Children’s temperament and parenting practices in the first five years of life and cognitive, academic and adiposity outcomes in later childhood and adolescence

Shiau Yun Chong

BSc (Hons), MPH

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

August 2016

School of Public Health
Faculty of Health Sciences
The University of Adelaide
Australia
Contents

Abstract ...................................................................................................................... vii
Declaration .................................................................................................................. x
Acknowledgements ..................................................................................................... xi
Publications contributing to this thesis ................................................................. xii
Presentations arising from this thesis ....................................................................... xiii
Abbreviations ............................................................................................................. xiv
List of tables ............................................................................................................... xvi
List of figures ............................................................................................................ xviii

CHAPTER 1. Introduction ........................................................................................... 1
  1.1 Child temperament and parenting ................................................................. 1
  1.2 Why study cognitive ability and overweight? .................................................. 3
  1.3 Thesis aim and research questions .................................................................. 4
  1.4 Thesis outline ................................................................................................... 5

CHAPTER 2. Literature review ................................................................................. 8
  2.1 Temperament ..................................................................................................... 8
      2.1.1 History of temperament ............................................................................. 8
      2.1.2 Definitions and models of temperament .................................................... 10
      2.1.3 Approaches to measuring temperament in infants and children .............. 24
      2.1.4 Stability of temperament .......................................................................... 25
      2.1.5 Differences in temperament by gender, socio-economic background, and culture .. 26
      2.1.6 Research question 1 .................................................................................. 28
  2.2 Parenting .......................................................................................................... 29
      2.2.1 Definition of parenting practices ................................................................. 30
      2.2.2 Parenting practices that are important for child cognitive and adiposity outcomes .30
  2.3 Temperament and parenting influences on child development ..................... 34
      2.3.1 Direct and indirect effects ........................................................................... 35
      2.3.2 Theoretical “interaction” models ................................................................. 37
  2.4 Temperament and parenting influences on cognitive outcomes .................... 42
      2.4.1 Temperament and cognitive outcomes ....................................................... 42
      2.4.2 Parenting influences on cognitive outcomes .............................................. 45
      2.4.3 Temperament and parenting and influence on cognitive outcomes .......... 47
7.3.5 Results ....................................................................................................................... 201
7.3.6 Discussion ................................................................................................................. 208
7.3.7 Online appendices .................................................................................................... 213

7.4 PART 3: Does temperament modify the association between parental feeding control and adiposity? ....................................................................................... 217
  7.4.1 Introduction .............................................................................................................. 217
  7.4.2 Method ..................................................................................................................... 218
  7.4.3 Result ........................................................................................................................ 218
  7.4.4 Discussion ................................................................................................................. 222

CHAPTER 8. Summary and Conclusions ........................................................................ 224
  8.1 Key findings and contributions .............................................................................. 225
  8.2 Limitations and future directions ........................................................................ 231
  8.3 Implications and recommendations ................................................................ 233
  8.4 Concluding remarks .......................................................................................... 234
  8.5 Appendices ........................................................................................................ 235

References ............................................................................................................... 245
Abstract

The aims of this thesis are to examine the associations between children’s temperament, parenting practices and three important public health outcomes: cognitive ability, academic achievement and adiposity. While there have been decades of psychological research in this area, this thesis takes a contemporary epidemiological approach to the topic and addresses some of the methodological limitations of past studies by using more advanced methods and longitudinal data from both Australia and the UK.

There are four papers in this thesis. The first study examined whether norms in the Revised Infant Temperament Questionnaire (RITQ) were suitable for use in a population sample of UK infants. The RITQ was normed on a small group of US infants in 1978 and has never been updated. Findings showed that 15% of children would be classified as temperamentally difficult using norms empirically derived from the UK infant data, compared to 24% using RITQ’s norms, suggesting that potential misclassification of infant temperament occurred from using different norms. This study highlighted the need for more recent and culturally-specific temperament norms to categorise infant temperament. Temperament categories defined using the norms in this study were used in subsequent analyses in study 3 and 4.

Children’s temperament may influence parenting, which is known to affect cognitive and academic outcomes. Most studies of temperament have not adequately accounted for parenting practices when examining the effect of temperament on cognitive and academic outcomes. To properly handle parenting practices at age 4 to 5 years as an intermediate variable, the second study used a marginal structural model to examine the
controlled direct effects of temperament at 2 to 3 years on cognitive and academic outcomes at 6 to 7 years in a nationally representative sample of Australian children. Temperament dimensions measured in this study were reactivity, approach, and persistence. This study found that the controlled direct effects of temperament on cognitive and academic outcomes was small. The largest effect (0.11 SD) was for persistence on verbal ability.

