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Adults Living with Autism Spectrum Disorder:

Self Perceived Traits of Autism, Marital Quality, Parenting Competency and Anxiety Symptoms

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Abstract

Autism Spectrum Disorder (ASD) are life-long conditions characterised by socio-communication deficits and stereotyped behaviours (American Psychiatric Association, 2013). To date, little is known about experiences of adults living with ASD, especially for those who manage to develop couple relationships and become parents (Howlin & Moss, 2012). This research examines the associations between self-perceived traits of autism and marital quality, parenting sense of competency and anxiety symptoms in adults affected by ASD. Uniquely, the sample encompasses 1) adults diagnosed with ASD whose children also have diagnosis of ASD; 2) non-ASD diagnosed parents who have children diagnosed with ASD and; 3) non-ASD parents who have typically developing children. Parents of children diagnosed with ASD are particularly targeted for their susceptibility to tendency towards autism (Bernier, Gerdts, Munson, Dawson, & Estes, 2011), and their distinctively high prevalence of psychiatric illness and marital breakdowns (Benson & Kersh, 2011; Hayes & Watson, 2013). Effects of child versus parental traits of autism were considered simultaneously.

The thesis entails five empirical studies of which four have been published in peer-reviewed journals and one currently under review. Study 1 (chapter 5) investigated the associations between adult attachment style, marital quality and parenting satisfaction in adults formally diagnosed with Asperger's Disorder/Asperger's Syndrome (AS; a higher functioning variant of ASD). Strikingly, as high as 82% of this group reported insecure adult attachment style as opposed to 22% of non-ASD controls. Interestingly no association between insecure attachment style and marital dissatisfaction was found in the AS group, and their marital satisfaction did not differ from the non-ASD controls. Diagnosis of AS in child, but not in parent, was associated with parenting satisfaction. Study 2 (chapter 6) advanced the research by exploring the link between parental self-perceived traits of autism and parenting sense of efficacy in a significantly large sample of Australian parents (n=346). Interestingly, nearly half (47%) of the parents diagnosed with ASD rated themselves below the recommended diagnostic cut-off on the Autism Spectrum Quotient (AQ) whereas about 20% of the non-diagnosed parents of children with ASD scored above the cut-off on the AQ. Low parenting sense of efficacy was noted in undiagnosed mothers who scored highly on the AQ and in fathers who had formal diagnosis of ASD. These findings highlighted the importance of measuring traits of autism in parents of children with ASD and called for a reliable tool for this purpose. Thus Study 3 and Study 4 were devoted to test factorial solutions for the AQ. Study 3 (chapter 7) was based on data from 455

Australian adults of whom 141 had clinical diagnosis of ASD. Study 4 (chapter 8) drew from 4,192 Taiwanese parents of whom 1,208 had children with ASD. Each study resulted in a factor model (AQ-39 and AQ-Chinese respectively) that demonstrated significantly improved goodness of fit than previously published factorial solutions for the AQ. The AQ was found to have consistent reliability across non-clinical and clinical populations, was culturally robust and its constructs corresponded with the current diagnostic taxonomy of ASD. The AQ-Chinese was the first AQ factorial solution tailored to the Mandarin-speaking community. Study 5 (chapter 9) employed the AQ-Chinese to test the link between self-perceived traits of autism and anxiety symptoms in 491 Taiwanese couples raising children with ASD. Unique to this study were its couple-centred approach and its inclusion of all anxiety domains. Large effect sizes were found in social phobia and post traumatic stress disorders for both genders, and in general anxiety disorder and agoraphobia for female. These associations were irrespective of child’s tendency towards autism, spouse’s AQ scores and the couples’ compatibility in their tendency towards autism.

Findings from this research offer imperative theoretical and clinical implications in regard to broad autism phenotype in parents of children with ASD, parenting training and couple counselling approaches for adults with ASD, effects of child versus parental traits of autism on parental psychosocial functioning, cultural influence in autism, screening and diagnosing ASD in adults who are high functioning and research and clinical utility of the AQ.

Declaration by Author

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Publications during Candidature

Lau, W.Y.P. & Peterson, C. (2010). *Asperger Syndrome in Parent and in Child: The Effect on Marital Satisfaction and Family Dynamic.* In: The IX International Congress of Autism Europe, poster session, Catania: Italy.

Lau, W.Y.P., Peterson, C. & Kelly, A. (2010). *Asperger Syndrome in Marriage and Parenthood.* In: The 9th International Meeting for Autism Research (IMFAR), poster session. Philadelphia, USA.

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Lau, W. Y. P., Peterson, C. C., Attwood, T. J., Garnett, M. S. & Kelly, A. B. (under review). Parents on the Autism Continuum: Self-Perceived Autistic Traits and Parenting Efficacy. *(submitted on 17 May 2014).*

Lau, W. Y. P., Kelly, A. B. & Peterson, C. C. (2013). Further Evidence on the Factorial Structure of the Autism Spectrum Quotient (AQ) for Adults with and without a Clinical Diagnosis of Autism. *Journal of Autism and Developmental Disorders*, 43 (12), 2807-2815.

Lau, W. Y. P., Gau S. S., Chiu, Y. N., Wu, Y. Y., Chou, W. J., Liu, S. K. & Chou, M. C. (2013). Psychometric properties of the Chinese version of the Autism Spectrum Quotient (AQ). *Research in Developmental Disabilities, 34,* 294-305.

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Winnie Yu Pow Lau (candidate)	Recruited sample (100%) Developed and chose measures (100%) Performed data analyses (100%) Prepared tables (100%) Wrote manuscript drafts (100%) Revised manuscript for publication (70%)
Prof. Candida Peterson (primary supervisor)	Supervised (100%) Revised manuscript for publication (30%)

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Keywords

Autism Spectrum Disorders, adults, parents, couples, Autism Spectrum Quotient (AQ), adult attachment style, marital quality, parenting sense of efficacy, anxiety symptoms, factor analysis.

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Table of Contents

Abstract *I*
Declaration by Author *III*
Publications during Candidature *III*
Acknowledgments *Error! Bookmark not defined.*
Keywords *Error! Bookmark not defined.*
Table of Contents *XIII*
List of Abbreviations *XVI*
List of Tables *XVII*
List of Figures *XVIII*

OVERVIEW *1*

CHAPTER 1 *7*

RESEARCH CONTEXT

1.1. Autism Spectrum Disorder: Current Conceptualisation 7
1.2. Theories of Autism Spectrum Disorder 9
1.2.1. Genetic Predisposition 9
1.2.2. Biological Brain Theories 9
1.2.3. Cognitive Theories 10
1.3. Autism Spectrum Disorder: Implications on Social Functioning 11
1.4. Research Focus 13

CHAPTER 2 *14*

AUTISM SPECTRUM DISORDER IN ADULTHOOD: MARITAL AND PARENTING ASPECTS

2.1. Outcome Studies on Adults with Autism Spectrum Disorder 14
2.2. Diagnostic Status and Overall Functioning at Follow Up 16
2.3. Adults with Autism Spectrum Disorder in Long-term Relationships 17
2.4. Marital Satisfaction of Couples Where One Partner Has Autism Spectrum Disorder 20
2.5. Parenting Experience of Adults with Autism Spectrum Disorder 21
2.6. Psychiatric Risks of Adults with Autism Spectrum Disorder 22
2.7. Challenges in Diagnosing and Servicing Adults with Autism Spectrum Disorder 23
2.8. Parents with Autism Spectrum Disorder and Parents of Children with Autism Spectrum Disorder 27
2.9. Conclusions from a Review of Literature on Marital and Parenting Experience of Adults with Autism Spectrum Disorder 28

CHAPTER 3 *30*

PARENTS OF CHILDREN WITH AUTISM SPECTRUM DISORDER:

3.1. Stress in Parents of Children with Autism Spectrum Disorder 30
3.2. Parenting Efficacy and Marital Quality of Parents of Children with Autism Spectrum Disorder 33
3.3. Traits of Autism in Parents of Children with Autism Spectrum Disorder 36
3.4. Psychiatric Risks of Parents of Children with Autism Spectrum Disorder 38
3.5. Traits of Autism and Psychosocial Functioning of Parents of Children with Autism Spectrum Disorder 40

3.6. *Gender Differences in Coping with Parenting Stress* 41
3.7. *The Autism Spectrum Quotient as a Screening and Diagnostic Tool* 43
3.8. *Conclusions from a Review of Literature on Parents of Children with Autism Spectrum Disorder* 46

CHAPTER 4 **48**

THE PRESENT RESEARCH

4.1. *Summary of Needs for Research* 48
4.2. *Research Objectives* 49
4.3. *Proposed Conceptual Framework* 49
4.4. *Five Original Empirical Studies in the Research Project* 50

CHAPTER 5 **48**

STUDY ONE

Adults and children with Asperger syndrome: Exploring adult attachment style, marital satisfaction and satisfaction with parenthood **55**
5.1. *Rationale* 55
5.2. *Statement of Contributions of Joint Authorship* 57

CHAPTER 6 **48**

STUDY TWO

Parents on the Autism Continuum: Self Perceived Autistic Traits and Parenting Efficacy **66**
6.1. *Rationale* 66
6.2. *Statement of Contributions of Joint Authorship* 67

CHAPTER 7 **98**

STUDY THREE

Further Evidence on the Factorial Structure of the Autism Spectrum Quotient (AQ) for Adults with and without a Clinical Diagnosis of Autism **98**
7.1. *Rationale* 98
7.2. *Statement of Contributions of Joint Authorship* 100

CHAPTER 8 **110**

STUDY FOUR

Psychometric properties of the Chinese version of the Autism Spectrum Quotient (AQ) **110**
8.1. *Rationale* 110
8.2. *Statement of Contributions of Joint Authorship* 111

CHAPTER 9 **124**

STUDY FIVE

Autism Traits in Couple Dyads as a Predictor of Anxiety Spectrum Symptoms **124**
9.1. *Rationale* 124
9.2. *Statement of Contributions of Joint Authorship* 125

CHAPTER 10 **141**

GENERAL DISCUSSION

10.1.Summary of Research and Key Findings ***141***
10.2.Clinical and theoretical implications of the present research ***144***
10.3.The Relationship Experience of Adults Diagnosed With Autism Spectrum Disorder ***145***

10.3.1. Prospect for long-term relationships *145*
10.3.2. Quality of couple relationship *146*
10.3.3. Parenting experience *150*
10.3.4. Desirability versus competency in being a parent and a spouse *153*
10.4.Implications of Traits of autism on Parental Psychosocial Functioning ***154***
10.4.1. Effects of autism in parents versus in child *154*
10.4.2. Autistic manifestation beyond broader autism phenotype in parents *156*
10.4.3. Self-reported traits of autism: Future implications of current findings *158*
10.5.The Autism Quotient (AQ) as a diagnostic tool: Methodological issues ***159***
10.5.1. Comparing non-clinical and clinical groups *159*
10.5.2. Comparing diverse cultural groups *160*
10.5.3. Implications for the diagnostic process *161*
10.5.4. Capturing autism qualities among the higher functioning ASD population *162*
10.5.5. The issues of gender differences *163*
10.6.Theoretical And Practical Significance Of The Present Thesis Findings ***164***
10.6.1. The economic implications *165*
10.6.2. Treatment efficacy *165*
10.6.3. Couple counselling for adults affected by ASD *167*
10.6.4. Clinical utility of the Autism Spectrum Quotient (AQ) *168*
10.7.Overall Methodological Considerations ***168***
10.8.Overall Conclusions ***169***

REFERENCES ***170***

APPENDICES ***206***
Appendix A: ***206***
Ethical Clearance *206*
Appendix B: ***207***
Letter of Invitation (ASD Group) *207*
Appendix C: ***209***
Letter of Invitation (Control Group) *209*
Appendix D: ***211***
Study 1 Questionnaire *211*
Appendix E: ***222***
Letter of Invitation (ASD Group) *222*
Appendix F: ***224***
Letter of Invitation (Control Group) *224*
Appendix G: ***226***
Study 2 Questionnaire *226*
Appendix H: ***236***
Study 3 Questionnaire *236*
Appendix I: ***244***
Chinese Version of the Autism Spectrum Quotient *244*
Appendix J: ***248***
Study 2: Ancillary Analyses *248*
Appendix K: ***254***
Study 3: Ancillary Analyses *254*
Appendix L: ***260***
Study 4: Ancillary Analyses *260*

List of Abbreviations

ASD	Autism Spectrum Disorder; denotes autism, Asperger’s Disorder/Asperger’s Syndrome, High Functioning Autism and Pervasive Developmental Disorder-Not Otherwise Specified inclusive
AS	Asperger’s Disorder a.k.a. Asperger’s Syndrome
HFA	High Functioning Autism
PDD-NOS	Pervasive Developmental Disorder-Not Otherwise Specified
TD	typically developing
AAS	adult attachment style
QMI	Quality of Marriage Index
AQ	The Autism Spectrum Quotient
PSOC	Parenting Sense Of Competency Scale
PSOS	parenting sense of satisfaction
PSOE	parenting sense of efficacy
ASRI-4	Adult Self-Reported Inventory-Fourth Edition
ANX	anxiety
GAD	generalised anxiety disorder
SpP	specific phobia
SP	social phobia
Pa	panic
Ag	agoraphobia
PTSD	post-traumatic stress disorder
APGAR	family adaptability, partnership, growth, affection, and resolve
SRS	social responsiveness scale
BAP	broad autism phenotype
MAP	medium autism phenotype
NAP	narrow autism phenotype
DSM-5	The Diagnostic And Statistical Manual Of Mental Disorders, Fifth Edition
DSM IV-TR	The Diagnostic And Statistical Manual Of Mental Disorders, Fourth Edition
PCA	principal component analysis
EFA	exploratory factor analysis
CFA	confirmatory factor analysis

List of Tables

Table 1 Studies on outcome of ASD in adulthood with data on prevalence of long-term relationships...19
Table 2 Variance Explained for AQ-39 Responses...256
Table 3 Multi-group confirmatory factor analysis goodness of fit statistics for AQ-39 using the ASD group and non-ASD group...258
Table 4 Congruence coefficients across factors...259

List of Figures

Figure 1 Proposed Conceptual Framework 49
Figure 2 Process and Development of the Present Research 54
Figure 3 Proposed Conceptual Framework 143
Figure 4 Revised Conceptual Framework...144
Figure 5 Group and Gender Effect for Total AQ 248
Figure 6 Group and Gender Effect for the Subscale of Social Skills................................249
Figure 7 Group and Gender Effect for the Subscale of Attention Switching 250
Figure 8 Group and Gender Effect for the Subscale of Attention To Details....................251
Figure 9 Group and Gender Effect for the Subscale of Communication 252
Figure 10 Group and Gender Effect for the Subscale of Imagination 253
Figure 11 Scree plot for AQ-39 254
Figure 12 Horn's parallel analysis using total sample 255
Figure 13 AQ-39 257
Figure 14 Scree plot for AQ-Chinese 260
Figure 15 Distribution of Total AQ-Chinese Scores of Clinical and Community Sample.261

Autism Spectrum Disorder (ASD) range along a continuum of neuro-developmental conditions characterised by socio-communication deficits and restrictive/stereotypical behaviours (American Psychiatric Association, 2013). Although people with ASD can find socialisation strenuous, the condition does not preclude them from having long-term relationships. Recent outcome studies on adults with ASD reported an average of 14% of the samples entered couplehood and some, parenthood (Howlin & Moss, 2012; Howlin, Moss, Savage, & Rutter, 2013; Smith & Sharp, 2013). The prevalence is especially higher in studies that focussed on adults who had no intellectual impairment (e.g., Smith & Sharp, 2013).

This research was instigated by a dearth of empirical knowledge about the psychosocial functioning of adults affected by ASD who manage to develop and maintain long-term relationships. The research project in its entirety involved five successive studies exploring traits of autism in association with marital quality, parenting sense of competency and anxiety symptoms in adults living with ASD. The sample included not only adults who had a clinical diagnosis of ASD, but also those with a potential genetic link in some cases to certain ASD susceptibilities, namely parents of children with ASD (Bernier et al., 2011). Comparisons were also made with the non-ASD general population. Such as sample is more likely to represent the broad range of autism continuum, which is one of the novel aspects of this research.

Study 1 tested adult attachment style, marital quality and parenting satisfaction of adults diagnosed with Asperger's Syndrome (AS) whose child(ren) also had AS. It was published as a peer-review journal article [citation: Lau, W. Y. P. & Peterson, C. C. (2011). Adults and children with Asperger syndrome: Exploring adult attachment style, marital satisfaction and satisfaction with parenthood. *Research in Autism Spectrum Disorders, 5,* 392–399.]. To the best of this author's knowledge, this was the first published study among research on marital/parental functioning of parents with ASD that considered the diagnosis of ASD in a child and a parent concurrently. A strikingly high proportion of adults with AS in this sample (82%) reported an insecure attachment style as compared with only 22% of their non-ASD counterparts. Interestingly, insecure attachment style in the AS group did not affect their marital quality or parenting satisfaction relative to matched controls. Such a result is in contrast to some previous studies with adults in the general population (e.g., Alexandrov, Cowan, & Cowan, 2005; Hazan & Shaver, 1987). The diagnosis of AS in either a child or a parent made no difference to marital satisfaction. However, parenting satisfaction was significantly lower when there was a diagnosis of AS in both a child and a parent. This study, being exploratory in nature, was limited by including only participants who had an "official" (clinically-confirmed, DSM IV-based) diagnosis of AS, one of the four categorical subtypes of ASD, namely Autistic Disorder (autism), High Functioning Autism (HFA), Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) and AS (Miller & Ozonoff, 2011; Rutter & Schopler, 1992). Soon after the publication of this original study, the diagnostic criteria for ASD also began to adopt a dimensional approach to diagnosing ASD (American Psychiatric Association, 2011) which needed to be incorporated in subsequent research.

Study 2 was designed to extend beyond Study 1 by including a larger sample size (n= 346) and to incorporate a dimensional approach in assessing ASD, as proposed in the recently published DSM-5 (American Psychiatric Association, 2013). In this study, traits of autism in 346 parents were quantified using the widely used Autism Spectrum Quotient measure (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) in addition to data on their ASD diagnostic status via DSM criteria applied by practising clinicians. Parenting sense of efficacy was measured simultaneously to further test the association between parental tendency towards autism and parenting experience. This sample was unique in that it encompassed three groups of subjects: 1) parents of children with ASD who had themselves been clinically diagnosed with ASD; 2) non-diagnosed parents who had children with ASD; and 3) non-ASD parents of typically developing children. Analyses revealed that not only did parents who had a clinically confirmed diagnosis of ASD score highly on the AQ, a substantial proportion of non-diagnosed parents (especially fathers) of children with ASD did as well (22.6% fathers; 15.4% mothers). Among the fathers, only those whose self-rated AQ scores reflected their clinical diagnoses of ASD reported lower parenting sense of efficacy. Those who had not achieved a diagnosis, but had a high score on the AQ, reported a high level of parenting sense of efficacy. On the contrary, mothers who had no clinical diagnosis of ASD but scored highly on the AQ reported low parenting sense of efficacy. To the author's knowledge, this was the first empirical study that involved a sample that encompassed the broader autism phenotype. Results from Study 2 highlighted the inconsistency between the parents' self-ratings on the AQ and their diagnostic status of ASD. It confirmed the necessity to screen for the broad autism phenotype, and in some cases, diagnosis of ASD, among parents of children with ASD. This study also elucidated the need to enhance parenting sense of efficacy in fathers who have a clinical diagnosis of ASD and mothers who reported elevated traits of autism but are undiagnosed. This study has been submitted for publication as: Lau, W. Y. P., Peterson, C. C., Attwood, T. J., Garnett, M. S. & Kelly, A. B. (under review). Parents on the Autism Continuum: Self-Perceived Autistic Traits and Parenting Efficacy (submitted on 17 May 2014).

