCQ score was associated with 0.9 unit decrease in prosocial behaviors as reported by parents ($R^2 = 0.16$, 95% CI -1.2 to -0.5, $p < 0.001$), and a 0.3 unit decrease in prosocial behaviors as reported by teachers ($R^2 = 0.01$, 95% CI -0.8 to 0.1, $p = 0.10$) for children with ADHD.

Child mental health. Higher SCQ scores were associated with increased odds for meeting criteria for an internalizing and externalizing disorder in children with ADHD. For every standard deviation unit increase in SCQ score, the odds of meeting criteria for an

internalizing disorder increased by 1.8 (95% CI 1.3 to 2.6, p = 0.001), and by 1.5 for an externalizing disorder (95% CI 1.1 to 2.1, OR = 1.5 p = 0.02).

Each standard deviation increase in SCQ score was associated with a 0.7 and 0.5 unit increase in emotional problems as reported by parents (R^2 = 0.08, 95% CI 0.3 to 1.1, p = 0.001), and teachers (R^2 = 0.04, 95% CI 0.1 to 0.9, p = 0.02), respectively (see Table 9). Each standard deviation increase in SCQ score was associated with a 0.6 unit increase in parent reported conduct problems (R^2 = 0.08, 95% CI 0.3 to 1.0, p = 0.001) although there was less evidence of an association by teacher report.

Child sleep problems. Higher SCQ scores were associated with increased odds of the child having a moderate to large sleep problem. For every standard deviation increase in SCQ score, the odds of having a moderate to large sleep problem increased by 1.5 (OR = 1.5, 95% CI 1.0 to 2.2, p = 0.04).

Child QoL. Higher SCQ scores were associated with reduced total overall QoL (R^2 = 0.25, b = -6.9, p < 0.001, see Table 9), psychosocial QoL (R^2 = 0.26, b = -6.7, p < 0.001) and all subscales: physical (R^2 = 0.12, b = -7.3, p < 0.001), emotional (R^2 = 0.15, b = -7.1, p < 0.001), school (R^2 = 0.07, b = -4.3, p = 0.001), and social functioning (R^2 = 0.22, b = -8.9, p < 0.001).

Adjusted analyses. Most findings held in adjusted analyses. The association between SCQ score and externalizing disorder (OR = 1.4, 95% CI 0.9 to 2.2, p = 0.16) attenuated which appeared to be driven by the inclusion of internalizing disorders in the model (p = 0.005). The

relationship between SCQ score and sleep problems weakened (OR=1.2, 95% CI 0.7 to 2.0, p = 0.54), due to with the inclusion of socioeconomic status (p = 0.03) and ADHD symptom severity (p = 0.08) in the model.

Control group. In adjusted analyses, higher SCQ scores were associated with greater parent reported peer problems (R^2 = 0.17, b = 0.5, p = 0.04), less teacher reported prosocial behaviour (R^2 = 0.13, b = -0.9, p < 0.01) and more parent reported emotional problems (R^2 = 0.04, b = 0.6, p = 0.04, see Table 10). In adjusted analyses, there was some evidence to suggest an association between higher SCQ scores and increased odds of externalizing (p = 0.09) or internalizing disorder (p = 0.05). Higher SCQ scores were not associated with teacher reported peer problems, parent reported prosocial behavior, moderate/large sleep problems, child QoL, teacher and parent reported conduct problems and teacher reported emotional problems (see Table 10).

DISCUSSION

This study demonstrates that higher ASD symptom severity was associated with poorer functioning across multiple domains in children with ADHD including more internalizing and externalizing difficulties, greater peer problems and less prosocial behaviors, and poorer QoL. These findings held when accounting for potential confounding variables including ADHD symptom severity, comorbidities, gender and socioeconomic status. For control children, higher ASD symptom severity was associated with more parent-reported peer and emotional

problems and less teacher-reported prosocial behavior. This is the first study to comprehensively examine the association between ASD symptoms and a broad range of functional outcomes including QoL for children with ADHD and non-ADHD controls. Furthermore, this study utilized a rigorous method to assessing peer problems and mental health difficulties, in a community based sample of 6-10 year old boys and girls with ADHD and without ADHD.

We found evidence that ASD symptoms are associated with internalizing difficulties in children with ADHD, when assessed categorically using a gold-standard diagnostic interview, and also when assessed continuously by parent and teacher report using the SDQ. ASD symptoms and emotional problems were also associated with ASD symptoms for non-ADHD controls. This association between ASD symptoms and internalizing difficulties is consistent with a number of previous studies,[3,6,7] however, this is the first study to examine this association by teacher report. This finding is consistent with what is already known about children with ASD more generally, that comorbid anxiety is common, as is mood disturbance.[34-36] Forty percent of young people with ASD are diagnosed with one or more anxiety disorders[37] and families of young people with ASD rate anxiety as one of the major issues requiring attention.[38] Similarly, a recent paper found, in a clinical sample of children with ADHD that 26% of children had one anxiety disorder and 39% had two.[7]

There were mixed findings regarding an association between ASD symptoms and externalizing difficulties. Although we found an association between ASD symptoms and

parent reported conduct difficulties when measured continuously, the relationship between ASD symptoms and externalizing disorders attenuated when taking into account with the presence of an internalizing disorder and other potentially confounding variables, which is consistent with some other studies.[19,1] This may have been a consequence of different measurement tools. The lack of a significant association between ASD symptoms and externalizing disorder makes sense, given that externalizing difficulties are more common in children with ADHD than ASD (54% ODD in ADHD sample[8] vs. 28% ODD in ASD sample;[39] 10% conduct disorder in ADHD sample[8] vs. 3% conduct disorder in ASD sample[39]), however, our findings are suggestive of a relationship when conduct difficulties are measured dimensionally by parent report.

As expected, greater ASD symptoms in children with ADHD predicted poorer QoL, in physical, social, school and emotion domains. Although it is well established both that children with ASD[40] and children with ADHD[8] have poorer QoL compared to healthy controls, this is the first study to demonstrate the compounding effect of ASD symptoms on QoL for children with ADHD. We also found that parents and teachers reported more peer problems and less prosocial behaviors for children with ADHD and non-ADHD controls, who had more ASD symptoms, which is consistent with previous reports.[16,18] The peer problems subscale from the SDQ includes items that examine quality of friendships and peer rejection or bullying. It is well established that children with ADHD experience more peer relationship difficulties than their peers without ADHD.[41] Our findings demonstrate that ASD symptoms contribute to peer

relationship problems in children with ADHD. With regard to sleep, our findings are consistent with Thomas et al., who found that sleep problem severity did not differ between children with ADHD+ASD and those with ADHD alone.[22]

Our findings that ASD symptoms in children with ADHD are associated with poorer functioning across multiple domains, suggests intervention is crucial for these children. It is likely that the co-occurrence of ADHD and ASD indicates a more severe phenotype than ADHD alone.[42,43] Clinically it may be helpful to think of children with ADHD and clinically significant ASD symptoms as having a more severe neurodevelopmental disability rather than two separate diagnoses. Currently therapies are generally offered in silos tied to either an ASD or ADHD service model, however, our findings support an approach where intervention is directed at the diagnosis causing most impairment. It is likely that treatment additions or modifications will be necessary for children with ADHD who have additional ASD symptoms.

These results need to be considered in light of study strengths and limitations. This study included a large population-based sample of children with ADHD, with a relatively large sample of girls, compared to previous studies. Furthermore, our measure of internalizing and externalizing symptoms was comprehensive, as was the addition of measures of QoL and prosocial behavior, which have not been included in previous research. With regard to ASD symptoms, the SCQ is not a diagnostic measure of ASD symptoms. Inclusion of measures such as the Autism Diagnostic Observation Schedule or the Autism Diagnostic Interview, Revised may have provided more detailed diagnostic information. It is also acknowledged that our sleep

evaluation was not comprehensive, although the item administered has well established correspondence with more detailed sleep measure.[33] Of note, our approach to statistical analyses was rigorous, controlling for a number of confounding variables that may explain the association between constructs of interest.

CONCLUSION

ASD symptoms are common in children with ADHD and are associated with poorer social functioning, reduced QoL and greater mental health difficulties. Given the prevalence and burden of these symptoms, it is important for clinicians to include assessment of ASD symptoms in children with ADHD. Future research needs to examine whether established treatments for ASD are efficacious in improving social and communication skills in children with ADHD.

ACKNOWLEDGEMENTS

We would like to acknowledge all research staff, students and interns who contributed to data collection for this project. We would also like to thank the participating families, teachers and schools.

Figure 2. Study 2 Participant Flow

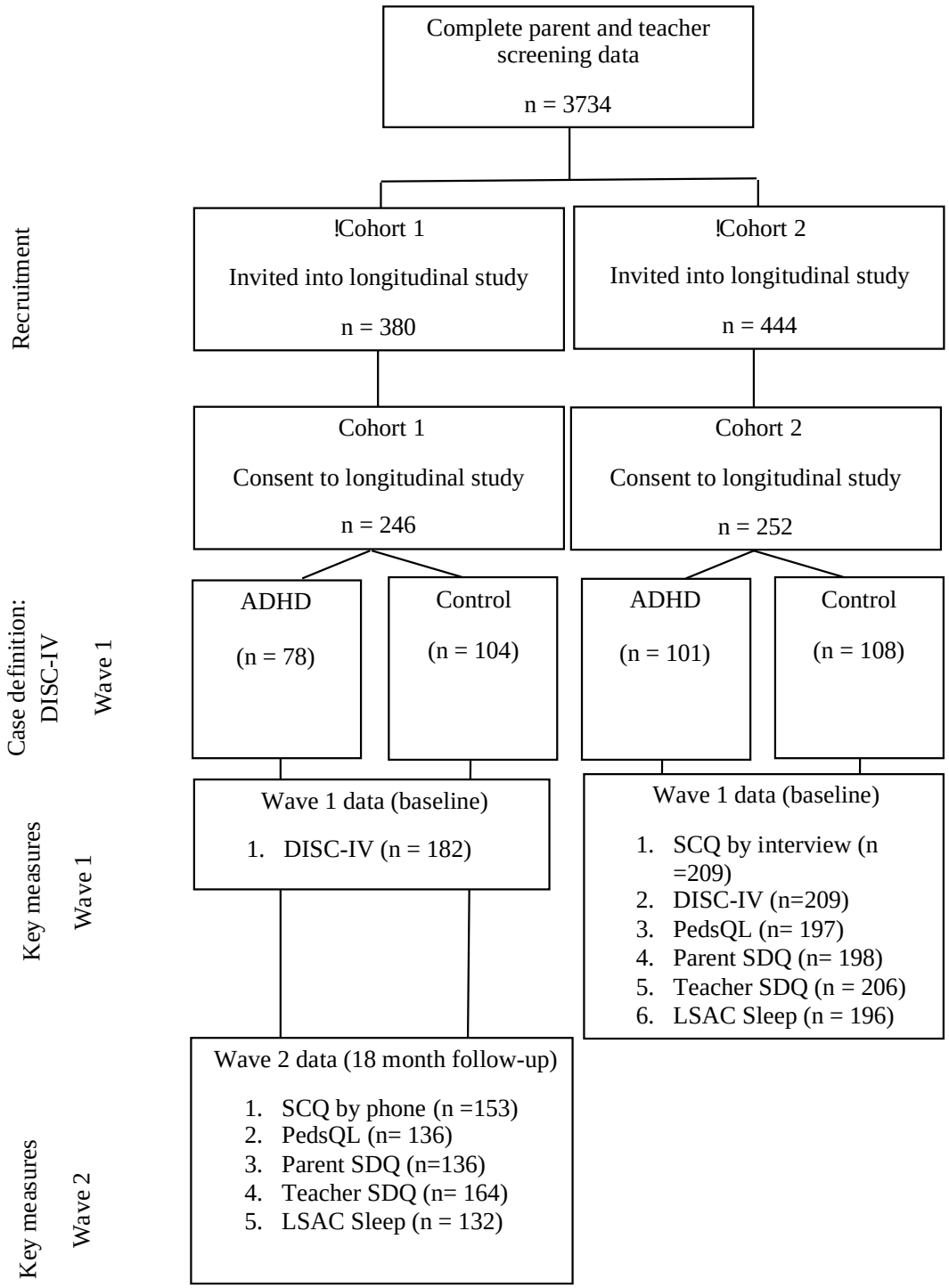


Table 8. Sample characteristics

	Control ***n = 198[a]***	**ADHD** ***n = 164[b]***	**P value**
Child Characteristics			
Child age in years, mean (SD)	8.1 (1.1)	7.9 (1.1)	0.13
Male, n (%)	128 (64.7)	114 (69.5)	0.30
Medication use (any), n (%)	1 (0.6)	27 (19.2)	<0.001
ASD			
Existing Autism Spectrum Disorder diagnosis, n (%)	3 (1.6)	35 (23.9)	<0.001
ADHD			
DISC-IV[c]: ADHD subtype, n (%)			
ADHD-Combined		83 (50.6)	
ADHD-Inattentive		62 (37.8)	
ADHD-Hyperactive/Impulsive		19 (11.6)	
Conners 3: ADHD symptom severity[d] – parent report, mean (SD)	1.3 (2.4)	13.1 (4.6)	<0.001
Conners 3: ADHD symptom severity[d] – teacher report, mean (SD)	0.8 (2.4)	11.5 (5.9)	<0.001
Mental health			
DISC-IV: Internalizing comorbidity[c] in past year, n (%)	9 (4.5)	43 (26.2)	<0.001
DISC-IV: Externalizing comorbidity[c] in past year, n (%)	14 (7.1)	87 (53.1)	<0.001
SDQ: Emotional problems[e] – parent report, mean (SD)	1.7 (1.8)	3.6 (2.5)	<0.001
SDQ: Emotional problems[e] – teacher report, mean (SD)	1.5 (1.8)	2.7 (2.6)	<0.001
SDQ: Conduct problems[e] – parent report, mean (SD)	1.2 (2.2)	4.0 (2.2)	<0.001
SDQ: Conduct problems[e] – teacher report, mean (SD)	0.6 (1.4)	2.9 (2.5)	<0.001

Quality of life			
PedsQL: Overall functioning [f], mean (SD)	81.7 (12.9)	63.3 (13.7)	<0.001
PedsQL: Psychosocial functioning[f], mean (SD)	80.3 (12.3)	57.4 (11.3)	<0.001
PedsQL: Physical functioning[f], mean (SD)	84.4 (17.9)	74.3 (20.2)	<0.001
PedsQL: Emotional functioning[f], mean (SD)	76.9 (13.9)	56.7 (18.4)	<0.001
PedsQL: Social functioning[f], mean (SD)	84.5 (16.2)	62.1 (19.5)	<0.001
PedsQL: School functioning[f], mean (SD)	79.7 (16.9)	53.3 (15.2)	<0.001
Social functioning			
SDQ: Peer problems[e] – parent report, mean (SD)	1.1 (1.4)	3.2 (2.2)	<0.001
SDQ: Peer problems[e]– teacher report, mean (SD)	1.1 (1.3)	2.9 (2.2)	<0.001
SDQ: Prosocial behavior[e] – parent report, mean (SD)	8.3 (1.6)	6.4 (2.1)	<0.001
SDQ: Prosocial behavior[e] – teacher report, mean (SD)	7.9 (2.2)	5.7 (2.7)	<0.001
Sleep			
LSAC: Sleep problems[g], mean (SD)	1.2 (0.6)	1.9 (1.0)	<0.001
Primary caregiver/family characteristics			
Parent completed high school, n (%)	156 (81.3)	97 (62.2)	<0.001
SEIFA[h], mean (SD)	1014.9 (46.0)	1012.1 (42.9)	0.55

[a] n ranges between 183 – 198; [b] n ranges between 144 - 164; [c] Diagnostic Interview Schedule for Children Fourth Edition (DISC-IV); [d] Conners 3 ADHD Index; [e] Strengths and Difficulties Questionnaire (SDQ); [f] Pediatric Quality of Life (PedsQL); [g] Single item from the Longitudinal Study of Australian Children; [h] Socio-Economic Indexes for Areas (SEIFA).

Table 9. Association between autism spectrum disorder symptoms[a] and social functioning, sleep, quality of life and mental health in children with ADHD.

	Unadjusted analyses [c] (N = 161[e])				**Adjusted analyses [d] (N =141[f])**			
Outcomes	Coefficient [b]	95% CI	*p*	R^2	Coefficient [b]	95% CI	p	R^2
Social functioning (SDQ)								
SDQ: Peer problems[g], parent report	1.1	0.8, 1.4	< 0.001	0.24	0.8	0.5, 1.2	< 0.001	0.31
SDQ: Peer problems[g], teacher report	0.7	0.4, 1.0	< 0.001	0.07	0.7	0.3, 1.1	< 0.001	0.16
SDQ: Prosocial behavior[g], parent report	-0.9	-1.2, -0.5	< 0.001	0.16	-1.0	-1.4, -0.6	< 0.001	0.26
SDQ: Prosocial behavior[g], teacher report	-0.3	-0.8, 0.1	0.10	0.01	-0.4	-0.9, 0.1	0.20	0.15
Sleep (LSAC)								
LSAC: Sleep problems[h]	1.5	1.0, 2.2	0.04	-	1.2	0.7, 2.0	0.54	-
Quality of life (PedsQL)								
PedsQL: Overall functioning [i]	-6.9	-9.0, -4.9	< 0.001	0.25	-5.7	-8.2, -3.3	< 0.001	0.31
PedsQL: Psychosocial functioning[i]	-6.8	-8.7, -4.8	< 0.001	0.26	-5.2	-8.2, -3.3	< 0.001	0.38
PedsQL: Physical functioning[i]	-7.3	-10.5, -4.1	< 0.001	0.12	-6.6	-10.5, -2.6	0.001	0.17

PedsQL: Emotional functioning[i]	-7.1	-9.9, -4.3	< 0.001	0.15	-5.1	-8.3, -1.9	0.001	0.32
PedsQL: School functioning[i]	-4.3	-6.8, -1.9	0.001	0.07	-2.9	-5.7, -0.1	0.04	0.24
PedsQL: Social functioning[i]	-8.9	-11.9, -5.9	< 0.001	0.22	-7.7	-8.2, -3.3	< 0.001	0.28
Mental health (SDQ)								
SDQ: Conduct problems[g], parent	0.6	0.3, 1.0	0.001	0.08	0.8	0.4, 1.2	< 0.001	0.19
SDQ: Conduct problems[g], teacher	0.2	-0.2, 0.6	0.27	0.01	0.1	-0.3, 0.6	0.54	0.06
SDQ: Emotional problems[g], parent	0.7	0.3, 1.1	0.001	0.08	0.7	0.2, 1.2	0.003	0.15
SDQ: Emotional problems[g], teacher	0.5	0.1, 0.9	0.02	0.04	0.5	0.0, 1.1	0.04	0.07

[a] Measured by the Social Communication Questionnaire- Lifetime Form; [b] Regression co efficients should be interpreted as a mean increase in the outcome for each standard deviation increase in SCQ score; [c] Adjusted for school clustering only; [d] Adjusted for child (age, sex, internalizing disorder, externalizing disorder, recruitment cohort) and family factors (parent high school completion, Socio-Economic Indexes for Areas Disadvantage Index, and school clustering). [e] N ranges from 140 to 161 [f] N ranges from 137 to 141. [g] Strengths and Difficulties Questionnaire (SDQ). [h] Single item from the Longitudinal Study of Australian Children. [i] Pediatric Quality of Life (PedsQL).

Table 10. Association between autism spectrum disorder symptoms[a] and social functioning, sleep, quality of life and mental health in children without ADHD.

	Unadjusted analyses [c] (N =187[e])				**Adjusted analyses [d] (N =178[f])**			
Outcomes	Coefficient [b]	95% CI	*p*	R^2	Coefficient [b]	95% CI	p	R^2
Social functioning (SDQ)								
SDQ: Peer problems[g], parent report	0.6	0.2, 0.9	0.002	0.05	0.5	0.0, 0.9	0.04	0.17
SDQ: Peer problems[g], teacher report	0.4	0.1, 0.7	0.02	0.02	0.1	-0.3, 0.6	0.55	0.04
SDQ: Prosocial behavior[g], parent report	-0.4	-0.8, 0.0	0.06	0.02	-0.4	-0.9, 0.1	0.16	0.15
SDQ: Prosocial behavior[g], teacher report	-1.2	-1.7, -0.7	< 0.001	0.09	-0.9	-1.5, -0.2	0.01	0.13
Sleep (LSAC)								
LSAC: Sleep problems[h]	2.4	0.9, 6.5	0.09	-	2.6	0.5, 12.6	0.24	-
Quality of life (PedsQL)								
PedsQL: Overall functioning [i]	-3.4	-6.9, -0.1	0.05	0.02	-3.4	-7.8, 1.0	0.13	0.09
PedsQL: Psychosocial functioning[i]	-3.2	-6.5, 0.1	0.06	0.02	-3.0	-7.1, 1.1	0.16	0.12
PedsQL: Physical functioning[i]	-4.3	-9.0, 0.5	0.08	0.02	-5.0	-11.1, 1.0	0.10	0.08
PedsQL: Emotional functioning[i]	-0.0	-3.7, 3.7	0.99	0.00	0.6	-3.9, 5.1	0.81	0.14

PedsQL: School functioning[i]	-5.5	-10.0, -1.0	0.02	0.03	-4.3	-9.9, 1.2	0.13	0.13
PedsQL: Social functioning[i]	-3.8	-8.2, 0.5	0.09	0.02	-4.5	-10.0, 1.1	0.11	0.09
Mental health (SDQ)								
SDQ: Conduct problems[g], parent	0.2	-0.2, 0.6	-0.2, 0.6	0.00	0.1	-0.4, 0.5	0.82	0.09
SDQ: Conduct problems[g], teacher	0.0	-0.3, 0.4	-0.3, 0.4	0.00	-0.1	-0.6, 0.3	0.51	0.08
SDQ: Emotional problems[g], parent	0.6	0.1, 1.0	0.1, 1.0	0.03	0.6	0.0, 1.2	0.04	0.14
SDQ: Emotional problems[g], teacher	0.3	-0.2, 0.8	-0.2, 0.8	0.00	0.1	-0.5, 0.7	0.73	0.06

[a] Measured by the Social Communication Questionnaire- Lifetime Form; [b] Regression co efficients should be interpreted as a mean increase in the outcome for each standard deviation increase in SCQ score; [c] Adjusted for school clustering only; [d] Adjusted for child (age, sex, internalizing disorder, externalizing disorder, recruitment cohort) and family factors (parent high school completion, Socio-Economic Indexes for Areas Disadvantage Index, and school clustering). [e] N ranges from 178 – 187 [f] N ranges from 169 – 178. [g] Strengths and Difficulties Questionnaire (SDQ). [h] Single item from the Longitudinal Study of Australian Children. [i] Pediatric Quality of Life (PedsQL).

Table 11. Measures & Informants

Construct	Measure	Informant
ASD Symptoms	Social Communication Questionnaire (SCQ) Lifetime Version[24]	Parent report
ADHD Symptom Severity	Conners' 3 Parent & Teacher ADHD Index[28]	Parent report Teacher report
ADHD Subtype, Internalizing and externalizing comorbidities	NIMH Diagnostic Interview Schedule for Children (DISC) IV[27]	Parent report
Total Quality of Life (QoL) Psychosocial Health QoL Physical QoL Emotional QoL School QoL Social QoL	Pediatric Quality of Life Inventory 4.0[29]	Parent report
Prosocial behaviour Peer problems Conduct problems Emotional problems	Strengths & Difficulties Questionnaire (SDQ)[26] Prosocial behaviour, Peer problems, conduct and emotional problems subscales	Parent report Teacher report
Moderate/severe sleep problems	Longitudinal Study for Australian Children (LSAC)[30,31] Parent reported item.	Parent report

References

1. Van der Meer JM, Lappenschaar MG, Hartman CA, Greven CU, Buitelaar JK, Rommelse NN. Homogeneous Combinations of ASD-ADHD Traits and Their Cognitive and Behavioral Correlates in a Population-Based Sample. *J Atten Disord.* 2014.
2. Ronald A, Larsson H, Anckarsater H, Lichtenstein P. Symptoms of Autism and ADHD: A Swedish Twin Study Examining Their Overlap. *Journal of Abnormal Psychology.* 2014;123(2):440-451.
3. Martin J, Hamshere ML, O'Donovan MC, Rutter M, Thapar A. Factor structure of autistic traits in children with ADHD. *J Autism Dev Disord.* 2014;44(1):204-215.
4. Green JL, Rinehart NJ, Anderson V, Nicholson JM, Jongeling B, Sciberras E. Autism spectrum disorder symptoms in children with ADHD: a community-based study. *Res Dev Disabil.* 2015.
5. Musser ED, Hawkey E, Kachan-Liu SS, et al. Shared familial transmission of autism spectrum and attention-deficit/hyperactivity disorders. *Journal of child psychology and psychiatry, and allied disciplines.* 2014;55(7):819-827.
6. Reiersen AM, Todorov AA. Association between DRD4 genotype and autistic symptoms in DSM-IV ADHD. *Journal of the Canadian Academy of Child and Adolescent Psychiatry / Journal de l'Academie canadienne de psychiatrie de l'enfant et de l'adolescent.* 2011;20(1):15-21.

7. Sciberras E, Lycett K, Efron D, Mensah F, Gerner B, Hiscock H. Anxiety in Children With Attention-Deficit/Hyperactivity Disorder. *Pediatrics.* 2014.

8. Efron D, Sciberras E, Anderson V, et al. A controlled community study of functional status in children with ADHD at age 6-8. *Pediatrics.* 2014;In Press.

9. Mrug S, Molina BS, Hoza B, et al. Peer rejection and friendships in children with attention-deficit/hyperactivity disorder: Contributions to long-term outcomes. *J Abnorm Child Psychol.* 2012;40(6):1013-1026.

10. Nijmeijer J, Minderaa RB, Buitelaar JK, Mulligan A, Hartman CA, Hoekstra PJ. Attention-deficit/hyperactivity disorder and social dysfunctioning. *Clin Psychol Rev.* 2008;28(4):692-708.

11. Lycett K, Mensah FK, Hiscock H, Sciberras E. A prospective study of sleep problems in children with ADHD. *Sleep Med.* 2014;15(11):1354-1361.

12. Wehmeier PM, Schacht A, Barkley RA. Social and emotional impairment in children and adolescents with ADHD and the impact on quality of life. *J Adolesc Health.* 2010;46(3):209-217.

13. Karande S. Quality of life in children diagnosed with specific learning disability or attention-deficit/hyperactivity disorder. *Handbook of children with special health care needs*. New York, NY: Springer Science + Business Media; US; 2012:73-85.

14. Mulligan A, Anney RJ, O'Regan M, et al. Autism symptoms in attention-deficit/hyperactivity disorder: A familial trait which correlates with conduct,

oppositional defiant, language and motor disorders. *Journal of Autism and Developmental Disorders.* 2009;39(2):197-209.

15. Grzadzinski R, Di Martino A, Brady E, et al. Examining autistic traits in children with ADHD: does the autism spectrum extend to ADHD? *J Autism Dev Disord.* 2011;41(9):1178-1191.

16. Van der Meer JMJ, Oerlemans AM, van Steijn DJ, et al. Are Autism Spectrum Disorder and Attention-Deficit/Hyperactivity Disorder Different Manifestations of One Overarching Disorder? Cognitive and Symptom Evidence From a Clinical and Population-Based Sample. *Journal of the American Academy of Child and Adolescent Psychiatry.* 2012;51(11):1160-1172.e1163.

17. Cooper M, Martin J, Langley K, Hamshere M, Thapar A. Autistic traits in children with ADHD index clinical and cognitive problems. *Eur Child Adolesc Psychiatry.* 2014;23(1):23-34.

18. Kotte A, Joshi G, Fried R, et al. Autistic Traits in Children With and Without ADHD. *Pediatrics.* 2013.

19. Kroger A, Hanig S, Seitz C, Palmason H, Meyer J, Freitag CM. Risk factors of autistic symptoms in children with ADHD. *Eur Child Adolesc Psychiatry.* 2011;20(11-12):561-570.

20. Achenbach T, Edelbrock C. *Manual for the Child Behavior Checklist and Revised Child Behavior Profile.* Burlington, VT.: University of Vermont, Department of Psychiatry; 1983.

21. Mulligan A, Anney RJ, O'Regan M, et al. "Autism symptoms in attention-deficit/hyperactivity disorder: A familial trait which correlates with conduct, oppositional defiant, language and motor disorders": Erratum. *Journal of Autism and Developmental Disorders.* 2009;39(2):210-211.

22. Thomas S, Lycett K, Papadopoulos N, Sciberras E, N. R. Exploring behavioural sleep problems in children with Attention Deficit/Hyperactivity Disorder and comorbid Autism Spectrum Disorder. *J Atten Disord.* 2015;In Press.

23. Sciberras E, Efron D, Schilpzand E, et al. The Children's Attention Project: a community-based longitudinal study of children with ADHD and non-ADHD controls. *BMC Psychiatry.* 2013;13(1):18.

24. Rutter M, Bailey A, Lord C. *Social Communication Questionnaire* Los Angeles, CA: Western Psychological Services (WPS); 2003.

25. Wiggins LD, Bakeman R, Adamson LB, Robins DL. The utility of the Social Communication Questionnaire in screening for autism in children referred for early intervention. *Focus on Autism and Other Developmental Disabilities.* 2007;22(1):33-38.

26. Goodman R. The Strengths and Difficulties Questionnaire: A Research Note. *Journal of Child Psychology and Psychiatry.* 1997;38(5):581-586.

27. Shaffer D, Fisher P, Lucas CP, Dulcan MK, Schwab-Stone ME. NIMH Diagnostic Interview Schedule for Children Version IV (NIMH DISC-IV): description, differences from previous versions, and reliability of some common diagnoses. *J Am Acad Child Adolesc Psychiatry.* 2000;39(1):28-38.

28. Conners C. *Conners.* 3rd edition ed. Toronto Multi-Health Systems; 2008.

29. Limbers CA, Ripperger-Suhler J, Boutton K, Ransom D, Varni JW. A comparative analysis of health-related quality of life and family impact between children with ADHD treated in a general pediatric clinic and a psychiatric clinic utilizing the PedsQL. *J Atten Disord.* 2011;15(5):392-402.

30. Quach J, Hiscock H, Canterford L, Wake M. Outcomes of Child Sleep Problems Over the School-Transition Period: Australian Population Longitudinal Study. *Pediatrics.* 2009;123(5):1287-1292.

31. Sung V, Hiscock H, Sciberras E, Efron D. Sleep problems in children with attention-deficit/hyperactivity disorder: Prevalence and the effect on the child and family. *Arch Pediatr Adolesc Med.* 2008;162(4):336-342.

32. Hiscock H, Canterford L, Ukoumunne OC, Wake M. Adverse associations of sleep problems in Australian preschoolers: national population study. *Pediatrics.* 2007;119(1):86-93.

33. Lycett K, Mensah F, Hiscock H, Sciberras E. The validity of a global measure of sleep problem severity in children with ADHD: a cross-sectional comparison with a validated multi-dimensional measure and sleep log. *Sleep Med.* 2015.

34. Strang JF, Kenworthy L, Daniolos P, et al. Depression and anxiety symptoms in children and adolescents with autism spectrum disorders without intellectual disability. *Research in Autism Spectrum Disorders.* 2012;6(1):406-412.

35. Gotham K, Brunwasser SM, Lord C. Depressive and anxiety symptom trajectories from school age through young adulthood in samples with autism spectrum disorder and developmental delay. *J Am Acad Child Adolesc Psychiatry.* 2015;54(5):369-376.e363.

36. Bitsika V, Sharpley CF. Differences in the Prevalence, Severity and Symptom Profiles of Depression in Boys and Adolescents with an Autism Spectrum Disorder versus Normally Developing Controls. *International Journal of Disability, Development and Education.* 2015;62(2):158-167.

37. van Steensel FJ, Bogels SM, Perrin S. Anxiety disorders in children and adolescents with autistic spectrum disorders: a meta-analysis. *Clin Child Fam Psychol Rev.* 2011;14(3):302-317.

38. McConachie H, Parr J, Glod M, et al. Systematic review of tools to measure outcomes for young children with autism spectrum disorder. *Health Technology Assessment.* 2015;19(41):1-538.

39. Simonoff E, Pickles A, Charman T, Chandler S, Loucas T, Baird G. Psychiatric disorders in children with autism spectrum disorders: prevalence, comorbidity, and associated factors in a population-derived sample. *J Am Acad Child Adolesc Psychiatry.* 2008;47(8):921-929.

40. van Steensel FJ, Bogels SM, Dirksen CD. Anxiety and quality of life: clinically anxious children with and without autism spectrum disorders compared. *J Clin Child Adolesc Psychol.* 2012;41(6):731-738.

41. Sciberras E, Ohan J, Anderson V. Bullying and peer victimisation in adolescent girls with attention-deficit/hyperactivity disorder. *Child Psychiatry and Human Development.* 2012;43(2):254-270.

42. Gillberg C, Fernell E. Autism Plus Versus Autism Pure. *Journal of Autism and Developmental Disorders.* 2014;44(12):3274-3276.

43. Gillberg C. The ESSENCE in child psychiatry: Early Symptomatic Syndromes Eliciting Neurodevelopmental Clinical Examinations. *Res Dev Disabil.* 2010;31(6):1543-1551.

44. Mikami AY, Jia M, Na JJ. Social Skills Training. *Child and Adolescent Psychiatric Clinics of North America.* 2014;23(4):775-788.

45. Mikami AY, Lerner MD, Griggs MS, McGrath A, Calhoun CD. Parental Influence on Children with Attention-Deficit/Hyperactivity Disorder: II. Results of a Pilot

Intervention Training Parents as Friendship Coaches for Children. *J Abnorm Child Psychol.* 2010;38(6):737-749.

46. Volkmar F, Siegel M, Woodbury-Smith M, King B, McCracken J, State M. Practice Parameter for the Assessment and Treatment of Children and Adolescents With Autism Spectrum Disorder. *J Am Acad Child Adolesc Psychiatry.*53(2):237-257.

47. Davis NO, Kollins SH. Treatment for co-occurring attention deficit/hyperactivity disorder and autism spectrum disorder. *Neurotherapeutics.* 2012;9(3):518-530.

Declaration for Thesis Chapter 5: Family Functioning Paper

Monash University

Declaration by candidate

In the case of Chapter 5, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Project design, review of relevant literature, attainment of ethics approval, recruitment and assessment of a sub-set of research participants, data analysis and writing of manuscript	70%

The following co-authors contributed to the work. If co-authors are students at Monash University, the extent of their contribution in percentage terms must be stated:

Name	Nature of contribution
Professor Nicole Rinehart	Contributed to project design and provided input during final draft stage of manuscript
Professor Vicki Anderson	Contributed to project design and provided input during final draft stage of manuscript
Dr Emma Sciberras	Contributed to project design and provided input during final draft stage of manuscript
Dr Daryl Efron	Provided input during final draft stage of manuscript
Professor Jan Nicholson	Provided input during final draft stage of manuscript
Dr Brad Jongeling	Provided input during final draft stage of manuscript
Professor Philip Hazell	Provided input during final draft stage of manuscript

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work*.

Candidate's Signature	[redacted]	**Date** 28/10/15
Main Supervisor's Signature	[redacted]	**Date** 20/10/2015

8. STUDY 3

8.1 STUDY 3 OVERVIEW

This chapter includes an empirical paper titled "Association between autism spectrum disorder symptoms and family functioning in children with attention-deficit/hyperactivity disorder: A community-based study**"**. This paper has been submitted to the *European Journal of Child and Adolescent Psychiatry.* This study aimed to examine the association between ASD symptoms (measured continuously) in children with and without ADHD and a broad range of family functioning variables. The second aim was to examine differences between ADHD+ASD, ADHD and control groups on family functioning variables.