Since temperament had such a small influence on children’s cognitive and academic outcomes, this thesis then examined parenting as the exposure, as parenting may have a greater influence on cognitive ability than temperament. The associations between parenting practices (warmth and control) and children’s IQ in the UK cohort were explored in study 3. Temperament was contextualised as an effect-measure modifier, a variable that may modify the associations between warmth, control and IQ. Low parental warmth and high parental control at 24 to 47 months were associated with lower IQ at age 8 years. Effect sizes for warmth and control were 0.03 SD and 0.15 SD, respectively. Counter to the study’s hypothesis, temperamentally easier children were more susceptible to the negative effects of low warmth and high control parenting than temperamentally difficult children.

Besides cognitive and academic outcomes, there is some evidence that parenting and temperament may influence children’s adiposity. The fourth study focused on two more specific dimensions of parenting, namely parental feeding control and using food to soothe a child. The associations between feeding control, using food to soothe, and body mass index (BMI) and fat mass were explored in the UK cohort. Whether these
associations differed for children with different temperaments were examined using an analysis of effect-measure modification. Contrary to some studies, higher parental feeding control at age 42 to 65 months was associated with lower BMI at ages 7 and 15 years and fat mass at age 15 years. No association between using food to soothe (42 months) and BMI (7 and 15 years) or fat mass (15 years) were found.

Using two large, longitudinal observational studies from different countries, different temperament tools, and measures of temperament at different ages, the research in this thesis indicated that the effect sizes for temperament on cognitive, academic and adiposity outcomes are at best, very small. The differential susceptibility theory suggested by previous psychological studies, that temperamentally difficult children were more vulnerable to the detrimental effects of negative parenting, was not supported in the UK cohort and using contemporary epidemiological methods. It is recommended that future studies adjust rigorously for important confounders and use large, representative samples when examining the effect-measure modification by temperament of the associations between parenting and cognitive, academic and adiposity outcomes.
Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

I give consent to this copy of my thesis when deposited in the University Library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968.

The author acknowledges that copyright of published works contained within this thesis resides with the copyright holder(s) of those works.

I also give permission for the digital version of my thesis to be made available on the web, via the University’s digital research repository, the Library Search and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

Signed ... Date 15-08-2016

x
Acknowledgements

I am very grateful to my supervisors – Associate Professor Lisa Smithers, Dr Catherine Chittleborough, Dr Tess Gregory, Professor John Lynch, and Dr Murthy Mittinty. Lisa, Cathy, and Tess have always provided me the support and encouragement throughout the candidature and I am very thankful for your patience and support all these years. Thank you John for your insightful comments on chapters and publications. You are always a great teacher and I have learned many things from being part of your team. Thank you Murthy for your advice and support to get me through the process of data analysis and interpretation.

I would also like to thank all participants and staff from the Avon Longitudinal Study of Parents and Children and the Longitudinal Study of Australian Children. I would like to acknowledge and thank the University of Adelaide and the Fraser Mustard Centre for funding this project. This thesis would not be possible without the data and funding sources.

A very special thank you goes to my parents, brothers, and sister. Thank you all for your unconditional love, patience, and giving me all the best opportunities in life. I would like to thank my PhD colleagues - Amelia Maika, Ting Xia, Edilene Lopes, Angela Gialamas, Gizachew Tessema, for sharing your expertise and lending me your ears. To my friends, especially Erica Sung, for your support all these years in my PhD journey. You listened to my frustration, talked through the issues with me, and I am so grateful to know you and your family.
Publications contributing to this thesis


• Chong SY, Chittleborough CR, Gregory T, Lynch JW, Mittinty MN, Smithers LG. Does temperament at ages 2-3 directly affect cognitive and academic outcomes at ages 6-7? Under review.

• Chong SY, Chittleborough CR, Gregory T, Lynch JW, Mittinty MN, Smithers LG. Associations of parental feeding control and use of food to soothe with adiposity in childhood and adolescence. Under review.
Presentations arising from this thesis

- Chong SY, Chittleborough CR, Gregory T, Mittinty MN, Lynch JW, Smithers LG.
  Parenting influence on the association between temperament and IQ. Infant and Early
  Childhood Social and Emotional Wellbeing Conference. Canberra, Australia, October
  2013.

- Chong SY, Chittleborough CR, Gregory T, Mittinty MN, Lynch JW, Smithers LG. Child
  temperament, parenting and IQ: Findings from a population-based cohort of parents
  and children. Public Health Association of Australia (South Australia Branch) State

- Chong SY, Chittleborough CR, Gregory T, Mittinty MN, Lynch JW, Smithers LG.
  Influence of parenting and child temperament on Intelligence Quotient (IQ) at 8 years.
  The 20th Occasional Temperament Conference. Lincoln, Nebraska, USA, November
  2014.