In view of a need for a valid, reliable screen for autism traits in parents of children with ASD for both clinical-therapeutic and research-theoretical reasons, Study 3 tested the clinical utility of the AQ (Baron-Cohen et al., 2001), a measure for quantifying traits of autism in adults. More specifically, this study validated the factor structure of the AQ and its reliability across clinical and non-clinical subjects. Data from 455 adults were analysed by means of principal component analysis followed by confirmatory factor analysis. Novel to the AQ literature, about a third of the participants in this study had a clinical diagnosis of ASD (n=141), making the sample more likely to be representative of the autism continuum. The outcome was a new factor model, AQ-39, which demonstrated markedly improved internal consistency and goodness of fit indices compared to previously proposed factor models for the AQ including the original AQ-50. The AQ-39 consisted of five theoretically coherent constructs that corresponded to the diagnostic taxonomy of ASD. This study was published as: Lau, W. Y. P., Kelly, A. B. & Peterson, C. C. (2013). Further Evidence on the Factorial Structure of the Autism Spectrum Quotient (AQ) for Adults with and without a Clinical Diagnosis of Autism. *Journal of Autism and Developmental Disorders*, 43 (12), 2807-2815.

In order to further substantiate and assess cross-culturally the factorial validity and clinical utility of the AQ, Study 4 cross-validated the constructs underlying the AQ using, for the first time, a Mandarin-speaking sample from the Chinese culture of Taiwan. This ethnic group was selected for its large global population as well as its diverse nature in relation to the Australian culture. In this factor analysis of the AQ, data from a large sample of 4,192 Taiwanese parents were included. About one third of these parents had children with ASD (n=1,208). As in Study 3, principal component analysis and confirmatory factor analysis methodologies were employed. The resultant model, AQ-Chinese, demonstrated characteristics comparable to AQ-39 suggesting the AQ was a culturally robust tool. In addition, psychometric qualities of the AQ-Chinese did not vary notably between clinical and community samples. This further validated its utility for both screening and diagnostic purposes. Study 4 was published as: Lau, W. Y. P., Gau S. S., Chiu, Y. N., Wu, Y. Y., Chou, W. J., Liu, S. K. & Chou, M. C. (2013). Psychometric properties of the Chinese version of the Autism Spectrum Quotient (AQ). *Research in Developmental Disabilities, 34,* 294-305.

The newly-validated AQ-Chinese was then employed to investigate the effect of parental tendency towards autism on psychosocial functioning. This project, Study 5, tested the association between traits of autism (in parent and in child) and parental anxiety symptoms using a sample of 491 Taiwanese couples who had at least one child diagnosed with ASD. This was a unique study in that a couple-centred approach was incorporated to understand the impact of traits of autism on well-being of parents of children with ASD. This methodology allowed exploration on self versus spousal effect, and gender differences. This study was the first to cover the wide spectrum of anxiety disorders and to consider the effect of child and parental tendency towards autism simultaneously. It was also the first study on the psychopathology of Chinese parents who were raising children with ASD. Results indicated significant self-effects in the link between parental traits of autism and anxiety symptoms across all domains (general anxiety disorder, specific phobia, panic disorder, social phobia, agoraphobia and post traumatic stress disorder), even after controlling for the child's characteristics of autism and parental demographics. Large effect sizes were found in the social phobia and post traumatic stress disorders domains for both genders, and also in general anxiety disorder and agoraphobia for mothers. These associations were irrespective of the spouse's traits of autism and the couple's compatibility in their autistic tendencies. Perceived family support and parental education moderated the link between tendency towards autism and anxiety symptoms though interestingly, not child autistic severity. Findings from this study led to several imperative pointers for future research, including genetic contribution to parental mood disorders in the ASD population, the direct effect of traits of autism on anxiety disorders and the implications of couple compatibility in autistic proneness. This study was published as: Lau, W. Y. P., Gau S. S., Chiu, Y. N., Wu, Y. Y. (2014). Autistic Traits in Couple Dyads as a Predictor of Anxiety Spectrum Symptoms. *Journal of Autism and Developmental Disorders, first published online in June 2014.*

As a whole, this research substantiated the notion of broad autism phenotype in parents of children with ASD. Furthermore, it showed that up to 23% fathers and 15% mothers of children with ASD fell within the clinical range of autistic symptoms according to the recommended diagnostic cut-off (total score >32) proposed in the original development of the AQ (Baron-Cohen et al., 2001). However, the majority of these parents had never received clinical diagnoses of ASD. There was a link between parental tendency towards autism and insecure adult attachment style, lower parenting sense of efficacy and more anxiety symptoms, independent of their children's ASD diagnostic status. Discrepancy was found between self-reported tendency towards autism on the AQ and one's ASD diagnostic status based on DSM IV in about half (48% men and 47% women) of the ASD group. Men who had been clinically diagnosed with ASD, as well as obtaining high AQ scores, felt less efficacious than other fathers in their parenting role. On the other hand, women who were diagnosed with ASD and scored highly on the AQ felt as confident as the controls in their parenting efficacy as contrasted with those who scored high on the AQ but would not qualify for a clinical diagnosis. Indeed, mothers who reported the lowest parenting sense of efficacy were those who obtained high AQ scores yet had not been clinically diagnosed. The association between high characteristics of autism and more anxiety symptoms was also stronger in female than in male subjects. As a tool, these studies all suggested the AQ is factorially valid, is culturally robust, has high discriminability for the specific condition of ASD and hence is suitable for screening characteristics of autism in parents of children with ASD. These studies also suggested topics for future research to clarify the interesting gender differences observed.

Findings from this research have significant clinical and theoretical implications which include: extending the scope of intervention by taking into account parental traits of autism and not focussing only on the child's autistic symptoms; understanding the worldview of adults with ASD regarding intimate relationships, developing parenting training programs for adults with ASD; and paying attention to genetic-based psychiatric risks among parents of children with ASD. Insights from this research are stepping stones for future research endeavours on the relationship experiences of higher functioning adults with ASD.

Outline of the Thesis:

This thesis presents the research project in 12 chapters. Chapter 1 reviews the current knowledge of the field in which three gaps in the research on ASD have been identified: marital and parenting experience of adults with higher functioning ASD; the implications of parental traits of autism on their psychosocial functioning; and identification of adults who have subclinical degrees of autistic symptoms. Chapters 2 and 3 are devoted to reviews of related literature for the proposed studies. Chapter 2 focuses on the experiences of adults with higher functioning ASD, with emphasis placed on the social outcomes of ASD in adulthood, challenges to obtaining a diagnosis, and psychiatric risks to this population. Chapter 3 appraises existing literature on the psychosocial risks of parents of children with ASD. More specifically, prevalence of the broad autism phenotype and its potential effect on parental well-being is reviewed. Chapter 4 delineates the overall rationales, objectives and process of this research project, then outlines the five empirical studies. Each of these studies is presented as a separate chapter (Chapter 5 to Chapter 9) that begins with a paragraph explaining its relevance to the overall objectives of this research project. Chapter 10 draws general discussion and conclusions from this research as a whole. A summary of key findings are presented and implications in relation to existing knowledge in the field of ASD discussed. Strengths and limitations of the research methodology will be considered and suggestions for future research and clinical applications will be offered. Finally, the thesis concludes with a reference list and appendices of supplementary information relevant to this research.

CHAPTER 1

RESEARCH CONTEXT

"For success in science or art, a dash of autism is essential. The essential ingredient may be an ability to turn away from the everyday world, from the simply practical and to rethink a subject with originality so as to create in new untrodden ways with all abilities canalised into the one specialty." (Asperger, 1979, p. 49).

1.1. Autism Spectrum Disorder: Current Conceptualisation

Autism Spectrum Disorder (ASD) is a neuro-developmental condition (Doyle-Thomas et al., 2014) characterised by pervasive social and communication difficulties, and restricted/repetitive behaviours, sensory sensitivities and interests (American Psychiatric Association, 2013). Over the past decade, the ASD population has attracted research and clinical attention for its striking prevalence, now reported to be as high as 1/68 (CDC, 2014). In a sample of 7,461 adults in the United Kingdom, the prevalence of ASD was found to be 1/102 which was comparable to findings among child and adolescent samples (Brugha, et al., 2011). Not only is the prevalence high, it is rapidly rising. For instance, a population-based study of 1997–2000 birth cohorts (children aged 3–6 years in 2003 and 7–10 years in 2007) in the United States revealed relative increases of two- to sixfold in ASD incidences between 2003 and 2007 (Schieve et al., 2012). In Australia, the estimated prevalence of ASD ranged in 2008 from 1/1,041 to 1/245 for the State and Territory data, and from 1/826 to 1/280 for comprehensive national data (Williams, MacDermott, Ridley, Glasson, & Wray, 2008). New diagnoses of ASD in Australia had increased nearly twentyfold over the past decade (Parner et al., 2011). The most recent Survey of Disability, Ageing and Carers reported as many as 115,400 (0.5%) Australians had ASD in 2012 (Australian Bureau of Statistics, 2014), posing a challenge to the welfare system to cater for the needs of this population.

Traditionally, ASD has been conceptualized as a group of five conditions under the umbrella of Pervasive Developmental Disorders. These conditions were: Autistic Disorder, Asperger Disorder (AS), Pervasive Developmental Disorder-Not Otherwise Specified

(PDD-NOS), Rett Syndrome and Childhood Disintegrative Disorder (DSM-IV-TR; American Psychiatric Association, 2000). Each of these categories shared the core features of the condition, but varied in the severity of symptomatology and levels of functioning of the individuals. Whilst many people with autism may present with severe speech and language deficits, normal to advanced language skills are typical for those with AS and PDD-NOS (Witwer & Lecavalier, 2008). Individuals with Autistic Disorder who have significantly delay in the development of early speech and language skills but are cognitively 'higher functioning' (that is, with an IQ of greater than 70) are described to have Higher Functioning Autism (Carpenter, Soorya & Helpern, 2009). There were, however, ongoing debates on whether a differentiation of autistic subtypes, especially AS and HFA, was possible and if so, whether it was a categorical or dimensional differentiation. In an attempt to clarify the dispute, Howlin (2003) conducted a systematic review of studies that investigated the differences between AS and HFA and concluded that there were *"no obvious differences in rates of social, emotional and psychiatric problems, current symptomatology, motor clumsiness or neuropsychological profiles between the two groups"* (Howlin, 2003, *p.10*). Macintosh and Dissanayake (2004) undertook another critical review of the relevant studies one year later and concluded that *"the validity of Asperger's disorder as a unique syndrome, separate from High Functioning Autism, has not yet been either conclusively established or refuted".* Thus AS and HFA continued to be used interchangeably in research.

As the categorical distinctions between AS, HFA, PDD-NOS and other subtypes of ASD faced more and more queries, the diagnostic taxonomy leaned increasingly between 2000 and 2013 towards a dimensional approach. Now, ASD is conceptualized as a spectrum of disorders (American Psychiatric Association, 2011), with the term 'spectrum' indicating the variation in the clinical phenotype (Kamp-Becker et al., 2010; Ritvo et al., 2011). In May 2013, through publication of the new Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association, 2013), the American Psychiatric Association officially eliminated the diagnosis of Asperger Disorder, along with Autistic Disorder and PDD-NOS, into a broad diagnosis of "Autism Spectrum Disorder". This means instead of having distinct diagnostic categories such as "Autistic Disorder" versus "PDD-NOS" or "AS", affected individuals are referred to as having one of three severity levels of ASD (Level 1, 2 or 3) according to their need for intervention (American Psychiatric Association, 2013). This dimensional approach of identifying ASD demands a change in how researchers measure ASD in their participants. Subsequently, instruments sensitive for discriminating the array of non-clinical, broad autism phenotype and clinical range of autistic tendencies will be needed.

1.2. Theories of Autism Spectrum Disorder

1.2.1. Genetic Predisposition

Full understanding of the aetiology of ASD remains elusive. Nonetheless, there are sufficient empirical findings to support the hypothesis that ASD is due to genetic transmission and/or different functioning of specific structures and systems in the brain (Frith, 2004; Rutter, 2005). It was a major breakthrough in the 1970s when, through twin and family studies, ASD research discovered genetics to be one of the aetiological factors (e.g., Bailey et al., 1995; Folstein & Rutter, 1977). Supporting evidence has multiplied since. A considerable number of these studies describe a mild manifestation of autism in first-degree relatives (Gerdts, Bernier, Dawson, & Estes, 2013). This subclinical range of autistic personality and cognitive traits is referred to as the broader autism phenotype. The phenotype of autism can be manifested in multifaceted ways including rigidity in thinking, aloofness, high levels of anxiety, social peculiarities and communicative difficulties (Bernier et al., 2011; Bishop et al., 2004; Bolton et al., 1994; Piven & Palmer, 1997; Seidman, Yirmiya, Milshtein, Ebstein, & Levi, 2011). Following discoveries about the broad autism phenotype, researchers have explored other related topics such as the prevalence of ASD diagnosis among siblings and screening protocols for this high risk population (Smith & Elder, 2010). There are several studies investigating the broad autism phenotype in parents of children with ASD (e.g., Sasson et al., 2013), however none, to the author’s knowledge, has considered the incidence of ASD diagnosis in this population.

1.2.2. Biological Brain Theories

Several neurological explanations have also been proposed in relation to the unique profile of ASD (see Fakhoury, 2015 for a review). Relevant to this thesis is the suggestion that ASD is a manifestation of an extreme male brain (Baron-Cohen, 2010). The extreme male brain theory of autism suggests that foetal testosterone exposure may underlie sex differences in traits of autism. Epidemiological studies show that ASD is more common in male than female (4.3:1; Fombonne, 2005), although the possibility of under-diagnosis in females due to their ‘non-male-typical’ clinical presentation has recently been raised (Attwood, 2007; Ben-Itzchak, Ben-Shachar, & Zachor, 2013).

Deficiency in the mirror-neuron system (MNS) has been proposed as one of the neurological abnormalities pertinent to socio-emotional functioning of individuals with ASD

(Cheng et al., 2008). The MNS is composed of brain cells that are active not only when one is reacting but also when one is observing others in the outside world. The MNS theory proposes that dysfunction of the MNS impairs imitation skills and expression of empathy in people with ASD. There are, however, empirical data challenging its claim. For example, Southgate and Hamilton (2008) argued persuasively that imitation does not depend solely on the MNS. They also noted that people with autism can often perform a variety of imitation tasks correctly when they are explicitly instructed to imitate. This suggested to them that MNS damage is not universal in ASD. A recent literature review which included 25 empirical studies on MNS concluded that evidence in favour of a dysfunction of the MNS in autism is limited (Hamilton, 2013).

Another widely researched neurological explanation to ASD is hypo- or/and hyper-connectivity, which refers to an increased or reduced functional and structural connectivity in the ASD brain. For instance, one study on 3 month old infants (Keehn, et al., 2013) found that those who were at risk for developing autism showed an increased functional connectivity relative to low-risk controls but then this difference gradually disappeared between the age of 6 and 9 months. By the age of 12 months, the high risk infants actually showed decreased connectivity compared to their low-risk counterparts. Similarly, studies on older samples using functional magnetic resonance imaging (fMRI) found a significant reduction in long-distance connectivity in the brains of individuals with ASD (Kana et. al., 2014). Investigators in this field associated the under-connectivity with reduced variability in motor behaviour (Hadders-Algra, 2008), atypical social behaviour (Lynch et al., 2013; O'Connor & Kirk, 2008) and savant syndrome in ASD (Takahata & Kato, 2008). It has been reported that up to 30% of individuals with ASD show some islets of outstanding abilities, referred to as savant skills (Heaton & Wallace, 2004; Howlin, Goode, Hutton & Rutter, 2009; Miller, 1999). Whilst the estimated prevalence of savant skills in individuals with ASD is considerably higher than in non-ASD population (i.e., 10% as opposed to 1%), not all savants have autism and not all individuals with autism have savant skills (Meilleur, Jelenic & Mottron 2015).

1.2.3. Cognitive Theories

There is also a range of cognitive theories that attempt to explain the causes of socio-emotional difficulties in individuals with ASD (see Rajendran & Mitchell, 2007 for a review). One is deficits in theory of mind, sometimes referred to as mind-blindness (Baron-Cohen, Leslie & Frith, 1985; Leslie, 1987). Essentially, theory of mind refers to the ability to infer another person’s mental state, that is, to recognise and understand the thoughts, beliefs, desires and intentions of other people. Often mind-blindness can cause, to a varied extent, difficulties in social relationships and communication for people with ASD. It has been found that, unlike those with autism, children with AS and PDD-NOS are able to interpret basic theory of mind activities accurately, although for more complex scenarios such as perceiving lying or unspoken intentions, even children with higher functioning ASD did not perform as well as typically developing children (Chevallier et al., 2014; Ozonoff & Miller, 1995). In adults with ASD, even those with high intellectual ability, theory of mind deficits can hamper one's socio-communication capacity (Llaneza et al., 2010).

The theory of deficits in executive functioning is another commonly accepted explanation of ASD (Ozonoff & Miller, 1995). Executive dysfunction refers to difficulties in higher order processing such as planning, self-monitoring, working memory and impulse control (Barnard, Muldoon, Hasan, O'Brien, & Stewart, 2008; Panerai, Tasca, Ferri, Genitori D'Arrigo, & Elia, 2014). Such deficiency can often lead to poor adaptive skills in daily living. Whilst this theory explains well the lack of flexibility and difficulties in being organized that are often evident in people with ASD, deficits in executive functioning are not unique to the ASD population (Rogers & Ozonoff, 2005). Furthermore, findings on executive functioning in older individuals with ASD have been inconsistent, or only minimal executive functioning difficulties in ASD subjects were found in most studies (Sachse et al., 2013).

Another hallmark of ASD is a tendency for preoccupation with details to the detriment of perceiving the bigger picture, a mindset described as 'weak central coherence' (Frith & Happé, 1994). The theory of weak central coherence was originated by Frith (1989) who argues that in the neurotypical perceptual-cognitive system there is an innate inclination to form coherence over as wide a range as possible. The mind of the person with ASD, however, lacks this coherence and has deficits in integrating this information into a higher level of holistic perception. This theory points out the cognitive deficits, as well as the strengths, in the ASD profile because it explains how people with ASD can have extraordinary abilities in specific areas, such as the arts and arithmetic.

1.3. Autism Spectrum Disorder: Implications on Social Functioning

Many of the theories of ASD as outlined in the previous section (e.g., deficiency in MNS, weak central coherence, executive dysfunction and theory of mind deficits) imply that individuals with ASD are at a distinct disadvantage in dealing with social relationships (Volkmar, 2011). As early as in infancy, ASD impacts on interpersonal relationships in ways such as reduced eye contact and impaired joint attention (Bedford et al., 2012) and deficits in object and gesture imitations (Ingersoll & Meyer, 2011). During the school years, characteristics of autism are often found to be positively associated with an active-but-odd interaction style which negatively affects the child's psycho-social health and peer relationships (Scheeren, Koot, & Begeer, 2012). Concerns over a lower prevalence of friendships, poorer quality of relationships with peers and higher levels of victimization in children with ASD compared to those without, have also been raised by parents and teachers (Kasari, Locke, Gulsrud, & Rotheram-Fuller, 2011; Rowley et al., 2012).

Unfortunately, social vulnerabilities continue to disadvantage some people with ASD throughout adolescence and adulthood. Stoke, Newton and Kaur (2007) studied 63 adolescents and adults with and without ASD and reported that the ASD group relied less on their peers for social and romantic learning than did the controls, and were more likely to engage in inappropriate courting behaviours. A recent systematic review (Magiati, Tay, & Howlin, 2014) found 25 outcome studies on adults with ASD published between 1984 and 2013 (N=2,043). Only 18 out of the 25 studies reported social outcomes of these subjects, and drew the conclusion that social integration of adults with ASD was 'poor to very poor'. More than 50% of these adults required specialized provision and high levels of support, were unemployed, had little or no autonomy and no friends. Another two literature reviews on outcome studies in ASD (Howlin & Moss, 2012; Levy & Perry, 2011) found only 10% of adults diagnosed with ASD developed lasting friendships and romantic relationships. There were vital limitations among these outcome studies, such as: the samples were heterogeneous (diagnoses varied from Autistic Disorder to AS; IQ mean score ranged from below 70 to 101 and ages ranged from 17 to 44 years); very small numbers of female subjects were included in most studies; and a wide range of measures were used to assess outcomes. Interestingly, one study which focussed on higher functioning adults with ASD (Farley et al., 2009) found that at the time of interviews, three participants (7%) were married and had children, another three (7%) were in long-term relationships, two (5%) were divorced and 13 (32%) had dated. No information on relationship quality or parenting experience was gathered. Of note was that these subjects all lived in a highly supportive church community.