8.2 STUDY 3 HYPOTHESES

It was hypothesised that greater ASD symptoms in children with ADHD would be associated with 1) poorer parent mental health; 2) poorer family quality of life (FQoL); 3) more couple conflict; 4) less couple support; and 5) lower parent self-efficacy, less parenting consistency and warmth, and more hostile parenting. We hypothesised that the ADHD+ASD group would have poorer family functioning, across all domains, when compared to the ADHD or control groups.

8.3 STUDY 3 PAPER.

Association between autism symptoms and family functioning in children with Attention-Deficit/Hyperactivity Disorder: a community-based study

Authors: Jessica L. Green[1,2], Nicole Rinehart[2,3], Vicki Anderson[2,4,5], Daryl Efron[2,4,5], Jan M. Nicholson[2,6], Brad Jongeling[7,8], Philip Hazell[9] and Emma Sciberras[2,3,4].

Institutions: [1] School of Psychological Sciences, Monash University, VIC Australia
[2] Murdoch Childrens Research Institute, Parkville, VIC Australia
[3]School of Psychology, Deakin University, Burwood, VIC Australia
[4] The Royal Children's Hospital, Parkville, VIC Australia
[5]The University of Melbourne, Parkville, VIC Australia
[6] Judith Lumley Centre, La Trobe University, Melbourne, VIC Australia
[7]Child Development Service, Joondalup, WA Australia
[8]The University of Western Australia, Perth, WA Australia
[9]Discipline of Psychiatry, The University of Sydney, Sydney, NSW Australia

Corresponding author: Ms. Jessica L. Green, Murdoch Childrens Research Institute, Flemington Road, Parkville, Victoria, Australia 3052. PH: [redacted]

Key words: Attention Deficit/Hyperactivity Disorder, Autism Spectrum Disorder, Family functioning.

Word count: (**Journal Limit:** Journal page limits: Cannot exceed 20 pages of max 32 lines each (words and tables). Can include 8 figures, taking up no more than 3 printed pages each).

Journal: European Journal of Child and Adolescent Psychiatry (ECAP)

Conflict of interest statement: Authors have no conflicts of interest to declare.

Abstract

Autism Spectrum Disorder (ASD) symptoms are elevated in populations of children with Attention Deficit/Hyperactivity Disorder (ADHD). This study examined cross-sectional associations between ASD symptoms and family functioning in children with and without ADHD. Participants were recruited to a longitudinal cohort study, aged 6-10 years (164 ADHD; 198 controls). ADHD cases were ascertained using community-based screening and diagnostic confirmation from a diagnostic interview. ASD symptoms were measured using the Social Communication Questionnaire. Outcome variables were parent mental health, family quality of life (FQoL), couple conflict and support, and parenting behaviours. After adjustment for a range of child and family factors (including other mental health comorbidities), higher ASD symptoms were associated with higher couple conflict (R^2 = 0.01, p = 0.04), lower couple support (R^2 = 0.10, p = 0.04), poorer FQoL (all subscales, $p \leq 0.001$) and more hostile parenting (R^2 = 0.01, p = 0.04). In adjusted analyses by subgroup, parents of children with ADHD+ASD had poorer parent self-efficacy (p = 0.01), poorer FQoL ($p < 0.05$), with weak evidence of an association for less couple support (p = 0.06), compared to parents of children with ADHD only. Inspection of covariates in the adjusted analyses indicated that the association between ASD symptoms and most family functioning measures was accounted for by child internalizing and externalizing disorders, ADHD severity, and socioeconomic status however, ASD symptoms appear to be independently associated with poorer FQoL in children with ADHD. The presence of ASD symptoms in children with ADHD may signal the need for enhanced family support.

Attention-Deficit/Hyperactivity Disorder (ADHD) is the most common neurodevelopmental disorder in children [1] and is highly comorbid with Autism Spectrum Disorder (ASD) [2,3]. Comorbid ASD symptoms are associated with poorer functioning for children with ADHD including mental health and peer problems [4,5]. Although it is well established that parents of children with either ADHD or ASD experience poorer family functioning including parent mental health problems, poorer family quality of life (FQoL) and parenting difficulties, it is unknown how comorbid ASD symptoms contribute to family functioning in children with ADHD. It is important to understand which comorbidities contribute to poorer family functioning to guide treatment planning and family support.

There is an extensive literature examining the family functioning of children with ADHD [6]. Parents of children with ADHD use less consistent and more hostile parenting behaviours than parents of non-ADHD controls (Cussen et al., 2012; Johnston & Mash, 2001[7]). They also have higher rates of depression and anxiety than parents of children without ADHD and poorer FQoL [8-10]. Research is mixed regarding couple functioning, with recent studies finding no difference between couples of children with and without ADHD on measures of couple conflict and couple support [11,10]. The presence of an additional comorbidity appears to be a risk factor for more relationship difficulties for couple who have a child with ADHD [12,13].

Parents of children with ASD have been found to have poorer family functioning, across multiple domains, including more depressive symptoms, compared to parents of children with ADHD or typically developing children [14,15]. Couples who have a child with ASD have lower relationship satisfaction [16,17] and higher rates of divorce [18] than couples with a child without ASD. These parents face specific challenges in parenting given the social communication impairments at the core of ASD. Surprisingly little research has examined parenting in children with ASD. Initial findings suggest that parents of children with ASD largely parent in a similar way to parents of typically developing children, with negative parenting behaviours almost entirely accounted for by parental stress [19,20].

While it is well established that families of children with ADHD or ASD have poor family functioning, the impact of combined ADHD and ASD symptoms on family functioning is less clear. To the best of our knowledge, only one study [2] has examined the association between ASD symptoms and family functioning in children with ADHD. This study included a clinical sample of youth with (n = 242) and without ADHD (n = 227), aged 6 to 18 years (M = 11.3 years; SD = 3.2 years). They found no differences in family functioning (expression, conflict

and cohesion) between families with a child with ADHD and those with a child who had ADHD+ASD [2]. However, couples that had a child with ADHD+ASD experienced significantly more conflict, and were more likely to be separated or divorced, than couples with a typically developing child [2]. The challenge remains to examine the association between ASD symptoms and family functioning more broadly, using a validated measure of ASD symptoms, whilst controlling for potentially important child and family covariates. This will help us better understand which children with ADHD are at risk of poorer family outcomes, with covariates indicating potential modifiable factors.

Using cross-sectional community-based data from the Children's Attention Project (CAP), the present study aimed to examine the association between ASD symptoms, assessed both categorically and dimensionally, in children with and without ADHD and a broad range of family functioning variables. We hypothesised that greater ASD symptoms in children with ADHD would be associated with: 1) poorer parent mental health; 2) poorer FQoL; 3) more couple conflict; 4) less couple support; and 5) poorer parenting (lower parent self-efficacy, parenting consistency and warmth; more hostile parenting). Secondly, the study aimed to examine differences between ADHD+ASD, ADHD and control groups on family functioning variables. We hypothesised that the ADHD+ASD group would have poorer family functioning, across all domains, when compared to the ADHD or control groups.

Method

Study design and participants. Participants were 6-10 year old children attending 43 schools in Melbourne, Australia, who were participating in a longitudinal cohort study [21]. There were 164 children with confirmed ADHD and 198 children who were confirmed negative for ADHD (see Table 1). Children with an intellectual disability or a serious medical condition were excluded, as were those whose parents lacked sufficient English to complete study questionnaires. Children in the control group with an existing ASD diagnosis (n = 3), or an SCQ score of 11 or more (n = 15), were also excluded from analyses.

Measures

ADHD and other comorbidities were identified using the Diagnostic Interview Schedule for Children, Version 4 (DISC-IV) [22], a parent-completed interview that assesses mental health conditions using DSM-IV-TR criteria. The measure has good diagnostic reliability and validity [22]. The DISC-IV (Version N, April 2007, algorithms) was used to determine *ADHD subtype* and to identify the presence of at least one *internalizing* (e.g.

Generalized Anxiety Disorder) *or externalizing* (e.g. Conduct Disorder) *disorder* in the year prior to the assessment. *ADHD symptom severity* was measured using the Conners 3 ADHD Index (3AI), a well validated and reliable 10-item measure of ADHD symptom severity [23].

ASD symptoms were assessed using the Social Communication Questionnaire (SCQ) [24], a 40-item, parent-report screening measure. The SCQ produces a total score and three subscale scores: (1) reciprocal social interaction; (2) communication; and (3) restricted, repetitive and stereotyped patterns of behaviour [25]. The SCQ has good validity with demonstrated high agreement with the Autism Diagnostic Interview Revised (ADI-R) and high discriminant validity between children with and without ASD [24]. Children were classified as screening positive for ASD if their total scores were 11 or above, capturing mild, moderate and more severe forms of ASD [26,27]. Therefore, the group classified as ADHD+ASD symptoms in this study, were participants who had a confirmed ADHD diagnosis on the DISC-IV *and* an SCQ score of 11 or more. It should be noted that the SCQ is only a screen for ASD symptoms, and is not indicative of an ASD diagnosis. Given this, ASD symptoms will be the term used throughout the manuscript.

Family quality of life (FQoL) was assessed using the Family Impact Scale of the Child Health Questionnaire Parent Form (CHQ-PF50) [28], which includes 10 items across three subscales with good internal consistency [29]. The two-item emotional impact subscale assesses the degree of worry or concern caused by their child's health and behaviour on the parent ($\alpha = 0.68$). The six-item family impact subscale examines the impact of the child's health and behaviour on family activities ($\alpha = 0.75$), while the 2-item time impact scale asks how often parents' time for their own personal needs was limited by their child's health and behaviour ($\alpha = 0.87$). Higher scores represent better family functioning.

Parent mental health was measured using the 6-item Kessler Screening Scale for Psychological Distress (K6) [30]. The measure assesses the frequency of symptoms of depression and anxiety in the previous four weeks, with each item rated on a 5-point scale from none of the time (1) to all of the time (5). Higher scores indicate greater psychological distress. The scale has good validity and reliability [30,31]. A recent study found Cronbach alpha to be 0.88 for the K6, with an optimal cut off of 14 [32].

Parenting behaviours, *couple support* and *couple conflict* were assessed using scales from the Longitudinal Study of Australian Children (LSAC) [33]. Parenting behavior subscales included hostile parenting (4-items), parental consistency (7-items), parental warmth (6-items)

and parental self-efficacy (1-item), which have been shown to impact on child health and development [33]. Higher scores indicate more hostile parenting, parental warmth and parental self-efficacy, while lower scores indicated more consistent parenting. The *couple support* scale from LSAC includes three items, with lower scores indicating less support (e.g. 'how often is your partner a resource and support to you in raising your child?'). The *couple conflict* scale from LSAC includes four items, with higher scores indicating more conflict (e.g. 'how often do you and your partner argue?'). All items were scored on a five-point scale from 1 (Never/Almost Never) to 5 (Almost always/All the time). All measures have been shown to have good to very good reliability and validity [33].

Procedure. Data were collected as part of a longitudinal cohort study of children with and without ADHD [21]. Ethics approval was obtained from The Royal Children's Hospital (#31056), the Victorian Department of Education and Early Childhood Development (#2011_001095) and Monash University (#CF12/4044 - 2012001944) Melbourne, Australia. All children in their first year of school (6-8 years) were screened for ADHD across two cohorts, with Cohort 1 recruited in 2011 and Cohort 2 in 2012 (see Figure 1). Completed parent and teacher screening surveys were received for 63% of the children. There were no differences between responders and non-responders on child age or gender however, responders were from more socially advantaged areas. Children were deemed to screen positive for ADHD if they had a prior diagnosis of ADHD, and/or if their scores on both the parent and teacher ADHD indices were $\geq 75^{th}$ percentile for boys, and $\geq 80^{th}$ percentile for girls. Children were deemed a negative screen if they did not have a prior diagnosis of ADHD and if their scores on both the parent and teacher Conners ADHD indices were $< 75^{th}$ percentile for boys and $< 80^{th}$ percentile for girls. Children screening positive for ADHD (n = 412) were randomly matched, based on gender and school, with a child screening negative for ADHD (n = 412).

The DISC-IV was completed during a clinical interview with the child's parents, and information about parent mental health, FQoL and parenting were collected by parent questionnaire. Families were followed-up at 18 months post-recruitment (Wave 2) to assess medium-term outcomes. The Social Communication Questionnaire – Lifetime form (SCQ) was introduced to the study for the first time in 2012, and collected at baseline for cohort 2 (Wave 1, age 6-8 years; face-to-face parent interview) and at the 18 month follow-up for cohort 1 (Wave 2, age 7.5-9.5 years; telephone parent interview). We report on Wave 1 family functioning variables for Cohort 2 participants and Wave 2 family functioning variables for Cohort 1, to correspond with SCQ data collection.

Statistical analysis. Total SCQ score was converted into standard deviation units to assist interpretation. Unadjusted and adjusted linear regressions were used to examine the association between ASD symptoms and family functioning in children with ADHD. Unadjusted and adjusted linear regressions were used to examine the association between SCQ subscale scores and family functioning, for domains where a relationship was found ($p<0.05$) between overall ASD symptoms and family functioning, in adjusted analyses. Adjusted analyses controlled for child (age, sex, internalizing disorder, externalizing disorder, recruitment cohort and ADHD symptom severity), school (school clustering) and family factors (parent high school completion and Socio-Economic Indexes for Areas Disadvantage Index). A series of linear regressions were used to examine differences in family functioning between children with ADHD+ASD, ADHD only and controls, firstly comparing ADHD and ADHD+ASD groups to controls and subsequently comparing ADHD+ASD to ADHD. All analyses were conducted using Stata 13.

Results

Sample characteristics. Compared to non-ADHD controls, children with ADHD were more likely to have a pre-existing diagnosis of ASD and had higher rates of internalizing and externalizing disorders (Table 1). Parents of children with ADHD reported poorer family functioning across all domains compared to non-ADHD controls (Table 1). With regard to demographic variables, children with ADHD were more likely to have a primary caregiver who had not completed high school, compared to control children (Table 1). Sixty-five children from the ADHD group (40%) fell into the ADHD+ASD group.

For each outcome, two sets of analyses are reported. One set of analyses examines the association between ASD symptoms and family functioning dimensionally (SCQ total score as predictor, see Table 2). The other set of analyses examines the association between ASD symptoms and family functioning categorically, comparing ADHD, ADHD+ASD and controls – analyses where controls were the reference group are summarized in Table 3, with ADHD reference group analyses reported in Table 4.

FQoL. For families of children with ADHD, more ASD symptoms were associated with greater emotional (β = -0.21, 95% CI -0.33 to -0.09, p = 0.001), family (β = -0.32, 95% CI -0.46 to -0.17, $p < 0.001$) and time impact on FQoL (β = -0.33, 95% CI -0.48 to -0.18, $p \leq 0.001$). These findings held in adjusted analyses for the association between SCQ total score and all FQoL scales ($p < 0.01$).

In adjusted analyses, greater emotional impact on the family was associated with more

reciprocal social interaction difficulties (β = -0.18, 95% CI -0.30; -0.05, p = 0.006) more repetitive behaviours (β = -0.17, 95% CI -0.30; -0.04, p = 0.012), but not communication impairments (β = -0.07, 95% CI -0.24; 0.09, p = 0.380). Greater impact on family activities was associated with more social interaction difficulties (β = -0.25, 95% CI -0.39; -0.11, p = 0.001), greater communication impairments (β = -0.19, 95% CI -0.38; -0.01, p = 0.039), but was not associated with repetitive behaviours (β = -0.15, 95% CI -0.30; 0.01, p = 0.063). Greater time impact was associated with interaction difficulties (β = -0.25, 95% CI -0.40; -0.09, p = 0.002) and repetitive behaviours (β = -0.19, 95% CI -0.36, -0.02, p = 0.025), but not communication impairments (β = -0.16, 95% CI -0.37; 0.04, p = 0.124).

In the subgroup analyses, families of children with ADHD+ASD had poorer FQoL than the ADHD group, with all findings holding in adjusted analyses, with 34-52% of the variance in FQoL scores explained by the models (emotional impact, β = -0.32, p = 0.01; family impact, β = -0.30, p = 0.03; time impact, β = -0.49, p = 0.001, see Table 4). The ADHD and ADHD+ASD group had significantly poorer FQoL across all domains, compared to the control group, with findings holding in adjusted analyses (Table 3).

Parent mental health. There was weak evidence of an association between ASD symptoms in children with ADHD and parent mental health (β = 0.15, 95% CI -0.01 to 0.32, p = 0.07), but this attenuating further in adjusted analyses (β = 0.08, 95% CI -0.10 to 0.26, p = 0.38), which appeared to be due to meaningful associations with comorbid internalising disorders (p = 0.003) and ADHD symptom severity (p = 0.005) (see Table 2). Similar results were obtained in our subgroup analyses (see Table 3). There was similar weak evidence of an association for poorer parent mental health in the ADHD+ASD group (β = 0.28, p = 0.08, see Table 4) compared to the ADHD group, but this finding attenuated due to significant associations with comorbid internalising disorder (p <0.001) and ADHD symptom severity (p = 0.001). Compared to controls, parents of children with ADHD had poorer mental health (p <0.001), as did parents of children with ADHD+ASD (p <0.001), but this attenuated when adjusting for confounding variables (see Table 3).

Parenting. There was evidence of an association between ASD symptoms and hostile parenting (β = 0.15, 95% CI 0.00 to 0.29, p = 0.04), however, this finding weakened in adjusted analyses (p = 0.06), with comorbid externalizing disorders (p = 0.002), lower parent education attainment (p = 0.05) and greater ADHD symptom severity (p = 0.02) also associated with hostile parenting. In unadjusted analyses, there was no evidence of an association between ASD symptoms and a) parental warmth (p = 0.89), b) consistent parenting (p = 0.22) or c) parental self-efficacy (p = 0.54). There was only one meaningful difference in adjusted

analyses between the ADHD group and the ADHD+ASD group, with parents of children with ADHD+ASD having significantly poorer parental self-efficacy (β = 0.42, p = 0.01, see Table 4). Compared to controls, parents of children with ADHD or ADHD+ASD utilized more hostile parenting behaviours, were less consistent and had lower parental self-efficacy, with all findings attenuating in adjusted analyses (see Table 3).

Couple support and conflict. For families of children with ADHD, there was evidence of an association between greater ASD symptoms and more couple conflict (β = 0.19, 95% CI 0.01 to 0.37, p = 0.04) and less couple support (β = -0.19, 95% CI -0.36 to -0.01, p = 0.04). This finding attenuated in adjusted analyses (see Table 2). There were no significant associations to explain the attenuating relationship for couple conflict, with lower socioeconomic status accounting for the attenuation of couple support (p = 0.003). In subgroup analyses, couples that had a child with ADHD+ASD had significantly more conflict (p = 0.04) and less support (p = 0.001), compared to couples that had a child with ADHD only (see Table 4). The association with couple conflict (p = 0.57) and couple support (p = 0.06) attenuated when considering confounding variables.

Discussion

The study involved a detailed examination of the association between ASD symptoms and family functioning in community-based sample of children with and without ADHD. Comorbid ASD, whether analysed categorically or dimensionally, was associated with poorer FQoL. Parents of children with ADHD+ASD felt less supported by their partner in their parenting role and less confident in their parenting abilities, compared to parents of children with ADHD alone, even after controlling for confounding variables. Although there was initial evidence that greater ASD symptoms were associated with greater couple conflict, more hostile parenting, and elevated parent mental health difficulties, these findings attenuated in adjusted analyses. Other characteristics of children with ADHD and their families were driving observed relationships including comorbid internalising and externalising disorders, ADHD symptom severity, and socioeconomic status.

We found strong evidence that ASD was associated with poorer FQoL, with the ADHD+ASD group having significantly worse FQoL than the ADHD group. Our results show that parents of children with ADHD+ASD, due to their child's behaviours, have less time to attend to their own personal needs, experience more worry about their child, and have greater restrictions on family activities, compared to parents of children with ADHD alone. These

findings were maintained when accounting a range of child and family characteristics demonstrating the unique contribution of ASD symptoms to FQoL.

Upon examination of the specific SCQ domains that were associated with FQoL, we found that social interaction difficulties was related to poorer FQoL across all three domains. Repetitive behaviours are known to be time consuming for families. Our findings suggest that repetitive behaviours particularly contribute to limitations on parent's time for their own needs, and to the emotional worry and concern parents have for their child. The link between greater communication problems and impact on family activities is interesting. The family impact scale captures the degree to which the child's behaviour interrupts daily activities (e.g. meal times, parent's work), limits the types of activities the family can do together (e.g. spontaneous outings) and causes conflict within the home. Conflict may be related to children's frustration at their difficulties communicating their needs. Similarly, interruption to family activities such as meal times may be related to difficulties these children have engaging in reciprocal conversation, which is captured by the SCQ Communication subscale. These findings are consistent with the clinical observation that parents and families of children with a more complex ADHD presentation have more challenges, and are likely to require more support. Children need to be seen within their family context. Perhaps goals for family life could be incorporated into a treatment plan, generated collaboratively with the child, their siblings and parents. The Child Health Questionnaire, FQoL scale provides a feasible way of measuring change over time in the family environment, and could be a helpful way to 'hold the family in mind' during the treatment process.

We found that ASD symptoms were associated with more hostile parenting (e.g., parents punishing their child when angry, telling the child that they are bad, or not as good as others). Interestingly though, it seems that this association was accounted for by child externalising disorder, parent educational attainment and the severity of ADHD symptoms. Our results are aligned with previous research on parenting more generally, which suggests that it is not specific symptoms per se that contribute to parenting behaviours, but the overall level of parenting stress, with greater child comorbidities culminating to more stress and thus, more hostile parenting behaviours [10,6,7]. We also demonstrated that parents of children with ADHD+ASD felt less competent in their parenting role, compared to parents of children with ADHD. Research has shown that poorer parental self-efficacy mediates the relationship between high parenting stress and elevated parent symptoms of depression and anxiety [34]. Greater parenting confidence has been shown to improve 'hardiness' in families with a child on the autism spectrum [35]. Future research is needed to examine whether improving parental

self-efficacy in this group (ADHD+ASD) leads to better outcomes for families. It would also be interesting to examine the association between paternal and maternal ASD/ADHD symptoms and family functioning, given this has been implicated in previous work [36-40].

Comorbid ASD symptoms appear to put parents of children with ADHD at greater risk of less couple support, with a non-significant trend for poorer mental health. The relationship between comorbid ASD symptoms and poorer mental health appears to be related to greater child internalising and ADHD symptoms, again suggesting that it may be the accumulation of child comorbidities, as opposed to the type of symptoms that contribute to poorer family functioning. This is consistent with Hurtig et al. (2007), who found that families who had a child with ADHD *plus* comorbidity were at greatest risk of poorer family functioning, even after considering child ADHD symptom severity. It was interesting that the ADHD+ASD group showed less couple support than ADHD alone, even after controlling for covariates. Similar to parental self-efficacy, it would be interesting to see if improvements in the level of support from a partner in the parenting role flows on to improved family functioning.

When compared to controls, the ADHD and ADHD+ASD groups had poorer mental health, poorer FQoL, more relationship difficulties, used more hostile and less consistent parenting, and felt less confident in their parenting abilities. Most of these findings attenuated, except FQoL, with no clear covariate associations and highlight that, consistent with previous work in the area [7,10], families who have a child with ADHD and ADHD+ASD are at greater risk for poorer family quality of life.

Our study adds weight to the debate within the literature, which says that it may be comorbidity, rather than particular symptoms per say (e.g., ADHD, ASD, internalising) that contribute to family functioning difficulties, given that many of the associations attenuated when adjusting for other comorbidities. This is supported by Gillberg's position, which suggests that children with comorbid conditions (e.g., ADHD and ASD) are likely to have a more severe neurodevelopmental condition, thus leading to more complex outcomes [41,42].

Future research needs to examine whether FQoL is amenable to intervention. Our research suggests that parent-self efficacy and couple support may be important treatment targets, particularly for the most at risk group of ADHD+ASD. Given that FQoL was found to be uniquely associated with ASD symptoms, these symptoms may be a good target for improving FQoL. As our measure of FQoL examined the impact of child's behaviours on family life, it might be helpful to look at which interventions best help parents to manage their

child's behaviours, so they have less of an impact on parents (e.g. level of worry, amount of time for their own needs) and the family (e.g. less disruption or limitations to family activities). Our work suggests that incorporating comorbidities into treatment plans is likely to have flow on effects for family functioning. Future research needs to examine whether FQoL only improves when ASD symptoms reduce, or whether we can improve FQoL by targeting behaviours associated with ASD – like anxiety. For example, a pilot randomised controlled trial conducted by Sciberras et al. [43] found that treating anxiety in children with ADHD was associated with marked improvements in family functioning, with a one standard deviation improvement in parent mental health for families in the intervention group.

Strengths and limitations. This study has a number of strengths. It included a large sample of children with and without ADHD from a community-based sample, in contrast to previous predominantly clinic-based studies which are biased towards the more severe end of the ADHD spectrum. Furthermore, our study measured the family environment around the child comprehensively, using measures of parent functioning, couple functioning and FQoL, controlling for a number of child and family factors that may have explained the relationship between these constructs. Associations were also considered from both a dimensional and categorical perspective.

Study limitations include a brief measure of parent mental health, couple relationship and parenting, and the use of a screening measure of ASD symptoms (SCQ). It would have been ideal to also include a comprehensive measure of ASD symptoms (ADOS, ADI-R), which would have allowed us to determine whether study participants met DSM-5 criteria for ASD however; this was not within study scope. We did not examine parental ASD and ADHD, therefore we were unable to examine the interaction between child and parent disorder. It is, therefore, possible that parental psychopathology influenced family functioning outcomes. The cross-sectional design is also a limitation.

Conclusion. ASD symptoms have an independent negative association with FQoL in children with ADHD at 6-10 years of age. Families of children with ADHD+ASD appear to be at greater risk for poorer family functioning, across multiple domains, compared to families of children with ADHD alone. The relationship between ASD symptoms and other aspects of family functioning appears to be driven mostly by internalizing and externalizing disorders, ADHD severity, and socioeconomic status. The presence of ASD symptoms in children with ADHD may signal the need for enhanced family support.

References

1. Polanczyk GV, Willcutt EG, Salum GA, Kieling C, Rohde LA (2014) ADHD prevalence estimates across three decades: an updated systematic review and meta-regression analysis. International journal of epidemiology 43 (2):434-442. doi:10.1093/ije/dyt261
2. Kotte A, Joshi G, Fried R, Uchida M, Spencer A, Woodworth KY, Kenworthy T, Faraone SV, Biederman J (2013) Autistic Traits in Children With and Without ADHD. Pediatrics. doi:10.1542/peds.2012-3947
3. Green JL, Rinehart NJ, Anderson V, Nicholson JM, Jongeling B, Sciberras E (2015) Autism spectrum disorder symptoms in children with ADHD: a community-based study. Res Dev Disabil
4. Cooper M, Martin J, Langley K, Hamshere M, Thapar A (2014) Autistic traits in children with ADHD index clinical and cognitive problems. Eur Child Adolesc Psychiatry 23 (1):23-34. doi:10.1007/s00787-013-0398-6
5. Van der Meer JMJ, Oerlemans AM, van Steijn DJ, Lappenschaar MGA, de Sonneville LMJ, Buitelaar JK, Rommelse NNJ (2012) Are Autism Spectrum Disorder and Attention-Deficit/Hyperactivity Disorder Different Manifestations of One Overarching Disorder? Cognitive and Symptom Evidence From a Clinical and Population-Based Sample. Journal of the American Academy of Child and Adolescent Psychiatry 51 (11):1160-1172.e1163
6. Johnston C, Mash E (2001) Families of Children With Attention-Deficit/Hyperactivity Disorder: Review and Recommendations for Future Research. Clinical Child and Family Psychology Review 4 (3):183-207. doi:10.1023/A:1017592030434
7. Modesto-Lowe V, Danforth JS, Brooks D (2008) ADHD: does parenting style matter? Clin Pediatr (Phila) 47 (9):865-872
8. Pressman LJ, Loo SK, Carpenter EM, Asarnow JR, Lynn D, McCracken JT, McGough JJ, Lubke GH, Yang MH, Smalley SL (2006) Relationship of family environment and parental psychiatric diagnosis to impairment in ADHD. J Am Acad Child Adolesc Psychiatry 45 (3):346-354. doi:10.1097/01.chi.0000192248.61271.c8
9. van Steijn DJ, Oerlemans AM, van Aken MA, Buitelaar JK, Rommelse NN (2014) The reciprocal relationship of ASD, ADHD, depressive symptoms and stress in parents of children with ASD and/or ADHD. J Autism Dev Disord 44 (5):1064-1076. doi:http://dx.doi.org/10.1007/s10803-013-1958-9
10. Cussen A, Sciberras E, Ukoumunne O, Efron D (2012) Relationship between symptoms of attention-deficit/hyperactivity disorder and family functioning: a community-based study. Eur J Pediatr 171 (2):271-280. doi:10.1007/s00431-011-1524-4
11. van Steijn DJ, Oerlemans AM, van Aken MA, Buitelaar JK, Rommelse NN (2015) The influence of parental and offspring autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) symptoms on family climate. Journal of Child and Family Studies 24 (7):2021-2030. doi:http://dx.doi.org/10.1007/s10826-014-0002-9
12. Hurtig T, Ebeling H, Taanila A, Miettunen J, Smalley S, McGough J, Loo S, Jarvelin MR, Moilanen I (2007) ADHD and comorbid disorders in relation to family environment and symptom severity. European child & adolescent psychiatry 16 (6):362-369. doi:10.1007/s00787-007-0607-2
13. Wymbs BT, Pelham WE, Gnagy EM, Molina BSG (2008) Mother and Adolescent Reports of Interparental Discord among Parents of Adolescents with and without Attention-Deficit Hyperactivity Disorder. Journal of emotional and behavioral disorders 16 (1):29-41. doi:10.1177/1063426607310849
14. Sikora D, Moran E, Orlich F, Hall TA, Kovacs EA, Delahaye J, Clemons TE, Kuhlthau K (2013) The relationship between family functioning and behavior problems in children with

autism spectrum disorders. Research in Autism Spectrum Disorders 7 (2):307-315. doi:http://dx.doi.org/10.1016/j.rasd.2012.09.006
15. Jellett R, Wood CE, Giallo R, Seymour M (2015) Family functioning and behaviour problems in children with Autism Spectrum Disorders: The mediating role of parent mental health. Clinical Psychologist 19 (1):39-48. doi:10.1111/cp.12047
16. Meadan H, Halle JW, Ebata AT (2010) Families with Children Who Have Autism Spectrum Disorders: Stress and Support. Exceptional Children 77 (1):7-36
17. Brobst JB, Clopton JR, Hendrick SS (2009) Parenting Children With Autism Spectrum Disorders: The Couple's Relationship. Focus on Autism and Other Developmental Disabilities 24 (1):38-49. doi:10.1177/1088357608323699
18. Hartley SL, Barker ET, Seltzer MM, Floyd F, Greenberg J, Orsmond G, Bolt D (2010) The Relative Risk and Timing of Divorce in Families of Children with an Autism Spectrum Disorder. Journal of family psychology : JFP : journal of the Division of Family Psychology of the American Psychological Association (Division 43) 24 (4):449-457. doi:10.1037/a0019847
19. Blacher J, Baker B, Kaladjian A (2013) Syndrome Specificity and Mother–Child Interactions: Examining Positive and Negative Parenting Across Contexts and Time. J Autism Dev Disord 43 (4):761-774. doi:10.1007/s10803-012-1605-x
20. Boonen H, Esch L, Lambrechts G, Maljaars J, Zink I, Leeuwen K, Noens I (2015) Mothers' parenting behaviors in families of school-aged children with autism spectrum disorder: An observational and questionnaire study. J Autism Dev Disord:No Pagination Specified. doi:http://dx.doi.org/10.1007/s10803-015-2506-6
21. Sciberras E, Efron D, Schilpzand E, Anderson V, Jongeling B, Hazell P, Ukoumunne O, Nicholson J (2013) The Children's Attention Project: a community-based longitudinal study of children with ADHD and non-ADHD controls. BMC Psychiatry 13 (1):18
22. Shaffer D, Fisher P, Lucas CP, Dulcan MK, Schwab-Stone ME (2000) NIMH Diagnostic Interview Schedule for Children Version IV (NIMH DISC-IV): description, differences from previous versions, and reliability of some common diagnoses. J Am Acad Child Adolesc Psychiatry 39 (1):28-38. doi:10.1097/00004583-200001000-00014
23. Conners C (2008) Conners. 3rd edition edn. Multi-Health Systems, Toronto
24. Rutter M, Bailey A, Lord C (2003) Social Communication Questionnaire Western Psychological Services (WPS), Los Angeles, CA
25. Wiggins LD, Bakeman R, Adamson LB, Robins DL (2007) The utility of the Social Communication Questionnaire in screening for autism in children referred for early intervention. Focus on Autism and Other Developmental Disabilities 22 (1):33-38. doi:http://dx.doi.org/10.1177/10883576070220010401
26. Norris M, Lecavalier L (2010) Screening Accuracy of Level 2 Autism Spectrum Disorder Rating Scales: A Review of Selected Instruments. Autism 14 (4):263-284. doi:10.1177/1362361309348071
27. Eaves LC, Wingert H, Ho HH (2006) Screening for autism: Agreement with diagnosis. Autism 10 (3):229-242. doi:10.1177/1362361306063288
28. Landgraf J, Abetz L, Ware J (1996) Child Health Questionnaire (CHQ): A User's Manual. The Health Institute Boston, MA
29. Waters E, Salmon L, Wake M (2000) The parent-form Child Health Questionnaire in Australia: comparison of reliability, validity, structure, and norms. Journal of pediatric psychology 25 (6):381-391
30. Furukawa TA, Kessler RC, Slade T, Andrews G (2003) The performance of the K6 and K10 screening scales for psychological distress in the Australian National Survey of Mental Health and Well-Being. Psychol Med 33 (2):357-362