- Chong SY, Chittleborough CR, Gregory T, Mittinty MN, Lynch JW, Smithers LG. Using
  marginal structural models to estimate the direct effect of temperament at 2-3 years
  on receptive vocabulary and academic achievement at 6-7 years. 2015 Robinson

- Chong SY, Chittleborough CR, Gregory T, Lynch JW, Mittinty MN, Smithers LG. Effects
  of parental feeding practices and temperament on BMI and fat mass from childhood
  through adolescence. 13th International Congress on Obesity, Vancouver, May 2016.
### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALSPAC</td>
<td>Avon Longitudinal Study of Parents and Children</td>
</tr>
<tr>
<td>ARS</td>
<td>Academic Rating Scale</td>
</tr>
<tr>
<td>ATP</td>
<td>Australian Temperament Project</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>CDE</td>
<td>Controlled direct effect</td>
</tr>
<tr>
<td>CDC</td>
<td>Centers for Disease Control and Prevention</td>
</tr>
<tr>
<td>CFQ</td>
<td>Child Feeding Questionnaire</td>
</tr>
<tr>
<td>CSE</td>
<td>Certificate of Secondary Education</td>
</tr>
<tr>
<td>DAG</td>
<td>Directed acyclic graph</td>
</tr>
<tr>
<td>DXA</td>
<td>Dual energy X-ray absorptiometry</td>
</tr>
<tr>
<td>EAS</td>
<td>Emotional, Activity, and Sociability</td>
</tr>
<tr>
<td>EMM</td>
<td>Effect-measure modification</td>
</tr>
<tr>
<td>FFQ</td>
<td>Food Frequency Questionnaire</td>
</tr>
<tr>
<td>IOTF</td>
<td>International Obesity Task Force</td>
</tr>
<tr>
<td>ITQ</td>
<td>Infant Temperament Questionnaire</td>
</tr>
<tr>
<td>IQ</td>
<td>Intelligence Quotient</td>
</tr>
<tr>
<td>IRSD</td>
<td>Index of Relative Socio-economic Disadvantage</td>
</tr>
<tr>
<td>K6</td>
<td>Kessler 6 Scale</td>
</tr>
<tr>
<td>LAB-TAB</td>
<td>Laboratory Temperament Assessment Battery</td>
</tr>
<tr>
<td>LCA</td>
<td>latent class analysis</td>
</tr>
<tr>
<td>MAR</td>
<td>Missing at random</td>
</tr>
<tr>
<td>MCAR</td>
<td>Missing completely at random</td>
</tr>
<tr>
<td>MNAR</td>
<td>Missing not at random</td>
</tr>
<tr>
<td>MICE</td>
<td>Multiple imputation by chained equation</td>
</tr>
<tr>
<td>LSAC</td>
<td>Longitudinal Study of Australian Children</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>MSM</td>
<td>Marginal structural model</td>
</tr>
<tr>
<td>NYLS</td>
<td>New York Longitudinal Study</td>
</tr>
<tr>
<td>PPVT</td>
<td>Peabody Picture Vocabulary Test</td>
</tr>
<tr>
<td>RERI</td>
<td>Relative excess risk due to interaction</td>
</tr>
<tr>
<td>RITQ</td>
<td>Revised Infant Temperament Questionnaire</td>
</tr>
<tr>
<td>RR</td>
<td>Risk ratio</td>
</tr>
<tr>
<td>SEM</td>
<td>Structural equation model</td>
</tr>
<tr>
<td>STSC</td>
<td>Short Temperament Scale for Children</td>
</tr>
<tr>
<td>STSI</td>
<td>Short Temperament Scale for Infants</td>
</tr>
<tr>
<td>STST</td>
<td>Short Temperament Scale for Toddlers</td>
</tr>
<tr>
<td>TBAQ</td>
<td>Toddler Behavior Assessment Questionnaire</td>
</tr>
<tr>
<td>TTS</td>
<td>Toddler Temperament Scale</td>
</tr>
</tbody>
</table>
List of tables