Though yet to be empirically validated, a wealth of personal accounts from adults with ASD (Grandin, 2010; Holliday Willey, 1999; Robison, 2008; Shore, 2003; Simone, 2010) has indicated that social challenges do not dissipate even for those who manage to develop long-term relationships, but any struggles are more likely to be camouflaged by their average to high intellectual abilities (Attwood, 2007). Of concern is that studies on how individuals with ASD perceive and experience intimate relationship are few and far between. A review of studies on adults with ASD published from 2000 to 2010 (Shattuck et al., 2012) noted the absence of participants beyond the age of 30 in all the 23 studies. This means empirical knowledge of intimate relationships and being a parent with autism is virtually non-existent.

1.4. Research Focus

In response to the lack of empirical data on couplehood and parenthood of adults with ASD, the present research is devoted to adults with higher functioning ASD who are engaging in long-term relationships. More specifically, their experience in couple relationships and in being a parent is explored. A detailed study devoted to this population is essential given that their socio-emotional challenges are likely to be camouflaged, yet could cause the greatest disablement later in life (Punshon, Skirrow, & Murphy, 2009). It has been asserted that the ramification of under-serving the “more able” population can mean a soaring prevalence of secondary psychiatric disorders in adults affected by ASD (Jones, Goddard, Hill, Henry, & Crane, 2014; Lugnegard, Hallerback, & Gillberg, 2011; Shattuck et al., 2012). Some unidentified adults with ASD can even be misdiagnosed with severe mental illnesses that lead to maltreatments (van Schalkwyk, Peluso, Qayyum, McPartland & Volkmar, 2015). Considering that parents of children with ASD have been found to be genetically liable for this condition (Bernier et al., 2011), this research pays particular attention to this population. A dimensional approach in measuring autism will be employed in this research to correspond with the new conceptualisation of ASD in DSM-5 (Tanguay, 2011).

CHAPTER 2

AUTISM SPECTRUM DISORDER IN ADULTHOOD: MARITAL AND PARENTING ASPECTS

> *“The difference between high-functioning and low-functioning is that high-functioning means your deficits are ignored, and low-functioning means your assets are ignored.” (Tisoncik, 2010)*

2.1. *Outcome Studies on Adults with Autism Spectrum Disorder*

The bulk of research on Autism Spectrum Disorder (ASD) and many or most intervention studies have traditionally focussed on young children and adolescents, even though ASD has long been known to be a lifelong condition (Woolfenden, Sarkozy, Ridley, & Williams, 2012). Mesibov (1983), in one of the first books about autism in adolescence and adulthood, highlighted the huge discrepancy between the number of studies on children with ASD and those on adults. Unfortunately, this lack of research on adults with ASD has remained largely unchanged since this gloomy conclusion was reached over three decades ago (Howlin & Moss, 2012). Services provision appears to “diminish dramatically” as individuals with ASD grow past adolescence (Howlin, 2008, p. 407). This is especially true for adults with ASD who have average to high intelligence (Howlin, 2012).

The author conducted a search on PsycINFO for publications on adults with ASD from 1960 to 2013 in accordance with standard empirical procedures (i.e., excluding clinical case histories or anecdotes). Initially, these keyword search terms were included: 1) autism, ASD, Asperger, PDD; and 2) Adult, people, individual. This yielded 7,964 peer-reviewed articles with a broad range of topics about adults with ASD. In order to extract studies relevant to outcomes for adults with ASD, a second layer of inclusion criteria was added (i.e., keyword search terms: outcome, follow-up, longitudinal, long-term). This search strategy yielded a total of 33 scientific papers examining adults with ASD or outcomes in adulthood of those diagnosed in childhood. Whilst these 33 studies were widely varied in sample sizes, time of follow-up, populations and criteria, findings were fairly consistent (Henninger & Taylor, 2013; Perkins & Berkman, 2012). The prognosis for adults diagnosed with ASD was generally described as poor, especially for individuals who were diagnosed in the 1950s to 1980s, when specialist provision or treatment was rare (Eisenberg, 1956). Five hundred and forty-four individuals of that era were followed up in 12 of the 33 outcome studies published between 1960 and 1999 (e.g., DeMyer et al., 1973; Gillberg & Steffenburg, 1987; Kanner, 1971; Kobayashi, Murata, & Yoshinaga, 1992; Larsen & Mouridsen, 1997; Lockyer & Rutter, 1969; Lotter, 1974; Szatmari, Bartolucci, Bremner, Bond, & Rich, 1989). Outcomes for these cohorts (diagnosed with autism, HFA or AS: IQ ranging from 50 to 140) were fairly pessimistic, in that a high proportion remained highly dependent on their parents or psychiatric institutions (22 - 93%), and very few were employed (13 - 34%). Being an adult with ASD in that period meant being poorly educated and likely to be diagnosed as having other psychiatric illnesses, such as schizophrenia (Henninger & Taylor, 2013; Howlin & Moss, 2012). There was little information on other aspects of these individuals' lives, such as social relationships.

After the year 2000, another 21 outcome studies on adults with ASD were retrievable (e.g., Bishop-Fitzpatrick, Minshew, & Eack, 2013; Cederlund, Hagberg, Billstedt, Gillberg, & Gillberg, 2008; Eaves & Ho, 2008; Engstrom, Ekstrom, & Emilsson, 2003; Esbensen, Bishop, Seltzer, Greenberg, & Taylor, 2010; Farley et al., 2009; Gillespie-Lynch et al., 2012; Hofvander et al., 2009; Howlin, 2003; Howlin, Goode, Hutton, & Rutter, 2004; Howlin et al., 2013; Kamio, Inada, & Koyama, 2013; Mazefsky, Williams, & Minshew, 2008; Smith & Sharp, 2013; Tani et al., 2012; Taylor & Seltzer, 2011). Three changes were observed in these more recent studies. First, the sample included more (>48%) adults with higher functioning ASD (i.e., IQ > 70). This may be a result of the expansion of autism diagnostic criteria in DSM-IV in the mid-1990s to include individuals with a broader range of functioning, compared with DSM III in the 1980s. Second, in addition to independent living and occupational domains, quality of friendships were considered in five of these 21 studies, whilst intimate relationships were considered as part of the outcome criteria in 12 of the 21 studies. A condition which was once regarded as a severe mental illness that would only end in institutionalization began to be considered as one that might include the prospect of developing long-term relationships. Third, in the eight studies published after 2011, outcomes of mid- (40-65 years old) to later (>65 years old) adulthood among individuals diagnosed with ASD have emerged. It would seem from this review that outcome studies on adults with ASD have begun to attend to older individuals and those who are higher functioning within the ASD population.

2.2. Diagnostic Status and Overall Functioning at Follow Up

A systematic review of the diagnostic stability of ASD (Woolfenden et al., 2012) found that diagnosis of ASD remains stable from childhood to adulthood for most individuals; however, the profile of ASD generally showed a positive trajectory, with a decrease in ASD symptoms with increasing age across the autism spectrum. The profile of abilities between those diagnosed with HFA and AS was found to be indistinguishable once the children with HFA caught up in their language skills (Howlin, 2003; Macintosh & Dissanayake, 2004). In some studies, a small proportion of subjects no longer met the diagnostic criteria for ASD at follow-up (Fein et al., 2013; Helt et al., 2008; McGovern & Sigman, 2005; Seltzer, Shattuck, Abbeduto, & Greenberg, 2004; Tani et al., 2012). For instance, Farley and colleagues (2009) re-assessed 41 adults with ASD who had no intellectual impairment about 25 years later and found 15% (*n*=6) of these subjects no longer met diagnostic criteria for any subtypes of ASD. Of note, however, was that these adults continued to find interpreting social behaviours difficult. The same findings were reported in a study of 70 males with AS by Cederlund and colleagues (2008), where 11% of their sample (n=8) no longer met diagnostic criteria at follow-up. Again, the authors highlighted that although these men did not have sufficient clinical impairment to warrant a clinical diagnosis of ASD, autistic-type problems persisted in them. Similar cases in the other studies also reported some residual characteristics of social, communication and/or behavioural idiosyncrasies (e.g., Fecteau, Mottron, Berthiaume, & Burack, 2003; Matson, Wilkins, & Fodstad, 2010) thus implying traits of autism, even at a subclinical level, do affect one’s functioning. A concern at hand is that individuals who fall within the subclinical range have received little to no attention in regard to the support and services they may require (Howlin, 2012; Howlin & Moss, 2012; Jones et al., 2014; Shattuck et al., 2012).

Adaptive functioning, vocational outcome and living situations in adults with ASD vary enormously. Whilst a large proportion remains highly dependent on their families or other support services, some adults acquire the skills to live independently in the community (Bishop-Fitzpatrick et al., 2013; Levy & Perry, 2011; Marriage, Wolverton, & Marriage, 2009). The few studies looking specifically at the outcome of adults with HFA and AS found this higher functioning subgroup of the ASD population is associated with greater variability in individual outcome ranging from fully dependent in all aspects of life to leading a normal or near-normal social and work life (Engstrom et al., 2003; Howlin et al., 2004; Jones et al., 2014). Two determining prognostic factors have been recurrently identified: intellectual abilities and language skills. Individuals with IQ > 70 and good early language development were significantly more likely to be functioning well in adulthood in general (e.g., Cederlund et al., 2008; Howlin et al., 2013; Magiati et al., 2014; Smith & Matson, 2010; Tani et al., 2012). Average to high IQ and age appropriate language development were two factors favouring the AS or HFA subtypes of ASD according to DSM-IV-TR (American Psychiatric Association, 2000). Indeed, these groups were often better off in adulthood compared to those diagnosed with Autistic Disorder in overall adaptation (Cederlund et al. 2008). However, given their good intellectual capacity, their social outcome is regarded as suboptimal. Even with the most positive outcomes, only 15-50% of the participants achieved independent living (Engstrom et al., 2003; Howlin & Moss, 2012; Marriage et al., 2009; Renty & Roeyers, 2007) and 53% had successfully maintained employment (Roux et al., 2013). Independent living for people with AS or HFA could be hampered by idiosyncrasies commonly occurring with ASD. For instance, Tani and colleagues (2012) studied 99 adults clinically diagnosed with either HFA, AS or PDD by a psychologist or a psychiatrist (mean age= 30.7 years, SD= 8.41). They found a higher prevalence of inflexible adherence to routines, egocentric behaviours, circumscribed interests, poor lifestyle habits and school non-attendance in their ASD group compared to non-clinical controls. The adaptive functioning of the ASD proband was significantly lower than non-ASD participants who have similar IQ scores. Given that the outcomes of the higher functioning ASD group were mixed, ranging from an isolated individual living on a disability pension to a married university professor, several studies concluded that social and occupational services must find ways to achieve more individually adjusted solutions in order to more efficiently cater for the needs of individuals with higher functioning ASD (Griffith, Totsika, Nash, Jones, & Hastings, 2012; Woods, Mahdavi, & Ryan, 2013). Howlin and Moss (2012) stated in their literature review that *“most adults with ASD have no access to specialist services and, unless they are supported by intellectual disability or mental health services, provision is both limited and inadequate”* (p. 279) implying that those with higher functioning ASD are probably the most underserviced population compared to those affected by other mental health conditions.

2.3. Adults with Autism Spectrum Disorder in Long-term Relationships

Whilst the profile of ASD is characterised by social and communication deficits, some studies (e.g., Farley et al., 2009; Hellemans, Colson, Verbraeken, Vermeiren, & Deboutte, 2007; Hintzen, Delespaul, van Os, & Myin-Germeys, 2010; Mazurek, 2013a) found the majority of this population have no less interest in socializing, and share a similar desire for intimate relationships, as their neurotypical peers. In fact, some have found an increased interest in intimate relationships during adolescence and adulthood (Orsmond, Krauss, & Seltzer, 2004), followed by a subsequent sense of loneliness owing to a lack of long-term relationships (Jobe & Williams White, 2007; Mazurek, 2013a). Unfortunately, social and communication deficits often persist into adulthood for individuals with ASD, and this is even true for those with normal IQ and language skills who no longer meet the diagnostic criteria for ASD as adults (Cederlund et al., 2008; Farley et al., 2009; Jones et al., 2014).

Sixteen out of the 33 studies on outcomes of adults with ASD considered whether or not the subjects had had long-term relationships (*Table 1*). These 16 studies had a collective sample of 872 adults diagnosed with ASD. One hundred and twenty-eight (14.7%) participants were married or had had long-term relationships (range from 0% to 62%) at follow-up. The sample included all subtypes of ASD diagnoses. Whilst there were children with autism who made good progress and became quite interested in other people and thus belied the aloof autistic presentation as an adult (Frith, 1991b; Howlin et al., 2004; Howlin & Moss, 2012), intimate relationships were more common in the AS or HFA group. Cerderlund and colleagues (2008) made distinctive comparisons between autism and AS or HFA groups and found that among the AS or HFA proband aged 16 to 36 years, 14% (*n*= 22) were living in a long-term relationship at the time of study and 45% had had relationships for varying periods of time in the past, whereas only 5% (*n*= 40) of the autism group had had long-term relationships. Another study that was exclusively devoted to higher functioning adults with ASD found 16% of their 99 adults with AS were married (Tani et al., 2012).

Several conclusions can be drawn from these findings. First, research on adults with ASD needs to acknowledge the heterogeneity of this population, and the differences in social outcome among the different subtypes should be delineated. Second, there is a notable proportion of adults with ASD who develop long-term relationships. Third, knowledge on parenthood for adults with ASD is almost absent. Fourth, psychosocial interventions for higher functioning adults with ASD will need to address more sophisticated aspects of socio-communication skills, and such interventions are still underdeveloped (Bishop-Fitzpatrick et al., 2013).

Table 1 Studies on outcome of ASD in adulthood with data on prevalence of long-term relationships

	Study	**Diagnosis**	***n***	**Age, years Mean (range)**	**Long-term Relationship or Married n, (%)**
1	Szatmari et al (1989)	ASD, Childhood Schizophrenia-psychosis	16	26 (17-34)	4 (25%)
2	Tantam (1991)	AS	85	24 (ns)	3 (4%)
3	Larsen and Mouridsen (1997)	ASD and AS	18	36 (ns)	4 (22%)
4	Howlin et al (2000)	ASD	19	24 (21-27)	1 (5%)
5	Engstrom et al (2003)	AS and HFA	16	31 (ns)	6 (38%)
6	Howlin et al (2004)	Autism and atypical autism	67	29 (21-49)	3 (4%)
7	Billstedt et al 2005)	ASD and AS	108	ns (17-40)	2 (1%)
8	Cederlund et al (2008)	Autism and ASD	140	23 (16-36)	15 (11%)
9	Eaves and Ho (2008)	ASD	47	24 (ns)	16 (33%)
10	Farley et al (2009)	Autism	41	33 (22-46)	9 (20%)
11	Hofvancer et al (2009)	Autism, AS and PDD-NOS	122	ns (16-60)	20 (16%)
12	Whitehouse et al (2009)	ASD	11	21 (19-37)	0 (0%)
13	Stuart-Hamilton and Morgan (2011)	Autism and HFA	14	49 (ns)	9 (62%)
14	Tani et al (2012)	AS and HFA	99	31 (18-63)	16 (16%)
15	Smith and Sharp (2013)	AS and HFA	9	33 (29-37)	3 (33%)
16	Howlin, Moss, Savage and Rutter, (2013)	AS and HFA	60	44 (29-64)	14 (24%)

2.4. Marital Satisfaction of Couples Where One Partner Has Autism Spectrum Disorder

It would seem from Table 1 that long-term relationships are possible for individuals with ASD. Nonetheless, empirical knowledge about marital quality of people with ASD is very limited. To the author's best knowledge, only two studies have been conducted on marital functioning of adults with ASD. Renty and Roeyers (2007) examined marital adaptations of 21 men (mean age = 43.52, range 35 to 54 years) diagnosed with ASD based on DSM-IV-TR criteria. The subjects and their wives provided ratings on traits of autism, informal social support, formal support, coping strategies, personal adaptation and marital adaptation. There was no correlation observed between traits of autism and marital adaptation reported by these men with ASD; however, the wife's marital adaptation was inversely correlated with the husband's autistic tendencies. Interestingly, the subjects reported significantly fewer traits of autism in themselves than their spouses' ratings on them. This raised a query on reliability of self-report data when studying subjects diagnosed with ASD. It also is important to point out that 81% of these couples had children with ASD. However, no consideration was given to the possible effect of the child's ASD on their marital adaptation, even though child ASD symptomatology can negatively affect parental well-being (Hall & Graff, 2012; Lecavalier, Leone, & Wiltz, 2006). In addition, not only was the sample small, it did not include females with ASD. Gender differences in stress and coping has been found to be evident in the ASD population (Gray, 2003; Hartley, Barker, Seltzer, Greenberg, & Floyd, 2011).

Lau and Peterson (2011) explored adult attachment style, marital quality and parenting satisfaction in 157 parents of children with AS. Twenty-two of these parents had a diagnosis of AS themselves. Strikingly, as high as 82% of these parents who had an official diagnosis of AS reported an insecure attachment style. Furthermore, their insecure attachment style did not imply low marital satisfaction as commonly found in the general population. On the contrary, they reported marital satisfaction that was comparable to non-ASD controls (i.e., no ASD in child or in parent). Neither a child's nor a parent's diagnosis of AS negatively affected marital satisfaction. It was noteworthy, however, that this sample was recruited from private psychology clinics. The subjects were predominantly middle class, and marital satisfaction in this sample was by and large higher than the general population.

There was another study (Pollmann, Finkenauer, & Begeer, 2010) that examined the association between traits of autism and marital quality; however, it was limited to a non-clinical sample. A total of 195 Dutch couples (husbands' mean age = 33.5 years and wives' mean age = 30.1 years) were administered the AQ and Dyadic Adjustment Scale together with measures for self-esteem, attachment style, responsiveness, intimacy and trust. In this non-clinical sample, husbands who reported more traits of autism felt less satisfied with their marital relationships, whereas wives with more traits of autism did not. Thus, one could infer that gender differences may alter the effect of traits of autism on one's marital experience. Lower responsiveness, less intimacy and lower trust were found in men and women with high tendency towards autism, indicating autism does adversely impact on couple relationships in general. Similar to findings of Lau & Peterson (2011), having more traits of autism was associated with insecure attachment style in this study. Contrary to the findings of Renty and Roeyers (2007), tendency towards autism did not affect spousal marital satisfaction. It is important to bear in mind that the range of tendency towards autism in this sample was non-clinical. Perhaps traits of autism only markedly affect spouse's marital satisfaction if at clinical levels. Studies that include participants with both clinical and non-clinical traits of autism simultaneously are necessary to shed light on this.

2.5. Parenting Experience of Adults with Autism Spectrum Disorder

Empirical knowledge of parenting by adults diagnosed with ASD is almost nonexistent (Howlin & Moss, 2012; Levy & Perry, 2011). A significant caveat in the research on adults with ASD is that almost all of the outcome studies included only individuals in their 20s to 40s. More specifically, in the 16 studies that explored long-term relationship experience of adults with ASD, the mean ages for the samples were predominantly younger than 25 years. Only two individuals out of all the 16 outcome studies had become parents, and one of them had a child with ASD (Howlin et al., 2013; Smith & Sharp, 2013). These data, however, did not preclude the possibility of more parents in the total sample because such information was not considered in most of the studies. The scarcity of systematic data on the quality of the subjects' long-term relationships or pattern of family life needs to be addressed, because living with a partner or a parent with ASD is likely to be challenging, or at least different. Furthermore, adults with ASD features are more likely to face the challenge of having children with ASD (Bernier et al., 2011). Success in marital relationships may lead to better adjustment in couplehood and parenthood for those living with ASD (Attwood, 2007; Marriage et al., 2009; Renty & Roeyers, 2007). To this end, there is a need to gather more knowledge about the relationship functioning of this population, focussing on the potent effect of characteristics of autism in self, spouse, and children.