31. Kessler RC, Green JG, Gruber MJ, Sampson NA, Bromet E, Cuitan M, Furukawa TA, Gureje O, Hinkov H, Hu C-y, Lara C, Lee S, Mneimneh Z, Myer L, Oakley-Browne M, Posada-Villa J, Sagar R, Viana MC, Zaslavsky AM (2010) Screening for Serious Mental Illness in the General Population with the K6 screening scale: Results from the WHO World Mental Health (WMH) Survey Initiative. Int J Methods Psychiatr Res 19 (0 1):4-22. doi:10.1002/mpr.310
32. Cornelius BL, Groothoff JW, van der Klink JJ, Brouwer S (2013) The performance of the K10, K6 and GHQ-12 to screen for present state DSM-IV disorders among disability claimants. BMC Public Health 13:128. doi:10.1186/1471-2458-13-128
33. Zubrick S, Lucas N, Westrupp EM, Nicholson JM (2013) Parenting measures in the Longitudinal Study of Australian Children: Construct validity and measurement quality, Waves 1 to 4. . Department of Social Services (formerly the Department of Families, Housing Community Services and Indigenous Affairs), Canberra: : Canberra, ACT
34. Rezendes DL, Scarpa A (2011) Associations between Parental Anxiety/Depression and Child Behavior Problems Related to Autism Spectrum Disorders: The Roles of Parenting Stress and Parenting Self-Efficacy. Autism research and treatment 2011:395190. doi:10.1155/2011/395190
35. Weiss JA, Robinson S, Fung S, Tint A, Chalmers P, Lunsky Y (2013) Family hardiness, social support, and self-efficacy in mothers of individuals with Autism Spectrum Disorders. Research in Autism Spectrum Disorders 7 (11):1310-1317. doi:http://dx.doi.org/10.1016/j.rasd.2013.07.016
36. van Steijn D, Oerlemans A, van Aken MG, Buitelaar J, Rommelse NJ (2015) The Influence of Parental and Offspring Autism Spectrum Disorder (ASD) and Attention-Deficit/Hyperactivity Disorder (ADHD) Symptoms on Family Climate. Journal of Child and Family Studies 24 (7):2021-2030. doi:10.1007/s10826-014-0002-9
37. van Steijn DJ, Oerlemans AM, van Aken MA, Buitelaar JK, Rommelse NN (2014) The reciprocal relationship of ASD, ADHD, depressive symptoms and stress in parents of children with ASD and/or ADHD. J Autism Dev Disord 44 (5):1064-1076. doi:10.1007/s10803-013-1958-9
38. van Steijn DJ, Oerlemans AM, de Ruiter SW, van Aken MA, Buitelaar JK, Rommelse NN (2013) Are parental autism spectrum disorder and/or attention-deficit/Hyperactivity disorder symptoms related to parenting styles in families with ASD (+ADHD) affected children? Eur Child Adolesc Psychiatry 22 (11):671-681. doi:10.1007/s00787-013-0408-8
39. van Steijn D, Oerlemans A, van Aken MG, Buitelaar J, Rommelse NJ (2013) Match or Mismatch? Influence of Parental and Offspring ASD and ADHD Symptoms on the Parent–Child Relationship. Journal of Autism and Developmental Disorders 43 (8):1935-1945. doi:10.1007/s10803-012-1746-y
40. van Steijn DJ, Richards JS, Oerlemans AM, de Ruiter SW, van Aken MA, Franke B, Buitelaar J, Rommelse NN (2012) The co-occurrence of autism spectrum disorder and attention-deficit/hyperactivity disorder symptoms in parents of children with ASD or ASD with ADHD. Journal of Child Psychology and Psychiatry 53 (9):954-963. doi:http://dx.doi.org/10.1111/j.1469-7610.2012.02556.x
41. Gillberg C, Fernell E (2014) Autism Plus Versus Autism Pure. Journal of Autism and Developmental Disorders 44 (12):3274-3276. doi:10.1007/s10803-014-2163-1
42. Gillberg C (2010) The ESSENCE in child psychiatry: Early Symptomatic Syndromes Eliciting Neurodevelopmental Clinical Examinations. Res Dev Disabil 31 (6):1543-1551. doi:http://dx.doi.org/10.1016/j.ridd.2010.06.002
43. Sciberras E, Mulraney M, Anderson V, Rapee RM, Nicholson JM, Efron D, Lee K, Markopoulos Z, Hiscock H (2015) Managing Anxiety in Children With ADHD Using Cognitive-Behavioral Therapy: A Pilot Randomized Controlled Trial. J Atten Disord. doi:10.1177/1087054715584054

Table 12. Sample characteristics for Study 3

	Control *n = 180*[a]	ADHD *n = 164*[b]	*P*
Child Characteristics			
Child age in years, mean (SD, n)	8.0 (1.0)	7.9 (1.1)	0.38
Male, n (%)	112 (62.2)	114 (69.5)	0.15
Total Autism Spectrum Disorder symptoms[c], mean (SD, n)	4.4 (2.7)	10.3 (7.2)	**<0.001**
Existing Autism Spectrum Disorder diagnosis, n (%)	0 (0)	35 (23.9)	**<0.001***
ADHD subtype, n (%)			
ADHD-Combined		83 (50.6)	
ADHD-Inattentive		62 (37.8)	
ADHD-Hyperactive/Impulsive		19 (11.6)	
ADHD symptom severity[d] – parent report, mean (SD, n)	1.2 (1.9)	12.9 (4.6)	**<0.001**
ADHD symptom severity[d] – teacher report, mean (SD, n)	0.8 (2.1)	11.5 (5.9)	**<0.001**
Internalizing comorbidity[e] in past year, n (%)	7 (3.9)	43 (26.2)	**<0.001**
Externalizing comorbidity[e] in past year, n (%)	14 (7.8)	87 (53.1)	**<0.001**
Medication use (any), n (%)	1 (0.6)	27 (19.3)	**<0.001**
Primary caregiver/family characteristics			
Parent completed high school, n (%)	145 (80.6)	97 (59.2)	**<0.001**
SEIFA, mean (SD, n)	1016.3 (45.8)	1012.7 (43.4)	0.46
Parent and family functioning variables			
Family quality of life[f]			
Emotional impact subscale, mean (SD, n)	85 (16.7)	44.0 (26.2)	**<0.001**
Family impact subscale, mean (SD, n)	89.6 (12.1)	61.1 (24.7)	**<0.001**
Time impact subscale, mean (SD, n)	94.8 (14.0)	70.2 (28.5)	**<0.001**
Parent mental health[g], mean (SD, n)	2.5 (2.9)	5.1 (4.5)	**<0.001**
Parental warmth[h], mean (SD, n)	4.4 (0.5)	4.2 (0.6)	0.09
Hostile parenting[h], mean (SD, n)	1.7 (0.5)	2.5 (0.7)	**<0.001**
Consistent parenting[h], mean (SD, n)	4.3 (0.7)	3.8 (0.8)	**<0.001**
Parental self-efficacy[h], mean (SD, n)	4.1 (0.8)	3.5 (0.9)	**<0.001**
Couple support[h], mean (SD, n)	13.6 (1.9)	12.5 (2.3)	**<0.001**
Couple conflict[h], mean (SD, n)	7.9 (2.6)	9.1 (3.2)	**<0.001**

Note. [a] In adjusted analyses, n ranged from 149-180 [b] In adjusted analyses, n ranged from 106- 164. Bolding denotes significant result. Chi-square analyses were run for categorical variables and t-tests for continuous data.*A Fisher's exact test was run due to small sample size. [c] Social Communication Questionnaire – Lifetime Form [d]Conners 3 ADHD Index (Collected at Wave 1 for Cohort 2 and Wave 2 for Cohort 1); [e]DISC-IV (Collected at Wave 1 for Cohort 1 and Cohort 2). [f]Measured by the Child Health Questionnaire – Family Quality of Life [g] Measured by the Kessler Screening Scale for Psychological Distress (K6) [h]Measured by the Longitudinal Study of Australian Children Parenting and Couple Scales.

Table 13. Association between autism spectrum disorder symptoms and parent/family functioning in children with ADHD.

	SCQ Total Score							
Outcomes	Unadjusted (N = 146)				Adjusted (N = 144)			
	β	*95% CI*	*p*	R^2	*β*	*95% CI*	*p*	R^2
Family quality of life								
Emotional impact	-0.21	-0.33; -0.09	0.001	0.07	-0.20	-0.34; -0.05	0.008	0.08
Family impact	-0.32	-0.46; -0.17	<0.001	0.11	-0.28	-0.44; -0.11	0.001	0.16
Time impact	-0.33	-0.48; -0.18	<0.001	0.14	-0.27	-0.45; -0.09	0.003	0.17
Parent mental health	0.15	-0.01; 0.32	0.07	0.02	0.08	-0.10; 0.26	0.38	0.14
Parental warmth	-0.01	-0.17; 0.15	0.89	0.01	0.04	-0.14; 0.22	0.64	0.10
Hostile parenting	0.15	0.00; 0.29	0.04	0.01	0.16	-0.01; 0.33	0.06	0.09
Consistent parenting	-0.09	-0.25; 0.06	0.22	0.01	-0.06	-0.23; 0.10	0.44	0.17
Parental self-efficacy	0.05	-0.10; 0.20	0.54	0.01	0.13	-0.03; 0.29	0.12	0.10
Couple support	-0.19	-0.36; -0.01	0.04	0.01	-0.03	-0.23; 0.17	0.78	0.21
Couple conflict	0.19	0.01; 0.37	0.04	0.01	0.09	-0.11; 0.29	0.38	0.10

Note. Bolding denotes significant result.

Table 14. Unadjusted and adjusted differences in family functioning with ADHD or ADHD+ASD compared to controls

Outcomes	Unadjusted (n = 255 – 312)						Adjusted[a] (n = 252 – 308)					
		Control (n = 180)	ADHD (n = 99)		ADHD+ASD (n = 65)			Control (n = 179[b])	ADHD (n = 87[c])		ADHD+ASD (n = 57[d])	
	R^2		β	p	β	p	R^2		β	p	β	p
Family quality of life[g]												
Emotional impact	0.50	----	-1.18	<0.001	-1.60	<0.001	0.52	----	-0.62	<0.001	-0.94	<0.001
Family impact	0.41	----	-0.99	<0.001	-1.49	<0.001	0.49	----	-0.36	0.04	-0.66	0.002
Time impact	0.26	----	-0.69	<0.001	-1.32	<0.001	0.34	----	-0.42	0.04	-0.91	<0.001
Parent mental health[e]	0.17	----	0.56	<0.001	0.85	<0.001	0.27	----	-0.16	0.45	-0.13	0.60
Parental warmth[f]	0.01	----	-0.20	0.12	-0.15	0.33	0.11	----	0.21	0.37	0.30	0.27
Hostile parenting[f]	0.20	----	0.93	<0.001	1.10	<0.001	0.27	----	0.11	0.58	0.13	0.57
Consistent parenting[f]	0.08	----	-0.53	<0.001	-0.64	<0.001	0.14	----	-0.17	0.44	-0.09	0.74
Parental self-efficacy[f]	0.10	----	-0.73	<0.001	-0.54	<0.001	0.17	----	0.02	0.92	0.44	0.09
Couple support[f]	0.09	----	-0.26	0.07	-0.89	<0.001	0.10	----	-0.04	0.89	-0.44	0.19
Couple conflict[f]	0.05	----	0.27	0.06	0.68	<0.001	0.09	----	-0.02	0.94	0.10	0.76

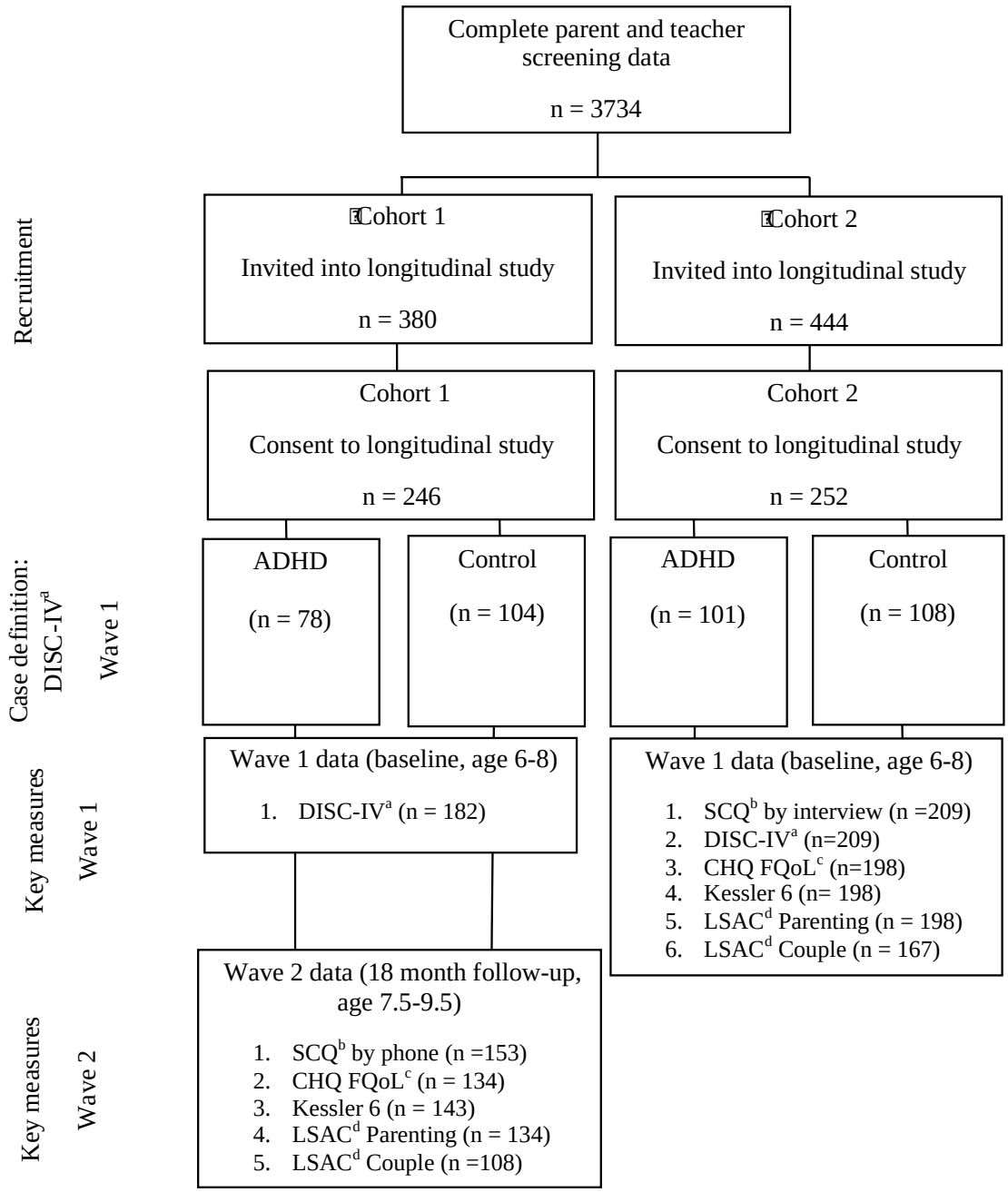
Note. Bolding denotes significant result. [a]Adjusted for child (age, sex, internalizing disorder, externalizing disorder, recruitment cohort) and family factors (parent high school completion, Socio-Economic Indexes for Areas Disadvantage Index and school clustering) [b]N ranges from 157 to 179, with a lower n for couple variables and missing parent education data [c] N ranges from 64 to 87, with a lower n for couple variables and missing parent education data [d] N ranges from 41 to 57, with a lower n for couple variables and missing parent education data [e] Measured by the K6 [f] Measured by the Longitudinal Study of Australian Children Parenting and Couple Scales [g] Measured by the Child Health Questionnaire – Family Quality of Life Scale.

Table 15. Unadjusted and adjusted differences in family functioning for children with ADHD+ASD controls compared to ADHD group

Outcomes	Unadjusted (n = 255 – 312)						Adjusted[a] (n = 252 – 308)					
		ADHD (n = 99)	Control (n = 180)		ADHD+ASD (n = 65)			ADHD (n=87[b])	Control (n =179[c])		ADHD+ASD (n = 57[d])	
	R^2		β	p	β	p	R^2		β	p	β	p
Family quality of life[g]												
Emotional impact	0.49	----	1.18	<0.001	-0.42	<0.001	0.52	----	0.62	<0.001	-0.32	0.01
Family impact	0.41	----	0.99	<0.001	-0.51	<0.001	0.49	----	0.36	0.04	-0.30	0.03
Time impact	0.26	----	0.69	<0.001	-0.64	<0.001	0.34	----	0.42	0.04	-0.49	0.001
Parent mental health[e]	0.17	----	-0.56	<0.001	0.280	0.08	0.27	----	0.16	0.45	0.03	0.86
Parental warmth[f]	0.01	----	0.20	0.12	0.05	0.76	0.11	----	-0.21	0.37	0.09	0.61
Hostile parenting[f]	0.20	----	-0.93	<0.001	0.17	0.26	0.27	----	-0.11	0.58	0.02	0.88
Consistent parenting[f]	0.08	----	0.53	<0.001	-0.11	0.51	0.14	----	0.17	0.44	0.08	0.63
Parental self-efficacy[f]	0.10	----	0.73	<0.001	0.19	0.24	0.17	----	-0.02	0.92	0.42	0.01
Couple support[f]	0.09	----	0.26	0.07	-0.63	0.001	0.10	----	0.04	0.89	-0.40	0.06
Couple conflict[f]	0.05	----	-0.27	0.06	0.41	0.04	0.09	----	0.02	0.94	0.12	0.57

Note. Bolding denotes significant result [a]Adjusted for child (age, sex, internalizing disorder, externalizing disorder, recruitment cohort) and family factors (parent high school completion and Socio-Economic Indexes for Areas Disadvantage Index and school clustering) [b] N ranges from 64 to 87, with a lower n for couple variables and missing parent education data [c] N ranges from 157 to 179, with a lower n for couple variables and missing parent education data [d]N ranges from 41 to 57, with a lower n for couple variables and missing parent education data [e] Measured by the K6 [f] Measured by the Longitudinal Study of Australian Children Parenting and Couple Scales [g] Measured by the Child Health Questionnaire – Family Quality of Life Scale.

Figure 3. Study 3 Participant Flow



[a]Diagnostic Interview Schedule for Children Version 4, [b]Social Communication Questionnaire Lifetime form, [c]Child Health Questionnaire Family Quality of Life [d]Longitudinal Study of Australian Children Parenting and Couple Scales.

Declaration for Thesis Chapter 6: General Discussion

Monash University

Declaration by candidate

In the case of Chapter 6, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Review of relevant literature and writing of general discussion chapter	70%

The following co-authors contributed to the work. If co-authors are students at Monash University, the extent of their contribution in percentage terms must be stated:

Name	Nature of contribution
Professor Nicole Rinehart	Contributed to project design and provided input during final draft stage of manuscript
Professor Vicki Anderson	Contributed to project design and provided input during final draft stage of manuscript
Dr Emma Sciberras	Contributed to project design and provided input during final draft stage of manuscript

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work*.

Candidate's Signature	[redacted]	**Date** 28/10/15
Main Supervisor's Signature	[redacted]	**Date** 20/10/2015

9. GENERAL DISCUSSION

9.1 PRINCIPAL FINDINGS

9.1.1 STUDY 1

This study found that children with ADHD had over 10 times the risk of clinically elevated ASD symptoms, compared to non-ADHD controls. Almost one in four children with ADHD had clinically significant ASD symptoms (23%). Children with ADHD showed elevated ASD symptoms across all core domains specifically social interaction, communication and repetitive and stereotyped behaviours compared to children without ADHD. Unsurprisingly, greater ADHD symptom severity was associated with greater ASD symptom severity. Boys with ADHD, compared to girls with ADHD, had greater ASD symptom severity. Although ASD symptom severity was similar across the ADHD subtypes there was some evidence that greater hyperactive/impulsive symptoms were associated with greater ASD symptoms in children with ADHD.

9.1.2 STUDY 2

Greater ASD symptoms were associated with more peer problems for children with and without ADHD. Children with and without ADHD were less likely to demonstrate prosocial social behaviours if they had more ASD symptoms. Greater ASD symptoms were associated with more mental health difficulties for children with ADHD. Those who had greater ASD symptoms were 1.8 times more likely to have an internalising disorder and 1.5 times more likely to have an externalising disorder. The relationship between externalising disorder and ASD symptoms in children with ADHD was partly related to comorbid internalising disorders. In children with ADHD, parent and teacher-reported emotional problems were associated with greater ASD symptoms, as were parent-reported conduct problems. For control children, there was only evidence of an association between greater parent-reported emotional problems and

ASD symptoms. There was non-significant evidence of an association between internalising disorders, externalising disorders and ASD symptoms in children without ADHD.

Greater ASD symptoms were initially associated with increased odds of the child having a moderate to large sleep problem for children with ADHD, but this attenuated in adjusted analyses, which appeared to be driven by the inclusion of socioeconomic status and ADHD symptom severity in adjusted models. For control children, there was no evidence of an association between SCQ scores and moderate to large sleep problems. ASD symptoms were independently associated with poorer QoL, across all subscales, for children with ADHD but this was not found for control children.

9.1.3 STUDY 3

In unadjusted dimensional analyses, higher ASD symptoms were associated with more couple conflict and poorer FQoL for all subscales, with some evidence for less couple support, more hostile parenting and poorer parent mental health. In adjusted dimensional analyses, higher ASD symptoms were only associated with poorer FQoL, across all subscales, with all other findings attenuating. The trend association between ASD symptoms and parent mental health attenuated due to meaningful associations with comorbid internalising disorder and ADHD symptom severity. The trend association, between ASD symptoms and hostile parenting, attenuated because of significant associations with comorbid externalising disorders, lower parent education attainment and greater ADHD symptom severity. Less couple support was found to be associated with lower socioeconomic status.

In unadjusted categorical analyses, parents of children with ADHD+ASD reported more couple conflict, less couple support, poorer FQoL and a non-significant trend for greater mental health difficulties, compared to the ADHD group. In adjusted categorical analyses,

parents of children with ADHD+ASD had poorer parent self-efficacy, poorer FQoL and a non-significant trend for less couple support, compared to parents of children with ADHD.

In unadjusted categorical analyses, family functioning was significantly poorer for the ADHD and ADHD+ASD groups, compared to controls for most outcomes. In adjusted categorical analyses, all findings attenuated except FQoL was significantly poorer for the ADHD and ADHD+ASD groups, compared to controls.

9.2 INTERPRETATION IN LIGHT OF PREVIOUS LITERATURE

9.2.1 STUDY 1

HYPOTHESIS 1. *Children with ADHD would have more ASD symptoms across all domains, compared to non-ADHD controls.* This hypothesis was supported. Interestingly, our finding that 23% of children with ADHD had clinically significant ASD symptoms is similar to reported rates in clinical samples (Kochhar et al., 2011b). Kochhar et al. (2011) found that 28% of clinically referred children with ADHD had ASD symptoms within the clinical range, while Reiersen et al. (2007) found that 22% of children with ADHD, who were from the community, had clinically significant ASD symptoms, using the SRS. Our findings confirm that children with ADHD are more likely to have clinically elevated ASD symptoms, with prevalence rates similar in community and clinically referred samples.

Previous literature is mixed regarding the types of ASD symptoms that are present in children with ADHD. Our findings are consistent with findings of elevated ASD symptoms across all three-core domains of ASD (Nijmeijer et al., 2009) and in contrast with research suggesting that only one core domain (repetitive or communication domain) is elevated in children with ADHD (Kochhar et al., 2011b; Polderman et al., 2014). In saying this, we did find the largest effect size (unadjusted = 0.8; adjusted 0.7) for the repetitive and stereotyped behaviours symptom domain, when comparing children with ADHD and children without

ADHD, which is consistent with Polderman et al.'s (2014) work, with smaller effect sizes for the communication (unadjusted = 0.6; adjusted = 0.5) and social interaction domains (unadjusted = 0.5; adjusted = 0.4).

HYPOTHESIS 2. *Greater ASD symptom severity would be observed in girls with ADHD compared to boys with ADHD.* This hypothesis was not supported. Using parent reported ASD symptoms, boys with ADHD were more likely to have clinically significant ASD symptoms, compared to girls, which is consistent with Reiersen et al.'s (2007) population based work. In our study, the proportion of girls and boys scoring in the clinical range for ASD symptoms was equivalent, with no significant differences found. This finding is in contrast to Reiersen et al.'s (2007) study, which found that significantly more girls with combined type ADHD (75%) had clinically significant ASD symptoms, compared to 32% of boys with ADHD combined type. It is possible that this contrasting finding is due to a larger, more representative sample of girls in our study (n = 50 versus n = 19 in Reiersen's study), or perhaps due our narrower age range, and differences in ASD measure (SCQ vs. SRS). When examining Reiersen's paper more closely, there was evidence that her sample of girls with ADHD was more impaired than ours, with 37% of her sample of girls with ADHD (overall, not subtype specific) above the clinical cut off, compared to only 16% of ours, albeit on a different measure of ASD symptoms.

HYPOTHESIS 3. *Children with ADHD combined type would have more ASD symptoms compared to children with ADHD inattentive or hyperactive/impulsive type.* This hypothesis was not supported. Our findings did not support a relationship between ADHD subtype and ASD symptoms. This is in contrast to the work of Reiersen et al. (2007), who found that children with ADHD combined and inattentive type were more likely to have elevated ASD symptoms and Ronald et al. (2014), who reported greater ASD symptoms in children with ADHD inattentive type. Due to this unexpected finding, we conducted more

detailed analyses to explore associations with ADHD symptom type more specifically. We initially found a significant relationship between hyperactive/impulsive symptoms and overall ASD symptoms in children with ADHD, similar to Kroger et al. (2011), but this attenuated in adjusted analyses. We found no relationship between inattentive symptoms and total ASD symptoms in children with ADHD. It should be noted though, that we had little variability in inattentive and hyperactive/impulsive scores, given that all children met criteria for ADHD, so the majority of scores were between 6 and 9. Given this, it may be that the presence of ASD symptoms is more associated with a greater cluster of ADHD symptoms overall, rather than the specific *type* of ADHD symptom domains. This explanation is consistent with the finding in past research of a tendency towards 'double severity', whereby children with greater ASD symptoms also have more severe ADHD symptom severity (Reiersen, 2011). It appears that greater ADHD symptom severity, defined as a greater number of total ADHD symptoms, is more related to the presence of ASD symptoms, than the presence of a specific type of ADHD symptoms.

HYPOTHESIS 4. *Greater ADHD symptom severity would be associated with more ASD symptoms.* This hypothesis was supported. We found that children with more severe ADHD symptoms also had more severe ASD symptoms, a double severity as such. This finding held in adjusted analyses, when taking into account a number of other important child and family factors such as child internalising and externalising comorbidities and socioeconomic status. This finding is consistent with Van der Meer et al.'s (2012) work, in a mixed population-based clinical sample of children with ADHD between the ages of 5 and 17 years, which found increasing ASD symptoms with greater ADHD symptom severity. Our finding is also aligned with St Pourcain's (2011) argument that comorbid ASD symptoms may act as a marker of greater ADHD severity, and visa versa.

9.2.2 STUDY 2.

HYPOTHESIS 1. *Greater ASD symptom severity in children with and without ADHD would be associated with greater peer problems and less prosocial behaviours.* This hypothesis was supported. This is to be expected given that social interaction impairments are at the core of ASDs. Children with ADHD, with significant ASD symptoms, have also been shown to have more peer problems by Van der Meer et al. (2012) and Kotte et al. (2013). Our work extends this area, by including a measure of prosocial behaviours, and thorough teacher-reported measures, which to our knowledge, has not been done previously.

HYPOTHESIS 2. *Greater ASD symptom severity in children with and without ADHD would be associated with poorer child mental health.* This hypothesis was partially supported. We found that greater ASD symptom severity was associated with more internalising symptoms in children with ADHD, but evidence was mixed regarding the association with externalising symptoms. The association between ASD symptoms and internalising disorders in children with ADHD has been found in previous studies (Martin et al., 2014; Reiersen & Todorov, 2011), but we are the first to examine this association by teacher report. This finding is consistent with what is already known about children with ASD more generally, that comorbid anxiety is common, as is mood disturbance (Bitsika & Sharpley, 2015; Gotham et al., 2015; Strang et al., 2012). Forty percent of young people with ASD are diagnosed with one or more anxiety disorders (van Steensel et al., 2011) and families of young people with ASD rate anxiety as one of the major issues requiring attention (McConachie et al., 2015). Similarly, a recent paper found, in a clinical sample of children with ADHD that 26% of children had one anxiety disorder and 39% had two (Sciberras, Lycett, et al., 2014).

There were mixed findings regarding an association between ASD symptoms and externalising difficulties. Although we found an association between ASD symptoms and parent reported conduct difficulties when measured continuously, the relationship between

ASD symptoms and externalising disorders attenuated when taking into account the presence of an internalising disorder and other potentially confounding variables, which is consistent with some other studies (Kroger et al., 2011; Van der Meer et al., 2014). This may have been a consequence of different measurement tools. The lack of a significant association between ASD symptoms and externalising disorder makes sense, given that externalising disorders are more common in children with ADHD than ASD (54% ODD in ADHD sample (Efron et al., 2014a) vs. 28% ODD in ASD sample (Simonoff et al., 2008) and 10% conduct disorder in ADHD sample (Efron et al., 2014a) vs. 3% conduct disorder in ASD sample (Simonoff et al., 2008), however, our findings are suggestive of a relationship when conduct difficulties are measured dimensionally by parent report. In summary, there is clear evidence that internalising symptoms are associated with ASD symptoms in children with ADHD, with only some evidence of an association between ASD symptoms and externalising symptoms, with comorbid internalising symptoms partly explaining the association.

HYPOTHESIS 3. *Greater ASD symptom severity in children with and without ADHD would be associated with moderate to large sleep problems.* This hypothesis was partially supported. We initially found that ASD symptom severity was associated with increased odds of having a moderate to large sleep problem for children with ADHD, but this attenuated when taking into account socioeconomic status and ADHD symptom severity. Our findings are consistent with the only other study in the area, which found that sleep problem severity did not differ between children with ADHD+ASD compared to ADHD alone (Thomas et al., 2015). Our finding builds on this study, by suggesting that socioeconomic status and ADHD symptom severity may be particularly related to moderate to large sleep problems for children with ADHD elevated ASD symptoms.

HYPOTHESIS 4. *Greater ASD symptom severity in children with and without ADHD would be associated with poorer psychosocial QoL.* This hypothesis was supported. Children

had poorer social, physical, psychological and school-based QoL, even when accounting for important covariates such as internalising and externalising comorbidities, socioeconomic status and gender. Whilst it is well established in the broader ADHD and ASD literature that children with ASD or ADHD had poorer QoL than typically developing children (Efron et al., 2014b; van Steensel et al., 2012), our study is the first to indicate the independent contribution of ASD symptoms to poorer QoL in children with ADHD.

9.2.3 STUDY 3.

HYPOTHESIS 1. *Greater ASD symptoms, when measured categorically and continuously, would be associated with poorer parent mental health.* This hypothesis was partially supported. We found some evidence that parents of children with more ASD symptoms have poorer mental health, when measured continuously and categorically. However, these associations were non-significant trends, which attenuated due to meaningful associations with other variables including comorbid internalising disorders and ADHD symptom severity. Similarly, compared to controls, parents of children with ADHD had poorer mental health, as did parents of children with ADHD+ASD, however, this finding attenuated in adjusted analyses. We are the first to examine the contribution of ASD symptoms to poorer mental health in parents of children with ADHD.

These findings suggest that it may be the accumulation of child comorbidities, as opposed to ASD symptoms, that contribute to poorer parent mental health. This is consistent with Hurtig et al. (2007), who found that families who had a child with ADHD *plus* an additional comorbidity were at greatest risk of poorer family functioning, even after controlling for ADHD symptom severity. Our work is consistent with previous findings, that parents of children with significant ASD or ADHD symptoms have poorer mental health, than parents of typically developing children (Cussen et al., 2012; Jellett et al., 2015; Sikora et al., 2013). This

study extends previous work by suggesting that child internalising comorbidities and ADHD symptom severity may be driving the poorer mental health observed in the ADHD+ASD group.

HYPOTHESIS 2. *Greater ASD symptoms, when measured categorically and dimensionally, would be associated with poorer FQoL.* This hypothesis was supported. Our study is the first to examine that association between poorer FQoL in children with ADHD and ASD symptoms. It appears that ASD symptoms contribute to poorer FQoL, independent of other covariates, and that families of children with ADHD+ASD have poorer FQoL than families of children with ADHD alone. More specifically, our work demonstrates that parents of children with ADHD+ASD, due to their child's behaviours, have less time to attend to their own personal needs, experience more worry about their child, and have greater restrictions on family activities, compared to parents of children with ADHD alone.

It is well established in the literature that families of children with ADHD and ASD tend to have poorer family functioning than families of typically developing children (Jellett et al., 2015; Johnston & Mash, 2001; Sikora et al., 2013). What is less clear is what factors contribute to this poorer QoL, which is what we need to know to modify outcomes. Our finding is in contrast to the work on Kotte et al. (2013), who examined family functioning more generally (examining expression, conflict and cohesion in the family unit). Kotte et al. found no differences in family functioning between families who had a child with ADHD, compared to families who had a child with ADHD+ASD. It is likely that we found different results because we used a specific measure of FQoL from the Child Health Questionnaire, which was more specific to child health and behaviour than the measure used by Kotte et al. (2013). The measure of FQoL taps quite different constructs to those examined by the Moos Family Environment Scale used by Kotte et al. (2013). The Moos Family Environment Scale assesses the degree of expression, conflict and cohesion in the family. The FQoL scale measures the degree to which child behaviours 1) impact on time parents have for their own needs, 2) cause

parents worry and 3) impact on family activities. It is possible that the FQoL was able to tap the tangible day-to-day functioning impacts of having a child with ADHD and significant ASD symptoms.

HYPOTHESIS 3. *Greater ASD symptoms, when measured categorically and continuously, would be associated with poorer couple functioning (more conflict and less support).* This hypothesis was partially supported. We found initial evidence that greater ASD symptoms, when measured dimensionally and categorically, were associated with more couple conflict for parents of children with ADHD, however, findings attenuated in adjusted analyses. Similarly for less couple support, ASD symptoms were somewhat related when measured continuously, and significantly related when examined categorically. Couples who had a child with ADHD+ASD reported less couple support than couples whom a child who has ADHD only, with lower socioeconomic status also predictive of poorer couple support. This may be because those of lower socioeconomic status have less access to other sources of support, so they are more reliant on their partner for support in their parenting role (Zubrick et al., 2013). No previous work has examined couple functioning and the contribution of ASD symptoms in children with ADHD. Our work indicates that there is some association between more ASD symptoms and poorer couple functioning, but other child and family variables account for this relationship. It appears that couples who have a child with ADHD+ASD may feel less supported by their partner in their parenting role, than parents of a child with ADHD only, particularly if they are of lower socioeconomic status.

HYPOTHESIS 4. *Greater ASD symptoms, when measured categorically and continuously, would be associated with more parenting difficulties (lower parent self-efficacy, less parenting consistency and parental warmth and more hostile parenting).* This hypothesis was partially supported. There was some evidence that greater ASD symptoms contribute to more parenting difficulties in two domains; more hostile parenting and less confidence in one's

parenting abilities. The association between ASD symptoms and more hostile parenting was partly accounted for by externalising behaviours, parent education level and ADHD symptom severity. We found clear evidence that parents of children with ADHD+ASD were less confident in their parenting abilities than parents of children with ADHD alone, even after accounting for covariates. It is well established that parents of children with neurodevelopmental disorders have more parenting difficulties (REFS), as would be expected due to the additional challenges that come with the disorders. No previous work has specifically examined the relationship between parenting behaviours and ASD symptoms in children with ADHD. These findings suggest that greater ASD symptoms contribute to poorer parental self-efficacy in families who are more vulnerable, with a child who has both ADHD and significant ASD symptoms.

9.3 STUDY STRENGTHS

This study has a number of strengths, which support the validity and importance of our research findings. Our study is one of only a few papers that have examined rates of ASD symptoms in a community or population based sample of children with ADHD. This is important, given that clinical samples tend to be more biased towards the severe end of the ADHD spectrum and have smaller samples of girls (male only or 80% plus). Population-based approaches have the advantage of providing findings that are more representative of the general population (E. Sciberras, 2014). Clinical studies also tend to have mostly boys with ADHD combined type. This limits our understanding of outcomes for girls with ADHD, and children with other ADHD subtypes, such as inattentive or hyperactive/impulsive. A further strength is the inclusion of a large sample of girls in our study (n = 50, 30.5%) and a greater diversity of ADHD subtypes (Inattentive type 37.8%, Hyperactive/impulsive type 11.6%), compared to previous clinical-based research, where most children have ADHD combined type. The large

overall sample size also gave us power to detect small effect sizes and split the sample into three groups, to allow for categorical comparisons.