Table 2.1 Definitions, dimensions, and questionnaires used for temperament.......................... 11
Table 2.2 Definitions and sample items of the nine temperament dimensions proposed by Thomas and Chess27 ................................................................................................ 15
Table 2.3 The main dimensions and sub-dimensions of temperament proposed by Rothbart5 ................................................................................................................. 18
Table 3.1 Outline of data used to answer each research question........................................ 59
Table 3.2 International Obesity Task Force (IOTF) age and sex specific cut points for BMI used to define overweight/obesity201 ..................................................................... 64
Table 4.1 Socio-demographic characteristics of the Avon Longitudinal Study of Parents and Children (ALSPAC) sample ............................................................................. 103
Table 4.2 Comparison of temperament subscale means and SDs (norms) in the Revised Infant Temperament Questionnaire (RITQ) and Avon Longitudinal Study of Parents and Children (ALSPAC) samples ............................................................................. 105
Table 4.3 Temperament categorisation of the Avon Longitudinal Study of Parents and Children (ALSPAC) sample based on means and SDs from the Revised Infant Temperament Questionnaire (RITQ) and ALSPAC samples (n=10937) ............................................................................. 106
Table 4.4 Norms from the Avon Longitudinal Study of Parents and Children (ALSPAC) and the four randomly split subsamples ............................................................................. 110
Table 4.5 Temperament categorisation in the Avon Longitudinal Study of Parents and Children (ALSPAC) sample and the four randomly split subsamples .................... 111
Table 5.1 Characteristics of response, complete case, and imputed samples .................. 125
Table 5.2 Controlled direct effects (CDEs) of temperament reactivity, approach, and persistence at ages 2 to 3 years on child outcomes at ages 6 to 7 years (n=5107) ................................................................................................................. 127
Table 5.3 Stabilised inverse probability of treatment weights ........................................ 133
Table 5.4 The effect of a potential unmeasured binary confounder U of parenting practices to outcomes pathway .......................................................... 137
Table 6.1 Parenting measures in the ALSPAC questionnaires ........................................... 152
Table 6.2 IQ, parenting, temperament, and demographic characteristics of response, complete case and imputed sample .......................................................... 159
Table 6.3 Association between parenting warmth and control, and child temperament on children’s IQ (Imputed sample, n=7044) ...............................................................161
Table 6.4 Effect-measure modification of the effect of parenting warmth on IQ (<85) by child temperament (Imputed sample, n=7044)...............................................................163
Table 6.5 Effect-measure modification of the effect of parenting control on IQ (< 85) by child temperament (Imputed sample, n=7044)...............................................................165
Table 7.1 Characteristics of ALSPAC and LSAC samples.....................................................184
Table 7.2 Association between temperament (6, 24 months, and 38 months) and BMI z-score at 7 years in ALSPAC .....................................................................................186
Table 7.3 Association between temperament (0 to 1, 2 to 3 and 4 to 5 years) and BMI z-score at 6 to 7 years in LSAC ..................................................................................187
Table 7.4 Maternal and child characteristics of those participants according to their responses to the feeding control and use of food to soothe items at 3.5 years (n=7312) .................................................................................................................203
Table 7.5 Associations between parental feeding control (3.5 years) on BMI z-score at 7 and 15 years, and fat mass at 15 years in imputed sample (n=7312) .........................206
Table 7.6 Associations between parental use of food to soothe (3.5 years) on BMI z-score at 7 and 15 years, and fat mass at 15 years in imputed sample (n=7312) .................207
Table 7.7 Characteristics of ALSPAC study participants............................................................215
Table 7.8 Effect-measure modification by temperament on the association between parental feeding control and overweighta at age 15 years (n=7312) .........................220
Table 7.9 Effect-measure modification by temperament on the association between parental feeding control and excess fat massa at age 15 years (n=7312) .................221
List of figures

Figure 1.1: Socio-ecological context shaping child development\textsuperscript{2} ........................................ 1

Figure 2.1 Regression approach to estimate direct effect with exposure $X$, mediator $M$, outcome $Y$ and a set of confounders $C$...................................................................................... 36

Figure 2.2 Adapted figure for diathesis stress and differential susceptibility model\textsuperscript{132} ..... 39

Figure 3.1 ALSPAC eligible study areas. Pregnant women from three District Health Authorities (DHA) were recruited\textsuperscript{198} ........................................................................ 61

Figure 3.2 An example in the Matrix Reasoning test ............................................................ 70

Figure 3.3 DAG of the hypothesized effect of temperament and parenting practices on cognitive and academic achievement ................................................................. 75

Figure 3.4 Latent class model of parenting warmth and control. Latent variable (oval), latent class indicators (rectangles), associations between latent variable and indicators (arrows)........................................................................................................ 80

Figure 3.5 DAG representing the effect of feeding control on child adiposity outcomes .. 85

Figure 3.6 DAG representing the effect of food to soothe on child adiposity outcomes ... 86

Figure 4.1 Categorisation algorithm for each temperament group...................................... 101

Figure 5.1 Causal diagram of the hypothesized effects of temperament at 2 to 3 years and parenting practices at 4 to 5 years on cognitive and academic outcomes at ages 6 to 7 years ........................................................................................................ 131

Figure 6.1 Eligible cohort and numbers included................................................................. 149

Figure 6.2 Effect-measure modification of the effect of parenting warmth on IQ by child temperament........................................................................................................ 176

Figure 6.3 Effect-measure modification of the effect of parenting control on IQ by child temperament........................................................................................................ 177

Figure 7.1 Flow chart of participants.................................................................................... 198