2.6. Psychiatric Risks of Adults with Autism Spectrum Disorder

As mentioned earlier, the prognosis for adults with AS or HFA is generally optimistic in comparison to that of their counterparts with autism (Cederlund et al., 2008); however, this is only superficial. There is growing evidence to suggest that adults with ASD are vulnerable to developing psychiatric and psychosocial problems (Barnhill, 2007; Henninger & Taylor, 2013; Hofvander et al., 2009; Perkins & Berkman, 2012; Vannucchi et al., 2014) and are not receiving adequate recognition and services to assist them with their difficulties related to their unique profile of abilities (Jones et al., 2014; Shattuck et al., 2012). Estimates of co-morbid psychiatric problems in adults with ASD varied from 4% to 81% (Davis et al., 2011; Sterling, Dawson, Estes, & Greenson, 2008), even higher than the range estimated for individuals with developmental disabilities (Smith & Matson, 2010). When researchers compared the quality of life of 70 adults with ASD and 70 age-matched adults with Down Syndrome, those with ASD were found to have more unmet service needs, and received fewer services as compared to adults with Down syndrome (Esbensen et al., 2010). Of note was that over 60% of the ASD group in this study were receiving psychological or psychiatric services as opposed to 19% in the adults with Down Syndrome, again highlighting the high co-morbidity of psychological disorders among individuals with ASD. The most common co-morbid disorders were anxiety disorders including generalised anxiety disorders, agoraphobia, separation anxiety and simple phobias (7 - 84% of cases) (Eaves & Ho, 2008; Howlin, 2005; Hughes, 2008; Simonoff et al., 2008). Prevalence of clinical depression could be as high as 25% to 32% (Farley et al., 2009; Marriage et al., 2009; Tani et al., 2012). Commonly identified risk factors for psychiatric conditions included major life transitions, loss, inadequate support, or social isolation (Hutton, Goode, Murphy, Le Couteur, & Rutter, 2008). The mental health and well-being of adults with ASD can in turn affect their general functioning (Hofvander et al., 2009; Joshi et al., 2013; Stewart, Barnard, Pearson, Hasan, & O'Brien, 2006).

Underwood, McCarthy and Tsakanikos (2010) found that adults with ASD who had normal IQ were more susceptible to psychiatric illness than those with lower IQ. In a study exclusively on adults with ASD who had normal intelligence, 53% of the 122 adults met clinical criteria for mood disorder, 8% for bipolar disorder and 12% for psychotic disorders (Hofvander et al., 2009). These results were supported by a large scale study of two nationwide twin cohorts of adults with ASD (N=18,349) which found 21.2% of their sample exhibited DSM-based anxiety symptoms and 11.7% depressive symptoms. Despite the overwhelmingly high psychiatric prevalence, a review of literature over the past decade concluded that evidence-based services for adults with ASD were underdeveloped

(Shattuck et al., 2012). Reflecting this insufficiency, Shattuck et al. (2012) emphasised that heterogeneity of both abilities and challenges exhibited across the autism spectrum had not been adequately addressed and that future research should entail characterizing the wide diversity of service needs in this diverse population.

2.7. Challenges in Diagnosing and Servicing Adults with Autism Spectrum Disorder

In a community sample of 7,461 adults in the United Kingdom, nearly 1% met diagnostic criteria for an ASD (Brugha et al., 2011). Many individuals with ASD with unimpaired intellectual abilities are not formally diagnosed, or else are misdiagnosed, as there are several challenges in obtaining an accurate diagnosis for this particular population (Dossetor, 2007; Wolff & McGuire, 1995). First of all, it is not at all uncommon that the ASD symptoms are subtle enough to be overlooked in childhood and only become more conspicuous in adolescence or adulthood, leading to a late diagnosis (Fombonne, 2012; Geurts & Jansen, 2012; Lehnhardt et al., 2012; Tantam, 1991). This is especially when a child achieves his/her language developmental milestone aged-appropriately. Among the different subtypes of ASD, AS is one of the major subgroups pertaining to late diagnosis (James, Mukaetova-Ladinska, Reichelt, Briel, & Scully, 2006; Oslejskova, Kontrova, Foralova, Dusek, & Nemethova, 2007). In fact, the term ‘Asperger Syndrome’ was originally introduced by Wing (1981) for two important reasons: to elucidate that there was a marked variation in the presentation of individuals with AS compared to those with classic autism or HFA; and to enhance the awareness of psychiatrists that ASD was not a condition restricted to childhood, but a possible diagnosis in adults. Unfortunately, despite Wing (1981)’s intention, most English-speaking medical and allied health professionals were not acquainted with AS until Frith (1991) published the first book on AS in English one decade later. It was not until 1994 that the international classification systems (ICD-10, WHO) recognised AS as an official diagnostic category. Many adults with AS unfortunately were misdiagnosed prior to that (Klin, McPartland & Volkmar, 2005). Even adults with ASD in a most recent study (Jones et al., 2014) remarked that “professionals displayed narrow and stereotyped views on ASD and the range of way that ASD could manifest in adults at the higher end of the spectrum” (no pagination given).

Reports from this survey conducted by Jones and colleagues (2014) shed light to the poor state of services for adults with higher functioning ASD in the United Kingdom. Of the 128 participants (84% diagnosed with AS, 7% HFA and 6% autism), 40% found the diagnostic process to be very/quite dissatisfying, 18.5% had to attend six or more referrals before being accurately diagnosed, and the average time between concerns first emerging to obtaining a diagnosis was 5.2 years. Notably, 68% of this sample was living independently alone or with their partners/children, 74.2% had successfully completed secondary education, 46.1% obtained A-Level qualifications, and 44.5% were self-referred for the diagnostic assessment. The average age of diagnosis in this group was 34.4 years (ranged from eight to 75 years). Of concern was that 41.9% of these individuals were offered no form of post-diagnostic support.

The challenge of recognising adults with the profile of AS has been compounded by the lack of consensus in the diagnostic criteria for this condition (Matson & Boisjoli, 2008). Studies on the experience of adults with ASD describe the diagnostic process as something that gives a name to a diverse range of practices (Bagatell, 2007; Matson & Neal, 2009). To this day, the diagnostic nomenclature is challenged by alternative diagnostic standards such as those that are more reflective of the original accounts of Asperger (1944), and those that include strengths that come with the unique profile of abilities as well as the deficits, formulating an alternative experienced-based knowledge of ASD (Bertilsdotter Rosqvist, 2012; Brownlow, 2010; Matson & Neal, 2009). Subsequently, the diagnostic taxonomy in the recently published DSM-5 (American Psychiatric Association, 2013) has discarded AS as a diagnosis, and even this is arousing heated debate among the experts in this field (Kite, Gullifer & Tyson, 2013). This change from a categorical to a dimensional approach for assessing ASD will call for tools that are sensitive in capturing the ‘spectrum’ nature of ASD.

One of the challenges of providing support to adults with ASD can be when the individual’s intellectual ability is high and environmental support is good, but over time and in unexpected situations the façade of social normality cannot be maintained (Frith, 2004). Given their ability to camouflage their differences very well, it is common that adults with ASD seldom find the support and empathy they deserve and need (Shattuck, et al. 2012). Frith (1991b), in her review of the earliest accounts on AS, stated that the capacity of AS individuals to achieve “near-normal” social integration is the single most distinctive feature of AS as opposed to other forms of ASD. In fact, she described AS as “a well-camouflaged handicap” and raised the danger for AS individuals in being considered the same as others due to their ability to disguise their differences. Yet their hard-won adaptation is often achieved at a price that is detrimental to their own well-being. Some adults with ASD are even motivated to conceal their difficulties or diagnosis in fear of the stigma that may hinder their careers or personal advancement (Punshon et al., 2009; Rodman, 2003; Tantam, 2003); but then they find it exhausting to live and work with others due to their idiosyncrasies, egocentric bluntness and social gullibility (Attwood, 2007; Frith, 1991b; Henninger & Taylor, 2013; Howlin & Moss, 2012).

Another challenge to the provision of support for adults with higher functioning abilities is simply a lack of programs that target their subtle yet debilitating social deficits. Adults with higher functioning ASD have indicated their preference for flexible support as their needs fluctuated in response to life events and over time (Griffith, Totsika, Nash, Jones, et al., 2012). Shattuck and colleagues (2012) conducted a review of research on services for adults with ASD published from 2000 to 2010. A total of 23 studies was retrieved, of which 16 focussed exclusively on employment. They found limited data on services to support social functioning. Similarly, in a review of 20 studies on adaptive skills training for young adults with ASD, Palmen, Didden, and Lang (2012) concluded that even in research that specifically focussed on those who were higher functioning , no intervention for long-term relationship skills was available. The eight programs that considered social interaction skills targeted only basic interaction skills such as eye-contact (Dotson, Leaf, Sheldon, & Sherman, 2010), initiating and maintaining a conversation (Howlin & Yates, 1999), and asking and answering questions (Koegel, Bradshaw, Ashbaugh, & Koegel, 2014; Palmen, Didden, & Arts, 2008).

Recently, Bishop-Fitzpatrick, Minshew, and Eack (2013) conducted another systematic review of peer-review studies which targeted psychosocial intervention for adults with ASD published since 1950. Tellingly, of the 1,217 studies found, only 13 met simple inclusive criteria (i.e., reported quantitative findings, included participants aged 18 years and older, and included participants with ASD). Five out of the 13 studies were single case studies, only two studies had a sample size of $N > 50$ (García-Villamisar & Dattilo, 2010; Golan & Baron-Cohen, 2006) and only two included 30% or more of female subjects (Gantman, Kapp, Orenski, & Laugeson, 2012; García-Villamisar & Dattilo, 2010). Despite methodological limitations, findings were promising in that treatment efficacy yielded large positive effect-sizes ranging from $d = 0.14 – 3.59$. Three main intervention approaches in these studies were social cognition training, Applied Behavioural Analysis and community-based programs. Those studies that looked at social cognition training were most promising in that they employed the most rigorous methodologies while maintaining adequate power and effect sizes. The efficacy of social cognitive training had significant clinical implications for adult relationships, especially those designed to facilitate the generalisation of social-cognitive abilities such as perspective-taking and social context appraisal to unrehearsed social situations. One of these studies (Gantman et al., 2012) found a caregiver-assisted social skills training intervention (PEERS for Young Adults) was associated with less loneliness and improved social skills, empathy, social responsiveness and frequency of socialisation. Whether or not these effects could be generalised to couple relationships for adults with ASD has not been tested. Major caveats in these 13 studies were that only two of them had a sample with a mean age of >30 years (García-Villamisar & Dattilo, 2010; Turner-Brown, Perry, Dichter, Bodfish, & Penn, 2008), and none of the programs targeted the more advanced social cognition that would be required in intimate relationships.

Thus, all three reviews (Bishop-Fitzpatrick et al., 2013; Palmen et al., 2012; Shattuck et al., 2012) concluded that services for adults with ASD were underdeveloped and could be considered a field of enquiry that is relatively unformed. The heterogeneity of the ASD population was inconsistently characterised, subjects were predominantly young adults, few targeted more complex interpersonal skills, and the extent of research did not reflect the range of services that adults with ASD require to lead purposeful lives in the community. Given a large proportion of studies on services for adults with ASD were published after 2010, it is clear that this topic is demanding more attention.

Designing an intervention program for adults with higher functioning ASD is complicated when the presentation of ASD profiles can be heterogeneous and the individuals' strengths, such as strong vocabulary skills and rote memory, can mask their deficit areas (Frith, 2004). With their average to high intelligence and sometimes special skills and talents, people with higher functioning ASD can become well adapted and exceptionally successful in adulthood (Attwood, 2007). It has even been argued that ASD, particularly the subtype of AS, denotes not deficits but merely a difference in neurology (Baron-Cohen, 2002). Many people with ASD have been found to possess outstanding rote memory and extraordinary talents (Baron-Cohen & Wheelwright, 1999; Boucher & Bowler, 2008), making this condition unique and fascinating. In his seminal paper, Hans Asperger (1944) noted the following: "*Able autistic individuals can rise to eminent positions and perform with such outstanding success that one may even conclude that only such people are capable of certain achievements...Their unswerving determination and penetrating intellectual powers, part of their spontaneous and original mental activity, their narrowness and single-mindedness, as manifested in their special interests, can be immensely valuable and can lead to outstanding achievements in their chosen areas. (in Frith, 1991, p.68).* There are subsequent speculative claims that historical figures such as Albert Einstein, Michelangelo, Wolfgang Amadeus Mozart and Ludwig Wittgenstein displayed behaviours associated with autism (Fitzgerald, 2005; James, 2006) leading to a growing appreciation that people with ASD, especially those who are higher functioning, can bring remarkable advancement to our society. When the individual has acquired the technical and social skills needed to be successful in employment and to develop a long-term relationship, the challenges pertinent to poor theory of mind, executive dysfunctions, communication difficulties and rigidity in thinking can be camouflaged in adulthood.

2.8. *Parents with Autism Spectrum Disorder and Parents of Children with Autism Spectrum Disorder*

Of all the adults affected by ASD at risk of neglect due to lack of knowledge and support, parents of children with ASD are probably the most understudied subpopulation. The risk of psychosocial challenges related to traits of autism in parents of children diagnosed with ASD is not a new concern but, sadly, unattended. Ever since the 1940s, this observation has been highlighted. For example, in Hans Asperger (1944)'s description of four prototypical cases of AS, he illustrated in considerable detail how much the parents of these children shared the characteristics of AS themselves, including eccentricity, poor social adaptation, a lack of social intuition, a tendency to be a loner, poor coping with the practical matters of life, poor self-care, and a tendency to retreat to a special interest as a means of coping with stress; yet they could have good insights into their children's difficulties due to their own personal experiences. Tellingly, these phenomena were borne out in all his case studies except for Hellmuth, whose AS features were due to an organic disorder. The same remark was made when Asperger (1944) accounted for a wider range of subjects: *'We want only to state briefly that over the course of ten years we have observed more than 200 children who all showed autism to a greater or lesser degree. We have been able to discern related incipient traits in parents or relatives, in every single case where it was possible for us to make a closer acquaintance. Usually certain autistic peculiarities were present, but often we also found the fully fledged autistic picture starting with abnormalities of expressive functions and gaucheness up to the higher level of 'integration difficulties'* (Frith, 1991b, p. 84).

About five decades later, another prominent researcher and clinician in the field of ASD, Gillberg (1991), restated this phenomenon. He conducted extensive examinations on six families of children with ASD and found that parents in four of these families had traits of AS, with some even meeting Gillberg's diagnostic criteria for AS (Gillberg & Gillberg, 1989). And again, subsequent reports by other experienced clinicians (e.g., Attwood, 2007; Baron-Cohen, Ring, et al., 2006; Happé, Briskman, & Frith, 2001; Piven et al., 1994) concurred with this observation. For instance, when Piven and colleagues (1994) closely examined the personalities of 87 parents of children with ASD, they observed this group to be significantly more aloof, tactless and undemonstrative when compared to parents of children with Down Syndrome. Unfortunately, the attention that needs to be paid to these parents due to their own characteristics of autism has been overshadowed by the needs of their child with ASD. Even today, the coping styles and difficulties of parents with ASD, when dealing with both themselves and their offspring, are attributed predominantly to their children's ASD symptomatology in the absence of other empirical evidence.

Whilst studies have been conducted on the broad autism phenotype in parents of children with ASD (refer to *section 3.3*), the possibility of clinical diagnosis of ASD in these parents has not been addressed empirically. Clinical notes from experts in the field suggest that it is often through the diagnostic assessment for a child that a late diagnosis for the parent is made (e.g., Attwood, 2007). Unfortunately, in some cases it means that much harm has been inflicted on the family dynamic due to non-recognition of ASD symptomatology in the parent. Seventy-two percent of the 128 adults diagnosed with ASD in Jones and colleagues (2014)'s survey reported a sense of relief about their diagnosis, and they *"wished that they had received their diagnosis earlier in life"* (no pagination given). New knowledge about a parent's autism can fundamentally reformulate the clinician's intervention plan for the family. In an autobiography of a parent diagnosed with ASD, Liane Holliday-Willey (1999) stated that the accurate diagnosis of ASD in herself was the foremost intervention for her family. This benefit of recognizing ASD diagnosis in a parent has been echoed by many other spokespersons for ASD (e.g., Robison, 2008; Slater-Walker, Slater-Walker, & Attwood, 2002), though it is yet to be examined by research. A point to consider is that given ASD affects social communication skills, the majority of parents struggling with ASD traits in themselves may not have the ability to convey their needs and vulnerabilities. Thus, this is a group that requires a more proactive approach to the development of a scientific understanding of their needs in order to more effectively cater for these at a clinical level.

2.9. Conclusions from a Review of Literature on Marital and Parenting Experience of Adults with Autism Spectrum Disorder

The field of ASD has been rigorously studied over the past 60 years; however, a disproportionate number of studies have focussed on ASD in childhood. Research on adults living with ASD remains scarce (Howlin & Moss, 2012). Adults with autism who are high functioning can develop long-term relationships, although social and communication deficits often persist in this population (Levy & Perry, 2011). To date, only two empirical studies have been conducted on couple relationship of adults with ASD (Lau & Peterson, 2011; Renty & Roeyers, 2007). These studies were limited by small sample sizes, and either included only one gender or one particular ASD subtype. Adults with ASD who are in long-term relationships especially need research and clinical attention because they are at a higher risk of having children with ASD (Folstein & Piven, 1991). Yet this population is currently under-serviced due to low efficacy in screening for ASD in adults and a lack of programs specific to their needs; and, in many cases, their talents and coping strategies camouflage their impairments (Geurts & Jansen, 2012; Matson & Neal, 2009). Research needs to be more vigilant in identifying ASD traits in such a population, and not rely solely on the presence of clinical diagnosis. Parents of children with ASD should be given precedence in studies of adults affected by ASD, because they have been consistently found to manifest more traits of autism than do the general population (Bishop et al., 2004; Sasson et al., 2013). Based on the conclusions drawn from this literature review, the five studies comprising the present research will focus on parents of children with ASD, both with or without a clinical diagnosis of ASD themselves.

CHAPTER 3

PARENTS OF CHILDREN WITH AUTISM SPECTRUM DISORDER:

TRAITS OF AUTISM AND PSYCHOSOCIAL FUNCTIONING

> *“The fact that some parents of children with HFA and AS themselves have autism-associated features begs the question of parenting skills in such individuals. It would not be unreasonable to assume poor empathy in the parent might contribute to some behavioural/psychological problem in the child quite apart from genetic influence. However, one might equally argue that a parent with similar but milder problems would be better able to understand and cope with some of the child’s problems because they may be perceived as personality style rather than ‘disorder’. Future studies should seek to explore these issues and try sensibly and sensitively to avoid the mistake of the past regarding the scape-goating of parents.” (Gillberg, 1998, p. 208)*

3.1. Stress in Parents of Children with Autism Spectrum Disorder

To the author’s knowledge, no empirical research has been conducted on the parenting experience of adults with Autism Spectrum Disorder (ASD) prior to the studies in this thesis. A search on PsycINFO using keywords 1) autism, Asperger’s Syndrome, Asperger, PDD, autistic; 2) adults, individuals; and 3) parents, parenting, parenthood yielded 33,546 peer-reviewed articles with a broad range of topics about parents raising children with ASD. In order to specify the target population (i.e., parents diagnosed with ASD themselves), a second layer of inclusion criteria were added (i.e., keyword search terms: autistic parents; and age group: adulthood). This search strategy yielded a total of 675 scientific papers of which none included parents with a diagnosis of ASD.