A further study strength was the use of a rigorous screening measure of ASD symptoms. Our main outcome measure, the SCQ Lifetime form, is the most researched ASD screening measure, with eleven studies examining the validity and reliability in a range of samples (Norris, 2010). The SCQ is also the most frequently used measure in previous research, allowing for clear comparison to previous research in the area. Finally, from a feasibility perspective, the SCQ is briefer than other ASD screening measures (e.g. SRS), whilst retaining good psychometric properties (Allen, Silove, Williams, & Hutchins, 2007; Bolte, Westerwald, Holtmann, Freitag, & Poustka, 2011; Norris, 2010). In addition to using a rigorous measure of ASD symptoms, we examined ASD symptoms from a continuous and categorical perspective, which is aligned with the DSM-5's approach (American Psychiatric Association, 2013).

The response rates for CAP, including this study, are impressive (Schilpzand, Sciberras, Efron, Anderson, & Nicholson, 2015).. Where the SCQ was completed at interview, 100% of families completed the questionnaire. Where the SCQ was completed over the phone, our response rate was 84% (n = 153/182).

A number of previous studies allocate participants to ADHD groups on the basis of clinician diagnosis, questionnaires, or file review, without follow up using a structured diagnostic interview (Clark et al., 1999; Gadow et al., 2009; Ghaziuddin et al., 2010; Hattori et al., 2006; Kanne et al., 2009; Luteijn et al., 2000; Mayes et al., 2012; Nijmeijer et al., 2009; Angela M. Reiersen et al., 2008; Van der Meer et al., 2012). Confirming ADHD diagnosis is important, as being clearly aware of the characteristics and severity of study samples, is central to determining the application of the results. This study confirmed ADHD and other comorbidities using a structured diagnostic interview, which was completed by blinded interviewers.

A further strength is our comprehensive measurement of child and family functioning. We assessed child mental health using both a diagnostic interview and validated parent- and teacher-reported measures. We have expanded previous research in the area by including a measure of child QoL and prosocial behaviours, which to our knowledge, have not been examined in previous research examining the association between ASD symptoms and child functioning for children with ADHD. Our inclusion of teacher-reported child functioning outcomes (e.g. child mental health, peer problems, quality of life) is a further strength. Teachers provide insight about the child's functioning within the classroom environment, with particular relevance for the prosocial behaviour and peer problem measures. For our family functioning study, we measured the community around the child comprehensively, using measures of parent functioning, couple functioning and FQoL. This is the first study to examine the contribution of ASD symptoms to poorer FQoL in children with ADHD.

Another strength was the effort to eliminate bias due to confounding variables. Confounding variables were identified *a priori*. Of note, our approach to statistical analyses was rigorous, controlling for a number of child and family characteristics that may explain the association between ASD symptoms and functioning outcomes. This understanding of what variables explain specific associations is likely to help us determine important targets for intervention.

9.4 LIMITATIONS

The study also has a number of limitations. Firstly, the cross-sectional design of the study means that directionality cannot be determined. Future research needs to examine the association between ASD symptoms and child and family functioning longitudinally to help us determine directionality.

The DISC-IV, child assessment and parent questionnaire data were not collected concurrently with the SCQ data for Cohort 1. Whilst the most proximal measure was used

wherever possible, there is a possibility that a child's presentation (e.g., internalising and externalising comorbidities and ADHD symptom severity) may have changed during the 18-month period. With regard to our main measure, the SCQ is a screening, not a diagnostic measure of ASD. Future research could replicate our findings using the Autism Diagnostic Observation Schedule (ADOS) and the Autism Diagnostic Interview Revised (ADI-R), which is the gold standard for ASD diagnostic assessment. This measure would have allowed us to gather helpful information about the specificity of the SCQ (e.g. how many children with clinically significant ASD symptoms meet criteria for an Autism Spectrum Disorder based on the ADOS assessment?). Although parent and teacher reports of functioning were collected, child reported measures were not. Given that child-reported outcomes are particularly important for accurately measuring internalising symptoms, future research should replicate our findings by child-report. In addition, our family functioning variables only include one parents' perspective. Our findings need replication using secondary caregiver reports.

It is also acknowledged that our sleep evaluation was not comprehensive, although the item administered has well established correspondence with more detailed sleep measure (Lycett et al., 2015). Our measure of parent mental health was also brief (K6). Similarly, our measures of social functioning (SDQ Peer Problems and Prosocial behaviour) were relatively brief. It would have also been ideal to include a more in depth measure of QoL and have a QoL child-reported measure. Lastly, the samples in our subgroup analyses were relatively small, especially in the ADHD+ASD group. Our findings should be replicated with a larger ADHD+ASD in particular.

9.5 IMPLICATIONS

9.5.1 CLINICAL PRACTICE. Our first study highlighted the importance of taking a multi-dimensional approach to assessing children with ADHD, which incorporates an assessment of children's ASD symptoms. Our findings show that this is particularly important for boys with

ADHD, and children with more severe ADHD symptoms, as they are more likely to have clinically significant ASD symptoms. A recent paper showed that there is often a three year delay in the diagnosis of ASD, for children who were initially diagnosed with ADHD (Miodovnik et al., 2015). This may be because clinicians are not considering the comorbid diagnosis of ASD from the point of initial assessment. Children who were diagnosed with ADHD first were almost thirty times more likely to receive their ASD diagnosis after the age six years. This delay in diagnosis means that children miss out on early intervention and funding, which is available to children in Australia if they are diagnosed before the age of 7 years. In addition, research suggests that children with ADHD and clinically elevated ASD symptoms may be at risk of persistent ADHD symptoms over time, compared to children with ADHD alone (St. Pourcain et al., 2011). The assessment and diagnosis of ASD, where appropriate, may be an important prognostic indicator for clinicians.

There is a general argument within the literature that the co-occurrence of ADHD and ASD is likely to indicate a more severe phenotype than ADHD alone. Our findings of 'double hazard', whereby children with greater ASD symptoms also have more internalising disorders, emotional and conduct difficulties, peer problems and greater ADHD symptom severity adds weight to this argument. Similarly, comorbid internalising and externalising disorders, ADHD symptom severity, and lower socioeconomic status appear to contribute to family functioning difficulties. Clinically, it may be helpful to consider children with ADHD and clinically significant ASD symptoms as having a more severe neurodevelopmental disability, rather than two separate diagnoses. Our study adds weight to the debate within the literature, which says that it may be comorbidity, rather than particular symptoms per say (e.g. ADHD, ASD, internalising) that contribute to family functioning difficulties, given that many of the associations attenuated when adjusting for other comorbidities in our study.

We found strong evidence that ASD symptoms contribute to poorer FQoL. Poorer FQoL ratings on the CHQ suggest that children's behaviours are impacting the family and parent's ability to meet their own needs, and do things that the family do together. There is an element to which the concept of 'in our world, in their own way' applies here, which a phrase often used to describe the experience of children on the autism spectrum. Some family activities may be too tricky, whilst others more possible. Clinicians can play an active role in reducing the impact of the child's ASD symptoms on family life. Goals for family activities, as well as parent goals for their own needs, could be incorporated into a treatment plan, generated collaboratively with the child, their siblings and parents. These goals may require scaffolding, problem solving, and new skills to be learnt along the way, but clinician support may well help families to priories their own needs and family activities, that may be currently limited by their child's behaviours. The CHQ (Landgraf & Abetz, 1996), FQoL scale provides a tangible way of measuring change over time in the family environment, and could be a helpful way to 'hold the family in mind' during the treatment process.

9.5.2 FUTURE RESEARCH. Current treatment approaches are often offered in silos where by children are offered treatments from the ASD or ADHD service model. What we need to know is how can we improve child and family functioning outcomes for children with both conditions – ADHD and ASD? Future research needs to examine whether evidence based interventions for children with ASD are effective in treating ASD symptoms in children with ADHD. Do these interventions lead to improvements in child and family functioning for children with ADHD and clinically significant ASD symptoms? Research needs to examine which are the key treatment targets to improving child functioning – should ASD symptoms be the target or comorbid features, such as anxiety difficulties?

Further research needs to examine the mechanisms by which ASD contributes to poorer FQoL and the ways by which FQoL can be improved. Given that poorer FQoL is specifically

about the child's behaviours restricting parents being able to meet their own needs, and the family being able to do activities together, this may involve placing limits around the child's behaviours. The Triple P parenting program has recently been adapted for children with neurodevelopmental disabilities (called Stepping Stones), with a specific focus on behavioural management (Tellegen & Sanders, 2013). RCT trials have shown that the Stepping Stones program can be effective in reducing child behaviour problems and improving parental self-efficacy, and a range of other outcomes (Sofronoff, Jahnel, & Sanders, 2011; Whittingham, Sofronoff, Sheffield, & Sanders, 2009). It would be interesting to see if such a program improved FQoL and parental self-efficacy for families who a child who has ADHD+ASD.

It would also be interesting to better understand which factors need to change for child and family functioning outcomes to improve to children with ADHD+ASD. Our research suggests that ASD symptoms and other comorbidities are important to consider. Future research needs to examine whether FQoL only improves when ASD symptoms reduce, or whether we can improve FQoL by targeting behaviours associated with ASD – like anxiety. For example, one pilot randomised controlled trial by Sciberras et al. (2015) found that treating anxiety in children with ADHD was associated with marked improvements in family functioning, with a one standard deviation improvement in parent mental health for families in the intervention group. Given that the evidence base for interventions that improve ASD symptoms specifically is limited, targeting comorbidities in this at risk group may be a helpful way forward.

As suggested in a recent paper by Davis (2012), we need to know more about the types of social skills difficulties these children have, and the impact of these difficulties on developmental trajectories, in order to establish tailored, evidenced-based psycho-social interventions that may improve functioning for these children. Establishing, piloting and researching interventions could be seen as a medium term goal, with the initial goal of better

characterising the difficulties seen in this group, to ensure the appropriateness of these interventions. One way of doing this may be to examine the relationship between ADHD symptoms and ASD symptoms longitudinally, across a number of developmental periods (Reiersen, 2011). This longitudinal research may also allow us to see whether high ASD symptoms in ADHD is a marker of severity by assessing the risk for additional psychological disorders in children with ADHD+ASD, compared to those with only one diagnosis (Reiersen, 2011).

9.6 CONCLUSION. Little is known about what improves outcomes for children with ADHD. The *Children's Attention Project* was designed to address this question, with the goal of identifying risk and protective factors for better and poorer outcomes. Our study indicates that children with ADHD are more likely to have ASD symptoms than children without ADHD. Boys appear to be at particular risk of comorbid ASD, as are those with more severe ADHD symptoms. We have found associations between more ASD symptoms and a range of child and family functioning difficulties, suggesting that ASD symptoms in children with ADHD is a risk factor for poorer outcomes. It appears that the relationship between ASD symptoms and broader family functioning is largely driven by other comorbidities, with FQoL independently associated with ASD symptoms. Future research needs to determine the key modifiable factors for improving child and family functioning for children with ADHD and ASD.

CHAPTER REFERENCES

Allen, C., Silove, N., Williams, K., & Hutchins, P. (2007). Validity of the Social Communication Questionnaire in assessing risk of autism in preschool children with developmental problems. *Journal of Autism and Developmental Disorders, 37*(7), 1272-1278. doi: http://dx.doi.org/10.1007/s10803-006-0279-7

American Academy of Child and Adolescent Psychiatry. (2007). Practice Parameter for Attention deficit hyperactivity disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 46*, 894-921.

American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders 5*. Washington, DC: American Psychiatric Association.

APA. (2013). *Diagnostic and Statistical Manual of Mental Disorders 5*. Washington, DC: American Psychiatric Association.

Australian Bureau of Statistics. (2013). Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA), Australia—data only. Canberra.

Baio, J. (2012). Prevalence of Autism Spectrum Disorders: Autism and Developmental Disabilities Monitoring Network, 14 Sites, United States, 2008. Morbidity and Mortality Weekly Report. Surveillance Summaries. Volume 61, Number 3. *Centers for Disease Control and Prevention*.

Biederman, J., Faraone, S., Milberger, S., Guite, J., Mick, E., Chen, L., . . . Perrin, J. (1996). A prospective 4-year follow-up study of attention-deficit hyperactivity and related disorders. *Arch Gen Psychiatry, 53*(5), 437-446.

Bitsika, V., & Sharpley, C. F. (2015). Differences in the Prevalence, Severity and Symptom Profiles of Depression in Boys and Adolescents with an Autism Spectrum Disorder versus Normally Developing Controls. *International Journal of Disability, Development and Education, 62*(2), 158-167. doi: 10.1080/1034912X.2014.998179

Blacher, J., Baker, B., & Kaladjian, A. (2013). Syndrome Specificity and Mother–Child Interactions: Examining Positive and Negative Parenting Across Contexts and Time. *Journal of Autism and Developmental Disorders, 43*(4), 761-774. doi: 10.1007/s10803-012-1605-x

Bolte, S., Westerwald, E., Holtmann, M., Freitag, C., & Poustka, F. (2011). Autistic traits and autism spectrum disorders: the clinical validity of two measures presuming a continuum of social communication skills. *Journal of Autism & Developmental Disorders, 41*(1), 66-72.

Boonen, H., Esch, L., Lambrechts, G., Maljaars, J., Zink, I., Leeuwen, K., & Noens, I. (2015). Mothers' parenting behaviors in families of school-aged children with autism spectrum disorder: An observational and questionnaire study. *Journal of Autism and Developmental Disorders*, No Pagination Specified. doi: http://dx.doi.org/10.1007/s10803-015-2506-6

Booster, G. D., Dupaul, G. J., Eiraldi, R., & Power, T. J. (2012). Functional impairments in children with ADHD: unique effects of age and comorbid status. *Journal of Attention Disorders, 16*(3), 179-189.

Brobst, J. B., Clopton, J. R., & Hendrick, S. S. (2009). Parenting Children With Autism Spectrum Disorders: The Couple's Relationship. *Focus on Autism and Other Developmental Disabilities, 24*(1), 38-49. doi: 10.1177/1088357608323699

Busch, B., Biederman, J., Cohen, L. G., Sayer, J. M., Monuteaux, M. C., Mick, E., . . . Faraone, S. V. (2002). Correlates of ADHD among children in pediatric and psychiatric clinics. *Psychiatric Services, 53*(9), 1103-1111.

Chandler, S., Charman, T., Baird, G., Simonoff, E., Loucas, T., Meldrum, D., . . . Pickles, A. (2007). Validation of the social communication questionnaire in a population cohort of

children with autism spectrum diorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, *46*(10), 1324-1332. doi: http://dx.doi.org/10.1097/chi.0b013e31812f7d8d

Charman, T., Baird, G., Simonoff, E., Loucas, T., Chandler, S., Meldrum, D., & Pickles, A. (2007). Efficacy of three screening instruments in the identification of autistic-spectrum disorders. *British Journal of Psychiatry*, *191*, 554-559.

Clark, T., Feehan, C., Tinline, C., & Vostanis, P. (1999). Autistic symptoms in children with attention deficit-hyperactivity disorder. *European Child & Adolescent Psychiatry*, *8*(1), 50-55.

Cohen, J. (1992). A Power Primer. *Psychological Bulletin*, *112*(1), 155-159.

Conners, C. (2008). *Conners* (3rd edition ed.). Toronto Multi-Health Systems.

Cooper, M., Martin, J., Langley, K., Hamshere, M., & Thapar, A. (2014). Autistic traits in children with ADHD index clinical and cognitive problems. *European Child & Adolescent Psychiatry*, *23*(1), 23-34. doi: 10.1007/s00787-013-0398-6

Cornelius, B. L., Groothoff, J. W., van der Klink, J. J., & Brouwer, S. (2013). The performance of the K10, K6 and GHQ-12 to screen for present state DSM-IV disorders among disability claimants. *BMC Public Health*, *13*, 128. doi: 10.1186/1471-2458-13-128

Cussen, A., Sciberras, E., Ukoumunne, O., & Efron, D. (2012). Relationship between symptoms of attention-deficit/hyperactivity disorder and family functioning: a community-based study. *European Journal of Pediatrics*, *171*(2), 271-280. doi: 10.1007/s00431-011-1524-4

Dadds, M. R., MacDonald, E., Cauchi, A., Williams, K., Levy, F., & Brennan, J. (2014). Nasal oxytocin for social deficits in childhood autism: a randomized controlled trial. *Journal of Autism & Developmental Disorders*, *44*(3), 521-531. doi: 10.1007/s10803-013-1899-3

Daley, D., van der Oord, S., Ferrin, M., Danckaerts, M., Doepfner, M., Cortese, S., & Sonuga-Barke, E. J. S. (2014). Behavioral Interventions in Attention-Deficit/Hyperactivity Disorder: A Meta-Analysis of Randomized Controlled Trials Across Multiple Outcome Domains. *Journal of the American Academy of Child & Adolescent Psychiatry*, *53*(8), 835-847.e835. doi: http://dx.doi.org/10.1016/j.jaac.2014.05.013

Eaves, L. C., Wingert, H., & Ho, H. H. (2006). Screening for autism: Agreement with diagnosis. *Autism*, *10*(3), 229-242. doi: 10.1177/1362361306063288

Efron, D., Sciberras, E., Anderson, V., Hazell, P., Ukoumunne, O., Jongeling, B., . . . Nicholson, J. (2014a). A controlled community study of functional status in children with ADHD at age 6-8. *Pediatrics, In Press*.

Efron, D., Sciberras, E., Anderson, V., Hazell, P., Ukoumunne, O. C., Jongeling, B., . . . Nicholson, J. M. (2014b). Functional Status in Children With ADHD at Age 6–8: A Controlled Community Study. *Pediatrics*. doi: 10.1542/peds.2014-1027

Elberling, H., Linneberg, A., Olsen, E. M., Houmann, T., Rask, C. U., Goodman, R., & Skovgaard, A. M. (2014). Infancy predictors of hyperkinetic and pervasive developmental disorders at ages 5-7 years. *Results from the Copenhagen Child Cohort CCC2000*, *55*(12), 1328-1335.

Elsabbagh, M., Divan, G., Koh, Y. J., Kim, Y. S., Kauchali, S., Marcin, C., . . . Fombonne, E. (2012). Global prevalence of autism and other pervasive developmental disorders. *Autism research : Official Journal of the International Society for Autism Research*, *5*(3), 160-179. doi: 10.1002/aur.239

Enticott, P. G., Fitzgibbon, B. M., Kennedy, H. A., Arnold, S. L., Elliot, D., Peachey, A., . . . Fitzgerald, P. B. (2014). A double-blind, randomized trial of deep repetitive transcranial magnetic stimulation (rTMS) for autism spectrum disorder. *Brain Stimul*, *7*(2), 206-211. doi: 10.1016/j.brs.2013.10.004

Faraone, S. V., Perlis, R. H., & Doyle, A. E. (2005). Molecular genetics of attention-deficit/hyperactivity disorder. *Biological Psychiatry, 57*, 1313-1323.

Faraone, S. V., Perlis, R. H., Doyle, A. E., Smoller, J. W., Goralnick, J. J., Holmgren, M. A., & Sklar, P. (2005). Molecular genetics of attention-deficit/hyperactivity disorder. *Biological Psychiatry, 57*(11), 1313-1323.

Feldman, H. M., & Reiff, M. I. (2014). Attention Deficit-Hyperactivity Disorder in children and adolescents. *New England Journal of Medicine, 370*, 9.

Furukawa, T. A., Kessler, R. C., Slade, T., & Andrews, G. (2003). The performance of the K6 and K10 screening scales for psychological distress in the Australian National Survey of Mental Health and Well-Being. *Psychological Medicine, 33*(2), 357-362.

Gadow, K. D., DeVincent, C. J., & Schneider, J. (2009). Comparative study of children with ADHD only, autism spectrum disorder + ADHD, and chronic multiple tic disorder + ADHD. *Journal of Attention Disorders, 12*(5), 474-485.

Ghanizadeh, A., Mohammadi, M. R., & Moini, R. (2008). Comorbidity of psychiatric disorders and parental psychiatric disorders in a sample of Iranian children with ADHD. *J Atten Disord, 12*(2), 149-155. doi: 10.1177/1087054708314601

Ghaziuddin, M., Welch, K., Mohiuddin, S., Lagrou, R., & Ghaziuddin, N. (2010). Utility of the Social and Communication Questionnaire in the differentiation of autism from ADHD. *Journal of Developmental and Physical Disabilities, 22*(4), 359-366. doi: http://dx.doi.org/10.1007/s10882-010-9199-8

Gillberg, C. (2010). The ESSENCE in child psychiatry: Early Symptomatic Syndromes Eliciting Neurodevelopmental Clinical Examinations. *Research in Developmental Disabilities, 31*(6), 1543-1551. doi: http://dx.doi.org/10.1016/j.ridd.2010.06.002

Gillberg, C., & Fernell, E. (2014). Autism Plus Versus Autism Pure. *Journal of Autism and Developmental Disorders, 44*(12), 3274-3276. doi: 10.1007/s10803-014-2163-1

Goodman, R. (1997). The Strengths and Difficulties Questionnaire: A Research Note. *Journal of Child Psychology and Psychiatry, 38*(5), 581-586. doi: 10.1111/j.1469-7610.1997.tb01545.x

Gotham, K., Brunwasser, S. M., & Lord, C. (2015). Depressive and anxiety symptom trajectories from school age through young adulthood in samples with autism spectrum disorder and developmental delay. *Journal of the American Academy of Child & Adolescent Psychiatry, 54*(5), 369-376.e363. doi: 10.1016/j.jaac.2015.02.005

Graetz, B., Sawyer, M., Hazell, P., Arney, F., & Baghurst, P. (2001). Validity of ADHD subtypes in a nationally representative sample of Australian children and adolescents. *Journal of American Academy of Child and Adolescent Psychiatry, 40*, 1410-1417.

Green, J. L., Rinehart, N. J., Anderson, V., Nicholson, J. M., Jongeling, B., & Sciberras, E. (2015). Autism spectrum disorder symptoms in children with ADHD: a community-based study. *Research in Developmental Disabilities*.

Greene, R. W., Biederman, J., Faraone, S. V., Monuteaux, M. C., Mick, E., DuPre, E. P., . . . Goring, J. G. (2001). Social impairment in girls with ADHD: Patterns, gender comparisons, and correlates. *Journal of the American Academy of Child & Adolescent Psychiatry, 40*(6), 704-710. doi: http://dx.doi.org/10.1097/00004583-200106000-00016

Grzadzinski, R., Di Martino, A., Brady, E., Mairena, M. A., O'Neale, M., Petkova, E., . . . Castellanos, F. X. (2011). Examining autistic traits in children with ADHD: does the autism spectrum extend to ADHD? *Journal of Autism & Developmental Disorders, 41*(9), 1178-1191.

Harpin, V., Mazzone, L., & Raynaud, J. P. (2013). Long-Term Outcomes of ADHD: A Systematic Review of Self-Esteem and Social Function. *Journal of Attention Disorders, May 22*.

Hartley, S. L., Barker, E. T., Seltzer, M. M., Floyd, F., Greenberg, J., Orsmond, G., & Bolt, D. (2010). The Relative Risk and Timing of Divorce in Families of Children with an Autism Spectrum Disorder. *J Fam Psychol, 24*(4), 449-457. doi: 10.1037/a0019847

Hattori, J., Ogino, T., Abiru, K., Nakano, K., Oka, M., & Ohtsuka, Y. (2006). Are pervasive developmental disorders and attention-deficit/hyperactivity disorder distinct disorders? *Brain and Development, 28*(6), 371-374. doi: 10.1016/j.braindev.2005.11.009

Hiscock, H., Canterford, L., Ukoumunne, O. C., & Wake, M. (2007). Adverse associations of sleep problems in Australian preschoolers: national population study. *Pediatrics, 119*(1), 86-93. doi: 10.1542/peds.2006-1757

Hiscock, H., Sciberras, E., Mensah, F., Gerner, B., Efron, D., Khano, S., & Oberklaid, F. (2015). Impact of a behavioral sleep intervention on ADHD symptoms, child sleep and parent health: A randomized controlled trial. *BMJ, 350*, h68.

Hurtig, T., Ebeling, H., Taanila, A., Miettunen, J., Smalley, S., McGough, J., . . . Moilanen, I. (2007). ADHD and comorbid disorders in relation to family environment and symptom severity. *Eur Child Adolesc Psychiatry, 16*(6), 362-369. doi: 10.1007/s00787-007-0607-2

Jellett, R., Wood, C. E., Giallo, R., & Seymour, M. (2015). Family functioning and behaviour problems in children with Autism Spectrum Disorders: The mediating role of parent mental health. *Clinical Psychologist, 19*(1), 39-48. doi: 10.1111/cp.12047

Johnston, C., & Mash, E. (2001). Families of Children With Attention-Deficit/Hyperactivity Disorder: Review and Recommendations for Future Research. *Clinical Child and Family Psychology Review, 4*(3), 183-207. doi: 10.1023/A:1017592030434

Joshi, G., Faraone, S. V., Wozniak, J., Tarko, L., Fried, R., Galdo, M., . . . Biederman, J. (2014). Symptom Profile of ADHD in Youth With High-Functioning Autism Spectrum Disorder A Comparative Study in Psychiatrically Referred Populations. *Journal of Attention Disorders*, 1087054714543368.

Kanne, S. M., Christ, S. E., & Reiersen, A. M. (2009). Psychiatric symptoms and psychosocial difficulties in young adults with autistic traits. *Journal of Autism and Developmental Disorders, 39*(6), 827-833. doi: http://dx.doi.org/10.1007/s10803-008-0688-x

Karande, S. (2012). Quality of life in children diagnosed with specific learning disability or attention-deficit/hyperactivity disorder *Handbook of children with special health care needs* (pp. 73-85). New York, NY: Springer Science + Business Media; US.

Kessler, R. C., Green, J. G., Gruber, M. J., Sampson, N. A., Bromet, E., Cuitan, M., . . . Zaslavsky, A. M. (2010). Screening for Serious Mental Illness in the General Population with the K6 screening scale: Results from the WHO World Mental Health (WMH) Survey Initiative. *International Journal of Methods in Psychiatric Research, 19*(0 1), 4-22. doi: 10.1002/mpr.310

Kochhar, P., Batty, M., Liddle, E., Groom, M., Scerif, G., Liddle, P., & Hollis, C. (2011a). Autistic spectrum disorder traits in children with attention deficit hyperactivity disorder. *Child: Care, Health and Development, 37*(1), 103-110. doi: http://dx.doi.org/10.1111/j.1365-2214.2010.01123.x

Kochhar, P., Batty, M. J., Liddle, E. B., Groom, M. J., Scerif, G., Liddle, P. F., & Hollis, C. P. (2011b). Autistic spectrum disorder traits in children with attention deficit hyperactivity disorder. *Child: Care, Health & Development, 37*(1), 103-110. doi: http://dx.doi.org/10.1111/j.1365-2214.2010.01123.x

Kotte, A., Joshi, G., Fried, R., Uchida, M., Spencer, A., Woodworth, K. Y., . . . Biederman, J. (2013). Autistic Traits in Children With and Without ADHD. *Pediatrics*. doi: 10.1542/peds.2012-3947

Kroger, A., Hanig, S., Seitz, C., Palmason, H., Meyer, J., & Freitag, C. M. (2011). Risk factors of autistic symptoms in children with ADHD. *European Child & Adolescent Psychiatry, 20*(11-12), 561-570. doi: http://dx.doi.org/10.1007/s00787-011-0221-1

Landgraf, J., & Abetz, L. W., JR. (1996). *Child Health Questionnaire (CHQ): A User's Manual*. Boston, MA: The Health Institute

Lichtenstein, P., Carlström, E., Råstam, M., Gillberg, C., & Anckarsäter, H. (2010). The genetics of autism spectrum disorders and related neuropsychiatric disorders in childhood. *American Journal of Psychiatry, 167*(11), 1357-1363.

Limbers, C. A., Ripperger-Suhler, J., Boutton, K., Ransom, D., & Varni, J. W. (2011). A comparative analysis of health-related quality of life and family impact between children with ADHD treated in a general pediatric clinic and a psychiatric clinic utilizing the PedsQL. *Journal of Attention Disorders, 15*(5), 392-402. doi: http://dx.doi.org/10.1177/1087054709356191

Luteijn, E., Serra, M., Jackson, S., Steenhuis, M., Althaus, M., Volkmar, F., & Minderaa, R. (2000). How unspecified are disorders of children with a pervasive developmental disorder not otherwise specified? A study of social problems in children with PDD-NOS and ADHD. *European Child & Adolescent Psychiatry, 9*(3), 168-179. doi: http://dx.doi.org/10.1007/s007870070040

Lycett, K., Mensah, F., Hiscock, H., & Sciberras, E. (2015). The validity of a global measure of sleep problem severity in children with ADHD: a cross-sectional comparison with a validated multi-dimensional measure and sleep log. *Sleep Medicine*.

Lycett, K., Mensah, F. K., Hiscock, H., & Sciberras, E. (2014). A prospective study of sleep problems in children with ADHD. *Sleep Medicine, 15*(11), 1354-1361. doi: 10.1016/j.sleep.2014.06.004

Martin, J., Hamshere, M. L., O'Donovan, M. C., Rutter, M., & Thapar, A. (2014). Factor structure of autistic traits in children with ADHD. *Journal of Autism & Developmental Disorders, 44*(1), 204-215. doi: http://dx.doi.org/10.1007/s10803-013-1865-0

May, T., Cornish, K., & Rinehart, N. (2014). Does gender matter? A one year follow-up of autistic, attention and anxiety symptoms in high-functioning children with autism spectrum disorder. *Journal of Autism & Developmental Disorders, 44*(5), 1077-1086. doi: 10.1007/s10803-013-1964-y

Mayes, S. D., Calhoun, S. L., Mayes, R. D., & Molitoris, S. (2012). Autism and ADHD: Overlapping and discriminating symptoms. *Research in Autism Spectrum Disorders, 6*(1), 277-285. doi: 10.1016/j.rasd.2011.05.009

McConachie, H., & Diggle, T. (2007). Parent implemented early intervention for young children with autism spectrum disorder: a systematic review. *J Eval Clin Pract, 13*(1), 120-129. doi: 10.1111/j.1365-2753.2006.00674.x

McConachie, H., Parr, J., Glod, M., Hanratty, J., Livingstone, N., Oono, I., . . . Williams, K. (2015). Systematic review of tools to measure outcomes for young children with autism spectrum disorder. *Health Technology Assessment, 19*(41), 1-538. doi: 10.3310/hta19410

Meadan, H., Halle, J. W., & Ebata, A. T. (2010). Families with Children Who Have Autism Spectrum Disorders: Stress and Support. *Exceptional Children, 77*(1), 7-36.

Miodovnik, A., Harstad, E., Sideridis, G., & Huntington, N. (2015). Timing of the Diagnosis of Attention-Deficit/Hyperactivity Disorder and Autism Spectrum Disorder. *Pediatrics*. doi: 10.1542/peds.2015-1502

Modesto-Lowe, V., Danforth, J. S., & Brooks, D. (2008). ADHD: does parenting style matter? *Clinical Pediatrics, 47*(9), 865-872.

Mrug, S., Molina, B. S., Hoza, B., Gerdes, A. C., Hinshaw, S. P., Hechtman, L., & Arnold, L. (2012). Peer rejection and friendships in children with attention-deficit/hyperactivity

disorder: Contributions to long-term outcomes. *Journal of Abnormal Child Psychology, 40*(6), 1013-1026. doi: http://dx.doi.org/10.1007/s10802-012-9610-2

Mulligan, A., Anney, R. J., O'Regan, M., Chen, W., Butler, L., Fitzgerald, M., . . . Gill, M. (2009). Autism symptoms in attention-deficit/hyperactivity disorder: A familial trait which correlates with conduct, oppositional defiant, language and motor disorders. *Journal of Autism and Developmental Disorders, 39*(2), 197-209. doi: http://dx.doi.org/10.1007/s10803-008-0621-3

Mulligan, A., Anney, R. J., O'Regan, M., Chen, W., Butler, L., Fitzgerald, M., . . . Minderaa, R. (2009). Autism symptoms in attention-deficit/hyperactivity disorder: a familial trait which correlates with conduct, oppositional defiant, language and motor disorders. *Journal of Autism and Developmental Disorders, 39*(2), 197-209.

Musser, E. D., Hawkey, E., Kachan-Liu, S. S., Lees, P., Roullet, J. B., Goddard, K., . . . Nigg, J. T. (2014). Shared familial transmission of autism spectrum and attention-deficit/hyperactivity disorders. *Journal of Child Psychology & Psychiatry & Allied Disciplines, 55*(7), 819-827. doi: 10.1111/jcpp.12201

National Health and Medical Research Council. (2012). *Clinical Practice Points on the diagnosis, assessment and management of Attention Deficit Hyperactivity Disorder in children and adolescents.*: Retrieved from http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/ch54_draft_guidelines.pdf.

Nijmeijer, J., Hoekstra, P. J., Minderaa, R. B., Buitelaar, J. K., Altink, M. E., Buschgens, C. J. M., . . . Hartman, C. A. (2009). PDD symptoms in ADHD, an independent familial trait? *Journal of Abnormal Child Psychology, 37*(3), 443-453.

Nijmeijer, J., Minderaa, R. B., Buitelaar, J. K., Mulligan, A., Hartman, C. A., & Hoekstra, P. J. (2008). Attention-deficit/hyperactivity disorder and social dysfunctioning. *Clinical Psychology Review, 28*(4), 692-708. doi: 10.1016/j.cpr.2007.10.003

Norris. (2010). Screening accuracy of Level 2 autism spectrum disorder rating scales. A review of selected instruments. *Autism., 14*(4), 263-284.

Norris, M., & Lecavalier, L. (2010). Screening Accuracy of Level 2 Autism Spectrum Disorder Rating Scales: A Review of Selected Instruments. *Autism, 14*(4), 263-284. doi: 10.1177/1362361309348071

Papadopoulos, N., Sciberras, E., Hiscock, H., Mulraney, M., McGillivray, J., & Rinehart, N. (2015). The Efficacy of a Brief Behavioral Sleep Intervention in School-Aged Children With ADHD and Comorbid Autism Spectrum Disorder. *Journal of Attention Disorders*. doi: 10.1177/1087054714568565

Pfiffner, L. J., Mikami, A. Y., Huang-Pollock, C., Easterlin, B., Zalecki, C., & McBurnett, K. (2007). A randomized, controlled trial of integrated home-school behavioral treatment for ADHD, predominantly inattentive type. *Journal of the American Academy of Child and Adolescent Psychiatry, 46*(8), 1041-1050. doi: 10.1097/chi.0b013e313064675f

Polanczyk, G. V., Willcutt, E. G., Salum, G. A., Kieling, C., & Rohde, L. A. (2014). ADHD prevalence estimates across three decades: an updated systematic review and meta-regression analysis. *Int J Epidemiol, 43*(2), 434-442. doi: 10.1093/ije/dyt261

Polderman, T. J. C., Hoekstra, R. A., Posthuma, D., & Larsson, H. (2014). The co-occurrence of autistic and ADHD dimensions in adults: an etiological study in 17770 twins. *Transl Psychiatry, 4*, e435. doi: 10.1038/tp.2014.84

Pressman, L. J., Loo, S. K., Carpenter, E. M., Asarnow, J. R., Lynn, D., McCracken, J. T., . . . Smalley, S. L. (2006). Relationship of family environment and parental psychiatric diagnosis to impairment in ADHD. *J Am Acad Child Adolesc Psychiatry, 45*(3), 346-354. doi: 10.1097/01.chi.0000192248.61271.c8

Quach, J., Hiscock, H., Canterford, L., & Wake, M. (2009). Outcomes of Child Sleep Problems Over the School-Transition Period: Australian Population Longitudinal Study. *Pediatrics, 123*(5), 1287-1292. doi: 10.1542/peds.2008-1860

Reiersen, A. M., Constantino, J. N., Grimmer, M., Martin, N., & Todd, R. D. (2008). Evidence for shared genetic influences on self-reported ADHD and autistic symptoms in young adult Australian twins. *Twin Research and Human Genetics, 11*(6), 579-585. doi: http://dx.doi.org/10.1375/twin.11.6.579

Reiersen, A. M., Constantino, J. N., Grimmer, M., Martin, N. G., & Todd, R. D. (2008). Evidence for shared genetic influences on self-reported ADHD and autistic symptoms in young adult Australian twins. *Twin Research and Human Genetics, 11*(06), 579-585.