The vast amount of literature on the effects of raising children with ASD in non-diagnosed parents found this population to report significantly higher levels of stress when compared to parents with typically developing children (Benson & Karlof, 2009; Johnson, Frenn, Feetham, & Simpson, 2011; Moh & Magiati, 2012; Mori, Ujiie, Smith, & Howlin, 2009; Rao & Beidel, 2009; Smith et al., 2010; Strauss et al., 2011) but also when compared to parents of children with other developmental disabilities (Griffith, Hastings, Nash, & Hill, 2010; Hastings & Johnson, 2001; Hayes & Watson, 2013; Tomanik, Harris, & Hawkins, 2004). For example, when Dabrowska and Pisula (2010) compared the parental stress of those raising young children with ASD (n=51), Down syndrome (n=54) and typically developing children (n=57), they found that the ASD group reported significantly higher stress not only compared to the typically developing group but also to the Down syndrome group. Interestingly, gender difference was found only in the ASD group, where mothers reported higher stress than fathers. Another noteworthy finding was that parents from the ASD group were less likely to use social diversion as a coping mechanism. The authors speculated that this could be explained by the broad autism phenotype in parents of children with ASD. They suggested future research to explore the association between personality profile and coping styles among parents of children with ASD.

Traditionally, research has attributed high levels of parenting stress related to their child(ren)'s condition in the population of parents whose children have ASD. Many studies suggest that characteristics of autism exacerbate challenging behaviours in these children, which may lead to higher parenting stress (e.g., Estes et al., 2009; Hall & Graff, 2012; Lecavalier et al., 2006; Tomanik et al., 2004; Wolf, Noh, Fisman, & Speechley, 1989). For example, sensory perception may be different in children with ASD (Blakemore et al., 2006; Case-Smith, Weaver, & Fristad, 2014; Rogers, Hepburn, & Wehner, 2003), with a greater degree of sensitivity reported in many sensory modalities (e.g., tactile, proprioception, visual, auditory, gustatory). Individuals' reactions to these sensitivities are often intense, painful or uncomfortable, and emotional, leading to a 'meltdown' that requires the child to be removed from commonplaces (Hazen, Stornelli, O'Rourke, Koesterer, & McDougle, 2014). Such reactions are likely to cause stress for their carers (Ben-Sasson, Soto, Martinez-Pedraza, & Carter, 2013). Another commonly observed ASD characteristic is executive dysfunction, which can impede ability to plan, organise, pay attention and prioritise in day-to-day activities (Semrud-Clikeman, Walkowiak, Wilkinson, & Butcher, 2010). The levels of a child's ability to complete daily activities independently have been investigated as plausible sources of stress for parents, although findings have been somewhat inconsistent (Hall & Graff, 2011; Hastings & Johnson, 2001; Lecavalier et al., 2006). Some studies (e.g., Firth & Dryer, 2013; Kasari & Sigman, 1997; Zablotsky, Anderson, & Law, 2013) revealed that high levels of stress in parents with children with ASD were positively correlated with parental reports that the child had poor social responsiveness, and with objective data that performances on developmental measures were low. Parenting in ASD is also particularly affected by the child’s inability to adjust to changes, acceptability (e.g., the parent’s perception of the child as less intelligent), and demandingness, including the frequency and severity of the child’s minor behavioural problems such as crying, disobeying, seeking attention and requesting help (Noh, Dumas, Wolf, & Fisman, 1989). Essentially, Mandell, Walrath, Manteuffel, Sgro & Pinto-Martin (2005) identified disruptive behaviour issues as the most common reason for referral of children with ASD to community-based mental health services.

One might intuitively posit that parents of children with ASD subtypes of AS or HFA are somehow less vulnerable to parenting stress compared to those with children with classic autism, given the higher functioning nature of their children and the later age of diagnosis (Maenner et al., 2013). However, this is not the case. Despite their intact language and intellectual abilities, children with higher functioning ASD can exhibit cognitive and behavioural characteristics that can be equally, if not more, challenging to parents (Epstein, Saltzman-Benaiah, O'Hare, Goll, & Tuck, 2008; McConachie, Le Couteur, & Honey, 2005). In fact, behavioural problems are the most common reasons for a child falling within the AS subtype to be referred early, even more so than for children with Autistic Disorder (McConachie et al., 2005). A study by Allik, Larsson, and Smedje (2006) that examined health-related quality of life for parents of children with higher functioning ASD (i.e., AS and HFA) revealed that mothers’ reported poorer quality of life was positively associated with symptoms of hyperactivity and conduct problems in the child.

Executive dysfunctions (i.e., difficulties in planning, working memory multi-tasking and flexibility in problem solving; Ozonoff et al., (2005)) are equally prevalent in individuals manifesting the profile of AS, HFA or PDD-NOS compared to the Autistic Disorder subgroup (Kleinhans, Akshoomoff, & Delis, 2005; McCrimmon, Schwean, Saklofske, Montgomery, & Brady, 2012; Ozonoff, Pennington, & Rogers, 1991). A recent study on 168 children with ASD showed that executive dysfunctions were related to profound decreases in adaptive functioning even after controlling for age, IQ and severity of ASD symptoms (McLean, Johnson, Zimak, Joseph and Morrow, 2014). Many parents of children with ASD find strenuous the need to constantly remind their child of the day-to-day tasks (Harper, Dyches, Harper, Roper, & South, 2013). Another stressor specific to parents of children with higher functioning ASD is the diagnostic process. Accounts from parents have highlighted that the challenge of pursuing a referral for diagnostic assessment or intervention when the child appears to be developing normally in a number of areas can create significant stress for the family (Chamak, Bonniau, Oudaya, &

Ehrenberg, 2011; Glazzard & Overall, 2012; Moh & Magiati, 2012; van Tongerloo, Bor, & Lagro-Janssen, 2012).

On the whole, findings from existing literature on parenting children with ASD affirm that autism, including the higher functioning subtypes, affects not only psychosocial functioning of the individuals but also their family members (e.g., Johnson et al., 2011; Pottie, Cohen, & Ingram, 2009). There is need for a better understanding of the cause of high parenting stress in this population, and the development of intervention programs that match the unique requirements of parents with children with ASD. This is especially so since clinicians and researchers have long known that parents play a crucial role in intervention efficacy for children with ASD (Barlow, Parsons, & Stewart-Brown, 2005; Burrell & Borrego Jr, 2012; Solomon, Ono, Timmer, & Goodlin-Jones, 2008). It has been found that ignoring parental factors in intervention programs for children with ASD can cause further distress to the family dynamic (Karst & Van Hecke, 2012).

3.2. Parenting Efficacy and Marital Quality of Parents of Children with Autism Spectrum Disorder

Extensive research on families without ASD reported that marital conflict may undermine effective parenting practices (e.g., Belsky, 1984) and so may affect children (Algood, Harris, & Hong, 2013; Fauber & Long, 1991; Siffert & Schwarz, 2011). Conflicted marital relationships adversely affect both the consistency and quality of parenting, which in turn relates to child maladjustment (Fauber, Forehand, Thomas, & Wierson, 1990; Krishnakumar & Buehler, 2000; Schwarz, Stutz, & Ledermann, 2012). Marital dissatisfaction may also contribute to inter-parental differences in beliefs about child-rearing and discipline, leading to inconsistencies in the two parents' responses to child misbehaviour as well as parental disputes over expectations and rules (Fincham, Grych, & Osborne, 1994; Wymbs, 2011). Discipline practices that are associated with disruptive child behaviour (e.g., vague instructions, failure to enforce rules, or affection while managing misbehaviour) may be exacerbated when parents are in conflict with each other (Campbell, 1995; Grych, Oxtoby, & Lynn, 2013).

In families of children with ASD, family conflict was found to predict anxiety and depression symptoms in children with ASD (N= 322, mean age = 10.9 years) which in turn predicted ASD symptomatology (Kelly, Garnett, Attwood, & Peterson, 2008). Conversely, ASD in children had been found to negatively impact on parental well-being (Mori et al., 2009; Rao & Beidel, 2009) and family quality of life (Khanna et al., 2011; Lee, Harrington, Louie, & Newschaffer, 2008), especially when challenging behaviours were present

(Sikora et al., 2013). Higher levels of parental stress in the ASD population are associated with parents' negative perceptions of their own care-giving abilities (Gray, 2003; Hastings & Brown, 2002; Horowitz, 2004; Tomanik et al., 2004; Zhou & Yi, 2014). This pattern is commensurate with the widely recognised model for parenting stress of Abidin (1995), which suggests that demanding characteristics in children can not only cause stress to parents, but may influence parental sense of competency in managing their children's difficult behaviours. Family theory (Cox & Paley, 1997) proposes that parenting challenges and marital conflicts influence each other in a bidirectional manner.

There is increasing evidence in the ASD literature to show that parenting efficacy and marital quality are strong predictors for parental stress and coping (Benson & Kersh, 2011; Smith, Greenberg, & Seltzer, 2012; Weitlauf, Vehorn, Taylor, & Warren, 2014; Woodman & Hauser-Cram, 2013). Benson and Kersh (2011) investigated cross-sectional and longitudinal relationships between marital quality and parental depressed mood, parenting efficacy, and subjective wellbeing in 136 mothers of children with ASD. Better marital quality negatively predicted maternal depression and positively predicted parenting efficacy. Another study involving 67 families of children with ASD (Kersh, Hedvat, Hauser-Cram, & Warfield, 2006) similarly found greater marital quality predicted lower levels of stress and depression above and beyond that accounted for by other parent, family and child predictors. Again, in a study using a sample of 91 married couples, subjects who reported above-average marital satisfaction felt less burdened in parenting their adolescent and adult children with ASD (Hartley et al., 2011). More recently, Eates, Olson, Sullivan, Greenson, Winter, Dawson, and Munson (2013) found that among 46 parents of young children with ASD, parental confidence and ability to manage and reduce behavioural problems in their children built a critical buffer against parenting-related stress. Angus (2007) studied 262 parents of children with ASD and identified a strong relationship between marital status (i.e., married or divorced) and parenting behaviours. Parents who employed authoritative parenting (assertive but not intrusive and restrictive towards their children) had better marital satisfaction than those who used authoritarian parenting (have high demands but are not responsive to their children).

As practitioners and researchers in the ASD field become increasingly aware of the importance of marital well-being on the family's overall functioning, of concern is the alarming prevalence of marital breakdown in families of children with ASD (Hartley, Barker, Baker, Seltzer, & Greenberg, 2012; Hartley et al., 2010). A study in the United States has estimated the divorce rate for parents raising a child with autism to be as high as 80% (Bolman, 2006; Lofholm, 2008), which is drastically higher than the average for first time marriage of 22% in Australia (Australian Bureau of statistics, 2013). Hartley, Barker, Seltzer, Floyd, Greenberg, and Orsmond (2010) studied occurrence and timing of divorce in 391 parents of children with ASD in Massachusetts and Wisconsin and found a higher rate of divorce (23.5%) among these parents than demographically matched parents of children without developmental disabilities (13.8%). Similarly, lower marital satisfaction was reported in a Taiwanese sample of 151 families of children with ASD in comparison to 113 families of typically developing children (Gau et al., 2012). This finding was supported by other studies, which concluded that raising children with ASD negatively impacts on couple relationships (e.g., Hartley et al., 2011; Lickenbrock, Ekas, & Whitman, 2011).

It is important to note that findings on the marital experience of parents raising children with ASD have been inconsistent. One study followed 119 couples with children diagnosed with ASD in France over a period of 10 years and found 75% of the couples remained together, indicating no difference in the rate of divorce between the ASD population and the general population (Baeza-Velasco, Michelon, Rattaz, Pernon, & Baghdadli, 2013). Likewise, a population-based (n=77,911 parents) study on the relationship status of parents of children with ASD across 50 states in America found no evidence to suggest higher risks of parental separation or divorce among this group when compared to the general population, even after controlling for relevant covariates including basic demographics, maternal characteristics, socioeconomic indicators and other psychiatric disorders (Freedman, Kalb, Zablotsky, & Stuart, 2012). More specifically, Brobst, Clopton, and Hendrick (2009) compared 25 couples in Texas whose children had ASD to 20 non-clinical controls and found large differences in parenting stress, a marginally significant difference in total marital satisfaction and no differences at all on scales of marital commitment, spousal support or feelings of respect for the spouse. Other studies likewise found that while couples with children with ASD reported higher levels of parenting stress, they did not differ in their marital functioning compared to demographically matching controls (Lee, 2009; Montes & Halterman, 2007).

Why some couples raising children with ASD are satisfied with their marital relationships whereas some are not, remains largely unknown. To the author’s knowledge, little exploration has been undertaken to answer this question. It is noteworthy that few, if any, existing studies on parents of children with ASD includes parents who themselves have ASD. Considering that parents of children with ASD are genetically liable to a broader autism phenotype (Bishop et al., 2004; Kose, Bora, Erermiş, et al., 2013), a plausible way to address this question is to explore the probable impact of the parents’ own ASD-like characteristics on their parenting and marital experience and their anxiety symptoms, in addition to the child's autistic challenges. This is a key research question undertaken in this thesis.

3.3. Traits of Autism in Parents of Children with Autism Spectrum Disorder

Though not exclusively determined by heredity, there is compelling evidence that ASD is genetically related (Eapen, 2011; Folstein & Rutter, 1977; Hallmayer et al., 2011; Ronald & Hoekstra, 2011). The genetic liability for autism may predispose to a milder, subclinical autism-related phenotype referred to as broader autism phenotype (Piven, Palmer, Jacobi, Childress, & Arndt, 1997). Parents of children with ASD have been found to manifest broader autism phenotype (e.g., Baron-Cohen, 2006; Bernier et al., 2011; Bolte & Poustka, 2006; Bolton et al., 1994; Sasson et al., 2013; Scheeren & Stauder, 2008; Wheelwright, Auyeung, Allison, & Baron-Cohen, 2010) in forms of aloofness and rigidity in personality (De la Marche et al., 2011; Seidman et al., 2011), communicative difficulties (Ruser et al., 2007; Taylor et al., 2013), poor facial recognition ability (Wilson, Freeman, Brock, Burton, & Palermo, 2010), alexithymia, i.e., impairment in emotional processing (Szatmari et al., 2008; Tajmirriyahi, Nejati, Pouretemad, & Sepehr, 2013), weak central coherence (Happé et al., 2001) and executive dysfunction (Bolte & Poustka, 2006). Though most of these manifestations are pertinent to socio-emotional functioning, we know little about the effect of the broad autism phenotype on parents' marital and parenting experience. At this stage, better established is evidence for the degree of tendency towards autism in parents of children with ASD.

Research on the prevalence of broader autism phenotype in parents of children with ASD has included samples from diverse cultural backgrounds and much of this research has utilised the AQ (Baron-Cohen, Wheelwright, Skinner, Martin & Clubley, 2001). The AQ is a self-report questionnaire developed to quantify traits of autism in adults with normal intelligence. About a decade ago, Bishop, Maybery, Maley, Wong, Hill, and Hallmayer (2004) administered the AQ to 121 parents of children with ASD and 89 parents of typically developing children in Australia. Comparing the two groups, parents of children with ASD reported significantly more traits of autism on the *Social Skills* and *Communication* subscales of the AQ compared to parents of typically developing children. Gender effect was substantial in their sample, with men scoring higher in all subscales except the *Attention to Details* domain, where an opposite direction was observed, in synchrony with the findings of Baron-Cohen et al.'s (2001) original study. Liu (2008), in a study on 142 Taiwanese parents, reported results similar to those of Bishop et al. (2004), in that parents of children with ASD reported significantly higher AQ scores compared to parents of typically developing children.

More recently, the occurrence of traits of autism in parents was explored again, this time in a sample of 2,000 parents of children with ASD (571 fathers and 1,429 mothers) and 1,070 parents of typically developing children (349 fathers and 658 mothers) in the United Kingdom (Wheelwright et al., 2010). In this study, subcategories broader autism phenotype (BAP), medium autism phenotype (MAP) and narrow autism phenotype (NAP) were introduced to depict moderate to high levels of features of autism presented in the parents, as quantified using the AQ. Wheelwright and colleagues defined BAP by total AQ score of 1 to 2 standard deviations above the mean; MAP 2 to 3 standard deviations above the mean; and NAP 3 or more standard deviation above the mean of non-ASD subjects. As high as 33% of the fathers and 23% of the mothers of children with ASD in their sample met arbitrary criteria for BAP, MAP and NAP inclusive. The pattern of gender effect was identical with Bishop and colleagues (2004)'s results. This study was then replicated by Ruta, Mazzone, Wheelwright and Baron-Cohen (2012). In this Italian sample of 245 parents of children with ASD and 300 parents of typically developing children (controls), the proportions of mothers and fathers falling within the BAP range in the two groups were the same. However, significantly more parents of children with ASD (17 fathers and 8 mothers) reported AQ scores within the MAP compared to controls (3 fathers and no mothers). Seven fathers and one mother from the ASD group met criteria for NAP whereas none in the non-ASD group did. The main effects were found on the total AQ, Social Skills, Communication and Imagination subscales, with the ASD group scoring higher than the controls. Gender effect was found in all domains except Attention to Switching. Then again, similar results were found in parents of children with ASD in Iran (Mohammadi, Zarafshan, & Ghasempour, 2012) and Turkey (Kose, Bora, Erermis, et al., 2013), demonstrating that parents of children with ASD across diverse ethnic backgrounds generally manifest more characteristics of autism than in the general population. A substantial proportion of these parents also obtained AQ scores that fell within the clinical range. Of note was that none of these studies considered whether any of these parents had received a formal diagnosis of ASD. Whether there is a phenomenon of under-diagnosis of ASD among parents of children with ASD, or a tendency for the AQ to over-portray ASD symptoms of those manifesting broad autism phenotype, has never been explored.

3.4. Psychiatric Risks of Parents of Children with Autism Spectrum Disorder

The demanding role of raising a child with ASD is also believed to increase parental vulnerability to psychiatric problems (Ingersoll, Meyer, & Becker, 2011; Lee, 2009; Piven & Palmer, 1999). Davis and Carter (2008) examined the well-being of 54 couples with young children diagnosed with ASD in the United States and found 6% of these parents reported clinically significant anxiety symptoms, and as high as 33% of mothers and 17% of fathers scored within the clinical range for depression. Unfortunately, these overwhelming figures are not unprecedented in this population. One earlier study (Sharpley, Bitsika, & Efremidis, 1997), involving 219 parents of children with ASD in Australia found 27.7% of the parents experienced high to severe anxiety whilst 19.1% were moderately to severely depressed. More strikingly, a population-representative study on parents of 18,415 children concluded that the presence of ASD, but not intellectual disability, is significantly linked with more frequent maternal emotional disorders (Totsika, Hastings, Emerson, Lancaster, & Berridge, 2011). Similar findings were reported by a more recent study conducted in Wisconsin and Massachusetts (Hartley et al., 2012), which compared depressive symptoms among fathers raising children with ASD (n= 135), Fragile X syndrome (n= 46) and Down syndrome (n= 59). Fathers from the ASD group reported significantly (p<.01) higher levels of depressive symptoms than the other groups of fathers. Interestingly, further analyses revealed that maternal depression and the presence of an additional child with a disability were the only significant predictors of paternal depression in the ASD group. No difference in coping styles was found among the three groups of fathers.

Whilst parental psychiatric problems are generally attributed to challenges related to their children's social and adaptive functioning deficits, a substantial number of parents reported the onset of anxiety and depressive symptoms prior to having children with ASD (Bolton, Pickles, Murphy, & Rutter, 1998; Micali, Chakrabarti, & Fombonne, 2004). When Piven and colleagues (1991) directly assessed 81 parents of children with ASD and 34 parents of children with Down syndrome using a semi-structured psychiatric interview, the ASD group reported significantly higher rates of generalised anxiety disorder (GAD), panic and major depressive disorder than did their Down syndrome counterparts. Similarly, a study of 36 families found higher rates of major depressive disorder and social phobia in relatives of individuals with ASD than in the comparison subjects (Smalley, McCracken, & Tanguay, 1995). The point is that in both studies, a substantial proportion of the parents with major depressive disorder experienced their first depressive episode before the birth of a child with ASD. In view of these findings, the high occurrence of psychiatric symptoms in parents cannot be explained solely by the burden of raising children with ASD.

In attempting to explain the above phenomenon, a genetic standpoint has been taken. One of the bases for this proposition is the fact that autistic-related impairments are often present in other psychiatric disorders such as schizophrenia (Russell-Smith, Maybery, & Bayliss, 2011; Spek & Wouters, 2010), personality disorders (Lugnegård, Hallerbäck, & Gillberg, 2012; Soderstrom, Rastam, & Gillberg, 2002) and attention deficit/hyperactivity disorder (Bolte & Poustka, 2006), suggesting an epigenetic overlap between different psychiatric symptoms. A population-based twin study in Sweden (consisting of 11,222 children and 18,349 adults) using the Autism-Tics, attention deficit/hyperactivity disorder and other comorbidities checklist (Hansson, Svanstrom Rojvall, Rastam, Gillberg, & Anckarsater, 2005) found the presence of more traits of autism significantly increased the risk for both depression and anxiety in their subjects (Lundström et al., 2011). This pattern was identified even in subjects with one or two traits of autism. More specifically, the risk of anxiety and depression in participants diagnosed with ASD was 21-22 and 12 times greater respectively compared to subjects who showed no autistic-like traits. The genetic viewpoint had also been supported by a meta-analysis of relevant research between 1973 and 2003, conducted by Yirmiya and Shaked (2005). When comparing parents of children with ASD with those with no known genetic risk such as parents of typically developing children, parents of children with Down Syndrome, and parents of children with intellectual impairment of unknown aetiology, they found parents with children with ASD to be evidently more vulnerable to anxiety, depression and thought disorder. On the contrary, when compared with parents of children with learning disabilities, who were genetically liable like the ASD group, parents of children with ASD actually reported fewer psychiatric symptoms. These findings highlighted genetic liability to be one of the contributing factors for the high incidence of psychiatric illness in parents of children with ASD. Thus, elevated psychiatric difficulties in parents of children with ASD are likely to be related to genetic risk associated with autism.

Indeed, a review of recent literature revealed rates of mood disorders among first-, second-, and third-degree relatives of individuals with ASD to be as high as 60-74% (DeLong, 2004; Ghaziuddin, 2005; Mazefsky et al., 2008). In studies specifically focussed on the parents (Ghaziuddin & Greden, 1998; Mazefsky, Conner, & Oswald, 2010), positive history of major depressive disorder in parents was linked to as high as 80% of comorbid depression in their children with ASD. A recent study (Kanai et al., 2011) examined the relationship between co-morbid depression or anxiety in adolescents with ASD and maternal depressive as well as anxious mood symptoms. Their regression results indicated that maternal phobic anxiety and hostility were significant predictors of proband anxiety, and maternal anxiety of proband's depression. Although none of these studies were designed to factor out environmental versus genetic influences, the results alluded to the genetic nature of depression and anxiety susceptibilities in the ASD population.

All in all, there are equally convincing data supporting the proposition of an innate as well as an experiential origin for the high psychiatric prevalence in parents of children with ASD. This unfortunately implies that parents of children with ASD who, on one hand are environmentally challenged from living with ASD (refer to *section 3.1*), and on the other are genetically predisposed, are doubly at risk of psychiatric difficulties.

3.5. Traits of Autism and Psychosocial Functioning of Parents of Children with Autism Spectrum Disorder

Aspects of the broad autism phenotype, especially those of a social and emotional nature (e.g., alexithymia, aloof personality and communication deficits) are likely to affect intimate relationships (Kadak, Demirel, Yavuz, & Demir, 2014; Karney & Bradbury, 1995), psychological well-being (Ingersoll et al., 2011) and everyday functioning (Happé et al., 2001). There are more specific associations found between broad autism phenotype and social communication deficits. Parents of children with ASD, particularly fathers, have been found to demonstrate poorer ability to read social and emotional cues depicted in one's eyes compared to parents of typically developing children (Baron-Cohen & Hammer, 1997; Tajmirriyahi et al., 2013). When presented with questions that assessed the abilities to reason and correct inconsistent emotional expressions, parents of children with ASD were found to be outperformed by control parents (Gokcen, Bora, Erermis, Kesikci, & Aydin, 2009). Even when compared to parents of children with Prader Willi syndrome, those with children with ASD had a higher prevalence of alexythimia, (Berthoz, Lalanne, Crane, & Hill, 2013; Kadak et al., 2014; Palermo, Pasqualetti, Barbati, Intelligente, & Rossini, 2006; Szatmari et al., 2008). Prader Willi syndrome is another condition with genetic and phenotypic complexities that can affect social and emotional functioning of an individual (Laurier et al., 2015). Findings from another two studies also suggest that impairments in social cognition may only be relevant for parents of children with ASD who have elevated traits of autism such as "aloof" personality styles (Losh & Piven, 2007; Murphy et al., 2000).

Recently, research has begun to examine directly the connection between traits of autism and psychiatric symptoms in parents of children with ASD. One of these studies analysed the associations between parental broad autism phenotype, child ASD severity and parental stress and depression in 149 parents (136 mothers, 13 fathers) of children with ASD (Ingersoll & Hambrick, 2011). They found that child ASD severity and parental traits of autism were both specific predictors of depressive symptoms in parents of children with ASD, supporting the claim that parental tendency towards autism has an independent effect on parental mood disorder symptoms. Interestingly, parental stress was predicted by the child's ASD symptom severity, but not by the parent's traits of autism. Following this study, Ingersoll, Meyer and Becker (2011) extended their investigation by including parents of non-ASD children. They examined comorbid depression in 71 mothers of children with ASD and 94 with non-ASD children. Again, their results indicated increased depressed mood in mothers of the ASD group, with this depressed mood being predicted by their characteristics of autism even after controlling for parenting stress and child ASD severity. Given both of these studies used relatively small sample sizes and the subjects were predominantly mothers, the results must be considered preliminary.

Parents of children with ASD have been found to have elevated depressive as well as anxiety symptoms (refer to *section 3.5*). It is worth mentioning that the association between having autism or characteristics of autism and depressive symptoms seems to be consistently supported whereas this is not the case with anxiety. For instance, when compared to parents of children with obsessive-compulsive disorders, parents of children with ASD scored significantly higher on schizoid traits and depressive symptoms, but not in anxiety. There was no difference found in anxiety symptoms (except for phobic-anxiety) when comparing parents of children with ASD to those with the early onset schizophrenia and their normative counterparts. This was in concert with an earlier study by Bolton et al. (1998) who examined 218 first-degree relatives of people with ASD and 87 first-degree relatives of individuals with Down syndrome and found higher rates of major depressive disorder but not generalised anxiety disorder or panic disorder, phobic disorder in the ASD group. Given none of these studies directly tested the connection between autistic tendencies and anxiety symptoms, there is a need to further investigate the effect, if any, of parental traits of autism on their anxiety levels.

Albeit preliminary, the literature is suggesting a direct association between elevated traits of autism and poor psychosocial functioning in parents of children with ASD. Thus, research on the marital and parenting experiences of adults raising children with ASD ought to take into consideration the influence of autistic tendencies in the individual in addition to the effect of caring for the child.

3.6. Gender Differences in Coping with Parenting Stress

It is quite clear that the literature on parents of children with ASD is currently dominated by accounts from mothers, although the few studies that included both genders in their sample suggested that mothers and fathers were affected differently. One helpful study compared similarities and differences between 64 fathers' and 64 mothers' reactions to the challenges of parenting children with ASD, by exploring the relationships between parenting stress, support from family functioning, and parental physical and mental health (Johnson et al., 2011). The results indicated that the stress of care-giving was closely associated with poor physical health for the mothers, whereas for the fathers, it was stress in personal and family life. For both genders, nonetheless, the higher the discrepancy scores between expected and actual family functioning, the lower their physical and mental health. Kaniel and Siman-Tov (2011) analysed the parenting experience of 88 pairs of parents raising children with ASD in Israel using a multivariate model. Compared to fathers, mothers in their study felt more threatened and more stressed, which adversely impacted on their mental health and quality of marriage. A most recent study conducted in Canada (Rivard, Terroux, Parent-Boursier, & Mercier, 2014) found contradictory patterns in that fathers of children with ASD (*n*= 118) reported significantly higher levels of stress than the mothers. Only paternal stress, but not maternal stress, was associated with the child's gender and the severity of the autistic symptoms. Like other studies, this one focussed heavily on risk factors associated with the child; the possibility of parental vulnerabilities such as elevated traits of autism and psychiatric predisposition were not considered.

Mothers and fathers often seem to adopt different coping mechanisms in the context of ASD. Lee (2009) examined depression, anxiety, marital adjustment and coping of 48 parents of children with higher functioning ASD and 26 parents of typically developing children living in the United States. Her results showed that parents of children with ASD exhibited fewer adaptive coping skills than parents of typically developing children. When comparing between mothers and fathers of children with ASD, she found the mothers exhibited more adaptive coping skills and perceived higher degrees of consensus in their couple relationships than did the fathers. More specifically, coping mechanisms used by these mothers of children with ASD included relying on professional and peer support, using spiritual support to help maintain their self-esteem and psychological well-being, seeking informal support from family members and relatives, and maintaining a more optimistic perspective. Similarly, when Gray (2003) interviewed 32 mothers and 21 fathers of children with higher functioning ASD in Australia about their coping styles, mothers were more likely to rely largely on friends and other parents of children with ASD for their emotional comfort, whereas fathers were more likely to use their work as a coping strategy, and suppression of feelings was common among the fathers.

Based on these studies, one may conclude that gender difference is possibly present in parental reactions to the raising of children with ASD in that mothers are more likely to seek external support than fathers. Nonetheless, given empirical data have been predominantly provided by mothers only, analyses on gender differences have been limited. Further understanding on the gender effect can be illuminated only if we can overcome the barriers of recruiting fathers to participate in research. Another major caveat of the existing literature is that, apart from the traditional conceptualisation of gender prototype, none of the studies involving both genders considered variables which may have contributed to the differences between the couples. For instance, whether or not personality traits of the father or mother play a role in their stress and coping style has not been explored. Given parents of children with ASD are more likely to share traits of autism, the aspect of parental characteristics is especially relevant in this population.

3.7. The Autism Spectrum Quotient as a Screening and Diagnostic Tool

Among the measures for identifying the broad autism phenotype, the AQ has been the most frequently used, playing a crucial role in a wide range of imperative investigations on ASD. Several studies have relied on the AQ to investigate the notion of ASD as a continuum in the general population (Hoekstra, Bartels, Verweij, & Boomsma, 2007; Hurst, Mitchell, Kimbrel, Kwapil, & Nelson-Gray, 2007),whereas some utilised this measure to discriminate the ASD profile from other mental health conditions such as schizophrenia (Naito, Matsui, Maeda, & Tanaka, 2010; Wouters, 2011), attention deficit hyperactivity disorder (Sizoo et al., 2009) and anxiety disorders (Cath, Ran, Smit, van Balkom, & Comijs, 2008). Still other researchers have used the AQ to explore the conceptualisation of personality theory (Wakabayashi, Baron-Cohen, & Wheelwright, 2006) and the cognitive manifestations of ASD neurology (Sutherland & Crewther, 2010; Wheelwright et al., 2006). Not only is the AQ popular in English speaking countries, it has been administered efficiently to culturally diverse samples over the years, demonstrating stable reliability and validity with Japanese (Wakabayashi et al., 2007; Wakabayashi, Baron-Cohen, Wheelwright, & Tojo, 2006; Wakabayashi, Tojo, Baron-Cohen, & Wheelwright, 2004), Austrian (Voracek & Dressler, 2006), Italian (Ruta, Mazzone, Mazzone, Wheelwright, & Baron-Cohen, 2011), Dutch (Hoekstra, Bartels, Cath, & Boomsma, 2008), Scottish (Steward and Austin, 2009), French-Canadian (Lepage, Lortie, Taschereau-Dumouchel, & Théoret, 2009) and Taiwanese (劉萌容, 2008) populations. There are also versions of the AQ developed for children (Auyeung, Baron-Cohen, Wheelwright, & Allison, 2008) and adolescents (Baron-Cohen, Hoekstra, Knickmeyer, & Wheelwright, 2006).

The AQ has been widely used by clinicians for screening ASD in adults (Kurita & Koyama, 2006; Kurita, Koyama, & Osada, 2005; Naito et al., 2010). Being quick and easy to administer, it is indeed a promising instrument useful for research and clinical endeavours. However, a predicament is that the psychometric validity of AQ is yet to be substantiated, in particular, its factor structure. The scoring protocol of the AQ was guided by clinical presentations of ASD at the outset without factor analytic investigation to verify if the five dimensions provide the best reduction of the item set, or whether a different structure exists. Furthermore, test–retest reliability and internal consistency coefficients on the total, and five domains in the original study (Baron-Cohen et al., 2001), were suboptimal: *Communication* (α=.65), *Social Skills* (α=.77), *Attention Switching* (α=.67*),* *Imagination* (α=.65), and *Attention to De*tails (α=.63). A Cronbach's alpha of .7 or higher is commonly regarded as good (George & Mallery, 2003). In response to the aforementioned shortcomings, several factor analytical studies have been conducted over the past decade to verify the factor structure and reliability of the AQ. The first factor analysis was undertaken by Austin (2005), who administered the questionnaire to 201 university students (mean age = 20.9 years) and found a three-factor model using principal component analysis (PCA). In this model, 26 out of the 50 items loaded >.40 explaining 28% of the variance and composing three designated factors: *social skills* (α=.85), *detail/patterns* (α=.70) and *communication/mindreading* (α=.66). The three factors were respectively highly correlated with the original subscales of *Social Skills*, *Attention To Details* and *Communication*, supporting three of the five subscales in Baron-Cohen and colleagues (2001)'s model.

Hurst and colleagues (2007) later tested the original five-factor model (Baron-Cohen et al., 2001) and the three-factor model (Austin, 2005) using PCA with a sample of 1,005 undergraduate university students aged 19.36 years on average. Their scree plot supports a three-factor model which closely resembles Austin's (2005) model, except that only 18 instead of 26 items loaded >.40, explaining 29% of the variance. The internal consistencies of the three subscales were not as satisfactory, specifically, *social skills* (α=.75), *detail/patterns* (α=.54) and *communication/mindreading* (α=.42). A separate PCA based on the five-factor model yielded considerably poorer Cronbach's alphas compared to that in the original study: *Communication* (α=.47), *Social Skills* (α=.66), *Attention Switching* (α=.41), *Imagination* (α=.40), and *Attention To Details* (α=.60). Only 20 out of the 50 items loaded >.40 on their designated factor, explaining 27% of the variance. In summary, Hurst, et al. (2007)'s study supported Austin (2005)'s three-factor solution. The authors recommended future research to further establish the three factor solution on AQ commensurate with the autism triad and then current diagnostic criteria of ASD. Of note is that 78% of the sample group in this study was female, and the age range and IQ were restricted by using university students.

The five factor model and three factor models were then tested again, this time using a confirmatory factor analysis (CFA), by Hoekstra and colleagues (2008) using data from a Dutch sample of 961 university students (mean age= 21.19 years) and 302 parents of twins (mean age= 35.68 years) . In this study, the five domain model showed more satisfactory fit indices than the three domain model. Still, an even more parsimonious model was ascertained by clustering four highly correlated domains (*Social skills, Communication, Attention switching* and *Imagination*) into one higher order factor named *social interaction,* with the remaining domain (*attention to details*) as a separate factor. This two-factor model was referred to as the hierarchical factor model. The internal consistency was assessed separately with the two samples, resulting in Cronbach's alphas improved on the original five factor model: *social interaction* (α=.84/.77) and *attention to details* (α=.63/.68). Twenty-five of the items loaded >.40 in this hierarchical factor model. It is noteworthy that even this enhanced factor structure did not achieve the recommended model fit of comparative fit index (CFI) ≥.95, root mean square error of approximation (RMSEA) ≤ .05 and standardized root mean square residual (SRMR) ≤ .08 (Browne & Cudeck, 1993; Hu & Bentler, 1999).

Stewart and Austin (2009) administered the AQ to 536 Scottish university students (mean age = 24.3 years) to test its factor structure. Their exploratory factor analysis (EFA) initially suggested an eight-factor solution; however, a more rigorous analysis using CFA later extracted four factors with 43 items loaded >.40, accounting for 29% of the variance. The first three factors, hereby named *sociability* (α=.83), *patterns* (α=.69), *understanding others/communication* (α=.71), were commensurate with Austin (2005) and Hurst and colleagues (2007)'s three domains. The fourth factor was Imagination (α=.55). All four factors were highly correlated with the corresponding subscales in the original study of AQ. Although the internal reliabilities were satisfactory, this model too did not meet the recommended criteria for good overall fit.

More recently, Kloosterman, Keefer, Kelly, Summerfeldt and Parker (2011) used rigorous model-testing techniques to elucidate the relative merits of the above competing factorial models. This large scale study involved 522 undergraduate university students with a mean age of 21 years. Their CFA results indicated the 3- and 4- factor solutions offered the best fit to their data, yet again neither of them met the set criteria for good fit. In order to ascertain a model representative of their data, Kloosterman and colleagues (2011) then performed separate sets of PCA and CFA resulting in a 28 item, five-factor model somewhat similar to that of Baron-Cohen and colleagues (2001). Kloosterman and colleagues' five domains and the Cronbach alphas respectively were: s*ocial skills* (α=.86), c*ommunication/mindreading* (α=.65), r*estrictive/repetitive behaviour* (α=.40), *imagination* (α=.57) and *attention to details* (α=.59). As in previous studies, this new model also fell short of the goodness of fit indices. Two strengths of this new model were that it explained considerably more variance in item responses (45%) than did previous models, and its factor solution more closely corresponds to the original theoretical conceptualisation of the AQ in general.

In summary, several measurement models have been proposed for the AQ, suggesting that it is multifactorial and encompasses at least one factor relevant to social behaviours and another factor being cognitive pattern. More specifically, two consistently verified constructs were *social skills/sociability* and *pattern/attention to details*. Importantly, however, none of the aforementioned factorial models achieved adequate goodness of fit indices recommended for CFA (Browne & Cudeck, 1993; Hu & Bentler, 1999) suggesting the factor solution of AQ needed further revision. Perhaps the discrepancies among previous factorial studies were due to the use of different study samples and statistical approaches (e.g., PCA versus CFA). The existing models were predominantly built on data from university students, but parents of children with ASD not only were comparatively older than university students, they probably would exhibit more characteristics of autism compared to the general population, as asserted by the theory of broad autism phenotype. Given the AQ is increasingly relied on for genotypic studies on parents with children with ASD, the factorial validity of the AQ for this population warrants exploration. Thus, further factor-analytic studies were conducted as part of this thesis and are reported in Chapter 7 and Chapter 8.

3.8. Conclusions from a Review of Literature on Parents of Children with Autism Spectrum Disorder

Parents of children with ASD experience stress even greater than do those raising children with other developmental disabilities (Hayes & Watson, 2013). In spite of consistent evidence that parents of children with ASD are genetically liable to autism, rarely do researchers and clinicians take into account the impact of parental tendency towards autism when trying to explain the overwhelmingly high parental stress and psychiatric problems in this population (Johnson et al., 2011; Rao & Beidel, 2009). No known empirical study to date has examined whether there is a link between traits of autism in the parents and their often reported marital and parenting dissatisfaction, and their high levels of anxiety. We know, however, that manifestations of broader autism phenotype in parents of children with ASD include aloofness and rigidity in personality (De la Marche et al., 2011; Seidman et al., 2011), communicative difficulties (Ruser et al., 2007), alexithymia (Szatmari et al., 2008), weak central coherence (Happé et al., 2001), executive dysfunction (Bolte & Poustka, 2006) and higher rates of depression (Ingersoll & Hambrick, 2011). These aspects, particularly those of a social and communicative nature, are indispensable for the engagement in intimate relationships, hence likely to be associated with negative effects on marital and parenting quality (Karney & Bradbury, 1995). Thus, one of the research gaps lies within the link between tendency towards autism and marital and parenting functioning, and psychiatric problems of parents of children with ASD. This will be the focal enquiry of the present research. There is also a need to validate the psychometric property of the AQ, a tool widely used to quantify traits of autism in parents of children with ASD.