Reiersen, A. M., Constantino, J. N., Volk, H. E., & Todd, R. D. (2007). Autistic traits in a population-based ADHD twin sample. *Journal of Child Psychology and Psychiatry, 48*(5), 464-472. doi: 10.1111/j.1469-7610.2006.01720.x

Reiersen, A. M., & Todorov, A. A. (2011). Association between DRD4 genotype and autistic symptoms in DSM-IV ADHD. *Journal of the Canadian Academy of Child and Adolescent Psychiatry / Journal de l'Academie canadienne de psychiatrie de l'enfant et de l'adolescent, 20*(1), 15-21.

Rentz, A. M., Matza, L. S., Secnik, K., Swensen, A., & Revicki, D. A. (2005). Psychometric validation of the child health questionnaire (CHQ) in a sample of children and adolescents with attention-deficit/hyperactivity disorder. *Qual Life Res, 14*(3), 719-734.

Rommelse, N. N., Franke, B., Geurts, H. M., Hartman, C. A., & Buitelaar, J. K. (2010). Shared heritability of attention-deficit/hyperactivity disorder and autism spectrum disorder. *European Child & Adolescent Psychiatry, 19*(3), 281-295.

Ronald, A., Larsson, H., Anckarsater, H., & Lichtenstein, P. (2014). Symptoms of Autism and ADHD: A Swedish Twin Study Examining Their Overlap. *Journal of Abnormal Psychology, 123*(2), 440-451.

Ronald, A., Simonoff, E., Kuntsi, J., Asherson, P., & Plomin, R. (2008). Evidence for overlapping genetic influences on autistic and ADHD behaviours in a community twin sample. *Journal of Child Psychology and Psychiatry, 49*(5), 535-542. doi: 10.1111/j.1469-7610.2007.01857.x

Rubia, K., Alegria, A. A., & Brinson, H. (2014). Brain abnormalities in attention-deficit hyperactivity disorder: a review. *Revista De Neurologia, 58*, S3-S18.

Rutter, M., Bailey, A., & Lord, C. (2003). *Social Communication Questionnaire* Los Angeles, CA: Western Psychological Services (WPS).

Schilpzand, E. J., Sciberras, E., Efron, D., Anderson, V., & Nicholson, J. M. (2015). Improving Survey Response Rates from Parents in School-Based Research Using a Multi-Level Approach. *PLoS ONE [Electronic Resource], 10*(5), e0126950. doi: 10.1371/journal.pone.0126950

Sciberras, E. (2014). ADHD research: the power of population-based studies. *The Lancet Psychiatry, 1*(4), 248-249. doi: 10.1016/S2215-0366(14)70341-4

Sciberras, E., Efron, D., Schilpzand, E., Anderson, V., Jongeling, B., Hazell, P., . . . Nicholson, J. (2013). The Children's Attention Project: a community-based longitudinal study of children with ADHD and non-ADHD controls. *BMC Psychiatry, 13*(1), 18.

Sciberras, E., Lycett, K., Efron, D., Mensah, F., Gerner, B., & Hiscock, H. (2014). Anxiety in Children With Attention-Deficit/Hyperactivity Disorder. *Pediatrics*. doi: 10.1542/peds.2013-3686

Sciberras, E., Mueller, K. L., Efron, D., Bisset, M., Anderson, V., Schilpzand, E. J., . . . Nicholson, J. M. (2014). Language Problems in Children With ADHD: A Community-Based Study. *Pediatrics, 133*(5), 793-800. doi: 10.1542/peds.2013-3355

Sciberras, E., Mulraney, M., Anderson, V., Rapee, R. M., Nicholson, J. M., Efron, D., . . . Hiscock, H. (2015). Managing Anxiety in Children With ADHD Using Cognitive-Behavioral Therapy: A Pilot Randomized Controlled Trial. *Journal of Attention Disorders*. doi: 10.1177/1087054715584054

Sciberras, E., Ohan, J., & Anderson, V. (2012). Bullying and peer victimisation in adolescent girls with Attention-Deficit/Hyperactivity Disorder. *Child Psychiatry and Human Development, 43*, 254-270.

Sciberras, E., Ukoumunne, O., & Efron, D. (2011). Predictors of Parent-Reported Attention-Deficit/Hyperactivity Disorder in Children Aged 6–7 years: A National Longitudinal Study. *Journal of Abnormal Child Psychology, 39*(7), 1025-1034. doi: 10.1007/s10802-011-9504-8

Shaffer, D., Fisher, P., Lucas, C. P., Dulcan, M. K., & Schwab-Stone, M. E. (2000). NIMH Diagnostic Interview Schedule for Children Version IV (NIMH DISC-IV): description, differences from previous versions, and reliability of some common diagnoses. *Journal of the American Academy of Child & Adolescent Psychiatry, 39*(1), 28-38. doi: 10.1097/00004583-200001000-00014

Sikora, D., Moran, E., Orlich, F., Hall, T. A., Kovacs, E. A., Delahaye, J., . . . Kuhlthau, K. (2013). The relationship between family functioning and behavior problems in children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 7*(2), 307-315. doi: http://dx.doi.org/10.1016/j.rasd.2012.09.006

Silk, T., Vance, A., Rinehart, N., & et al. (2005). Decreased fronto-parietal activation in Attention Deficit Hyperactivity Disorder, combined type (ADHD-CT): an fMRI study. *British Journal of Psychiatry, 187*, 282-283.

Simonoff, E., Pickles, A., Charman, T., Chandler, S., Loucas, T., & Baird, G. (2008). Psychiatric disorders in children with autism spectrum disorders: prevalence, comorbidity, and associated factors in a population-derived sample. *Journal of the American Academy of Child & Adolescent Psychiatry, 47*(8), 921-929. doi: 10.1097/CHI.0b013e318179964f

Sinzig, J., Walter, D., & Doepfner, M. (2009). Attention deficit/hyperactivity disorder in children and adolescents with autism spectrum disorder: Symptom or syndrome? *Journal of Attention Disorders, 13*(2), 117-126. doi: http://dx.doi.org/10.1177/1087054708326261

Sofronoff, K., Jahnel, D., & Sanders, M. (2011). Stepping Stones Triple P seminars for parents of a child with a disability: A randomized controlled trial. *Research in Developmental Disabilities, 32*(6), 2253-2262. doi: http://dx.doi.org/10.1016/j.ridd.2011.07.046

St. Pourcain, B., Mandy, W. P., Heron, J., Golding, J., Smith, G. D., & Skuse, D. H. (2011). Links between co-occurring social-communication and hyperactive-inattentive trait trajectories. *Journal of the American Academy of Child & Adolescent Psychiatry, 50*(9), 892-902. doi: http://dx.doi.org/10.1016/j.jaac.2011.05.015

Strang, J. F., Kenworthy, L., Daniolos, P., Case, L., Wills, M. C., Martin, A., & Wallace, G. L. (2012). Depression and anxiety symptoms in children and adolescents with autism spectrum disorders without intellectual disability. *Research in Autism Spectrum Disorders, 6*(1), 406-412. doi: http://dx.doi.org/10.1016/j.rasd.2011.06.015

Sung, V., Hiscock, H., Sciberras, E., & Efron, D. (2008). Sleep problems in children with attention-deficit/hyperactivity disorder: Prevalence and the effect on the child and family. *Archives of Pediatrics & Adolescent Medicine, 162*(4), 336-342. doi: 10.1001/archpedi.162.4.336

Tellegen, C. L., & Sanders, M. R. (2013). Stepping Stones Triple P-Positive Parenting Program for children with disability: A systematic review and meta-analysis. *Research in*

Developmental Disabilities, 34(5), 1556-1571. doi: http://dx.doi.org/10.1016/j.ridd.2013.01.022

Thapar, A., Cooper, M., Jefferies, R., & Stergiakouli, E. (2012). What causes attention defi cit hyperactivity disorder? *Archives of Disease in Childhood, 97*, 260–265.

The MTA Cooperative Group. (1999). A 14-month randomized clinical trial of treatment strategies for attention-deficit/hyperactivity disorder. *Arch Gen Psychiatry, 56*, 1073-1086.

Thomas, S., Lycett, K., Papadopoulos, N., Sciberras, E., & Rinehart, N. (2015). Exploring behavioural sleep problems in children with Attention Deficit/Hyperactivity Disorder and comorbid Autism Spectrum Disorder. *Journal of Attention Disorders, In Press*.

Thomas, S., Sciberras, E., Lycett, K., Papadopoulos, N., & Rinehart, N. (2015). Physical Functioning, Emotional, and Behavioral Problems in Children With ADHD and Comorbid ASD: A Cross-Sectional Study. *Journal of Attention Disorders*. doi: 10.1177/1087054715587096

Tonge, B., Brereton, A., Kiomall, M., Mackinnon, A., & Rinehart, N. J. (2014). A randomised group comparison controlled trial of 'preschoolers with autism': A parent education and skills training intervention for young children with autistic disorder. *Autism, 18*(2), 166-177. doi: 10.1177/1362361312458186

Van der Meer, J. M., Lappenschaar, M. G., Hartman, C. A., Greven, C. U., Buitelaar, J. K., & Rommelse, N. N. (2014). Homogeneous Combinations of ASD-ADHD Traits and Their Cognitive and Behavioral Correlates in a Population-Based Sample. *Journal of Attention Disorders*. doi: 10.1177/1087054714533194

Van der Meer, J. M. J., Oerlemans, A. M., van Steijn, D. J., Lappenschaar, M. G. A., de Sonneville, L. M. J., Buitelaar, J. K., & Rommelse, N. N. J. (2012). Are Autism Spectrum Disorder and Attention-Deficit/Hyperactivity Disorder Different Manifestations of One Overarching Disorder? Cognitive and Symptom Evidence From a Clinical and Population-Based Sample. *Journal of the American Academy of Child and Adolescent Psychiatry, 51*(11), 1160-1172.e1163.

van Steensel, F. J., Bogels, S. M., & Dirksen, C. D. (2012). Anxiety and quality of life: clinically anxious children with and without autism spectrum disorders compared. *Journal of Clinical Child & Adolescent Psychology, 41*(6), 731-738. doi: 10.1080/15374416.2012.698725

van Steensel, F. J., Bogels, S. M., & Perrin, S. (2011). Anxiety disorders in children and adolescents with autistic spectrum disorders: a meta-analysis. *Clinical Child & Family Psychology Review, 14*(3), 302-317. doi: 10.1007/s10567-011-0097-0

van Steijn, D. J., Oerlemans, A. M., van Aken, M. A., Buitelaar, J. K., & Rommelse, N. N. (2014). The reciprocal relationship of ASD, ADHD, depressive symptoms and stress in parents of children with ASD and/or ADHD. *Journal of Autism and Developmental Disorders, 44*(5), 1064-1076. doi: http://dx.doi.org/10.1007/s10803-013-1958-9

van Steijn, D. J., Oerlemans, A. M., van Aken, M. A., Buitelaar, J. K., & Rommelse, N. N. (2015). The influence of parental and offspring autism spectrum disorder (ASD) and attention-deficit/hyperactivity disorder (ADHD) symptoms on family climate. *Journal of Child and Family Studies, 24*(7), 2021-2030. doi: http://dx.doi.org/10.1007/s10826-014-0002-9

Waters, E., Salmon, L., & Wake, M. (2000). The parent-form Child Health Questionnaire in Australia: comparison of reliability, validity, structure, and norms. *J Pediatr Psychol, 25*(6), 381-391.

Wehmeier, P. M., Schacht, A., & Barkley, R. A. (2010). Social and emotional impairment in children and adolescents with ADHD and the impact on quality of life. *Journal of Adolescent Health, 46*(3), 209-217.

Whittingham, K., Sofronoff, K., Sheffield, J., & Sanders, M. (2009). Stepping Stones Triple P: An RCT of a Parenting Program with Parents of a Child Diagnosed with an Autism Spectrum Disorder. *Journal of Abnormal Child Psychology, 37*(4), 469-480. doi: 10.1007/s10802-008-9285-x

Wilens, T. E., Biederman, J., Brown, S., Tanguay, S., Monuteaux, M. C., Blake, C., & Spencer, T. J. (2002). Psychiatric comorbidity and functioning in clinically referred preschool children and school-age youths with ADHD. *J Am Acad Child Adolesc Psychiatry, 41*(3), 262-268. doi: 10.1097/00004583-200203000-00005

Williams, N. M., Zaharieva, I., Martin, A., Langley, K., Mantripragada, K., Fossdal, R., . . . Thapar, A. (2010). Rare chromosomal deletions and duplications in attention-deficit hyperactivity disorder: a genome-wide analysis. *Lancet, 376*(9750), 1401-1408. doi: 10.1016/s0140-6736(10)61109-9

Wolraich, M., Brown, L., Brown, R., DuPaul, G., Earls, M., Feldman, H., . . . Perrin, J. (2011). Subcommittee on Attention-Deficit/Hyperactivity Disorder; Steering Committee on Quality Improvement and Management. ADHD: clinical practice guideline for the diagnosis, evaluation, and treatment of attention-deficit/hyperactivity disorder in children and adolescents. *Pediatrics, 128*(5), 1007-1022.

Wymbs, B. T., Pelham, W. E., Gnagy, E. M., & Molina, B. S. G. (2008). Mother and Adolescent Reports of Interparental Discord among Parents of Adolescents with and without Attention-Deficit Hyperactivity Disorder. *Journal of emotional and behavioral disorders, 16*(1), 29-41. doi: 10.1177/1063426607310849

Zubrick, S., Lucas, N., Westrupp, E. M., & Nicholson, J. M. (2013). Parenting measures in the Longitudinal Study of Australian Children: Construct validity and measurement quality, Waves 1 to 4. . Canberra: : Canberra, ACT: Department of Social Services (formerly the Department of Families, Housing Community Services and Indigenous Affairs).

APPENDICES

Declaration for Paper in Appendix: Editorial

Monash University

Declaration by candidate

In the case of Editorial in the Appendix, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Writing of editorial paper and review of relevant literature	70%

The following co-authors contributed to the work. If co-authors are students at Monash University, the extent of their contribution in percentage terms must be stated:

Name	Nature of contribution
Professor Nicole Rinehart	Provided input during the planning and final draft stage of manuscript
Dr Emma Sciberras	Provided input during final draft stage of manuscript

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work*.

Candidate's Signature	[redacted]	**Date** 28/10/15
Main Supervisor's Signature	[redacted]	**Date** 28/10/15

APPENDIX A: INVITED EDITORIAL PAPER

Title: Two years post DSM-5: the emerging picture of Attention Deficit Hyperactivity Disorder and Autism.

Authors: Jessica Leigh Green[1, 2], Dr Emma Sciberras[2,3] and Professor Nicole Rinehart[2,3]

Affiliations: [1] School of Psychological Sciences, Monash University, VIC Australia

[2] Murdoch Childrens Research Institute, Parkville, VIC Australia

[3]School of Psychology, Deakin University, Burwood, VIC Australia

Journal: Belonging Early Years Journal, Australian Childcare Alliance

Introduction. More often than not, Autism Spectrum Disorder (ASD) and Attention Deficit Hyperactivity Disorder (ADHD) co-occur (Melhior, Pryor, & Van der Waerden, 2015). There is good evidence that ASD and ADHD can be separate disorders however, co-occurrence of disorders is typically the rule, rather than the exception (Gillberg, 2010). Despite this, it has only been possible to diagnose both conditions together in the last few years (Leitner, 2014). This paper is intended to be a two-year update of research examining the comorbidity between ASD and ADHD. These two neurodevelopmental conditions are common and we know children with these conditions present with additional challenges in the social, emotional and physical domains (Gillberg & Fernell, 2014). This can lead us to focus on the things that are trickier for children with ADHD and ASD, rather focusing on the things they can do - their strengths and interests. What we want to know is does having ADHD *and* ASD make things doubly worse for these kids? (Reiersen, 2011). Rosenbaum and Gorter's (2011) model, based on the International Classification of Functioning (ICF) Health and Disabilities framework, has

been particularly helpful in focusing the research community on health and strengths, not just disability and impairments (Rosenbaum & Gorter, 2011). For this reason, I will frame the research update around these core areas, Fitness and Function, Friendships, Family and Fun, and finally, the Future.

ADHD and ASD. The core impairments for children with ADHD are inattention and/or hyperactivity/impulsivity, with social and communication difficulties core for children with ASD (Gargaro, Rinehart, Bradshaw, Tonge, & Sheppard, 2011). We know that around 18% of children with ADHD also have ASD symptoms in the clinical range (Kotte et al., 2013). In Australia and around the world, a diagnosis of ASD often leads to more intervention and schooling support (Randall et al., 2015). This has led to a phenomenon whereby ASD plus comorbidities that warrant treatment (e.g. ADHD, anxiety) is diagnosed as ASD-only (Randall et al., 2015). Gillberg points out that this ASD-only approach puts children at risk of not receiving adequate support for comorbid conditions that can often be just as, if not more impairing than ASD (Gillberg & Fernell, 2014). We know that children with ASD+ADHD have a more severe emotional and behavioural disturbance than children with ADHD or ASD only (Gargaro et al., 2014).

Fitness and Function. Physical activity, play and participation are core business for children, including those with ASD and ADHD. Some very interesting work is being done at the Deakin Child Study Centre, considering the relationship between children's gross motor skills and their participation in physical activity and play. There is evidence that children with ASD and ADHD have a different gait (way of walking) than children without these conditions (Nayate et al., 2012; Papadopoulos, McGinley, Bradshaw, & Rinehart, 2014). We know that children with ASD often have difficulties joining in with their peers, likely due to the social and communication difficulties at the core of ASD. However, recently the research community has wondered if the differences in gait, and motor difficulties we see in children with ASD,

may lead children to be less involved in physical activity and play, giving them less opportunities to practice these skills, leading to less confidence and participation. Could a modifiable factor be helping children with their motor skills? This may be a tangible way to help children with ASD to be more physically active and involved in play with their peers. Rosenbaum and Gorter (2011) make the important point that we need to encourage children with neurodevelopmental disorders to engage in play and sport in their own way, which is unlikely to be the same as their peers. Recent research has shown emotional and behavioural difficulties in children with ADHD and ASD are partly related to poorer physical quality of life (Thomas, Sciberras, Lycett, Papadopoulos, & Rinehart, 2015), further highlighting the importance of research in this area. Deakin University, the Australian Football League (AFL) and Irabina Autism Services have recently partnered to develop an evidence-based tool, the AFL AusKick ToolKit, to identify current barriers to including children with ASD and other developmental disorders in Auskick football.

Friendships, Family and Fun. We don't yet understand what helps children with these neurodevelopmental disorders build friendships, but this is an important question to answer. We know that having a secure attachment to your parents and friendships with similar aged peers is an important part of development (Sivaratnam, Newman, Tonge, & Rinehart, 2015). Parents are a crucial part of the team when supporting children with ADHD and ASD. I often say to parents "You are the expert on your child. Together we can set goals to try to make things better". Our preliminary works suggests that clinically significant ASD symptoms in children with ADHD were associated with poorer family quality of life, more couple conflict and parents not feeling well supported by their partner. To support children with ADHD and ASD, we need to support their parents and family. Recent research has shown that a brief, tailored behavioural sleep program called Sleeping Sound significantly improves sleep and broader social, emotional and behavioural wellbeing for children with ADHD and ASD

(Papadopoulos et al., 2015). Perhaps improving sleep, like improving motor skills, is a modifiable factor for children with ADHD and ASD and can be one way of making life easier for children and their parents. Lastly, but most importantly, we need to ask kids what they like to do! Personalising our interventions around a child's interests and strengths is key to engaging them and improving long term outcomes. As I often say "if you've met one child with ASD, you've met one child with ASD!". We need an individualised, formulation based approach to our treatment of children with neurodevelopmental disorders. A 'one size fits all' approach, based on diagnosis alone, is not enough.

Conclusion. ASD and ADHD often co-occur, with comorbidity typically the rule, rather than the exception. We know that a child's physical functioning is linked to their psychosocial quality of life, and that children with ASD have a different gait to children without ASD. What we need to find out is whether children with ASD have motor difficulties that may impact on their ability to participate in play (e.g. sport), a primary 'function' of being a child. Improving motor skills may be one modifiable factor in improving fitness, function and participation for children with neurodevelopmental disorders. Having comorbid ASD symptoms in children with ADHD is associated with peer problems, emotional difficulties and poorer quality of life for children, and poorer family quality of life and couple relationship difficulties for their parents. There is evidence that we can improve sleep and broader outcomes for children with ADHD and ASD using a brief behavioural sleep program. More research is needed to examine other ways that we can improve outcomes for children and their families, particularly in the areas of forming friendships and supporting parents. Rosenbaum's model, based on the ICF model, provides a helpful way for us to think, allowing us to devise an individual plan for each child, in conjunction with their parents, which goes beyond their diagnosis and holds their future in mind.

REFERENCES

Gargaro, B., May, T., Tonge, B. J., Sheppard, D. M., Bradshaw, J. L., & Rinehart, N. J. (2014). Using the DBC-P Hyperactivity Index to screen for ADHD in young people with autism and ADHD: A pilot study. *Research in Autism Spectrum Disorders, 8*, 1008-1015.

Gargaro, B. A., Rinehart, N. J., Bradshaw, J. L., Tonge, B. J., & Sheppard, D. M. (2011). Autism and ADHD: how far have we come in the comorbidity debate? *Neuroscience & Biobehavioral Reviews, 35*(5), 1081-1088.

Gillberg, C. (2010). The ESSENCE in child psychiatry: Early Symptomatic Syndromes Eliciting Neurodevelopmental Clinical Examinations. *Research in Developmental Disabilities, 31*(6), 1543-1551. doi: http://dx.doi.org/10.1016/j.ridd.2010.06.002

Gillberg, C., & Fernell, E. (2014). Autism Plus Versus Autism Pure. *Journal of Autism and Developmental Disorders, 44*(12), 3274-3276. doi: 10.1007/s10803-014-2163-1

Kotte, A., Joshi, G., Fried, R., Uchida, M., Spencer, A., Woodworth, K. Y., . . . Biederman, J. (2013). Autistic Traits in Children With and Without ADHD. *Pediatrics*. doi: 10.1542/peds.2012-3947

Leitner, Y. (2014). The co-occurrence of autism and attention deficit hyperactivity disorder in children – what do we know? *Frontiers in Human Neuroscience, 8*, 1-8.

Melhior, M., Pryor, L., & Van der Waerden, J. (2015). Commonalities and specificities between attention deficit/ hyperactivity disorder and autism-spectrum disorders: can epidemiology contribute? *European Child and Adolescent Psychiatry, 24*, 855-858.

Nayate, A., Tonge, B. J., Bradshaw, J. L., McGinley, J. L., Iansek, R., & Rinehart, N. J. (2012). Differentiation of high-functioning autism and Asperger's disorder based on neuromotor behaviour. *Journal of Autism and Developmental Disorders, 42*(5), 707-717. doi: 10.1007/s10803-011-1299-5

Papadopoulos, N., McGinley, J. L., Bradshaw, J. L., & Rinehart, N. J. (2014). An investigation of gait in children with Attention Deficit Hyperactivity Disorder: a case controlled study. *Psychiatry Res, 218*(3), 319-323. doi: 10.1016/j.psychres.2014.04.037

Papadopoulos, N., Sciberras, E., Hiscock, H., Mulraney, M., McGillivray, J., & Rinehart, N. (2015). The Efficacy of a Brief Behavioral Sleep Intervention in School-Aged Children With ADHD and Comorbid Autism Spectrum Disorder. *Journal of Attention Disorders*. doi: 10.1177/1087054714568565

Randall, M., Sciberras, E., Brignell, A., Ihsen, E., Efron, D., Dissanayake, C., & Williams, K. (2015). Autism spectrum disorder: Presentation and prevalence in a nationally representative Australian sample. *Australian and New Zealand Journal of Psychiatry*. doi: 10.1177/0004867415595287

Reiersen, A. M. (2011). Links between autism spectrum disorder and ADHD symptom trajectories: Important findings and unanswered questions. *Journal of the American Academy of Child & Adolescent Psychiatry, 50*(9), 857-859. doi: http://dx.doi.org/10.1016/j.jaac.2011.06.012

Rosenbaum, P., & Gorter, J. W. (2011). The 'F-words' in childhood disability: I swear this is how we should think! . *Child: care, health and development, 38*(4), 457-463.

Sivaratnam, C., Newman, L., Tonge, B., & Rinehart, N. (2015). Attachment and emotion-processing in children with autism spectrum disorders: neurobiological, neuroendocrine, and neurocognitive considerations. *Review Journal of Autism and Developmental Disorders, 2*(2), 222-242.

Thomas, S., Sciberras, E., Lycett, K., Papadopoulos, N., & Rinehart, N. (2015). Physical Functioning, Emotional, and Behavioral Problems in Children With ADHD and Comorbid ASD: A Cross-Sectional Study. *Journal of Attention Disorders*. doi: 10.1177/1087054715587096

Declaration for Paper in Appendix: Book Chapter

Monash University

Declaration by candidate

In the case of the book chapter included in the appendix, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Writing of the case vignette and treatment sections and editing of overall document	40%

The following co-authors contributed to the work. If co-authors are students at Monash University, the extent of their contribution in percentage terms must be stated:

Name	Nature of contribution
Professor Nicole Rinehart	Provided input during the final draft stage of manuscript
Professor John Bradshaw	Provided input during the final draft stage of manuscript
Associate Professor Peter Enticott	Writing of chapter sections and input during the final draft stage of manuscript
Dr Emma Sciberras	Writing of chapter sections and input during the final draft stage of manuscript

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work*.

Candidate's Signature	[redacted]	**Date** 28/10/15
Main Supervisor's Signature	[redacted]	**Date** 28/10/15

APPENDIX B: BOOK CHAPTER

Chapter 16: Conduct Disorder and Oppositional Defiant Disorder

Jessica Green[1], Emma Sciberras[1], & Peter G. Enticott[2]

[1]Murdoch Childrens Research Institute, Melbourne, Australia.

[2]School of Psychology, Deakin University, Melbourne, Australia.

Antisocial behavior, including aggression and frequent interpersonal conflict, has long been observed as a common feature of frontostriatal impairment. Following Phineas Gage's famous accident, which involved extensive damage to ventral and dorsal aspects of the frontal lobe, friends and colleagues noted his tendency toward aggressive, offensive, and generally antisocial behavior (although this account is potentially somewhat apocryphal; McMillan, 2000; Horn et al., 2012). Unlike many of the disorders presented in this volume, those with Oppositional Defiant Disorder (ODD) or Conduct Disorder (CD), particularly childhood onset CD, can have involvement with the criminal justice system from an early age. While perhaps not as widely studied as other neurodevelopmental disorders, there is evidence for a range of neuropsychological and neurobiological impairments in ODD/CD that are closely related to frontostriatal circuitry.

Case study

Max, an eight-year-old boy, was referred for a clinical psychology assessment by his pediatrician. Max's parents reported frequent occasions where Max would lose his temper with his parents and sisters, often without a clear trigger and that he often blamed others for his mistakes. They also noted that Max rarely did what he was asked to the point in which it was

having a great impact on Max and the family's functioning. Max's two older sisters described how Max would deliberately annoy them while they were doing their homework almost every day and that he been observed to ruin family property on multiple occasions.

Max's classroom teacher reported a similar history of oppositional behaviour and property destruction at school over the past year, with these behaviours contributing to academic and social difficulties. She said that Max persistently annoyed his peers, leading him to become increasingly isolated from them. He had also initiated four physical fights with peers over the past year. A cognitive assessment showed that Max's intellectual abilities were in the High Average Range, with superior abilities in perceptual reasoning.

Following assessment, Max was diagnosed with moderate ODD according to DSM-5 criteria. The psychologist noted that Max also exhibited early signs of CD (e.g., deliberate destruction of property and initiating physical fights), but this was not sufficient for a diagnosis. Parent training with a Clinical Psychologist was recommended for his parents and ongoing pediatrician review.

When Max was in Year 7, he was re-referred to the psychology service. The referring pediatrician noted that Max had deteriorating academic and social functioning. He had initiated a number of physical fights with peers at high school leading to significant injuries, made daily verbal threats to his teachers and parents, and had stayed out past midnight on four occasions, despite a 9pm curfew set by his parents. Max's daily verbal threats led his classroom teacher to become visually upset, eventually needing to take sick leave from her work at the school. Max was reported to be cold and uncaring in response to his teacher's distress. They were also concerned by the number of suspensions he had received, with the most recent suspension given when Max graffitied the school hall. The pediatrician also noted that Max's school was concerned about his unexplained absences from school, which had occurred consistently throughout the year, with a week long absence in fourth term. Max was reported to consistently

show a similar lack of remorse and empathy towards his peer and his mother. Max was diagnosed with moderate DSM-5 CD, Childhood-Onset type, with limited prosocial emotions, specifically a lack of empathy and a lack of remorse.

Clinical Description, Etiology and Epidemiology

ODD and CD are described in the 'Disruptive, Impulse-Control, and Conduct Disorders' section of the Diagnostic and Statistical Manual of Mental Disorders Version 5 (DSM-5) (American Psychiatric Association, 2013). The hallmark features of these disorders are difficulties in emotional and behavioural self-control, which manifest in behaviours that violate the rights of others (American Psychiatric Association, 2013; Klahr & Burt, 2014). These are disorders that have their origins in childhood or adolescence; it is rare for either of these disorders to appear for the first time in adulthood (Blair, Leibenluft, & Pine, 2014). Most adolescents with CD have previously met criteria for ODD, however, it is important to note that the majority of children with ODD do not go on to meet the full criteria for CD (Blair et al., 2014; Rowe, Costello, Angold, Copeland, & Maughan, 2010).

Clinical presentation and diagnosis

Within DSM-5, ODD is diagnosed on the basis of a pattern of 'angry/irritable mood' (e.g., often loses temper), 'argumentative/defiant behavior' (e.g., often argues with authority figures), or vindictiveness (American Psychiatric Association, 2013). Symptoms need to be present for 6 months and occur during interactions with at least one person that is not a sibling. In order to meet diagnostic criteria, the behaviours must result in distress to the individual or others or need to have a negative impact on daily functioning. ODD behaviours may only manifest in one setting, typically home, however, the pervasiveness of symptoms is usually reflective of the severity of the disorder (American Psychiatric Association, 2013).

CD is a more severe behavioural disorder characterized by repetitive and persistent behaviour that violates the basic rights of others or major age-appropriate societal norms (American Psychiatric Association, 2013). Fifteen CD symptoms are included in the diagnostic criteria, categorised across four domains including aggression to people and animals, destruction of property, deceitfulness or theft, and serious violations of rules. However, only 3 behaviours need to be present over the past 12 months (with at least one in the past 6 months) in order to make a diagnosis, which makes the clinical presentation of CD quite heterogeneous (Klahr & Burt, 2014). For example, physical or overtly aggressive behaviour appears to be distinct from non-aggressive rule-breaking behaviour (Frick et al., 1993). Physical aggression seems to be a more stable interpersonal trait with early physical aggression being predictive of later physical aggression (Blair et al., 2014). While physical aggression generally tends to decline with age, nonaggressive rule breaking behaviour sharply increases from childhood to adolescence (Blair et al., 2014; Maughan, Rowe, Messer, Goodman, & Meltzer, 2004).

In order to diagnose CD, the behaviours must cause clinically significant impairment in functioning and the pattern of behavior needs to be present across multiple settings (American Psychiatric Association, 2013). The DSM-5 criteria includes two important specifiers, which are likely to be important when considering the neuropsychological and neurobiological underpinning of CD, namely age of onset and the presence of callous and unemotional (CU) traits.

Developmental progression and outcomes

Although CD can occur during the early preschool school years, the first signs of the condition typically emerge from middle childhood through to middle adolescence. Based on age of onset, CD can be classified according to two main subtypes, childhood onset subtype, with at least one behaviour present prior to age 10 years, and adolescent onset subtype

(American Psychiatric Association, 2013). Adolescents with the childhood onset type are more likely to have a history of ODD (American Psychiatric Association, 2013). The less serious symptoms of CD tend to emerge first (e.g. lying, shoplifting), with more severe symptoms emerging later in its developmental progression (e.g., rape, theft while confronting victim). Nevertheless there is a great deal of heterogeneity in the presentation and course of CD.

For most, the disorder remits in adulthood, particularly for those presenting with the adolescent type, but those with childhood onset CD carry a poorer prognosis including increased physical aggression, poorer social relationships, elevated comorbid disorders, and increased persistence into adulthood, in comparison to the adolescent onset subtype (Blair et al., 2014; Klahr & Burt, 2014). As a group, youth with CD are at risk for multiple psychiatric disorders in adulthood including anxiety, mood, impulse-control, psychotic and substance-related disorders in adulthood (Morcillo et al., 2012).

More broadly, CD is associated with a number of negative functional outcomes including school suspension/expulsion, risky sexual behavior (e.g., sexually transmitted diseases, unplanned pregnancies), physical injuries from accidents/fights, contact with the criminal justice system, earlier onset of sexual behavior and substance abuse (Elkins, McGue, & Iacono, 2007; American Psychiatric Association, 2013; Burke, Rowe, & Boylan, 2014).

ODD symptoms often emerge during preschool and it is rare for symptoms to first emerge later in adolescence. Although most children with ODD do not go on to have CD, the disorder is not benign (Rowe et al., 2010). Children with ODD are at later risk for anxiety and mood disorder even in the absence of CD (Rowe et al., 2010). The presence of defiant, argumentative and vindictive ODD symptoms convey the most risk for CD, whereas the angry-irritable mood ODD symptoms place children at particular risk of internalising disorders (Leadbeater & Homel, 2015). As a group, children with ODD are also at risk of poorer adult

outcomes including antisocial behavior, impulse-control problems and substance abuse (Morcillo et al. 2012).

ODD and CD are considered to be developmental precursors to diagnoses made in adulthood, such as antisocial personality disorder and psychopathy (Blair et al., 2014). Similar to ODD and CD, these conditions involve a high level of interpersonal conflict and a violation of the rights of others. Unsurprisingly, prevalence rates among incarcerated populations are high (Boduszek, Belsher, Dhingra, & Ioannou, 2013; Teplin, Abram, McClelland, Dulcan, & Mericle, 2002).

Presence of Callous and Unemotional (CU) traits

CU traits, including a lack of empathy and guilt, are present in 10-50% of youth with CD (Kahn, Frick, Youngstrom, Findling, & Youngstrom, 2012). The presence of CU traits, for both males and females with CD, is more likely predictive of a poorer prognosis, characterized by a more severe, aggressive, and persistent pattern of antisocial behaviour compared to youth with CD without CU traits (Blair et al., 2014; Frick & White, 2008; Kahn et al., 2012). CU traits appear to be more elevated in the childhood onset version of the disorder and may have stronger neurocognitive underpinnings (Blair et al., 2014).

The 'limited prosocial emotions' specifier can be used to note the presence of CU traits in youth with CD (American Psychiatric Association, 2013). This specifier was an important addition to the DSM-5 that recognised the differential presentation and prognosis of CD in the presence or absence of CU. This specifier can be applied if two or more of the following characteristics have been present over the past 12 months across multiple relationships and settings (American Psychiatric Association, 2013, p.470):

1) Lack of remorse or guilt e.g., general lack of concern about negative consequences of actions;

2) Callousness or lack of empathy e.g., disregards and unconcerned about feelings of others;

3) Being unconcerned about poor or problematic performance; and

4) Shallow or deficient affect (e.g., does not express feelings or show emotions to others except in ways that may be shallow or superficial.

Prevalence

DSM-5 reports the prevalence of ODD and CD to be 3% (range: 1-11%) and 4% (range: 2-10%), respectively (American Psychiatric Association, 2013). A recent meta-analysis examining the worldwide prevalence of mental health disorders in 41 studies across 27 countries reported the prevalence of disruptive behavior disorders (ODD/CD) to be 5.7% (CI 95% 4.0–8.1) and 3.6% (CI 95% 2.8–4.7) for ODD and 2.1% for CD (95% CI 1.6–2.9) (Polanczyk, Salum, Sugaya, & et al., 2015). The prevalence of ODD and CD is higher in males; accordingly, the majority of previous research has centred on males with these disorders, leaving females with CD a particularly under-researched group. There are more notable gender differences for physically aggressive behaviours than for non-aggressive rule breaking behaviour (Blair et al., 2014).

Comorbidity

ODD and CD rarely occur in isolation; the most common comorbidity is attention deficit/hyperactivity disorder (ADHD) (Efron et al., 2014; Martel, Nikolas, Jernigan, Friderici, & Nigg, 2012). Approximately one-third of children with severe ADHD go on to have CD (Beauchaine, Hinshaw, & Pang, 2010). ADHD symptoms often precede the development of

ODD symptoms, which in turn increases the risk for CD symptoms (Beauchaine et al., 2010). ADHD appears to be more strongly correlated with childhood onset CD and is more generally associated with greater impairment compared to CD alone (Pardini & Fite, 2010; Waschbusch, 2002). Mood disorders, anxiety disorders, non-suicidal self-injury, substance use and learning disorders are also commonly associated with ODD and CD (Preyde et al, 2012; American Psychiatric Association, 2013; Blair et al., 2014).

Aetiology

A number of risk factors have been implicated in the development of ODD including harsh, inconsistent or neglectful parenting behaviours, a child temperament characterized by high emotional reactivity, and poor frustration tolerance (American Psychiatric Association, 2013; Burke, Loeber, & Birmaher, 2002). Similarly, CD has been associated with a number of child factors including difficult infant temperament and cognitive and neuropsychological deficits, which are reviewed in the latter part of this chapter (Cunningham & Boyle, 2002; Stringaris, Maughan, & Goodman, 2010). Indeed, dysfunction within several frontostriatal circuits appears to be associated with both ODD and CD, and this is likely a result of the influence of both genetic and environmental factors on developmental of the central nervous system. A number of family and community level factors have also been linked with CD including parental rejection and neglect, hostile parenting practices, abuse history (physical and/or sexual), large family size, parental criminality, and a family history of psychopathology (e.g., CD, substance use disorders, mood disorders or ADHD) (American Psychiatric Association, 2013; Burke et al., 2002). Community level factors include a history of peer rejection, association with delinquent peer groups, and neighbourhood violence. The presence of multiple individual and family risk factors are particularly predictive of the childhood onset

subtype (Fairchild, van Goozen, Calder, & Goodyer, 2013; Frick & Viding, 2009), as opposed to the adolescent onset subtype.

The aetiology of CD may also differ depending on the presence of CU traits. Whilst aggression and CU traits have moderate-high heritability, CD without CU is more modestly influenced by genetics (Tuvblad & Beaver, 2013). Moreover, although positive and negative parenting practices have been longitudinally associated with CU (Waller, Gardner, & Hyde, 2013), it has been suggested that the association between parenting practices and CD is not as strong when high CU traits are present (Klahr & Burt, 2014). It is likely that the relationship between parenting behaviours and CD and CU is bidirectional, as CU traits in youth are likely to elicit more negative parenting behaviours (Klahr & Burt, 2014).

Evidence-based treatment for Oppositional Defiant Disorder and Conduct Disorder

Treatment for Oppositional Defiant Disorder (ODD)

Evidence based psychosocial interventions, such as Parent Child Interaction Therapy (PCIT), which is a parent training program, are the gold standard treatment for children and adolescents with ODD (Kapalka et al, 2015). Medication is sometimes used to treat comorbid conditions, or to manage aggression, but is not recommended as the sole intervention for ODD (Steiner & Remsing, 2007). The first line psychosocial treatment for children with ODD is parent training (Eyberg, Nelson, & Boggs, 2008). Established evidence based programs include Parent Child Interaction Therapy (McNeil & Hembree-Kigin, 2010), The Incredible Years (IY), Triple P Positive Parenting Program (Sanders, 1999), Parent Management Training – Oregon model (PMTO; Patterson & Reid, 1975) and Helping the Non-Compliant Child (HNC; McMahon & Forehand, 2003). Treatment for adolescents typically focuses on individual or group treatment for the child, with an adjunct of parent training (Wu et al., 2015). Current

evidence based programs include Problem Solving Skills training (PSST; Kazdin, 2010), a cognitive behavioural individual therapy program, with a focus on cognitive restructuring and problem solving, and Anger Control Training (ACT; Larson & Lochman, 2002), a group school based program targeting defiance towards teachers, with an individual and parent adjunct called Coping Power (Larson & Lochman, 2002). Randomised controlled trials of these programs show superior outcomes to waitlist and control groups, with significant reductions in ODD symptoms following treatment.

Treatment for Conduct Disorder (CD)

Guidelines for treating CD in children and adolescents suggest creating an individual treatment plan based on the type of CD symptoms and the age of symptom onset (Pardini & Frick, 2013). Behavioural parent-management training is recommended across all subtypes of CD, however the specific emphasis within parent training, and the selection of appropriate adjunct treatments, can be informed by the presenting CD subtype (Henggeler & Sheidow, 2012; Klahr & Burt, 2014). Specific evidence based programs for CD include PSST (Kazdin, 2010), Parent Management Training (PMT; (Kazdin, 2005), PCIT (McNeil & Hembree-Kigin, 2010), Multi-systemic therapy (Henggeler & Borduin, 1990), functional family therapy (Alexander, 1994) and brief strategic family therapy (Szapocznik, 2003).

Behavioural parent-management training is effective for those with CD and callous-unemotional traits (CU), with some additional requirements (Klahr & Burt, 2014). Research suggests that treatment needs to focus on intensive highly structured positive reinforcement plans that are implemented across all settings (e.g. home and school; Klahr & Burt, 2014). It is recommended that psychotropic medication be considered for children with CD + CU traits at the commencement of therapy (Wu et al., 2015), together with multi-systemic therapy, given its comprehensive and intensive approach (Wagner, Borduin, Sawyer, & Dopp, 2014).

Any treatment plan needs to also consider intervention for comorbid conditions and difficulties that children with ODD or CD may present with. This commonly includes ADHD, social difficulties, internalising symptoms or academic problems (Pardini & Frick, 2013).

A limitation of treatment studies in this area is that outcome evaluations do not specifically measure changes in frontostriatal deficits. Whilst a number of the treatment programs specifically target frontostriatal deficits, such as poor problem solving and impulsivity, treatment outcome studies rarely examine changes in these skills from a neuropsychological or physiological perspective. Future research would benefit from including this within treatment outcome evaluations.

Neuropsychology of Oppositional Defiant Disorder/Conduct Disorder

As noted above, psychosocial risk factors for ODD/CD have been explored at length (e.g., poor attachment, reduced academic performance, rearing within criminogenic environments, early aggressive behaviour; (Bassarath, 2001), but in this section we examine the likely frontostriatal contribution from a neuropsychological perspective. These studies of ODD/CD can be difficult to interpret, largely because of the aforementioned common comorbidities, and require careful study design to ensure that specific contributions from ODD/CD to neuropsychological impairment can be ascertained. This might involve, for instance, a matched ADHD group who are not comorbid for ODD/CD, or careful use of ADHD symptom measures that are then accounted for during statistical analyses. It is also apparent that despite a number of group-level trends, neuropsychological aspects of CD/ODD are highly heterogeneous (Närhi, Lehto-Salo, Ahonen, & Marttunen, 2010). There is also a lack of longitudinal data on the neuropsychology/neurobiology of these conditions (Blair et al., 2014), which is critical considering the developmental trajectory of ODD/CD.

Verbal ability

Historically, perhaps the most commonly reported neuropsychological impairment in CD is reduced verbal ability (Bassarath, 2001; Hill, 2002; Närhi et al., 2010). Verbal ability has been measured in various ways, including the verbal scales of the Wechsler Intelligence Scale for Children (WISC) and more detailed language/verbal assessment. Importantly, these verbal deficits in CD are evident even after controlling for the influence of ADHD symptomatology/comorbidity (Déry, Toupin, Pauzé, Mercier, & Fortin, 1999), and have been associated with increased physical aggression and theft (Barker et al., 2011).

Executive Function

As noted, CD/ODD are typically comorbid with a range of other conditions for which developmental frontostriatal dysfunction is evident, most notably ADHD. Nevertheless, where CD/ODD have been examined, there is evidence for specific neuropsychological impairments in these conditions (Hill, 2002; Pajer et al., 2008; Teichner & Golden, 2000).

Many of the studies conducted have examined executive abilities relevant to externalising behaviours; for instance, response inhibition and emotional regulation. These are often interpreted in the context of characteristic behaviours, including impulsiveness, aggression, and violence. For instance, children with CD demonstrate impaired delay of gratification (Dolan & Lennox, 2013), response disinhibition (Dougherty, Bjork, Marsh, & Moeller, 2000; Nigg, 2003), faster responding (Dougherty et al., 2000), and poor cognitive control for emotive stimuli (Euler, Sterzer, & Stadler, 2014). Increased response perseveration has also been reported in "pure" CD, but this was less impaired than among those with CD/ADHD (Matthys, Van Goozen, De Vries, Cohen-Kettenis, & Van Engeland, 1998), while Toupin et al. (Toupin, Déry, Pauzé, Mercier, & Fortin, 2000) found a range of executive

impairments (e.g., perseveration, poor planning, impaired conflict resolution) in CD after controlling for ADHD symptoms. When accounting for comorbid intellectual disability, Van Der Meer et al. (Van Der Meer & Van Der Meere, 2004) still found evidence for go/no go response disinhibition in CD.

Nevertheless, there is evidence to suggest that many executive deficits that might be seen in CD/ODD are attributable to comorbid ADHD (Clark, Prior, & Kinsella, 2000; Déry et al., 1999; Dolan & Lennox, 2013), and thus not attributable to CD/ODD *per se*, while Narhi et al. (Närhi et al., 2010) suggest that CD is not associated with either visuospatial or memory impairments. Some authors have also warned against the use of many of these measures in clinical settings (P. J. Frick & Loney, 2000).

Social Cognition: Facial emotion recognition, theory of mind, and empathy

As children with CD consistently violate the rights of others, they can appear to have reduced empathy and a bias toward misinterpreting others' emotions (e.g., attribution of hostility). Accordingly, most recent studies examining neuropsychological function in these groups have focused primarily on social cognitive abilities. Perhaps unsurprisingly, children with CD have been found to have reduced empathy and automatic facial mimicry, yet this is not identical to the social cognitive impairments seen in autism spectrum disorder (ASD; Bons et al., 2013). Children with CD also show deficits in facial affect recognition (Fairchild, Stobbe, Van Goozen, Calder, & Goodyer, 2010; Fairchild, Van Goozen, Calder, Stollery, & Goodyer, 2009), particularly for negative emotions (Bowen, Morgan, Moore, & Van Goozen, 2014), which may lead to attribution errors in interpersonal settings. Results, however, are not consistent across all studies (Schepman, Taylor, Collishaw, & Fombonne, 2012), and an examination of girls with CD revealed no impairments in facial affect recognition (Pajer, Leininger, & Gardner, 2010), suggesting possible differential gender effects on CD. Children

with CD have shown impairment on "theory of mind" tasks assessing false beliefs (i.e., recognition that another individual can hold a belief that you know is factually incorrect), which is typically linked to dorsomedial prefrontal and temporoparietal regions, and considered characteristic of ASD (Happe & Frith, 1996).

Developmental Neurobiology: Frontostriatal Impairments

Relative to other neurodevelopmental disorders addressed in this volume, there have been relatively few neuroimaging and neurophysiological investigations of CD/ODD. Early studies employing electroencephalography (EEG) revealed a reduced P300 amplitude in children with CD (Bauer & Hesselbrock, 1999, 2003), which was broadly interpreted as reflecting delayed maturation of prefrontal regions critical for executive abilities. There is also evidence to suggest altered autonomic arousal in CD/ODD (Beauchaine, Katkin, Strassberg, & Snarr, 2001; Fairchild et al., 2010; Herpertz et al., 2005), which has been related to deficits in motivation and social cognitive responsiveness.

Structural neuroimaging (magnetic resonance imaging [MRI]) studies have revealed several anatomical differences in CD. Compared to healthy controls, boys with CD (some of which have comorbid ADHD) have shown reduced grey matter volume in orbitofrontal cortex, amygdala, and hippocampus (Huebner et al., 2008), while boys with CD/ODD also show evidence of a larger cavum septum pellucidum (indicative of abnormal brain development) (White et al., 2013) and reduced grey matter volume in temporal cortex (Michalska, Decety, Zeffiro, & Lahey, 2014) (although the latter study failed to replicate earlier studies demonstrating more widespread grey matter reductions in CD). Examining "pure" CD and ADHD groups, Stevens and Haney-Caron (Stevens & Haney-Caron, 2012) found extensive reductions in grey matter volume in children with CD, including frontostriatal regions.

Diffusion tensor imaging (DTI), which maps and assessed the integrity of white matter pathways in the brain, has revealed white matter abnormalities, with adolescents with CD showing increased fractional anisotropy (FA) in the uncinate fascicle, which links amygdala with orbitofrontal regions, even after accounting for comorbid ADHD (Passamonti et al., 2012). Such abnormalities in limbic-prefrontal circuitry may relate to difficulties in regulating behavior in the context of strong emotionality, which is consistent with some of the neuropsychological data (Euler et al., 2014). By contrast, however, McAlonan et al. (2007) found that, among a small sample of children with ADHD, comorbid CD/ODD did not have a significant effect on grey and white matter volume, while Hummer et al. (Hummer, Wang, Kronenberger, Dunn, & Mathews, 2015) found that children with CD/ODD did not show grey matter volume or FA differences after accounting for ADHD.

Functional neuroimaging studies of CD/ODD have also demonstrated specific evidence for neurobiological impairment. Children with CD/ODD display reduced amygdala activation when viewing fearful faces, and reduced functional connectivity between ventromedial cortex and amygdala (perhaps consistent with structural abnormalities in uncinate fascicle; (Passamonti et al., 2012; Marsh et al., 2008). In a series of studies involving "pure" groups of children with CD and ADHD, boys with CD demonstrated less activation in posterior cingulate and inferior parietal/superior temporal cortical regions during failed response inhibition (Rubia et al., 2008), reduced activity in frontal cortex, insula, hippocampus, and cerebellum during a sustained attention task (Rubia et al., 2009), and reduced activity in temporal, parietal, and occipital cortices during a cognitive flexibility task (Rubia et al., 2010). More recently, adolescent females with CD have shown reduced activity with orbitofrontal cortex and insula during facial emotion processing, yet these did not remain when controlling for ADHD symptoms (Fairchild et al., 2014). Although not examining CD/ODD per se, Cohn et al. (2015) found associations between abnormal resting-state connections and psychopathic traits among

adolescents who had had contact with the juvenile criminal justice system, including a link between enhanced connectivity in a frontal pole region and increased callous-unemotional traits (Cohn et al., 2015).

Summary

Children with CD/ODD show deficits in a range of abilities that are typically mediated by frontostriatal networks, including verbal ability, inhibitory control, facial emotion recognition, theory of mind, and verbal intelligence. Many of these impairments are evident even after accounting for comorbidities including ADHD and intellectual disability, although there remains much controversy as to the specific contribution of neuropsychological impairments to the cognitive profile of CD/ODD. Data from neurophysiological and neuroimaging studies provides evidence for impairments in a range of networks the brain, including prefrontal and limbic structures.

Despite these studies, our neuropsychological and neurobiological understanding of CD/ODD remains quite limited. The research to date is characterized by small and confounded samples, a limited number of experimental paradigms, and somewhat inconsistent findings. Even where "pure" samples of CD/ODD are employed, this is generally a less representative sample and it is unclear whether the findings will generalize to those with, for example CD and ADHD, or CD and mood/anxiety disorder. The sheer variety of measures employed, even within a specific domain (e.g., response inhibition), also makes it difficult to summarise these studies. In addition, while there are several neuropsychological and neurobiological studies of CD, there are very few such studies of ODD.

Further reading

Kapalka, G. M. (Ed.). (2015). *Treating Disruptive Disorders: A Guide to Psychological, Pharmacological, and Combined Therapies*. New York: Routledge.

Klahr, A. M., & Burt, S. A. (2014). Practitioner Review: Evaluation of the known behavioral heterogeneity in conduct disorder to improve its assessment and treatment. *Journal of Child Psychology and Psychiatry, 55*(12), 1300-1310. doi: 10.1111/jcpp.12268

Pardini, D. A., & Fite, P. J. (2010). Symptoms of Conduct Disorder, Oppositional Defiant Disorder, Attention-Deficit/Hyperactivity Disorder, and Callous-Unemotional Traits as Unique Predictors of Psychosocial Maladjustment in Boys: Advancing an Evidence Base for DSM-V. *Journal of the American Academy of Child and Adolescent Psychiatry, 49*(11), 1134-1144. doi: 10.1016/j.jaac.2010.07.010

Steiner, H., & Remsing, L. (2007). Practice Parameter for the Assessment and Treatment of Children and Adolescents With Oppositional Defiant Disorder. *Journal of the American Academy of Child & Adolescent Psychiatry, 46*(1), 126-141. doi: 10.1097/01.chi.0000246060.62706.af

Waller, R., Gardner, F., & Hyde, L. W. (2013). What are the associations between parenting, callous–unemotional traits, and antisocial behavior in youth? A systematic review of evidence. *Clinical Psychology Review, 33*(4), 593-608. doi: http://dx.doi.org/10.1016/j.cpr.2013.03.001

References

Alexander, J. F. (1994). The process and outcome of marital and family therapy research: Review and evaluation. In A. E. Bergin & S. L. Garfield (Eds.), *Handbook of behavior therapy and behavior change* (4th edition ed., pp. 595–630). New York: Wiley.

American Psychiatric Association. (2013). *The Diagnostic and Statistical Manual of Mental Disorders (5th Ed.)*. Arlington, VA: American Psychiatric Publishing.

Barker, E. D., Tremblay, R. E., Van Lier, P. A., Vitaro, F., Nagin, D. S., Assaad, J. M., & Séguin, J. R. (2011). The neurocognition of conduct disorder behaviors: Specificity to physical aggression and theft after controlling for ADHD symptoms. *Aggressive Behavior, 37*(1), 63-72. doi: 10.1002/ab.20373

Bassarath, L. (2001). Conduct disorder: A biopsychosocial review. *Canadian Journal of Psychiatry, 46*(7), 609-616.

Bauer, L. O., & Hesselbrock, V. M. (1999). Subtypes of family history and conduct disorder: Effects on P300 during the Stroop Test. *Neuropsychopharmacology, 21*(1), 51-62. doi: 10.1016/S0893-133X(98)00139-0

Bauer, L. O., & Hesselbrock, V. M. (2003). Brain maturation and subtypes of conduct disorder: Interactive effects on P300 amplitude and topography in male adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry, 42*(1), 106-115. doi: 10.1097/00004583-200301000-00017

Beauchaine, Hinshaw, & Pang. (2010). Comorbidity of Attention-Deficit/Hyperactivity Disorder and Early-Onset Conduct Disorder: Biological, Environmental, and Developmental Mechanisms. *Clinical Psychology: Science and Practice, 17*(4), 327-336. doi: 10.1111/j.1468-2850.2010.01224.x

Beauchaine, T. P., Katkin, E. S., Strassberg, Z., & Snarr, J. (2001). Disinhibitory psychopathology in male adolescents: Discriminating conduct disorder from attention-deficit/hyperactivity disorder through concurrent assessment of multiple autonomic states. *Journal of Abnormal Psychology, 110*(4), 610-624. doi: 10.1037/0021-843X.110.4.610

Blair, R. J. R., Leibenluft, E., & Pine, D. S. (2014). Conduct Disorder and Callous-Unemotional Traits in Youth. *New England Journal of Medicine, 371*(23), 2207-2216. doi: 10.1056/NEJMra1315612

Boduszek, D., Belsher, R., Dhingra, K., & Ioannou, M. (2013). Psychosocial correlates of recidivism in a sample of ex-prisoners: the role of oppositional defiant disorder and

conduct disorder. *The Journal of Forensic Psychiatry & Psychology, 25*(1), 61-76. doi: 10.1080/14789949.2013.862293

Bons, D., Van Den Broek, E., Scheepers, F., Herpers, P., Rommelse, N., & Buitelaaar, J. K. (2013). Motor, emotional, and cognitive empathy in children and adolescents with autism spectrum disorder and conduct disorder. *Journal of Abnormal Child Psychology, 41*(3), 425-443. doi: 10.1007/s10802-012-9689-5

Bowen, K. L., Morgan, J. E., Moore, S. C., & Van Goozen, S. H. M. (2014). Young offenders' emotion recognition dysfunction across emotion intensities: Explaining variation using psychopathic traits, conduct disorder and offense severity. *Journal of Psychopathology and Behavioral Assessment, 36*(1), 60-73. doi: 10.1007/s10862-013-9368-z

Burke, J. D., Loeber, R., & Birmaher, B. (2002). Oppositional Defiant Disorder and Conduct Disorder: A Review of the Past 10 Years, Part II. *Journal of the American Academy of Child & Adolescent Psychiatry, 41*(11), 1275-1293. doi: 10.1097/00004583-200211000-00009

Burke, J. D., Rowe, R., & Boylan, K. (2014). Functional outcomes of child and adolescent oppositional defiant disorder symptoms in young adult men. *J Child Psychol Psychiatry, 55*(3), 264-272. doi: 10.1111/jcpp.12150

Clark, C., Prior, M., & Kinsella, G. J. (2000). Do executive function deficits differentiate between adolescents with ADHD and Oppositional Defiant/Conduct Disorder? A neuropsychological study using the Six Elements Test and Hayling Sentence Completion Test. *Journal of Abnormal Child Psychology, 28*(5), 403-414. doi: 10.1023/A:1005176320912

Cohn, M. D., Pape, L. E., Schmaal, L., van den Brink, W., van Wingen, G., Vermeiren, R. R. J. M., . . . Popma, A. (2015). Differential relations between juvenile psychopathic traits and resting state network connectivity. *Human Brain Mapping, 36*(6), 2396-2405. doi: 10.1002/hbm.22779

Cunningham, C., & Boyle, M. (2002). Preschoolers at Risk for Attention-Deficit Hyperactivity Disorder and Oppositional Defiant Disorder: Family, Parenting, and Behavioral Correlates. *J Abnorm Child Psychol, 30*(6), 555-569. doi: 10.1023/A:1020855429085

Déry, M., Toupin, J., Pauzé, R., Mercier, H., & Fortin, L. (1999). Neuropsychological characteristics of adolescents with conduct disorder: Association with attention-deficit-hyperactivity and aggression. *Journal of Abnormal Child Psychology, 27*(3), 225-236. doi: 10.1023/A:1021904523912

Dolan, M., & Lennox, C. (2013). Cool and hot executive function in conduct-disordered adolescents with and without co-morbid attention deficit hyperactivity disorder:Relationships with externalising behaviours. *Psychological Medicine, 43*(11), 2427-2436. doi: 10.1017/S0033291712003078

Dougherty, D. M., Bjork, J. M., Marsh, D. M., & Moeller, G. F. (2000). A comparison between adults with conduct disorder and normal controls on a continuous performance test: Differences in impulsive response characteristics. *Psychological Record, 50*(2), 203-219.

Efron, D., Sciberras, E., Anderson, V., Hazell, P., Ukoumunne, O. C., Jongeling, B., . . . Nicholson, J. M. (2014). Functional Status in Children With ADHD at Age 6–8: A Controlled Community Study. *Pediatrics*. doi: 10.1542/peds.2014-1027

Elkins, I. J., McGue, M., & Iacono, W. G. (2007). Prospective effects of attention-deficit/hyperactivity disorder, conduct disorder, and sex on adolescent substance use and abuse. *Arch Gen Psychiatry, 64*(10), 1145-1152. doi: 10.1001/archpsyc.64.10.1145

Euler, F., Sterzer, P., & Stadler, C. (2014). Cognitive control under distressing emotional stimulation in adolescents with conduct disorder. *Aggressive Behavior, 40*(2), 109-119. doi: 10.1002/ab.21508

Eyberg, S. M., Nelson, M. M., & Boggs, S. R. (2008). Evidence-Based Psychosocial Treatments for Children and Adolescents With Disruptive Behavior. *Journal of Clinical Child & Adolescent Psychology, 37*(1), 215-237. doi: 10.1080/15374410701820117

Fairchild, G., Hagan, C. C., Passamonti, L., Walsh, N. D., Goodyer, I. M., & Calder, A. J. (2014). Atypical neural responses during face processing in female adolescents with conduct disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 53*(6), 677-687.E675. doi: 10.1016/j.jaac.2014.02.009

Fairchild, G., Stobbe, Y., Van Goozen, S. H. M., Calder, A. J., & Goodyer, I. M. (2010). Facial expression recognition, fear conditioning, and startle modulation in female subjects with conduct disorder. *Biological Psychiatry, 68*(3), 272-279. doi: 10.1016/j.biopsych.2010.02.019

Fairchild, G., van Goozen, S. H., Calder, A. J., & Goodyer, I. M. (2013). Research review: evaluating and reformulating the developmental taxonomic theory of antisocial behaviour. *J Child Psychol Psychiatry, 54*(9), 924-940. doi: 10.1111/jcpp.12102

Fairchild, G., Van Goozen, S. H. M., Calder, A. J., Stollery, S. J., & Goodyer, I. M. (2009). Deficits in facial expression recognition in male adolescents with early-onset or

adolescence-onset conduct disorder. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 50*(5), 627-636. doi: 10.1111/j.1469-7610.2008.02020.x

Frick, P. J., Lahey, B. B., Loeber, R., Tannenbaum, L., Vanhorn, Y., Christ, M. A. G., . . . Hanson, K. (1993). Oppostional Defiant Disorder and Conduct Disorder - A meta-analytic review of factor-analuses and cross-validation in a clinic sample. *Clinical Psychology Review, 13*(4), 319-340. doi: 10.1016/0272-7358(93)90016-f

Frick, P. J., & Loney, B. R. (2000). The Use of Laboratory and Performance-Based Measures in the Assessment of Children and Adolescents with Conduct Disorders. *Journal of Clinical Child and Adolescent Psychology, 29*(4), 540-554.

Frick, P. J., & Viding, E. (2009). Antisocial behavior from a developmental psychopathology perspective. *Development and Psychopathology, 21*(Special Issue 04), 1111-1131. doi: doi:10.1017/S0954579409990071

Frick, P. J., & White, S. F. (2008). Research Review: The importance of callous-unemotional traits for developmental models of aggressive and antisocial behavior. *Journal of Child Psychology and Psychiatry, 49*(4), 359-375. doi: 10.1111/j.1469-7610.2007.01862.x

Henggeler, S. W., & Borduin, C. M. (1990). *Family therapy and beyond: A multisystemic approach to teaching the behavior problems of children and adolescents*. Pacific Grove, CA: Brooks/Cole.

Henggeler, S. W., & Sheidow, A. J. (2012). Empirically Supported Family-Based Treatments for Conduct Disorder and Delinquency in Adolescents. *Journal of Marital and Family Therapy, 38*(1), 30-58. doi: 10.1111/j.1752-0606.2011.00244.x

Herpertz, S. C., Mueller, B., Qunaibi, M., Lichterfeld, C., Konrad, K., & Herpertz-Dahlmann, B. (2005). Response to emotional stimuli in boys with conduct disorder. *American Journal of Psychiatry, 162*(6), 1100-1107. doi: 10.1176/appi.ajp.162.6.1100

Hill, J. (2002). Biological, psychological and social processes in the conduct disorders. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 43*(1), 133-164. doi: 10.1111/1469-7610.00007

Horn, J. D., Irimia, A., Torgerson, C. M., Chambers, M. C., Kikinis, R., & Toga, A. W. (2012). Mapping Connectivity Damage in the Case of Phineas Gage. *PLoS One, 7*(5). doi: 10.1371/journal.pone.0037454

Huebner, T., Vloet, T. D., Marx, I., Konrad, K., Fink, G. R., Herpertz, S. C., & Herpertz-Dahlmann, B. (2008). Morphometric brain abnormalities in boys with conduct disorder. *Journal of the American Academy of Child and Adolescent Psychiatry, 47*(5), 540-547. doi: 10.1097/CHI.0b013e3181676545

Hummer, T. A., Wang, Y., Kronenberger, W. G., Dunn, D. W., & Mathews, V. P. (2015). The relationship of brain structure to age and executive functioning in adolescent disruptive behavior disorder. *Psychiatry Research - Neuroimaging, 231*(3), 210-217. doi: 10.1016/j.pscychresns.2014.11.009

Kahn, R. E., Frick, P. J., Youngstrom, E., Findling, R. L., & Youngstrom, J. K. (2012). The effects of including a callous-unemotional specifier for the diagnosis of conduct disorder. *Journal of Child Psychology and Psychiatry, 53*(3), 271-282. doi: 10.1111/j.1469-7610.2011.02463.x

Kapalka, G. M. (Ed.). (2015). *Treating Disruptive Disorders: A Guide to Psychological, Pharmacological, and Combined Therapies*. New York: Routledge.

Kazdin, A. E. (2005). *Parent management training: Treatment for oppositional, aggressive and antisocial behavior in children and adolescents*. New York: Oxford University Press.

Kazdin, A. E. (2010). Problem-solving skills training and parent management training for oppositional defiant disorder and conduct disorder. In A. E. Kazdin & J. R. Weisz (Eds.), *Evidence-based psychotherapies for children and adolescents* (2nd edition ed., pp. 211–226). New York: Guilford Press.

Klahr, A. M., & Burt, S. A. (2014). Practitioner Review: Evaluation of the known behavioral heterogeneity in conduct disorder to improve its assessment and treatment. *Journal of Child Psychology and Psychiatry, 55*(12), 1300-1310. doi: 10.1111/jcpp.12268

Larson, J., & Lochman, J. E. (2002). *Helping school children cope with anger: A cognitive behavioral intervention*. New York: Guilford Press.

Leadbeater, B., & Homel, J. (2015). Irritable and Defiant Sub-Dimensions of ODD: Their Stability and Prediction of Internalising Symptoms and Conduct Problems from Adolescence to Young Adulthood. *Journal of Abnormal Child Psychology, 43*(3), 407-421.

Marsh, A. A., Finger, E. C., Mitchell, D. G. V., Reid, M. E., Sims, C., Kosson, D. S., . . . Blair, R. J. R. (2008). Reduced amygdala response to fearful expressions in children and adolescents with callous-unemotional traits and disruptive behavior disorders. *American Journal of Psychiatry, 165*(6), 712-720. doi: 10.1176/appi.ajp.2007.07071145

Martel, M. M., Nikolas, M., Jernigan, K., Friderici, K., & Nigg, J. T. (2012). Diversity in pathways to common childhood disruptive behavior disorders. *J Abnorm Child Psychol, 40*(8), 1223-1236. doi: 10.1007/s10802-012-9646-3

Matthys, W., Van Goozen, S. H. M., De Vries, H., Cohen-Kettenis, P. T., & Van Engeland, H. (1998). The dominance of behavioural activation over behavioural inhibition in conduct disordered boys with or without attention deficit hyperactivity disorder. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 39*(5), 643-651. doi: 10.1017/S0021963098002534

Maughan, B., Rowe, R., Messer, J., Goodman, R., & Meltzer, H. (2004). Conduct Disorder and Oppositional Defiant Disorder in a national sample: developmental epidemiology. *Journal of Child Psychology and Psychiatry, 45*(3), 609-621. doi: 10.1111/j.1469-7610.2004.00250.x

McAlonan, G. M., Cheung, V., Cheung, C., Chua, S. E., Murphy, D. G. M., Suckling, J., . . . Ho, T. P. (2007). Mapping brain structure in attention deficit-hyperactivity disorder: A voxel-based MRI study of regional grey and white matter volume. *Psychiatry Research - Neuroimaging, 154*(2), 171-180. doi: 10.1016/j.pscychresns.2006.09.006

McMahon, R. J., & Forehand, R. (2003). *Helping the noncompliant child: Family-based treatment for oppositional behavior* (2nd edition ed.). New York: Guilford Press.

McNeil, C. B., & Hembree-Kigin, T. L. (2010). *Parent-child interaction therapy* (2nd edition ed.). New York: Springer.

Michalska, K. J., Decety, J., Zeffiro, T. A., & Lahey, B. B. (2014). Association of regional gray matter volumes in the brain with disruptive behavior disorders in male and female children. *NeuroImage: Clinical, 7*, 252-257. doi: 10.1016/j.nicl.2014.12.012

Morcillo, Carmen, Duarte, Cristiane S., Sala, Regina, Wang, Shuai, Lejuez, Carl W., Kerridge, Bradley T., & Blanco, Carlos. (2012). Conduct disorder and adult psychiatric diagnoses: Associations and gender differences in the U.S. adult population. *Journal of Psychiatric Research, 46*(3), 323-330

Närhi, V., Lehto-Salo, P., Ahonen, R., & Marttunen, M. (2010). Neuropsychological subgroups of adolescents with conduct disorder. *Scandinavian Journal of Psychology, 51*(3), 278-284. doi: 10.1111/j.1467-9450.2009.00767.x

Nigg, J. T. (2003) Response Inhibition and Disruptive Behaviors: Toward a Multiprocess Conception of Etiological Heterogeneity for ADHD Combined Type and Conduct Disorder Early-Onset Type. *Vol. 1008. Annals of the New York Academy of Sciences* (pp. 170-182).

Pajer, K., Chung, J., Leininger, L., Wang, W., Gardner, W., & Yeates, K. (2008). Neuropsychological function in adolescent girls with conduct disorder. *Journal of the*

American Academy of Child and Adolescent Psychiatry, 47(4), 416-425. doi: 10.1097/CHI.0b013e3181640828

Pajer, K., Leininger, L., & Gardner, W. (2010). Recognition of facial affect in girls with conduct disorder. *Psychiatry Research, 175*(3), 244-251. doi: 10.1016/j.psychres.2009.06.003

Pardini, D., & Frick, P. J. (2013). Multiple Developmental Pathways to Conduct Disorder: Current Conceptualizations and Clinical Implications. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, *22*(1), 20-25.

Pardini, D. A., & Fite, P. J. (2010). Symptoms of Conduct Disorder, Oppositional Defiant Disorder, Attention-Deficit/Hyperactivity Disorder, and Callous-Unemotional Traits as Unique Predictors of Psychosocial Maladjustment in Boys: Advancing an Evidence Base for DSM-V. *Journal of the American Academy of Child and Adolescent Psychiatry, 49*(11), 1134-1144. doi: 10.1016/j.jaac.2010.07.010

Passamonti, L., Fairchild, G., Fornito, A., Goodyer, I. M., Nimmo-Smith, I., Hagan, C. C., & Calder, A. J. (2012). Abnormal Anatomical Connectivity between the Amygdala and Orbitofrontal Cortex in Conduct Disorder. *PLoS ONE, 7*(11). doi: 10.1371/journal.pone.0048789

Patterson, G., & Reid, J. B. (1975). *A social learning approach to family intervention: Families with aggressive children* (Vol. 1). Eugene, Oregon: Castalia Pub. Co.