CHAPTER 4

THE PRESENT RESEARCH

4.1. Summary of Needs for Research

Evidence for high parental stress but not for poor marital quality in families with children with ASD has been consistent (Freedman et al., 2012; Hayes & Watson, 2013). A review of literature on the experience of parents of children with ASD (*sections 3.1 to 3.5*) revealed that the majority of previous studies had only taken into account variables pertaining to the child's diagnosis, whilst only a few had considered the personal characteristics of the parents. However, we know from research on the broader autism phenotype that these parents manifest more traits of autism than found in the general population (e.g., Bishop et al., 2004; Sasson et al., 2013). Expressions of the autism phenotype in parents of children with ASD can include alexithymia (Szatmari et al., 2008), weakness in mind-reading ability (Tajmirriyahi et al., 2013) and weak central coherence (Happé et al., 2001), all of which may cause difficulties in interpersonal relationships. Based on these premises, it is logical to deduce that tendency towards autism in parents of children with ASD is likely to impact on their parent-child and parent-parent relationships, independent of the child's ASD symptoms.

Knowledge on the experience of adults diagnosed with higher functioning ASD is scarce (Fombonne, 2012), especially regarding those who manage to develop and maintain long-term relationships (Magiati et al., 2014). It is not uncommon that these individuals are even mis- or undiagnosed (Dossetor, 2007; Fraser et al., 2012). Numerous empirical and anecdotal accounts have highlighted the costly ramifications of neglecting the socio-emotional challenges of adults with ASD, including poor psychiatric health (Hofvander et al., 2009; Jones et al., 2014). Furthermore, these adults are more liable to have children with ASD, which further increases their risk for psychopathology (Eapen, 2011; Ingersoll & Hambrick, 2011). Poor parental mental-health reduces family functioning, which can in turn exacerbate the child's ASD symptomatology (Johnson et al., 2011; Kelly et al., 2008).

To the author's knowledge, no study to date has taken into account the potentially potent effect of parental traits of autism on both relationships and parenting experience among those raising children with ASD. Future research needs to investigate whether or not parental traits of autism play a role in the well-being of parents of children with ASD.

The AQ (Baron-Cohen et al., 2001) can be utilised for measuring traits of autism in parents of children with ASD. It has been widely used; however, its existing factor models do not meet the recommended criteria for good overall fit (Kloosterman et al., 2011; Stewart & Austin, 2009). There remains a need to test its factorial validity and clinical utility.

4.2. Research Objectives

The purpose of this research project is three-fold: 1) to explore the relationship experience of adults with autism or characteristics of autism; 2) to investigate the effect of traits of autism on psychosocial functioning in parents of children with ASD, and 3) to establish a user-friendly tool suitable for quantifying tendency towards autism in parents of children with ASD. The ultimate objective of these investigations is to draw more attention to the needs of adults with ASD who are engaging in long-term relationships.

4.3. Proposed Conceptual Framework

At this stage, there is insufficient empirical evidence for the author to formulate a theoretical model on the relationships between tendency of autism in parent versus in child, and parental psychosocial functioning. Nonetheless, drawing from this literature review, the present research hypothesises that characteristics of autism in parent are associated with their marital satisfaction, parenting efficacy and psychiatric symptoms independent from diagnosis of ASD in child. To this end, the process of this research is guided by the following conceptual framework:

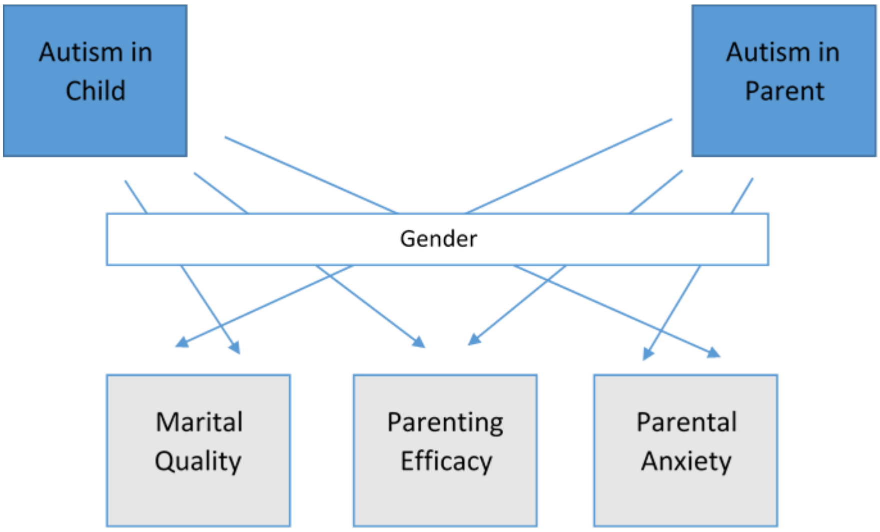

Figure 1 Proposed Conceptual Framework

4.4. Five Original Empirical Studies in the Research Project

Given there had been no previous study conducted on couplehood and parenthood of adults with ASD, the present research began by "casting the net wide", then progressively developing more specific research questions. This process of investigation (depicted in *Figure 1*) will be reported through five studies, each built in part on the findings of earlier ones. Four of the five studies have been published in peer-reviewed journals, whilst the one is under peer review.

4.4.1. Study 1 (Chapter 5)

Lau, W. Y. P. & Peterson, C. C. (2011). Adults and children with Asperger syndrome: Exploring adult attachment style, marital satisfaction and satisfaction with parenthood. *Research in Autism Spectrum Disorder, 5,* 392–399.

Due to the lack of existing research in this area, Study 1 was exploratory in nature. Subjects included 157 parents of children diagnosed with a higher functioning variant of autism, previously known as Asperger Syndrome (AS). Twenty-two of these parents had a clinical diagnosis of AS themselves, as well as their child. The first aim was to explore adult attachment styles of adults diagnosed with AS, and the association of AS with marital and parenting satisfaction. The second aim was to ascertain whether or not a parental diagnosis of AS had an effect on parenting and marital satisfaction independent of the child's diagnosis. Results indicated that parents diagnosed with AS reported astonishingly high prevalence of insecure attachment style; however, the diagnosis did not predict low marital and/or parenting satisfaction as is usually found in the general population. Marital quality was impervious to an ASD diagnosis, either in the child or in the parent. A child's diagnosis of AS, but not a parent's, adversely impacted on parenting satisfaction. This preliminary study instigated further exploration on the parenting experience of adults affected by ASD.

4.4.2. Study 2 (Chapter 6)

Lau, W. Y. P., Peterson, C. C., Attwood, T. J., Garnett, M. S. & Kelly, A. B. (under review). Parents on the Autism Continuum: Self-Perceived Autistic Traits and Parenting Efficacy. *(submitted on 17 May 2014).*

Study 2 further explored the parenting experience of adults diagnosed with ASD using the new dimensional approach (instead of categorical) to identifying tendency towards autism. Uniquely, the sample comprised 346 Australian parents, consisting of adults diagnosed with ASD themselves as well as their child, non-diagnosed adults whose child had a diagnosis of ASD, and non-diagnosed adults who had typically developing children. Each participant completed the Autism Spectrum Quotient (AQ) and Parenting Sense of Efficacy (PSOE) measures. Interestingly, the parents' self-reported AQ scores were inconsistent with their diagnostic status. Nearly a quarter of non-diagnosed fathers of children with ASD obtained an AQ score indicative of clinical diagnosis. Both gender and consistency between self-perceived traits of autism and diagnostic status appeared to be related to parenting sense of efficacy. Mothers who had no diagnosis of ASD but scored highly on the AQ felt less efficacious as a parent, whereas low parenting efficacy was found in fathers who not only scored highly on the AQ but also had a clinical diagnosis of ASD. A negative correlation between AQ scores and parenting sense of efficacy was found only in fathers. This study was the first if its kind to explore whether parental tendency towards autism was related to low parenting sense of efficacy in the ASD population. It was also the first to highlight the discrepancy between self-reported AQ scores and diagnostic status among parents of children with ASD.

4.4.3. Study 3 (Chapter 7)

Lau, W. Y. P., Kelly, A. B. & Peterson, C. C. (2013). Further Evidence on the Factorial Structure of the Autism Spectrum Quotient (AQ) for Adults with and without a Clinical Diagnosis of Autism. *Journal of Autism and Developmental Disorders, 43* (12), 2807-2815.

Results from Study 2 indicated that parental self-reported AQ scores did not consistently reflect a clinical diagnosis of ASD. One possible explanation for this phenomenon was a mismatch between the constructs underlying the AQ measure and the diagnostic criteria of ASD. Indeed, a review of the literature found that whilst the AQ had been heavily relied upon for research on adults affected by ASD, its psychometric properties were yet to be validated. This was particularly true for its factor structure. Thus, Study 3 specifically aimed to establish an internally coherent and reliable factor structure for the AQ, with the ultimate goal of improving its research and clinical utility. Data from 455 Australian adults, of whom 141 had clinical diagnoses of ASD, were analysed using principal component analysis followed by confirmatory factory analysis. Results yielded a 39-item questionnaire with five factors (AQ-39) which had sound goodness-of-fit indices, good-to-excellent internal consistency and test-retest reliability, and it was useful for differentiating between ASD and non-ASD adults. To the authors' knowledge, this was the first factorial analytic study on the AQ that included a sample which encompassed adults who were clinically diagnosed with ASD, adults liable to broader autism phenotype and neurotypical adults.

4.4.4. Study 4 (Chapter 8)

Lau, W. Y. P., Gau S. S., Chiu, Y. N., Wu, Y. Y., Chou, W. J., Liu, S. K. & Chou, M. C. (2013). Psychometric properties of the Chinese version of the Autism Spectrum Quotient (AQ). ***Research in Developmental Disabilities, 34,*** **294-305.**

To further differentiate between the cultural versus ASD-specific influence on the manifestation of characteristics of autism depicted by the AQ, Study 3 was replicated using data from a group of 4,192 Taiwanese parents (1,208 with children with ASD and 2,984 with typically developing children). The Taiwanese population was chosen given the factor structures of the AQ had previously been examined for several cultural groups such as English, Scottish, Dutch and Australian, but not Chinese, despite this being the world's second largest population. The results yielded a 35-item, five-dimensional factor solution (AQ-Chinese) that had more favourable psychometric characteristics than previously published AQ factor solutions. The AQ-Chinese further validated the utility of the AQ for clinical and non-clinical subjects. In addition, it confirmed the consistency of autistic manifestations across different cultural groups.

4.4.5. Study 5 (Chapter 9)

Lau, W. Y. P., Gau S. S., Chiu, Y. N., Wu, Y. Y. (2014). Autistic Traits in Couple Dyads as a Predictor of Anxiety Spectrum Symptoms. ***Journal of Autism and Developmental Disorders, first published online in June 2014. doi: 10.1007/s10803-014-2151-5.***

Having established the psychometric properties of the AQ-Chinese, this measure was then administered to 491 Taiwanese couples who had at least one child diagnosed with ASD. The primary objective of this study was to examine the association between parental traits of autism and anxiety symptoms. Data were analysed using a couple-centred approach where both self and spousal effect were considered. The results indicated that elevated traits of autism in self (but not in spouse) were associated with significantly more anxiety symptoms across all domains (general anxiety disorder, specific phobia, panic disorder, social phobia, agoraphobia and post traumatic stress disorder), even after controlling for the child's tendency towards autism and parental demographics.

Perceived family support and parental education moderated the link between tendency towards autism and anxiety symptoms, though interestingly, not the child’s autistic severity. This study was particularly important for its implications on psychosocial interventions for parents of children with ASD and knowledge of the genetic liability of autism.

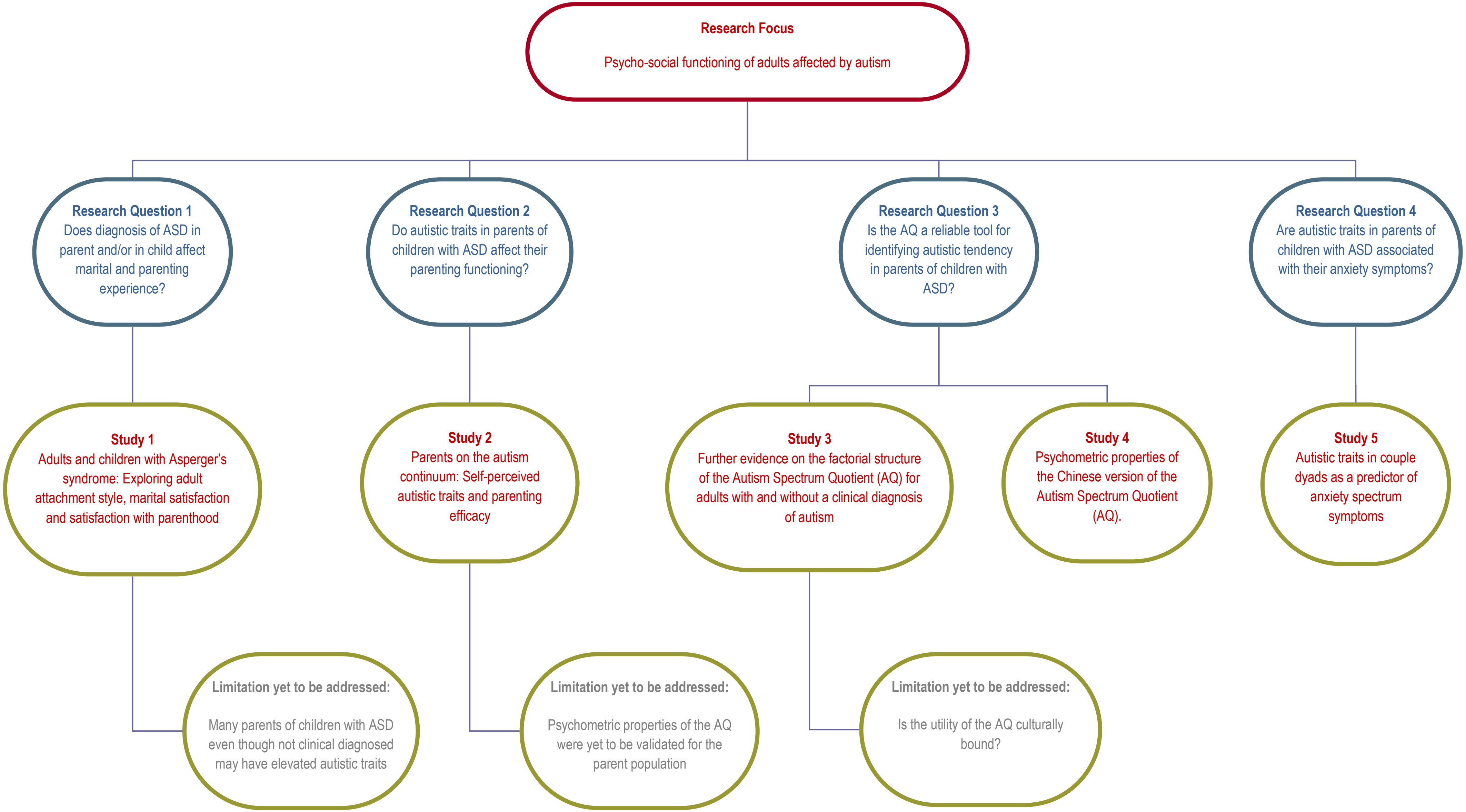

Figure 2 Process and Development of the Present Research

CHAPTER 5

STUDY ONE

Adults and children with Asperger syndrome: Exploring adult attachment style, marital satisfaction and satisfaction with parenthood

> *"In the year I had grown so close to Bryan I had never lost my fear and absolute nervousness at seeing him. Sometimes this had made seeing him a torture which was almost impossible to tolerate. I stuttered and shook much of the time. Because he was like me, he had all the right responses and merely looked into space, never letting it register that he noticed. Basically such things did not matter, and it was this simple unconditional acceptance which meant that in each other's company we were not being there for each other; we were simply 'being'. There was no desperateness to reach out and touch each other in 'the real world'. The only thing which mattered was that someone had been able to touch me emotionally within 'my world'." (Williams, 1992, p. 122).*

5.1. Rationale

Most longitudinal studies on people with ASD have found that although the majority of this population improve over time, difficulties in terms of communication skills and social functioning persist, even for those with high functioning ASD (Klin, 2006; McPartland & Klin, 2006; Orsmond, Shattuck, Cooper, Sterzing, & Anderson, 2013; Walton & Ingersoll, 2013). These social and communication challenges have been associated with difficulties in negotiating social relationships (Bishop-Fitzpatrick et al., 2013; Frith, 2004; Hurlbutt & Chalmers, 2004), developing intimate relationships (Orsmond et al., 2013; Whitehouse, Watt, Line, & Bishop, 2009), and understanding emotions (Berthoz et al., 2013; Cassidy, Ropar, Mitchell, & Chapman, 2014). Empirical studies (Howlin & Moss, 2012; Mazurek, 2013a), notes from clinicians (e.g., Asperger, 1944; Attwood, 2007; Frith, 1989; Wing, 1981), and personal accounts of adults with higher functioning ASD (e.g., Holliday Willey, 1999; Hughes, 2012; Robison, 2008, 2011; Simone, 2010; Williams, 1992), have emphasised that people with ASD are motivated to have interpersonal relationships, yet have difficulty maintaining these. Several common challenges have been noted by couples where one has ASD, including misconceptions due to different approaches to problem solving, the need for routines and repetitions, misunderstanding interpersonal cues, socio-emotional disappointment of the neurotypical partners, treading on sensory sensitivities, disagreement regarding the role of special interests in family life and difficulties in disclosing personal thoughts (e.g., Aston, 2003; Slater-Walker et al., 2002; Weston, 2010). Often the need for solitude by the partner with ASD becomes a threat to the couple's bond (Aston, 2003). To date, there is little empirical data about marital quality and the relationship dynamic of couples affected by ASD available to substantiate these anecdotal accounts.

Considering scientific knowledge on couples with ASD is in its infancy, the author drew from one of the most influential psychological theories about couple relationships, namely attachment theory. According to Bowlby's (1973) attachment theory, interactions with significant others who are available and supportive in times of stress, facilitate the formation of a sense of attachment security. This sense of attachment security provides an individual with a framework for maintaining well-being, formulating effective emotion-regulation devices, developing positive models of self and others, and engaging in exploration, affiliation, and care-giving activities (Bowlby, 1988). Compared to those with avoidant or anxious attachment style, individuals with secure attachment style are hypothesized to 1) hold more positive self-views (Bartholomew & Horowitz, 1991; Mikulincer, 1998a, 1998b); 2) react to stressful events with lower levels of distress (Berant, Mikulincer, & Florian, 2001; Feeney, 1996); 3) hold more positive expectations about their partners (Collins, 1996; Collins & Read, 1990); 4) be more responsive and sensitive towards their partner's needs (Feeney, 1996; Mikulincer, 1997; Mikulincer & Selinger, 2001); and 5) be more likely to cope with stress by relying on support-seeking (Fraley & Shaver, 2008; Simpson, Rholes, & Nelligan, 1992). Bowlby (1979) highlighted marriage as the affectionate bond in which the influence of attachment history is most likely to be manifested. Consequently, attachment style has become one of the fundamental models that guides research on marital and parent-child relationships.

Attachment orientations are not impervious to change (Rholes & Simpson, 2004). Bowlby (1988) contended that every meaningful interaction with significant others throughout life may affect beliefs about others' availability and supportiveness, although very little is known about how a person with ASD's lack of emotional reciprocity may impact on the course of adult attachment in self and in spouse. We know from autobiographies of individuals with ASD that atypical perception about connecting with others is not uncommon. For example, Williams (1992), a woman diagnosed with AS, stated this: *“People were saying that she (my mother) had caused me to be so withdrawn by her coldness and her violence. She probably believed this, and I let her. Had I ever wanted to reach out as myself to the intrusive outside world, I am sure she would have inhibited me. Yet even battered children form attachments with such a parent. I never did.”* (*Williams, 1992, p. 11).* It is the aim of this study to investigate the possible implications of attachment styles on couple relationships and parenting experiences where ASD is present in the child and in some cases, in the parents as well.

5.2. Statement of Contributions of Joint Authorship

Lau, W. Y. P. & Peterson, C. C. (2011). Adults and children with Asperger syndrome: Exploring adult attachment style, marital satisfaction and satisfaction with parenthood. *Research in Autism Spectrum Disorder, 5,* 392–399.