Polanczyk, G. V., Salum, G. A., Sugaya, L. S., & et al. (2015). Annual Research Review: A meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. *J Child Psychol Psychiatry, 56,* 345-365.

Preyde, M., Watkins, H., Csuzdi, N., Carter, J., Lazure, K., White, S., … Frensch, K. (2012). Non-Suicidal Self-Injury and Suicidal Behaviour in Children and Adolescents Accessing Residential or Intensive Home-Based Mental Health Services. *Journal of the Canadian Academy of Child and Adolescent Psychiatry, 21*(4), 270–281.

Rowe, R., Costello, E. J., Angold, A., Copeland, W. E., & Maughan, B. (2010). Developmental pathways in Oppositional Defiant Disorder and Conduct Disorder. *Journal of abnormal psychology, 119*(4), 726-738. doi: 10.1037/a0020798

Rubia, K., Halari, R., Cubillo, A., Mohammad, A. M., Scott, S., & Brammer, M. (2010). Disorder-specific inferior prefrontal hypofunction in boys with pure attention-deficit/hyperactivity disorder compared to boys with pure conduct disorder during cognitive flexibility. *Human Brain Mapping, 31*(12), 1823-1833. doi: 10.1002/hbm.20975

Rubia, K., Halari, R., Smith, A. B., Mohammed, M., Scott, S., Giampietro, V., . . . Brammer, M. J. (2008). Dissociated functional brain abnormalities of inhibition in boys with pure conduct disorder and in boys with pure attention deficit hyperactivity disorder. *American Journal of Psychiatry, 165*(7), 889-897. doi: 10.1176/appi.ajp.2008.07071084

Rubia, K., Smith, A. B., Halari, R., Matsukura, F., Mohammad, M., Taylor, E., & Brammer, M. J. (2009). Disorder-specific dissociation of orbitofrontal dysfunction in boys with pure conduct disorder during reward and ventrolateral prefrontal dysfunction in boys with pure ADHD during sustained attention. *American Journal of Psychiatry, 166*(1), 83-94. doi: 10.1176/appi.ajp.2008.08020212

Sanders, M. R. (1999). Triple P-Positive Parenting Program: Towards an Empirically Validated Multilevel Parenting and Family Support Strategy for the Prevention of Behavior and Emotional Problems in Children. *Clinical Child and Family Psychology Review, 2*(2), 71-90. doi: 10.1023/A:1021843613840

Schepman, K., Taylor, E., Collishaw, S., & Fombonne, E. (2012). Face emotion processing in depressed children and adolescents with and without comorbid conduct disorder. *Journal of Abnormal Child Psychology, 40*(4), 583-593. doi: 10.1007/s10802-011-9587-2

Steiner, H., & Remsing, L. (2007). Practice Parameter for the Assessment and Treatment of Children and Adolescents With Oppositional Defiant Disorder. *Journal of the American Academy of Child & Adolescent Psychiatry, 46*(1), 126-141. doi: 10.1097/01.chi.0000246060.62706.af

Stevens, M. C., & Haney-Caron, E. (2012). Comparison of brain volume abnormalities between ADHD and conduct disorder in adolescence. *Journal of Psychiatry and Neuroscience, 37*(6), 389-398. doi: 10.1503/jpn.110148

Stringaris, A., Maughan, B., & Goodman, R. (2010). What's in a Disruptive Disorder? Temperamental Antecedents of Oppositional Defiant Disorder: Findings from the Avon Longitudinal Study. *Journal of the American Academy of Child & Adolescent Psychiatry, 49*(5), 474-483. doi: 10.1016/j.jaac.2010.01.021

Szapocznik, J., et al. . (2003). *Brief strategic family therapy for adolescent drug abuse*. Bethesda, MD: National Institute on Drug Abuse.

Teichner, G., & Golden, C. J. (2000). The relationship of neuropsychological impairment to conduct disorder in adolescence: A conceptual review. *Aggression and Violent Behavior, 5*(6), 509-528. doi: 10.1016/S1359-1789(98)00035-4

Teplin, L. A., Abram, K. M., McClelland, G. M., Dulcan, M. K., & Mericle, A. A. (2002). Psychiatric Disorders in Youth in Juvenile Detention. *Archives of general psychiatry, 59*(12), 1133-1143.

Toupin, J., Déry, M., Pauzé, R., Mercier, H., & Fortin, L. (2000). Cognitive and familial contributions to conduct disorder in children. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 41*(3), 333-344. doi: 10.1017/S0021963099005296

Tuvblad, C., & Beaver, K. M. (2013). Genetic and environmental influences on antisocial behavior. *Journal of criminal justice, 41*(5), 273-276. doi: 10.1016/j.jcrimjus.2013.07.007

Van Der Meer, D. J., & Van Der Meere, J. (2004). Response inhibition in children with conduct disorder and borderline intellectual functioning. *Child Neuropsychology, 10*(3), 189-194. doi: 10.1080/09297040490911005

Wagner, D. V., Borduin, C. M., Sawyer, A. M., & Dopp, A. R. (2014). Long-term prevention of criminality in siblings of serious and violent juvenile offenders: a 25-year follow-up to a randomized clinical trial of multisystemic therapy. *J Consult Clin Psychol, 82*(3), 492-499. doi: 10.1037/a0035624

Waller, R., Gardner, F., & Hyde, L. W. (2013). What are the associations between parenting, callous–unemotional traits, and antisocial behavior in youth? A systematic review of evidence. *Clinical Psychology Review, 33*(4), 593-608. doi: http://dx.doi.org/10.1016/j.cpr.2013.03.001

Waschbusch, D. A. (2002). A meta-analytic examination of comorbid hyperactive-impulsive-attention problems and conduct problems. *Psychological Bulletin, 128*(1), 118-150. doi: 10.1037/0033-2909.128.1.118

White, S. F., Brislin, S., Sinclair, S., Fowler, K. A., Pope, K., & Blair, R. J. R. (2013). The relationship between large cavum septum pellucidum and antisocial behavior, callous-unemotional traits and psychopathy in adolescents. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 54*(5), 575-581. doi: 10.1111/j.1469-7610.2012.02603.x

Wu, T., Howells, N., Burger, J., Lopez, P., Lundeen, R., & Sikkenga, A. V. (2015). Conduct Disorder. Treating Disruptive Disorders : A Guide to Psychological, Pharmacological, and Combined Therapies. Hoboken: Taylor and Francis. Retrieved from http://MONASH.eblib.com.au/patron/FullRecord.aspx?p=1982470.

APPENDIX C: SOCIAL COMMUNICATION QUESTIONNAIRE

0387171524

Please fill the circles like this ●

ID # ☐☐☐☐

Today's Date ☐☐ / ☐☐ / ☐☐☐☐
Day Month Year

Children's Attention Project - Social Communication Questionnaire

I'm now going to ask you a number of questions about your child's social communication skills. Please answer each question by stating Yes or No. The first set of questions asks you about whether you have observed any of the following behaviours at any time in your child's life. Although you may be uncertain about whether some behaviours were ever present or not, please answer Yes or No to every question ***on the basis of what you think****.*

1. Is she/he now able to talk using short phrases or sentences?	O Yes **If *No*, skip to Question 8**	O No
2. Can you have a to and fro "conversation" with her/him that involves taking turns or building on what you have said?	O Yes	O No
3. Has she/he ever used odd phrases or said the same thing over and over in almost exactly the same way (either phrases that she/he has heard other people use or ones that she/he has made up)?	O Yes	O No
4. Has she/he ever used socially inappropriate questions or statements? For example, has she/he ever regularly asked personal questions or made personal comments at awkward times?	O Yes	O No
5. Has she/he ever got her/his pronouns mixed up (e.g. saying *you* or *she/he* for *I*)?	O Yes	O No
6. Has she/he ever used words that she/he seemed to have invented or made up her/himself; put things in odd, indirect ways; or used metaphorical ways of saying things (e.g., saying *hot rain* for *steam*)?	O Yes	O No
7. Has she/he ever said the same thing over and over in exactly the same way or insisted that you say the same thing over and over again?	O Yes	O No
8. Has she/he ever had things that she/he seemed to have to do in a very particular way or order or rituals that she/he insisted that you go through?	O Yes	O No
9. Has her/his facial expression usually seemed appropriate to the particular situation, as far as you could tell?	O Yes	O No
10. Has she/he ever used your hand like a tool or as if it were part of her/his own body (e.g. pointing with your finger, putting your hand on a doorknob to get you to open the door)?	O Yes	O No
11. Has she/he ever had any interests that preoccupy her/him and might seem odd to other people (e.g. traffic lights, drainpipes, or timetables)?	O Yes	O No
12. Has she/he ever seemed to be more interested in parts of a toy or an object (e.g. spinning the wheels of a car), rather than using the object as it was intended?	O Yes	O No

(Fill in one circle on each line)

13. Has she/he ever had any special interests that were *unusual* in their intensity but otherwise appropriate for her/his age and peer group (e.g., trains, dinosaurs)?	O Yes	O No
14. Has she/he ever seemed to be *unusually* interested in the sight, feel, sound, taste, or smell of things or people?	O Yes	O No
15. Has she/he ever had any mannerisms or odd ways of moving her/his hands or fingers, such as flapping or moving her/his fingers in front of her/his eyes?	O Yes	O No
16. Has she/he ever had any complicated movements of her/his whole body, such as spinning or repeatedly bouncing up and down?	O Yes	O No
17. Has she/he ever injured her/himself deliberately, such as by biting her/his arm or banging her/his head?	O Yes	O No
18. Has she/he ever had any objects (*other* than a soft toy or comfort blanket) that she/he *had* to carry around?	O Yes	O No
19. Does she/he have any particular friends or a best friend?	O Yes	O No

For the following behaviours, please focus on the time period between the child's fourth and fifth birthdays. You may find it easier to remember how things were at that time by focusing on key events, such as starting school, moving house, Christmastime, or other specific events that are particularly memorable for you as a family.

20. When she/he was 4 to 5, did she/he ever talk with you just to be friendly (rather than to get something)?	O Yes	O No
21. When she/he was 4 to 5, did she/he ever *spontaneously* copy you (or other people) or what you were doing (such as vacuuming, gardening, or mending things)?	O Yes	O No
22. When she/he was 4 to 5, did she/he ever spontaneously point at things around her/him just to show you things (not because she/he wanted them)?	O Yes	O No
23. When she/he was 4 to 5, did she/he ever use gestures, other than pointing or pulling your hand, to let you know what she/he wanted?	O Yes	O No
24. When she/he was 4 to 5, did she/he nod her/his head to mean *yes*?	O Yes	O No
25. When she/he was 4 to 5, did she/he shake her/his head to mean *no*?	O Yes	O No
26. When she/he was 4 to 5, did she/he usually look at you directly in the face when doing things with you or talking with you?	O Yes	O No
27. When she/he was 4 to 5, did she/he smile back if someone smiled at her/him?	O Yes	O No
28. When she/he was 4 to 5, did she/he ever show you things that interested her/him to engage your attention?	O Yes	O No

continued...

(Fill in one circle on each line)

29. When she/he was 4 to 5, did she/he ever offer to share things other than food with you?	O Yes	O No
30. When she/he was 4 to 5, did she/he ever seem to want you to join in her/his enjoyment of something?	O Yes	O No
31. When she/he was 4 to 5, did she/he ever try to comfort you if you were sad or hurt?	O Yes	O No
32. When she/he was 4 to 5, when she/he wanted something or wanted help, did she/he look at you and use gestures with sounds or words to get your attention?	O Yes	O No
33. When she/he was 4 to 5, did she/he show a normal range of facial expressions?	O Yes	O No
34. When she/he was 4 to 5, did she/he ever spontaneously join in and try to copy the actions in social games, such as *The Mulberry Bush* or *London Bridge is Falling Down*?	O Yes	O No
35. When she/he was 4 to 5, did she/he play any pretend or make-believe games?	O Yes	O No
36. When she/he was 4 to 5, did she/he seem interested in other children of approximately the same age whom she/he did not know?	O Yes	O No
37. When she/he was 4 to 5, did she/he respond positively when another child approached her/him?	O Yes	O No
38. When she/he was 4 to 5, if you came into a room and started talking to her/him without calling her/his name, did she/he usually look up and pay attention to you?	O Yes	O No
39. When she/he was 4 to 5, did she/he ever play imaginative games with another child in such a way that you could tell that they each understood what the other was pretending?	O Yes	O No
40. When she/he was 4 to 5, did she/he play cooperatively in games that required joining in with a group of other children, such as hide-and-seek or ball games?	O Yes	O No

Appendix D: Alternative Explanations to SCQ Items

Alternate Explanations		
Social Communication Questionnaire (SCQ)		
Item	**Question**	**Alternate explanation and example**
3 Stereotyped utterances	Has she/he ever used odd phrases or said the same thing over and over in almost exactly the same way (either phrases that she/he has heard other people use or ones that she/he has made up)?	For example, has your child ever said strange things or said the same thing repeatedly? This might be copying something someone else has said in almost exactly the same way, or repeating a sentence they have made up.
8 Compulsions & rituals	Has she/he ever had things that she/he seemed to do in a very particular way or order or rituals that she/he insisted that you go through?	For example, has your child ever had a need for order, routine or doing things in a particular way? This may include lining up toys or needing to follow a strict schedule for activities.
9 Inappropriate facial expression	Has her/his facial expression usually seemed appropriate to the particular situation, as far as you could tell?	Does your child's facial expression usually match the situation? For example, smiling at appropriate times when feeling happy.
33: Range of emotional expression	When she/he was 4 to 5, did she/he show a normal range of facial expressions?	For example, smiled when happy, frowned when sad & made other facial expressions indicating

		surprise, fear, anger & disgust.
34: Imitative social play	When he/she was 4 to 5, did she/he ever spontaneously join in and try to copy the actions in social games, such as The Mulberry Bush or London Bridge is Falling Down.	For example, if other children were singing & doing the actions of songs, would your child join in and imitate what the other children were doing? Ring a Ring a Rosy is another song that involves singing & children joining together to move & do the actions that you may be familiar with.
37: Response to other children's approaches	When she/he was 4 to 5, did she/he respond positively when another child approached her/him?	For example, did he/she join in or interact positively with the child when they were approached by other children?

APPENDIX E: CAP PARENT QUESTIONNAIRE

5633565834

Please fill the circles like this ●

ID # ☐☐☐☐

Today's Date ☐☐ / ☐☐ / ☐☐☐☐

Day Month Year

Section 1: Your child's behaviour and development

1.1. For each item, please mark the circle for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain. Please give your answers on the basis of the child's behaviour over the ***past 6 MONTHS.***

(Fill in one circle on each line)	Not true	Somewhat true	Certainly true
a. Considerate of other people's feelings	○	○	○
b. Restless, overactive, cannot stay still for long	○	○	○
c. Often complains of headaches, stomach-aches or sickness	○	○	○
d. Shares readily with other children, for example toys, treats, pencils	○	○	○
e. Often loses temper	○	○	○
f. Rather solitary, prefers to play alone	○	○	○
g. Generally well behaved, usually does what adults request	○	○	○
h. Many worries or often seems worried	○	○	○
i. Helpful if someone is hurt, upset or feeling ill	○	○	○
j. Constantly fidgeting or squirming	○	○	○
k. Has at least one good friend	○	○	○
l. Often fights with other children or bullies them	○	○	○
m. Often unhappy, depressed or tearful	○	○	○
n. Generally liked by other children	○	○	○
o. Easily distracted, concentration wanders	○	○	○
p. Nervous or clingy in new situations, easily loses confidence	○	○	○
q. Kind to younger children	○	○	○
r. Often lies or cheats	○	○	○
s. Picked on or bullied by other children	○	○	○
t. Often volunteers to help others (parents, teachers, other children)	○	○	○
u. Thinks things out before acting	○	○	○
v. Steals from home, school or elsewhere	○	○	○

continued...

(Fill in one circle on each line)	Not true	Somewhat true	Certainly true
w. Gets along better with adults than with other children	O	O	O
x. Many fears, easily scared	O	O	O
y. Good attention span, sees chores or homework through to the end	O	O	O

1.2. Overall, do you think that your child has difficulties in his/her emotions, concentration, behaviour, or being able to get along with other people? *(Fill in one circle)*

O Yes – minor difficulties
O Yes – definite difficulties
O Yes – severe difficulties
O No ⟶ ***Go to Question 1.7***

1.3. How long have these difficulties been present? *(Fill in one circle)*

O Less than a month O 1-5 months O 6-12 months O Over a year

1.4. Do these difficulties upset or distress your child? *(Fill in one circle)*

O Not at all O A little O A medium amount O A great deal

1.5. Do these difficulties interfere with your child's everyday life in the following areas?

(Fill in one circle on each line)	Not at all	A little	A medium amount	A great deal
a. Home life	O	O	O	O
b. Friendships	O	O	O	O
c. Classroom learning	O	O	O	O
d. Leisure activities	O	O	O	O

1.6. Do these difficulties put a burden on you or your family as a whole? *(Fill in one circle)*

O Not at all O A little O A medium amount O A great deal

1.7. Here are some things parents might say about their children. Please tell us about *your* child and what he/she has been like in the ***past 4 WEEKS.*** Read each item carefully, then mark how well it describes your child or how frequently it has happened in the ***past 4 WEEKS.***

Please fill in only one answer for each item. It is important to respond to every item.
For items that you find difficult to answer, please give your best guess.

*In the **past 4 WEEKS**, this was...* *(Fill in one circle on each line)*	**Not true at all** (never, seldom)	**Just a little true** (occasionally)	**Pretty much true** (often, quite a bit)	**Very much true** (very often, very frequent)
a. Fidgeting	○	○	○	○
b. Does not seem to listen to what is being said to him/her	○	○	○	○
c. Doesn't pay attention to details; makes careless mistakes	○	○	○	○
d. Inattentive, easily distracted	○	○	○	○
e. Has trouble organising tasks or activities	○	○	○	○
f. Gives up easily on difficult tasks	○	○	○	○
g. Fidgets or squirms in seat	○	○	○	○
h. Restless or overactive	○	○	○	○
i. Is easily distracted by sights or sounds	○	○	○	○
j. Interrupts others (for example, butts into conversations or games)	○	○	○	○

How your child gets along with others

1.8. Please read each item and think about your child's behaviour over the ***past 2 MONTHS***. Then, decide **how often** your child displays the behaviour.

(Fill in one circle on each line)	**Never**	**Seldom**	**Often**	**Almost always**
a. Takes care when using other people's things	○	○	○	○
b. Is well-behaved when unsupervised	○	○	○	○
c. Is aggressive toward people or objects	○	○	○	○
d. Resolves disagreements with you calmly	○	○	○	○
e. Respects the property of others	○	○	○	○
f. Takes responsibility for her/his own actions	○	○	○	○
g. Stays calm when teased	○	○	○	○

continued...

(Fill in one circle on each line)	Never	Seldom	Often	Almost always
h. Forces others to act against their will	O	O	O	O
i. Does what she/he promised	O	O	O	O
j. Takes criticism without getting upset	O	O	O	O
k. Makes a compromise during a conflict	O	O	O	O
l. Does things to make others feel scared	O	O	O	O
m. Tolerates peers when they are annoying	O	O	O	O
n. Takes responsibility for her/his own mistakes	O	O	O	O
o. Bullies others	O	O	O	O
p. Responds appropriately when pushed or hit	O	O	O	O
q. Stays calm when disagreeing with others	O	O	O	O
r. Keeps others out of social circles	O	O	O	O

1.9. How frequently has your child been bullied at school in the ***past MONTH?*** *(Fill in one circle)*

O Several times a week

O Once a week

O 2-3 times during the past month

O 1 time during the past month

O My child has not been bullied in the past month

1.10. Below are some descriptions about how children might interact with other children (peers). Please think of how peers interact with your child and decide where each statement falls on a scale of 1 (Never true) to 5 (Always true). Please complete this to the best of your knowledge.

(Fill in one circle on each line)	Never true				Always true
a. My child gets hit or kicked by kids	O	O	O	O	O
b. My child gets ignored by other kids when they are mad at him/her	O	O	O	O	O
c. My child gets pushed or shoved by kids	O	O	O	O	O
d. My child gets left out of the group when someone is mad at them or wants to get back at them	O	O	O	O	O
e. My child gets physically threatened by kids	O	O	O	O	O
f. My child is the target of rumours or gossip in the school-group	O	O	O	O	O

Please fill the circles like this ●

Section 2: Your child's health and wellbeing

2.1. In general, how would you say your child's current health is? *(Fill in one circle)*

○ Excellent ○ Very good ○ Good ○ Fair ○ Poor

2.2. During the ***past 12 MONTHS***, has your child been hurt, injured or had an accident needing medical attention from a doctor or hospital? *(Fill in one circle)*

○ Yes

○ No ⟶ ***Go to Question 2.5***

2.3. During the ***past 12 MONTHS***, how many times has your child been hurt, injured or had an accident and needed medical attention from a doctor or hospital?

☐☐ number

2.4. During the ***past 12 MONTHS***, has your child stayed in hospital for at least one night because of any (of these) injuries or accidents? *(Fill in one circle)*

○ Yes ○ No

2.5. For the following list, please tell us how much of a problem each one has been for your child in the ***past 4 WEEKS*** by filling in the circle

Physical Functioning (problems with....) *(Fill in one circle on each line)*	**Never**	**Almost never**	**Some-times**	**Often**	**Almost always**
a. Walking more than one block	○	○	○	○	○
b. Running	○	○	○	○	○
c. Participating in sports activity or exercise	○	○	○	○	○
d. Lifting something heavy	○	○	○	○	○
e. Taking a bath/shower by him or herself	○	○	○	○	○
f. Doing chores around the house	○	○	○	○	○
g. Having hurts or aches	○	○	○	○	○
h. Low energy level	○	○	○	○	○
Emotional Functioning (problems with....) *(Fill in one circle on each line)*	**Never**	**Almost never**	**Some-times**	**Often**	**Almost always**
a. Feeling afraid or scared	○	○	○	○	○
b. Feeling sad or blue	○	○	○	○	○
c. Feeling angry	○	○	○	○	○
d. Trouble sleeping	○	○	○	○	○
e. Worrying about what will happen to him or her	○	○	○	○	○

continued...

Social Functioning (problems with....) *(Fill in one circle on each line)*	**Never**	**Almost never**	**Some-times**	**Often**	**Almost always**
a. Getting along with other children	O	O	O	O	O
b. Other kids not wanting to be his or her friend	O	O	O	O	O
c. Getting teased by other children	O	O	O	O	O
d. Not able to do things that other children his/her age can do	O	O	O	O	O
e. Keeping up when playing with other children	O	O	O	O	O
School Functioning (problems with....) *(Fill in one circle on each line)*	**Never**	**Almost never**	**Some-times**	**Often**	**Almost always**
a. Paying attention in class	O	O	O	O	O
b. Forgetting things	O	O	O	O	O
c. Keeping up with schoolwork	O	O	O	O	O
d. Missing school because of not feeling well	O	O	O	O	O
e. Missing school to go to the doctor or hospital	O	O	O	O	O

2.6. How much is your child's sleeping pattern or habits a problem for you? *(Fill in one circle)*

- O A large problem
- O A moderate problem
- O A small problem
- O No problem at all
- O Not sure / Don't know

2.7. Does your child have any of these problems on ***4 or more nights a week***, that is, more than half the time? (*Mark Yes or No for each)*

Yes	No		Yes	No	
O	O	Wheezing or asthma	O	O	Nightmares or night terrors
O	O	Snoring or difficulty breathing	O	O	Seeming tired in the morning
O	O	Not happy to sleep alone	O	O	Restless sleep
O	O	Waking during the night	O	O	Difficulty getting off to sleep at night
O	O	Bed wetting	O	O	Other problems (please specify)

_____

2.8. Has your child ever been ***DIAGNOSED with or TREATED for*** any of the following by a health professional? *(Mark Yes or No for each)*

Yes	No	
O	O	Attention Deficit Hyperactivity Disorder (ADHD) / Attention Deficit Disorder (ADD)
O	O	Learning Disorder / Dyslexia / Learning Disability / Reading Disorder
O	O	Depression / Dysthymia
O	O	Anxiety (eg. Generalised Anxiety Disorder, Separation Anxiety Disorder, Social Phobia)
O	O	Oppositional Defiant Disorder
O	O	Conduct Disorder
O	O	Obsessive-Compulsive Disorder
O	O	Tourette's Syndrome / Tics
O	O	Speech / Language Disorder
O	O	Other (please specify): _____

2.9. Has your child ever been ***DIAGNOSED*** with an Autism Spectrum Disorder?

O Yes

O No ⟶ ***Go to Question 2.11***

2.10. If yes, please select which disorder your child has been diagnosed with: *(Fill in one circle)*

O Asperger Syndrome / High Functioning Autism

O Autism Spectrum Disorder

O Autism Spectrum Disorder with Intellectual Disability

O Other (please specify): _____

Your child's medication use

2.11. Is your child ***currently*** taking medication to assist with learning, behaviour, emotional or sleep difficulties?

O Yes

O No ⟶ ***Go to Section 3***

2.12. What type of medication is your child ***currently*** taking? *(Mark Yes or No for each)*

Yes	No		Yes	No	
O	O	Ritalin 10 tablets (methylphenidate)	O	O	Catapres (clonidine)
O	O	Ritalin LA capsules (methylphenidate)	O	O	Risperdal (risperidone)
O	O	Concerta tablets (methylphenidate)	O	O	Lovan / Prozac (fluoxetine)
O	O	Dexamphetamine	O	O	Circadin (melatonin)
O	O	Strattera (atomoxetine)	O	O	Other (please specify): _____

Please fill the circles like this ●

Section 3: Your relationship with your child

The next questions are about being a parent. There are no right or wrong answers, we are just asking about parents' views on their role as a parent with this child.

3.1. Overall, as a parent, do you feel that you are… *(Fill in one circle)*

- O Not very good at being a parent
- O A person who has some trouble being a parent
- O An average parent
- O A better than average parent
- O A very good parent

3.2. Thinking about your child over the ***past 6 MONTHS***, how often did you…

(Fill in one circle on each line)	Never / Almost never	Rarely	Some-times	Often	Always / Almost always
a. Hug or hold this child for no apparent reason?	O	O	O	O	O
b. Tell this child how happy he/she makes you?	O	O	O	O	O
c. Have warm, close times together with this child?	O	O	O	O	O
d. Enjoy listening to this child and doing things with him/her?	O	O	O	O	O
e. Feel close to this child both when he/she is happy and when he/she was upset?	O	O	O	O	O
f. Express affection by hugging, kissing and holding this child?	O	O	O	O	O

3.3. When parents spend time with their children, sometimes things go well and sometimes they don't. For each of the following questions, fill in the circle to indicate how often this happens:

(Fill in one circle on each line)	Never / Almost never	Less than half the time	About half the time	More than half the time	All the time
a. Of all the times that you talk to this child about his/her behaviour, how often is this praise?	O	O	O	O	O
b. Of all the times that you talk to this child about his/her behaviour, how often is this disapproval?	O	O	O	O	O
c. When you give this child an instruction or make a request to do something, how often do you make sure that he/she does it?	O	O	O	O	O
d. If you tell this child he/she will get punished if he/she doesn't stop doing something, but he/she keeps doing it, how often will you punish him/her?	O	O	O	O	O
e. How often does this child get away with the things that you feel should have been punished?	O	O	O	O	O
f. How often are you angry when you punish this child?	O	O	O	O	O

continued...

(Fill in one circle on each line)	Never / Almost never	Less than half the time	About half the time	More than half the time	All the time
g. How often do you feel you are having problems managing this child?	O	O	O	O	O
h. How often is this child able to get out of punishment when he/she really sets his/her mind to it?	O	O	O	O	O
i. When you discipline this child, how often does he/she ignore the punishment?	O	O	O	O	O
j. How often do you tell this child that he/she is bad or not as good as others?	O	O	O	O	O
k. How often do you think that the level of punishment you give this child depends on your mood?	O	O	O	O	O

3.4. In the ***past 18 MONTHS*** (ie. since completing the first Children's Attention Project survey), has your child ever lived out of your care for an extended period of time (e.g. more than one week)?

O Yes O No ⟶ ***Go to SECTION 4***

3.5. Which of the following options best describes the circumstances when your child has lived out of your care? *(Fill in one circle)*

O Living/staying with other biological parent
O Living/staying with extended family
O Hospital admission
O Residential care
O Foster care
O Other (please describe): _____

Section 4: Your wellbeing

4.1. In general, would you say your own health is: (*Fill in one circle*)

O Excellent O Very good O Good O Fair O Poor

4.2. In the ***past 4 WEEKS***, how often did you feel ...?

(Fill in one circle on each line)	None of the time	A little of the time	Some of the time	Most of the time	All of the time
a. Nervous	O	O	O	O	O
b. Hopeless	O	O	O	O	O
c. Restless or fidgety	O	O	O	O	O
d. That everything was an effort	O	O	O	O	O
e. So sad that nothing would cheer you up	O	O	O	O	O
f. Worthless	O	O	O	O	O

4.3. In the ***past 4 WEEKS***, how would you rate your sleep quality overall? *(Fill in one circle)*

O Very good O Fairly good O Fairly bad O Very bad

4.4. During the ***past 4 WEEKS***, how much emotional worry or concern did each of the following cause you:

(Fill in one circle on each line)	None	A little	Some	Quite a bit	A lot
a. Your child's emotional wellbeing or behaviour	O	O	O	O	O
b. Your child's attention or learning abilities	O	O	O	O	O

4.5. During the ***past 4 WEEKS***, were you limited in the amount of time you had for your own personal needs because of:

(Fill in one circle on each line)	No, did not limit me	Yes, limited a little	Yes, limited me some	Yes, limited me a lot
a. Your child's emotional wellbeing or behaviour	O	O	O	O
b. Your child's attention or learning abilities	O	O	O	O

4.6. During the ***past 4 WEEKS***, how often has your child's health or behaviour:

(Fill in one circle on each line)	Never	Almost never	Some-times	Fairly often	Very often
a. Limited the types of activities you could do as a family?	O	O	O	O	O
b. Interrupted various everyday family activities (eating meals, watching TV)?	O	O	O	O	O
c. Limited your ability as a family to "pick up and go" on a moment's notice?	O	O	O	O	O
d. Caused tension or conflict in your home?	O	O	O	O	O
e. Been a source of disagreement or arguments in your family?	O	O	O	O	O
f. Caused you to cancel or change plans (personal or work) at the last minute?	O	O	O	O	O

4.7. During the ***past 12 MONTHS***, did any of the following happen to you:

(Fill in one circle on each line)	No	Yes
a. You suffered a serious illness, injury or assault?	O	O
b. A close family member suffered a serious illness, injury or assault?	O	O
c. Your parent, partner or child died?	O	O
d. A close friend or family member died?	O	O
e. You separated from your partner or had a relationship end?	O	O

continued...

(Fill in one circle on each line)	No	Yes
f. You had a serious problem with a family member, close friend or neighbour?	○	○
g. You or your partner lost your job?	○	○
h. You had major financial difficulties?	○	○
i. You or a close family member had trouble with the police or a court appearance?	○	○
j. Something you valued was lost or stolen?	○	○
k. You moved house?	○	○
l. You became pregnant or had / adopted a child?	○	○

4.8. Listed below are items concerning behaviours or problems experienced by adults. Read each item carefully and decide how much or how frequently each item **describes you recently**. Indicate your response for each item by filling in the circle that corresponds to your choice.

(Fill in one circle on each line)	Not at all, never	Just a little, once in a while	Pretty much, often	Very much, very frequently
a. I am always on the go, as if driven by a motor	○	○	○	○
b. I have a short fuse/hot temper	○	○	○	○
c. I feel alert	○	○	○	○
d. I will throw tantrums	○	○	○	○
e. I avoid new challenges because I lack faith in my abilities	○	○	○	○
f. I feel inspired	○	○	○	○
g. I feel restless inside even if I am sitting still	○	○	○	○
h. Things I hear or see distract me from what I am doing	○	○	○	○
i. I feel determined	○	○	○	○
j. I am an underachiever	○	○	○	○
k. I can't get things done unless there's an absolute deadline	○	○	○	○
l. I feel attentive	○	○	○	○
m. I intrude on others' activities	○	○	○	○

continued...

(Fill in one circle on each line)	Not at all, never	Just a little, once in a while	Pretty much, often	Very much, very frequently
n. Sometimes my attention narrows so much that I'm oblivious to everything else; other times it's so broad that everything distracts me	O	O	O	O
o. I feel active	O	O	O	O
p. I can't keep my mind on something unless it's really interesting	O	O	O	O
q. My past failures make it hard for me to believe in myself	O	O	O	O

Section 5: You and your family

Regarding yourself

5.1. Are ***you*** this child's: *(Fill in one circle)*

O Biological parent O Step-parent O Foster parent O Other legal guardian

5.2. Did you complete the first Children's Attention Project survey (18 months ago)?

O Yes O No O I don't remember

5.3. Are you:

O Female O Male

5.4. Have you ***ever*** been diagnosed with any mental health condition by a health professional (eg. ADHD, depression, anxiety or psychosis)?

O No

O Yes ⟶ ***Please describe:*** _____

5.5. What is your age?

☐☐ Years

5.6. Are you currently in paid employment?

O Yes O No ⟶ ***Go to Question 5.9***

5.7. How many days per week do you usually work?

☐ number of days

5.8. Have you stopped working or reduced your work hours because of your child?

O Yes O No

Regarding your partner

5.9. Are you currently ***living*** with a partner (either married or de facto)?

O Yes O No ⟶ ***Go to Question 5.21***

5.10. Did you begin ***living*** with this partner within the ***last 18 MONTHS?***

O Yes O No, I've lived with my partner for longer than 18 months ⟶ ***Go to Question 5.20***

5.11. Is ***your partner*** this child's: *(Fill in one circle)*

O Biological parent O Step-parent O Foster parent O Other legal guardian

5.12. Is your partner:

O Female O Male

5.13. Is your partner currently in paid employment?

O Yes O No

5.14. How many days per week does your partner usually work?

☐ number of days

5.15. Has your partner stopped working or reduced his/her work hours because of your child?

O Yes O No

5.16. Has your partner ***ever*** been diagnosed with any mental health condition by a health professional (eg. ADHD, depression, anxiety or psychosis)?

O No

O Yes ⟶ ***Please describe:*** _____

5.17. What is your partner's age?

☐☐ years

5.18. What is the *highest year of school* that your partner has completed? *(Fill in one circle)*

O Year 9 or less O Year 10 or 11 O Year 12

5.19. Has your partner completed... *(Fill in one circle for each line)*

a. A vocational certificate or diploma, at TAFE or college? O Yes O No

b. A university degree? O Yes O No

5.20. How often, would you say that...

(Fill in one circle on each line)	Never	Rarely	Sometimes	Often	Always
a. Your partner is a resource or support to you in raising your child(ren)?	O	O	O	O	O
b. You are a resource or support to your partner in raising your child(ren)?	O	O	O	O	O
c. You feel that your partner understands and is supportive of your needs as a parent?	O	O	O	O	O
d. You and your partner disagree about basic child-rearing issues?	O	O	O	O	O
e. Your conversation with your partner is awkward or stressful?	O	O	O	O	O
f. You and your partner argue?	O	O	O	O	O
g. There is anger or hostility between you and your partner?	O	O	O	O	O

5.21. Does your child have ***another biological parent*** living elsewhere (eg. separated parent; egg/sperm donor)?

O Yes O No ⟶ ***Go to Section 6***

5.22. Is this parent:

O Female O Male

5.23. Has this parent ***ever*** been diagnosed with any mental health condition by a health professional (eg. ADHD, depression, anxiety or psychosis)? *(Fill in one circle)*

O Don't know

O No

O Yes ⟶ ***Please describe:*** _____

Please fill the circles like this ●

Section 6: Your use of services

6.1. Have you sought any professional help for any concerns about your **child's learning, behaviour or emotions** in the ***last 18 MONTHS*** (ie. since completing the first Children's Attention Project survey)?

○ Yes ○ No ⟶ ***You have now completed the survey.***

6.2. If yes, what kind of professional did you see about you **child's learning, behaviour or emotions**?

Professional type seen for concerns about learning, behaviour and emotions	**1. Please mark all that apply**	**2. Child's age when they first saw this type of professional?**	**3. How many times has your child visited this type of professional in the *past 12 MONTHS*?**
a. GP or Family Doctor	○	☐ Years	☐☐
b. Paediatrician	○	☐ Years	☐☐
c. Psychiatrist	○	☐ Years	☐☐
d. Psychologist	○	☐ Years	☐☐
e. Speech Pathologist	○	☐ Years	☐☐
f. Occupational Therapist	○	☐ Years	☐☐
g. Education Specialist	○	☐ Years	☐☐
h. Other eg. Chiropractor (please specify): _____	○	☐ Years	☐☐
i. Other eg. Naturopath (please specify): _____	○	☐ Years	☐☐

Thank you for your time!

Please check that you have answered all the questions. Return the completed questionnaire to the CAP Research Team in the reply-paid envelope provided.

We appreciate your contribution to CAP. We hope that our research will make a difference to the lives of children with attention and hyperactivity difficulties.

If you have any questions please call a member of the CAP Team on (03) 8341 6363 or email childrensattentionproject@mcri.edu.au

APPENDIX F: CAP TEACHER QUESTIONNAIRE

8877118921

Please fill the circles like this ●

ID # ☐☐☐☐

Today's Date ☐☐ / ☐☐ / ☐☐☐☐
Day Month Year

Section 1: Some questions about this child's behaviour

1.1. For each item, please mark the circle for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain. Please give your answer on the basis of the child's behaviour over the ***past 6 MONTHS***.

(Fill in one circle on each line)	Not true	Somewhat true	Certainly true
a. Considerate of other people's feelings	○	○	○
b. Restless, overactive, cannot stay still for long	○	○	○
c. Often complains of headaches, stomach-aches or sickness	○	○	○
d. Shares readily with other children, for example pencils, books, food	○	○	○
e. Often loses temper	○	○	○
f. Rather solitary, prefers to play alone	○	○	○
g. Generally well behaved, usually does what adults request	○	○	○
h. Many worries or often seems worried	○	○	○
i. Helpful if someone is hurt, upset or feeling ill	○	○	○
j. Constantly fidgeting or squirming	○	○	○
k. Has at least one good friend	○	○	○
l. Often fights with other children or bullies them	○	○	○
m. Often unhappy, depressed or tearful	○	○	○
n. Generally liked by other children	○	○	○
o. Easily distracted, concentration wanders	○	○	○
p. Nervous or clingy in new situations, easily loses confidence	○	○	○
q. Kind to younger children	○	○	○
r. Often lies or cheats	○	○	○
s. Picked on or bullied by other children	○	○	○
t. Often volunteers to help others (parents, teachers, other children)	○	○	○
u. Thinks things out before acting	○	○	○
v. Steals from home, school or elsewhere	○	○	○

continued...

(*Fill in one circle on each line*)	Not true	Somewhat true	Certainly true
w. Gets along better with adults than with other children	○	○	○
x. Many fears, easily scared	○	○	○
y. Good attention span, sees tasks through to the end	○	○	○

1.2. Overall, do you think that this child has difficulties in any of the following areas *(Fill in one circle on each line):*

	No	Yes - minor difficulties	Yes - definite difficulties	Yes - severe difficulties
a. Emotions	○	○	○	○
b. Concentration	○	○	○	○
c. Behaviour	○	○	○	○
d. Being able to get along with other people	○	○	○	○

If you have answered "Yes" to any of the above, please answer questions 1.3-1.6 about these difficulties. If "No" to all of the above, please go to question 1.7.

1.3. How long have these difficulties been present? *(Fill in one circle)*

○ Less than a month ○ 1-5 months ○ 6-12 months ○ Over a year

1.4. Do the difficulties upset or distress the child? *(Fill in one circle)*

○ Not at all ○ A little ○ A medium amount ○ A great deal

1.5. Do the difficulties interfere with the child's everyday life in the following areas?

(*Fill in one circle on each line*)	Not at all	A little	A medium amount	A great deal
a. Peer Relationships	○	○	○	○
b. Classroom Learning	○	○	○	○

1.6. Do the difficulties put a burden on you or the class as a whole? *(Fill in one circle)*

○ Not at all ○ A little ○ A medium amount ○ A great deal

1.7. Does this child receive any specialised services provided within the school because of a diagnosed disability or additional need? *(Fill in one circle)*

○ Yes ○ No ⟶ ***Go to Question 1.9***

APPENDIX G: CONNERS ADHD INDEX TEACHER

1.18 Here are some things teachers might say about their students. Please tell us about this student and what he/she has been like in the ***past 4 WEEKS*.** Read each item carefully, then mark how well it describes this student or how frequently it has happened in the ***past 4 WEEKS*.**

Rating: *In the **past 4 WEEKS**, this was...*	***Not true at all*** about this student. It never (or seldom) happened ***Just a little true*** about this student. It happened occasionally ***Pretty much true*** about this student. It happened often (or quite a bit) ***Very much true*** about this student. It happened very often (very frequently)

Please fill in only one answer for each item. It is important to respond to every item.
For items that you find difficult to answer, please give your best guess.

*In the **past 4 WEEKS**, this was ...* *(Fill in one circle on each line)*	**Not true at all** (never, seldom)	**Just a little true** (occasionally)	**Pretty much true** (often, quite a bit)	**Very much true** (very often, very frequent)
1. Fidgeting.	☐0	☐1	☐2	☐3
2. Does not seem to listen to what is being said to him/her.	☐0	☐1	☐2	☐3
3. Doesn't pay attention to details; makes careless mistakes.	☐0	☐1	☐2	☐3
4. Inattentive, easily distracted.	☐0	☐1	☐2	☐3
5. Has trouble organizing tasks or activities.	☐0	☐1	☐2	☐3
6. Gives up easily on difficult tasks.	☐0	☐1	☐2	☐3
7. Fidgets or squirms in seat.	☐0	☐1	☐2	☐3
8. Restless or overactive.	☐0	☐1	☐2	☐3
*In the **past 4 WEEKS**, this was ...* *(Fill in one circle on each line)*	**Not true at all** (never, seldom)	**Just a little true** (occasionally)	**Pretty much true** (often, quite a bit)	**Very much true** (very often, very frequent)
9. Is easily distracted by sights or sounds.	☐0	☐1	☐2	☐3
10. Interrupts others (for example, butts into conversations or games).	☐0	☐1	☐2	☐3

APPENDIX H: CAP ETHICS: ROYAL CHILDRENS HOSPITAL

The **Royal Children's Hospital** Melbourne

Research & Ethics

50 Flemington Road, Parkville
Victoria 3052, Australia
[redacted]
www.rch.org.au/ethics

17 May 2011

Ms Grace Terrill
Mental Health, Healthy Development Stream
MCRI

Dear Ms Terrill,

RE: HREC 31056 A
The Children's Attention Project: A community-based longitudinal study of children with ADHD and non-ADHD controls

Please find attached the RCH HREC Approval Certificate for the above project.

Also, please note the conditions of ethics approval which have been listed on the certificate.

The Committee wishes you well with your research study.

Yours sincerely

[redacted]

Ethics and Research Department, on behalf of the
RCH Human Research Ethics Committee

The Royal Children's Hospital Human Research Ethics Committee (RCH HREC) is constituted according to the National Health and Medical Research Council's 'National Statement on Ethical Conduct in Humans Research (2007). The committee operates in accordance with these guidelines and is registered with the NHMRC.

APPENDIX I: CAP ETHICS: DEPARTMENT OF EDUCATION

Department of Education and Early Childhood Development

Office for Policy, Research and Innovation

2 Treasury Place
East Melbourne, Victoria 3002
Telephone: +61 3 9637 2000
DX 210083
GPO Box 4367
Melbourne, Victoria 3001

2011_001095

Associate Professor Jan Nicholson
Murdoch Childrens Research Institute
Royal Children's Hospital
Flemington Road
PARKVILLE 3052

Dear Associate Professor Nicholson

Thank you for your application of 1 April 2011 in which you request permission to conduct research in Victorian government schools and/or early childhood settings titled *The children's attention project: a community-based longitudinal study of children with ADHD and non-ADHD controls.*

I am pleased to advise that on the basis of the information you have provided your research proposal is approved in principle subject to the conditions detailed below.

1. The research is conducted in accordance with the final documentation you provided to the Department of Education and Early Childhood Development.

2. Separate approval for the research needs to be sought from school principals and/or centre directors and this is to be supported by the DEECD approved documentation and the letter of approval from a relevant and formally constituted Human Research Ethics Committee.

3. The project is commenced within 12 months of this approval letter and any extensions or variations to your study, including those requested by an ethics committee must be submitted to the Department of Education and Early Childhood Development for its consideration before you proceed.

4. As a matter of courtesy, you advise the relevant Regional Director of the schools or early childhood settings that you intend to approach. An outline of your research and a copy of this letter should be provided to the Regional Director.

5. You acknowledge the support of the Department of Education and Early Childhood Development in any publications arising from the research.

6. The Research Agreement conditions, which include the reporting requirements at the conclusion of your study, are upheld. A reminder will be sent for reports not submitted by the study's indicative completion date.

I wish you well with your research study. Should you have further enquiries on this matter, please contact Kathleen Nolan, Research Officer, Education Policy and Research, by telephone [redacted]

Yours sincerely

[redacted]

Dr Elizabeth Hartnell-Young
Group Manager
Education Policy and Research

06/05/2011

enc

APPENDIX J: CURRENT ETHICS: MONASH UNIVERSITY

MONASH University

Monash University Human Research Ethics Committee (MUHREC)
Research Office

Human Ethics Certificate of Approval

Date:	**8 January 2013**
Project Number:	**CF12/4044 - 2012001944**
Project Title:	**Social and communicative difficulties in children with Attention Deficit Hyperactivity Disorder**
Chief Investigator:	**Prof Nicole Rinehart**
Approved:	**From: 8 January 2013 To: 8 January 2018**

Terms of approval

1. The Chief investigator is responsible for ensuring that permission letters are obtained, if relevant, and a copy forwarded to MUHREC before any data collection can occur at the specified organisation. **Failure to provide permission letters to MUHREC before data collection commences is in breach of the National Statement on Ethical Conduct in Human Research and the Australian Code for the Responsible Conduct of Research.**
2. Approval is only valid whilst you hold a position at Monash University.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by MUHREC.
4. You should notify MUHREC immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. **Complaints:** The researchers are required to inform MUHREC promptly of any complaints made about the project, whether the complaint was made directly to a member of the research team or to the primary HREC.
6. **Amendments to the approved project (including changes in personnel):** Requires the submission of a Request for Amendment form to MUHREC and must not begin without written approval from MUHREC. Substantial variations may require a new application.
7. **Future correspondence:** Please quote the project number and project title above in any further correspondence.
8. **Annual reports:** Continued approval of this project is dependent on the submission of an Annual Report. This is determined by the date of your letter of approval.
9. **Final report:** A Final Report should be provided at the conclusion of the project. MUHREC should be notified if the project is discontinued before the expected date of completion.
10. **Monitoring:** Projects may be subject to an audit or any other form of monitoring by MUHREC at any time.
11. **Retention and storage of data:** The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.

[redacted]

Professor Ben Canny
Chair, MUHREC

cc: Prof Vicki Anderson, Dr Emma Sciberras, Ms Jessica Green

Postal – Monash University, Vic 3800, Australia
Building 3E, Room 111, Clayton Campus, Wellington Road, Clayton
[redacted]
Email muhrec@monash.edu http://www.monash.edu.au/researchoffice/human/
ABN 12 377 614 012 CRICOS Provider #00008C

APPENDIX K: CURRENT ETHICS: ROYAL CHILDRENS HOSPITAL

The Royal Children's Hospital Melbourne
50 Flemington Road
Parkville Victoria 3052 Australia
[redacted]
www.rch.org.au

The Royal Children's Hospital Melbourne

RCH HUMAN RESEARCH ETHICS COMMITTEE APPROVAL

HREC REF. No:	**31056 D**
PROJECT TITLE:	The Children's Attention Project: A community-based longitudinal study of children with ADHD and non-ADHD controls
DOCUMENTS APPROVED:	Social Communication Questionnaire v1 dated July 2012 CAP Newsletter mid-year v1 dated July 2012 Stage 2 Parent Appointment Letter (Online Survey Option) v1 dated July 12 Principal Information Letter (Non-CAP School) v1 dated July 2012 Stage 2 Feedback Letter (Difficulties Identified) v4 dated July 2012 Teacher Screening Reminder Letter v3 dated July 2012 Parent Screening Reminder Letter v3 dated July 2012 Final Parent Reminder Letter v2 dated July 2012 CAP Teacher Screener Information Letter v2 dated July 2012 Unable to Book Parent Interview Letter v1 dated July 2012
APPROVED PROTOCOL:	Technical Protocol v7 dated July 2012
PRINCIPAL INVESTIGATOR:	Jan Nicholson
DATE OF MODIFICATION APPROVAL:	**16 July 2012**
DURATION:	22 months
DATE OF APPROVAL EXPIRY:	**17 May 2014**

SIGNED: [redacted] 18th July 2012

COMMITTEE REPRESENTATIVE

COMMENTS: Research Development & Ethics (RDE) acknowledges the submission of previously approved documents updated with administrative and formatting changes (branding etc).

APPROVED SUBJECT TO THE FOLLOWING CONDITIONS:

ALL PROJECTS

1. Must comply with the Investigator's Responsibilities in Research Procedure
2. Any proposed change in the protocol or approved documents or the addition of documents must be submitted to the Human Research Ethics Committee (HREC) for approval prior to implementation, including:
   - flyers, brochures, advertising material
   - Increase in recruitment target
3. The Principal Investigator must notify Research Development & Ethics of:
   - Any serious adverse effects of the study on participants and steps taken to deal with them.
   - Any unforeseen events (e.g. protocol violations or complaints).
   - Investigators withdrawing from or joining the project.
4. A progress report must be submitted annually and at the conclusion of the project.
5. RCH HREC approval must remain current for the entire duration of the project. If the project is not completed in

APPENDIX L: CAP PARENT INFORMATION STATEMENT

Murdoch Childrens Research Institute
Healthier Kids. Healthier Future.

PARENT/ GUARDIAN INFORMATION STATEMENT

HREC Project Number: 31056

Research Project Title: CAP – Children's Attention Project

Dear Parent,

Thank you for taking part in Stage 1 of CAP – Children's Attention Project. You gave us your contact details and indicated you may be interested in taking part in Stage 2 of the project. We are inviting a smaller number of families to participate in Stage 2 of the project. We would like to invite you to take part in Stage 2 and this letter gives you all the information about what is involved.

Purpose of the study:

The Children's Attention Project is about the long-term effects that children's attention difficulties and hyperactivity have on child behaviour, learning and day-to-day living, and also on their parents' well-being. For Stage 2 of the project, we are seeking the participation of parents, teachers and children in Grade 1.

This project is funded by the National Health and Medical Research Council and has been approved by the Human Research Ethics Committee of the Royal Children's Hospital and the Department of Education and Early Childhood Development, Victorian Government.

What participation involves:

Stage 2:

In Stage 2 of the project we would like to complete a detailed assessment of your child's behaviour. Participation in Stage 2 of this study involves four steps:

1. We would like you to **complete a questionnaire** about your child's behaviour, learning, and day-to-day living (e.g., how often has this been a problem for your child in the past month: feeling afraid or scared). The questionnaire also asks about your own well-being (e.g., in the past 4 weeks, how often did you feel nervous?). It will take about 20 minutes to complete. You can complete this at home.

2. We would like to **interview you** about your child's behaviour. This involves a face-to-face interview with a member of the CAP team at a time that is convenient for you. We can do this at the Royal Children's Hospital, at your child's school or at your home. Your child does not need to be present at this interview. It will take about 60-90 minutes to complete.

3. We would like to complete an **assessment with your child**. This involves your child completing some standard tests of cognitive ability, academic functioning (e.g., spelling and reading), language, attention visual-motor skills and memory commonly used with children. We would also like to take a measure of your child's weight and height. This is completed at your child's school during regular class time. We can also do this at the Royal Children's Hospital or at your home. It will take about 60-90 minutes to complete.

The Children's Excellence in clinical care, research and education
Patron Dame Elisabeth Murdoch AC DBE
Director Professor Terry Dwyer AO MD MPH
ABN 21 006 566 972
Royal Children's Hospital
Flemington Road Parkville
Victoria 3052 Australia
Phone +613 8341 6200
Fax +613 9348 1391
www.mcri.edu.au

4. Your child's teacher will also be asked to complete a questionnaire about your child. You don't have to consent to this if you do not want to. **Please tick the box on the consent form if you allow us to contact your child's teacher.**

Over time:

The Children's Attention Project is a long-term project that aims to follow-up children over their years of schooling to track their development. We will contact you to participate in follow-up assessments over the next three years of your child's development. In 12, 24, and 36 months time, we will contact you to complete a follow-up questionnaire to see how your child is going. We will also ask your child's teacher to complete questionnaires about your child's behaviour and learning at these times, if you allow us to contact him/her. Looking at the progress of children over time is an important part of our research and your participation would be greatly appreciated. **In 36 months time we will contact you to complete another interview about your child's behaviour and repeat an academic assessment with your child.**

Benefits of this research:

We will give you feedback on your child, based on the interview we do with you and the assessment we do with your child. We can direct you to services for further assessment if you wish. Your participation will also help to improve our understanding of childhood attention and hyperactivity difficulties and will help us to identify factors that will improve outcomes for children with such difficulties. Without the assistance of parents we are unable to undertake this important work, so we would greatly appreciate your participation.

Optional consent - Give your permission for CAP to carry out data retrieval or linkage:

As Australian children grow up, services and agencies collect and store information. You can give permission for the CAP team to access some of the information stored about your child which is related to health and learning. Below, we list the main organisations that store this information.

Health services:

- Medicare/ PBS (Pharmaceutical Benefits Scheme)

Educational services:

- School Entry Health Questionnaire
- Australian Early Development Index
- National Assessment Program- Language and Literacy (NAPLAN)

Over time, other databases may become available that could help our research. We are also asking your permission to access such information. This would also need approval from the Ethics Committee.

To collect this information, CAP will send a request to the organisation, which will include your child's name, birth date, or other details needed to identify your child's records, as well as your consent form. The organisation then gives the information directly and confidentially to the CAP researchers.

Patron Dame Elisabeth Murdoch AC DBE
Director Professor Terry Dwyer AO MD MPH
ABN 21 006 566 972
Royal Children's Hospital
Flemington Road Parkville
Victoria 3052 Australia
Phone +613 8341 6200
Fax +613 9348 1391
www.mcri.edu.au

Risks associated with this research:

We do not anticipate there to be any risks, side-effects or discomforts to you. There is a chance that some of the questions may stir up memories or feelings that could upset you (e.g., please rate how often in the past week 'I felt down-hearted and blue', please rate how often in the past week 'I felt I wasn't worth much as a person'). If this happens, we encourage you to call Dr Emma Sciberras on 9345 6662. She can then discuss these feelings with you and refer you for additional assistance if you wish.

Ensuring your privacy:

All the information you give us will stay private. We can only disclose the information with your permission, except as required by law. We will only use your information for this research project. We will remove your name from the information you give us and use a study number instead. We will keep all information in a private, locked room at the Murdoch Childrens Research Institute. The only people who can access your information are the research team and the RCH Ethics Committee. You have the right to access, and ask correction of, your information in accordance with the Freedom for Information Act 1982 (Vic). We will keep your information until your child is 25 years of age and after this time, we will destroy your information. The results of the project may be presented at conferences and published in professional journals. The results will not identify you or your family in any way.

The Children's Excellence in clinical care, research and education
Patron Dame Elisabeth Murdoch AC DBE
Director Professor Terry Dwyer AO MD MPH
ABN 21 006 566 972
Royal Children's Hospital
Flemington Road Parkville
Victoria 3052 Australia
Phone +613 8341 6200
Fax +613 9348 1391
www.mcri.edu.au

Feedback about the research:

We will send you a summary of the project's results when it is completed. The summary will be for the whole group of participants and will not have individual results. It will not identify you or your child.

Participating in the research:

We hope that you will consider participating in this study. You do not have to take part if you do not want to. If you decide to take part and later change your mind, you can withdraw from the project at any stage. If you decide to not participate in the project, it will not affect you or your child's standing at his/her school.

To take part in Stage 2 of this project please:

- **complete both consent forms and the questionnaire**
- **keep ONE copy of the consent form and this information letter for your records**
- **send the other consent form and the completed questionnaire to us in the reply-paid envelope provided**
- **when we receive your consent form, we will contact you to organise an interview time (if we haven't already booked this with you)**
- **If you consent to us contacting your child's teacher, we will send him/her a questionnaire to complete.**

Please do not hesitate to contact a member of the CAP Research Team on (03) 8341 6363 if you have any questions or wish to discuss the study in any way. We greatly appreciate families supporting research and your participation will help us to better our understanding of the emotional and physical health of Australian children. Thank you for considering participating in our study. We hope you will take part.

The CAP Research Team

[redacted]

Project Coordinator
Ms Liz Schilpzand
Murdoch Childrens Research Institute

[redacted]

If you have any concerns about the project, or the way it is being conducted, and would like to speak to someone independent of the project, please contact:

Head of Department
Ethics and Research Department
Human Research Ethics Committee
The Royal Children's Hospital
Telephone: (03) 9345 5044

Patron Dame Elisabeth Murdoch AC DBE
Director Professor Terry Dwyer AO MD MPH
ABN 21 006 566 972
Royal Children's Hospital
Flemington Road Parkville
Victoria 3052 Australia
Phone +613 8341 6200
Fax +613 9348 1391
www.mcri.edu.au

APPENDIX M: CAP PARENT CONSENT FORM

Murdoch Childrens Research Institute
Healthier Kids. Healthier Future.

CONSENT FORM FOR PARENT PARTICIPANT TO TAKE PART IN A RESEARCH PROJECT

HREC Project Number: 31056

Research Project Title: CAP – Children's Attention Project

I (Participant name) _____

☐ I voluntarily consent for me and my child to take part in the above research project.

☐ I give consent for the researchers to contact my child's school teacher to complete a survey.

- I believe I understand the purpose, extent and possible effects of my involvement in this project.
- I have had an opportunity to ask questions and I am satisfied with the answers I have received.
- I understand that this project has been approved by The Royal Children's Hospital Human Research Ethics Committee and will be carried out in line with the National Statement on Ethical Conduct in Human Research (2007).
- I understand I will receive a copy of this Participant Information Letter and Consent Form.

OPTIONAL CONSENT for data linkage and retrieval

☐	*Yes*, I do consent to all databases listed
☐	*Yes*, I do consent to all databases listed *and* future databases
☐	*No*, I do not consent

Participant Signature _____ **Date** _____

Child's name _____

I have supplied an Information Letter and Consent Form to the participant who has signed above, and believe that they understand the purpose, extent and possible effects of their involvement in this project.

Researcher Signature _____ **Date** _____

Note: All parties signing the Consent Form must date their own signature.

PLEASE RETAIN THIS COPY FOR YOUR RECORDS

The Children's Excellence in clinical care, research and education
Patron Dame Elisabeth Murdoch AC DBE
Director Professor Terry Dwyer AO MD MPH
ABN 21 006 566 972
Royal Children's Hospital
Flemington Road Parkville
Victoria 3052 Australia
Phone +613 8341 6200
Fax +613 9348 1391
www.mcri.edu.au

APPENDIX N: CAP TEACHER INFORMATION STATEMENT

Murdoch Childrens Research Institute
Healthier Kids. Healthier Future.

TEACHER PARTICIPANT INFORMATION LETTER

HREC Project Number: 31056

Research Project Title: Children's Attention Project (CAP)

Principal Researcher: Prof Jan Nicholson, Honorary Fellow

Version Number: 2 **Version Date:** 13/06/2013

Dear Teacher,

Thank you for taking the time to read this **Participant Information** Statement. This document is 4 pages long. Please make sure you have all of the pages.

A student in your class is participating in the Children's Attention Project (CAP), which is being conducted by the Murdoch Childrens Research Institute based at the Royal Children's Hospital. We first assessed children in Grade 1 and we are now seeing how children are going as they progress through primary school. The parent of your student has given their consent for us to contact you and ask you to complete a questionnaire about their child. We would like to invite you to participate in this study.

What is an Information Statement?
These pages tell you about the research project. It explains to you clearly and openly all the steps and procedures of the project. The information is to help you to decide whether or not you would like to take part in the research. Please read this Information Statement carefully.

Before you decide to take part or not, you can ask us any questions you have about the project. You may want to talk about the project with your family, friends or health care worker.

If you would like to take part in the research project, please indicate your consent to participate at the start of the online questionnaire. By doing this you are telling us that you:

- understand what you have read
- had a chance to ask questions and received satisfactory answers
- consent to taking part in the project

Please print a copy of this information for you to keep.

1. What is the research project about?

CAP is about the long-term effects that children's attention difficulties and hyperactivity have on child behaviour, learning and day-to-day living, and also on their parents' well-being. Although a vast amount of research has been published on various aspects associated with children experiencing these difficulties, relatively little is known about the long-term outcomes of these children. Approximately 500 children from almost 50 schools around Melbourne are participating in CAP.

The Children's
Excellence in clinical care, research and education
Murdoch Childrens Research Institute
Murdoch Childrens Research Institute
The Royal Children's Hospital
Flemington Road, Parkville VIC 3052 Australia
T 03 8341 6200 - F 03 9348 1391
ABN 21 006 566 972
www.mcri.edu.au
Chairman Leigh Clifford AO
Director Professor Kathryn North AM MD FRACP
Ambassador Sarah Murdoch

Murdoch Childrens Research Institute
Healthier Kids. Healthier Future.

2. Who is funding this research project?

This project is funded by the National Health and Medical Research Council and has been approved by the Human Research Ethics Committee of the Royal Children's Hospital and the Department of Education and Early Childhood Development, Victorian Government.

3. Why am I being asked to be in this research project?

A student in your class is participating in CAP. We first assessed children in Grade 1 and we are now seeing how children are going as they progress through primary school. The parent of your student has given their consent for us to contact you and ask you to complete a questionnaire about their child.

4. What does participation in this research involve?

We would like you to complete an online questionnaire about your student's behaviour and learning (e.g., Considering your teaching experience with children of this age, how severe are this child's problems at this time?). This questionnaire will take about 15 minutes to complete. If you haven't already done so, we would also like you to complete a short online questionnaire asking for some details about you as a teacher (e.g., Including this school year, how many years have you worked as a teacher?). This questionnaire will take about 5 minutes to complete.

5. What are my alternatives to taking part?

Participation in a research project is voluntary.

6. What are the possible benefits for me and other people in the future?

Although you are not likely to benefit directly from participation in this study, your participation will help to improve our understanding of the attention and hyperactivity difficulties in children and help us to identify factors that will improve outcomes for children with such difficulties. Teachers play a crucial role in a child's development and without the assistance of teachers we are unable to undertake this important work. We greatly appreciate your participation.

7. What are the possible risks, side-effects, discomforts and/or inconveniences?

We do not anticipate there to be any risks, side-effects or discomforts to you. It takes time to complete a questionnaire. We will try to minimise any disruption to your time. The questionnaire can be completed in your own time at your own pace. **If you have any concerns about your student's behavior and learning, we encourage you to talk to the child's parent about this.**

The Children's
Excellence in clinical care, research and education
Murdoch Childrens Research Institute
The Royal Children's Hospital
Flemington Road, Parkville VIC 3052 Australia
T 03 8341 6200 - F 03 9348 1391
ABN 21 006 566 972
www.mcri.edu.au
Chairman Leigh Clifford AO
Director Professor Kathryn North AM MD FRACP
Ambassador Sarah Murdoch

Murdoch Childrens Research Institute
Healthier Kids. Healthier Future.

8. What will be done to make sure my information is confidential?

All the information you give us will stay private. We can only disclose the information with your permission, except as required by law. We will only use your information for this research project. We will remove your name from the information you give us and use a study number instead. We will keep all information in a private, locked room at the Murdoch Childrens Research Institute. The only people who can access your information are the research team and the RCH Ethics Committee. You have the right to access, and ask correction of, your information in accordance with the Freedom for Information Act 1982 (Vic). We will keep your information until your student is 25 years of age and after this time, we will destroy your information. The results of the project may be presented at conferences and published in professional journals. The results will not identify you or your school in any way.

9. Will I be informed of the results when the research project is finished?

We will send you a summary of the project's results when it is completed. The summary will be for the whole group of participants and will not have individual results. It will not identify you.

The Children's
Excellence in clinical care, research and education
Murdoch Childrens Research Institute
THE UNIVERSITY OF MELBOURNE

Murdoch Childrens Research Institute
The Royal Children's Hospital
Flemington Road, Parkville VIC 3052 Australia
T 03 8341 6200 - F 03 9348 1391
ABN 21 006 566 972
www.mcri.edu.au

Chairman Leigh Clifford AO
Director Professor Kathryn North AM MD FRACP
Ambassador Sarah Murdoch

Participating in the research:

We hope that you will consider participating in this study. You do not have to take part if you do not want to. If you decide to take part and later change your mind, you can withdraw from the project at any stage. If you decide to not participate in the project, it will not affect your standing at your school.

To take part please:

- **keep a copy of this information letter for your records**
- **indicate your consent to participate at the start of the online questionnaire**
- **submit your completed questionnaire to us online within the next 5 business days**

Please do not hesitate to contact a member of the CAP Research Team on (03) 8341 6363 if you have any questions or wish to discuss the study in any way. We greatly appreciate teachers supporting research and your participation will help us to better our understanding of the emotional and physical health of Australian children. Thank you for considering participating in our study. We hope you will take part.

Yours sincerely,

The CAP Research Team

[redacted]

[redacted]

Project Coordinator
Mr Matthew Bisset
Murdoch Childrens Research Institute
[redacted]

[redacted]

Principal Investigator
Prof Jan Nicholson
Murdoch Childrens Research Institute

If you have any concerns and/or complaints about the project, the way it is being conducted or your rights as a research participant, and would like to speak to someone independent of the project, please contact:

Director
Research Development & Ethics
The Royal Children's Hospital Melbourne
[redacted]

Murdoch Childrens Research Institute
The Royal Children's Hospital
Flemington Road, Parkville VIC 3052 Australia
T 03 8341 6200 - F 03 9348 1391
ABN 21 006 566 972
www.mcri.edu.au

APPENDIX O: CAP TEACHER CONSENT FORM

Murdoch Childrens Research Institute
Healthier Kids. Healthier Future.

CONSENT FORM FOR TEACHER PARTICIPANT TO TAKE PART IN A RESEARCH PROJECT

HREC Project Number: 31056

Research Project Title: CAP – Children's Attention Project

I (Participant name) _____

voluntarily consent to take part in the above research project.

- I believe I understand the purpose, extent and possible effects of my involvement in this project.
- I have had an opportunity to ask questions and I am satisfied with the answers I have received.
- I understand that this project has been approved by The Royal Children's Hospital Human Research Ethics Committee and will be carried out in line with the National Statement on Ethical Conduct in Human Research (2007).
- I understand I will receive a copy of this Participant Information Letter and Consent Form.

Participant Signature _____ **Date** _____

I have supplied an Information Letter and Consent Form to the participant who has signed above, and believe that they understand the purpose, extent and possible effects of their involvement in this project.

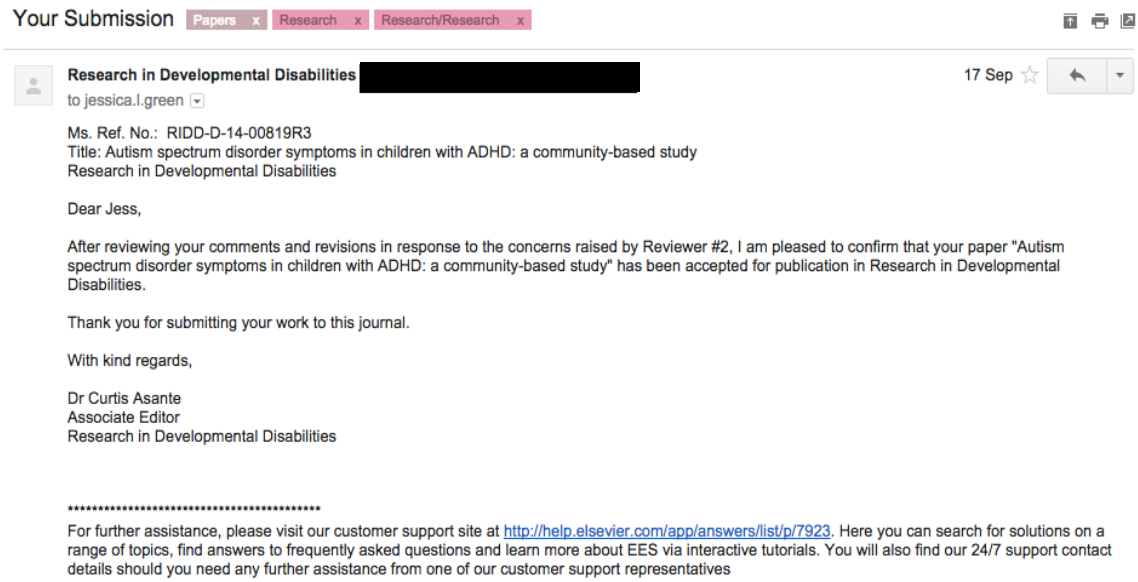
Researcher Signature _____ **Date** _____

Note: All parties signing the Consent Form must date their own signature.

PLEASE RETAIN THIS COPY FOR YOUR RECORDS

The Children's Excellence in clinical care, research and education
Patron Dame Elisabeth Murdoch AC DBE
Director Professor Terry Dwyer AO MD MPH
ABN 21 006 566 972
Royal Children's Hospital Flemington Road Parkville Victoria 3052 Australia
Phone +613 8341 6200 Fax +613 9348 1391 www.mcri.edu.au

APPENDIX P: ACCEPTANCE EMAIL PAPER 1



Your Submission Papers x Research x Research/Research x

Research in Developmental Disabilities [redacted] 17 Sep

to jessica.l.green

Ms. Ref. No.: RIDD-D-14-00819R3
Title: Autism spectrum disorder symptoms in children with ADHD: a community-based study
Research in Developmental Disabilities

Dear Jess,

After reviewing your comments and revisions in response to the concerns raised by Reviewer #2, I am pleased to confirm that your paper "Autism spectrum disorder symptoms in children with ADHD: a community-based study" has been accepted for publication in Research in Developmental Disabilities.

Thank you for submitting your work to this journal.

With kind regards,

Dr Curtis Asante
Associate Editor
Research in Developmental Disabilities

****

For further assistance, please visit our customer support site at http://help.elsevier.com/app/answers/list/p/7923. Here you can search for solutions on a range of topics, find answers to frequently asked questions and learn more about EES via interactive tutorials. You will also find our 24/7 support contact details should you need any further assistance from one of our customer support representatives