Contributor	Statement of Contribution
Winnie Yu Pow Lau (candidate)	Recruited sample Developed and chose measures Performed data analyses Prepared tables Wrote manuscript drafts
Prof. Candida Peterson (primary supervisor)	Supervised Co-wrote and edited manuscript

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Adults and children with Asperger syndrome: Exploring adult attachment style, marital satisfaction and satisfaction with parenthood

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ABSTRACT

Asperger syndrome (AS) is a disorder resembling autism in its problems with social interaction and cognitive flexibility. Today, a number of adults with AS marry and rear children. Yet there has been little research into the quality of their marital and parental relationships. This study explored romantic attachment style, marital satisfaction and parenthood satisfaction in 157 Australian men and women. There was a focal group 22 married adults with a clinically-confirmed AS diagnosis whose child also had AS and three neuro-typical adult control groups: (a) those whose spouse and child had AS, (b) those whose child had AS but spouse did not, and (c) those with no AS family members. Marital satisfaction was high in all four groups. Respondents who had AS themselves were predominantly insecurely avoidant in romantic attachment, in contrast to predominantly securely attachment in all other groups. Having a child with AS reduced parental (though not marital) satisfaction but there was no additional independent contribution of own or spouse's AS. Methodological and practical implications of the findings were considered.

Asperger syndrome (AS) is a pervasive neuro-developmental disorder on the autism spectrum that is characterized by severe social interaction problems, cognitive inflexibility/restricted interests and poor nonverbal communication skills (American Psychiatric Association (APA), 2000). Despite skilled language, social difficulties and poor understanding of others' minds often persist through adulthood (e.g., Senju, Southgate, White, & Frith, 2009). For example, one follow-up of a group of 67 men and women who had been diagnosed with AS or high-functioning autism in childhood revealed that only a few had mastered the skills for independent living and very few had experienced a long-term couple relationship (Hofvander et al., 2009). Yet adult outcomes are highly variable among individuals with the same diagnosis. In a long-term follow-up of 26 young adults in the normative IQ range who had been diagnosed with AS or autism in childhood, Szatmari, Bartolucci, Bremner, Bond, and Rich (1989) found that whereas problems in nonverbal communication (e.g., gesture, facial expressiveness) persisted in a large majority, this did not necessarily preclude romantic couplehood. About half the sample (44%) had, in fact, experienced a close sexual relationship, one quarter had made a longer-term commitment (dating or cohabitation) and one individual (4%) had married. Similarly, Larson and Mouridsen (1997) reported on a 30-year follow-up of a small sample ($N = 9$) of adults diagnosed in childhood with AS. At a mean age of 39 years, 56% were currently or previously married (including long-term cohabitation) and a number of these couples were also raising children.

Given that couplehood appears possible for at least some adults with AS, further questions arise. Is the romantic attachment process different for these men and women than for married people without AS? To what extent are relationship satisfaction and the emotional experiences associated with marriage and parenthood different for adults with AS, and/or for

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their spouses, as compared with the feelings and experiences of other couples without an autism-spectrum disorder? These are some of the questions for the present research.

1. Marital and parenting satisfaction in families with autism

To the best of our knowledge, this study is the first to systematically explore satisfaction with marriage and parenting in groups of couples where one spouse has a clinically-confirmed AS diagnosis. However, several clinical case histories (e.g., Attwood, 2007) and autobiographical accounts by individuals living with AS (e.g., Grandin, 2002; Jacobs, 2003; Slater-Walker & Slater-Walker, 2002) highlight that there can be negative but also positive features of these relationships for some individuals. For example, in a narrative account of her own marriage to an AS husband, one newspaper advice columnist (Jacobs, 2003), informally questioned several other similar married couples. Respondents who had AS themselves were generally content with marriage but a number of their spouses were less positive: "Their mental health had significantly deteriorated due to the relationship. They felt emotionally exhausted and neglected" (Attwood, 2007, p. 310).

While case histories and anecdotal accounts like these are not only insightful but also rich sources of testable hypotheses, there is a dearth of well-controlled empirical study of the marital quality of couples with AS. Our goal was therefore to systematically investigate relationship quality in such couples using standard, well-validated marital quality instruments and appropriate control groups. Specifically, we examined three relationship dimensions (adult attachment style, marital quality and parenthood satisfaction) that are widely deemed to be core features of healthy family and couple functioning and individual wellbeing (e.g., Hazan & Shaver, 1987, 1994; Noller, Feeney, & Peterson, 2001; Shaver & Mikulincer, 2008). To explore how having AS might shape relationship functioning in each of these key areas, we focussed on a target group of 22 men and women who themselves had a DSM-IV-based AS diagnosis (APA, 2000) that had been clinically-confirmed independently of this research. We also compared them with three distinct, theoretically-selected control groups, namely: (a) neuro-typical adults who were married to, and living with, both a spouse and a child with clinically-confirmed AS, (b) neuro-typical parents whose child (but not spouse) had AS, and (c) matched spouses in non-clinic households with no AS in either generation.

Our rationale for these empirical choices was grounded in a limited amount of indirectly relevant previous research that can be briefly outlined as follows.

2. Child autism and family relationship quality

Despite there being no known past studies sharing the present focus on the marital quality among spouses who themselves have AS, there has been a small amount of research on the marital satisfaction of neuro-typical parents with an AS child. For example, using a large national survey sample, Montes and Halterman (2007) selected 364 mothers who reported their child had been suspected of having autism (though not necessarily officially diagnosed). At an individual level, these mothers reported significantly higher levels of stress and poorer mental health than mothers in the general population, even after controlling for demographic factors. Yet their self-reported marital functioning (conflict-resolution style, disagreement frequency, closeness to spouse and frequency of domestic violence) was no different from that of respondents with no children with autism. Lee (2009) likewise found that, despite their low scores for shared leisure pursuits, respondents with children with autism did not differ significantly from control parents of children without disabilities. Brobst, Clopton, and Hendrick (2009) compared 25 couples whose child had an autism-spectrum disorder to 20 non-clinic controls and found large differences in parenting stress, a marginally significant difference in total marital satisfaction and no differences at all on scales of marital commitment, spousal support or feelings of respect for spouse.

All in all, then, these studies suggest, somewhat unexpectedly, that spouses' marital satisfaction may not be as drastically undermined by the challenge of rearing a child with an autism-spectrum disorder as has commonly been supposed. Indeed, quality of marriage may actually serve as a protective factor mediating the adverse link between a child's disability and parents' emotional wellbeing. For example, Kersh, Hedvat, Hauser-Cram, and Warfield (2006) studied martial satisfaction and parents' personal levels of stress and distress in families with children who had a wide range of disabilities. These included, but were not limited to, disorders on the autism spectrum. They found that whereas parents of disabled children generally reported more personal mental health problems and greater parenting stress than control parents whose children had no disabilities, a high quality marriage could serve as an antidote. Those mothers and fathers of disabled or nondisabled children who reported high levels of marital satisfaction had lower levels of personal stress and depressive symptoms than other parents, irrespective of whether or not their child had autism or any other disability.

A construct that is closely related to marital satisfaction is parenthood satisfaction. The latter term describes the overall balance of positive affective feelings (like pride, confidence and joy) relative to negative emotions (anger, self-doubt, sadness) that mothers and fathers gain from the parenting role (Johnston & Mash, 1989). In one study of neuro-typical parents, Benson and Karlof (2009) assessed levels of parenting satisfaction and stress, together with other possible sources of satisfaction in adults' lives (including careers, hobbies, marriage, finances). For mothers and fathers whose child had an autism-spectrum disorder, longitudinal analyses showed that other life dimensions mediated the impact of the severity of the child's symptoms upon parental depression over time. Hoffman, Sweeney, Hodge, Lopez-Wagner, and Looney (2009) compared mothers of children diagnosed with autism to a control group of mothers of age-matched typically developing children and found that "despite substantial stress, mothers of children with autism report close relationships to their children" (p. 178).

In other words, while there are a few suggestions in the published research literature that parental emotions may be influenced by stresses associated with rearing disabled children, including those with autism, there is clearly a need for further research. Not only will it be important in the present study to examine (for the first time) the effects of an AS diagnosis specifically, but it will also be important to explore connections of marital and parenthood satisfaction with a third key aspect of couple relationship quality, namely adult attachment style, as discussed below.

3. Adult attachment style in families with autism-spectrum disorders

In addition to marital satisfaction, an important barometer of the overall quality of marital relationships is the individual difference variable known as adult romantic attachment style (Fraley & Shaver, 2000). In pioneering research, Hazan and Shaver (1987) discovered that healthy adults in dating, married or cohabiting relationships had attitudes and emotional orientations to love that clustered into three distinct attachment styles resembling Ainsworth's (1979) three patterns of infant attachment to caregivers (i.e., avoidant, secure or anxious-ambivalent). Subsequent adult couple research has shown that these romantic attachment styles are related statistically, for couples in general, to key aspects of marital functioning including satisfaction, communication quality, conflict-resolution patterns and divorce-proneness. This supports the view that marital quality is "partly an attachment phenomenon" (Fraley & Shaver, 2000, p. 36).

Adult romantic attachment style has not previously been studied in married adults diagnosed with AS, but one previous study (Taylor, Target, & Charman, 2008) examined a related construct, parent-child attachment, among adults with a range of autism-spectrum disorders (ASD). In-depth interviewing was used to gather reminiscences from 20 unmarried adults with ASD about their childhood emotions and parent-child attachment experiences (e.g., with parental separation). Transcripts were scored using the codes of the "adult attachment interview" (AAI), a semi-projective clinical tool developed by George, Kaplan, and Main (unpublished, cited by Taylor et al., 2008). As Shaver and his colleagues have noted (e.g., Shaver et al., 2000), AAI-based reports of parent-child attachment are qualitatively and conceptually distinct phenomena from adult attachment to a marital partner. Despite this, some studies of non-clinic couples have shown small but significant associations between AAI security and secure adult attachment (Shaver et al., 2000), making Taylor et al.'s (2008) results of potential indirect relevance to the present study. In fact their results showed, unexpectedly, that the adults with ASD scored as high in AAI security codes as matched controls and "there was little evidence that parental attachment security was related to IQ [or] autistic symptomatology" (p. 145). This had to be qualified, however, by their observation that the semi-projective AAI interview may be "a difficult task for adults with autism because of its heavy reliance on discourse coherence, mentalising and conversational pragmatics" (p. 160). Noting that individuals with ASD are apt to have unusual and persistent difficulties with this type of interview, Target et al. called for future research using alternative attachment measures that may be "less strongly reliant on narrative than the AAI" (p. 162), a goal of the present study.

Also using the AAI, Kissgen et al. (2009) studied parental attachment reminiscences in neuro-typical mothers of children diagnosed with ADHD (attention deficit hyperactivity disorder). Even though this population of parents with children with a different disability is only tangentially relevant to the present study's focus on parents of children with AS, Kissgen et al.'s findings were intriguing. Significantly fewer mothers of a child with ADHD than matched control mothers had secure AAI attachments, even though it was their own childhoods long before the birth of the child with ADHD, that the AAI supposedly tapped into. No unique causal explanation for this link was forwarded, and the pattern may conceivably be specific to children ADHD. Alternatively, it is possible the same pattern could apply for parents of children with other disabilities (including those with AS) in line with Kissgen et al.'s suggestion that adults' internal mental models of attachment "are active constructs that may be restructured at any given time" (p. 206) in response to stressful life experiences such as coping with a disabled child's atypical development. If so, then parents of children with AS in the present study might conceivably be more insecure in adult romantic attachment style than parents of control children without disabilities.

4. Method

4.1. Participants

A total of 157 Australian men and women aged 29–71 years took part. All were parents in intact couple relationships. Seventy-five of them comprised the non-clinic control group with no family member (including self) with any autism-spectrum disorder or other diagnosed clinical condition of any kind. The remaining 82 respondents all had at least one child with a confirmed DSM-IV-based diagnosis of Asperger syndrome (AS) that had been conferred independently of this research by a team of clinicians including at least one medically-trained pediatrician or psychiatrist. A focal subgroup (Group 1) of 22 of these 82 adults was of primary interest because they not only had a child with AS but had received a similar, clinically-confirmed diagnosis of AS themselves. We selected only those whose diagnosis had been conferred, independently of this research, clinicians who used DSM-IV criteria (APA, 2000). There were 7 fathers and 15 mothers in Group 1. Group 2 consisted of 11 adults (1 father; 10 mothers) who did not have AS themselves, even though their spouse (who was not in Group 1) and at least one of their children had it. Group 3 consisted of 49 parents (13 fathers; 36 mothers) who had a child but no adult family member with a confirmed AS diagnosis.

The non-clinic control group (Group 4) of 75 parents (16 fathers; 59 mothers) was matched to each of these three clinical groups by respondents' age and gender, as well as in terms of the total numbers of offspring in their families. These adults were recruited via personal contacts, staff and student email and research participant pools at a major university and anyone reporting suspected or diagnosed ASD or other disorder in any family member was excluded.

For all four groups, inclusion required an intact couple relationship (married or cohabiting) that had produced at least one child (aged 3–18 years) who was still living at home. In cases where both members of a particular couple volunteered, we ensured that only one respondent per couple was included in the present sample so as to maintain the statistical independence of all of our group comparisons. Preliminary analyses confirmed that there was no difference among the four groups in respondent's age, $F(3,153) = 2.68$, $p > .05$, respondent's gender, $\chi^2(3) = 2.56$, $N = 157$, $p > .30$, or in total number of offspring, $F(3,153) = 1.16$, $p > .30$.

4.2. Materials and procedure

Having volunteered to take part in a study of "family attitudes", each participant responded anonymously to a set of printed materials. These included a preliminary demographic section, together with the following focal measures:

Adult attachment style. We used Hazan and Shaver's (1987) seminal vignette instrument, one of the most widely-used contemporary measures in published research on couples and close relationships (Noller et al., 2001) as supplemented by a more recently devised dimension scales (e.g., Mickelson, Kessler, & Shaver, 1997). The original vignette instrument consists of three short paragraphs, each translating one of the classic three infant attachment styles into "terms appropriate to adult love" (Hazan & Shaver, 1987, p. 513). We used these vignettes verbatim as they appeared in the original publication (Table 2, p. 515). Each vignette is phrased in the first person and highlights several key features of adults' attachment including (a) preference for autonomy over togetherness, (b) discomfort with dependency and (c) anxiety over rejection. For example, the description of the Type A (avoidant) style begins "I am somewhat uncomfortable being close to others" and concludes "[my] love partners often want me to be more intimate than I feel comfortable being" (p. 30) whereas the Type B (secure) vignette describes adults who trust their loved ones and feel comfortable being depended upon.

As recommended by Shaver and his colleagues (Mickelson et al., 1997) we supplemented the original forced-choice vignette measure with a trio of 7-point rating scales. This gave each respondent a quantitative score ranging from 1 to 7 for degree of self-perceived similarity to each of the Types A, B and C vignettes. Preliminary manipulation checks revealed a close correspondence between absolute style categorizations and continuous, quantitative scores for all four groups. Thus, all respondents, including those with AS, appeared to have comprehended and conformed with instructions.

Marital satisfaction. We administered a widely-used marital satisfaction scale, Norton's (1983) Quality Marriage Index (QMI) to assess respondents' levels of marital wellbeing and happiness. The revised QMI (Norton, 1983) consists of six items that were derived by Norton through factor analysis of 430 married couples' responses to a larger pool of 20 items. As recommended by Norton (1983), responses by the present sample were scored such that three distinct but converging indicators of levels of marital happiness were obtained.

The first of these was a global 10-point rating asking for "happiness, everything considered, in your marriage" (p. 146) to be rated from 1 = "very unhappy" to 10 = "perfectly happy". We used this item, as recommended by Norton both on its own "as a separate single item predictor" (p. 148) and also as part of a more comprehensive 6-item scale. For the latter, it was joined by five additional more specific items, all scored in 7-point Likert format from 1 = "strongly disagree" to 7 = "strongly agree" (e.g., "We have a good marriage", p. 146) and were found by Norton to load strongly on the same factor as the global (10-point) item. We summed responses to these five items, divided by 3.5 and added this subtotal to the global rating score so that the discrete and global items each contributed equally to a total satisfaction (TS) score, ranging from 2 to 20. Finally, the two remaining items from the primary factor in Norton's (1983) factor analysis "How often have you and your partner seriously discussed ending your relationship?" and "I have seriously considered ending my relationship with my partner" were rated (as per Norton) on 8-point Likert scales from 1 = "never" to 8 = "more than ten times". The two ratings were summed and used as a separate scale of "divorce cognitions". Norton noted that these cognitions, while often negatively correlated with the satisfaction items, are conceptually distinct. As he explained: "discussing marriage termination is not the same hybrid, evaluative variable [as satisfaction]" (p. 150). In fact, a respondent who is highly dissatisfied with marriage may never seriously consider ending it owing to religious reasons, children's needs, etc. Conversely, some couples who are generally highly satisfied may upon occasion seriously consider divorce (e.g., when in the throes of a heated dispute). Therefore, as recommended by Norton, we treated the divorce cognition (DC) total as a separate variable rather than summing it with the TS score.

Parenthood satisfaction. Johnston and Mash (1989) devised a 9-item measure of parents' affective feelings of joy or disappointment with parenthood. A sample items is: "Being a parent makes me tense and anxious" (reverse scored). Items are rated on a 6-point scale from "strongly disagree" (=1) to "strongly agree" (=6). We administered and scored this measure exactly as described by the original authors. With all items scored in a positive direction, totals can range from 9 (highly dissatisfied) to 54 (extremely satisfied). Rogers and Matthews (2004) previously validated the scale with a large Australian sample. Cronbach's alpha was $\alpha = .77$ in their study for 849 Australian mothers, and $\alpha = .80$ for 329 Australian fathers, respectively, testifying to the scale's sound internal consistency and psychometric appropriateness for the present group.

5. Results

5.1. Asperger syndrome and adult attachment style

Table 1 shows the distributions of Types A (avoidant), B (secure) and C (anxious) attachment style classifications from respondents' categorical self-descriptions.

Almost three quarters of the married parents who had AS in Group 1 selected the avoidant (Type A) attachment style as their most apt self-description and their frequency of doing so was significantly higher than in all the other groups combined, χ^2 (1) = 18.65, N = 157, $p < .001$. This is not surprising. Indeed, there is some conceptual overlap in the specific personality qualities (e.g., social aloofness) that define both avoidant romantic attachment, as per Hazan and Shaver's (1987) measure, and the diagnostic markers of AS, as clinically defined by DSM-IV criteria (APA, 2000). Yet it is worth noting that, since the Type A style is an insecure one (Ainsworth, 1979; Hazan & Shaver, 1987) the present result contrasts with Taylor et al.'s finding, for recalled parental AAI attachment, that insecure attachment was no more frequent for unmarried adults with autism than for control adults.

The secure (Type B) romantic attachment classification was chosen by most (72%) respondents in all three of the remaining groups, reflecting a pattern previously shown to be common to married adults in general. For example, Mickelson et al.'s (1997) survey of 8000 representative U.S. adults aged 15–54, revealed that 63% of married people chose the Type B (secure) vignette, which is almost identical to the 61% of Groups 2 and 3 who did so. The non-clinic control parents in Group 4 chose the secure category even more frequently (79%) than the married adults in Mickelson et al.'s survey, χ^2 (1) = 9.19, $p < .01$. This may conceivably have been due to our strict exclusion criteria for composition of this control group (see Section 4). The Type C (anxious-ambivalent) romantic attachment style was almost never chosen by any group in our sample (see Table 1). The fact that only 4% of the full present sample did so, closely matches the low rate of Type C choice observed by Mickelson et al. (1997) for married/cohabiting adults in the U.S.A. (8%).

Means on the continuous scales of Types A, B and C attachment (see Table 2) echoed these categorical choice patterns. A significant group difference in mean avoidance scores, F (3,153) = 15.81, $p < .001$, reflected adults with an AS diagnosis scoring significantly higher than those in all other groups (Newman–Keuls, $p < .05$). There was no significant group difference for anxious attachment (Type C) scores, $F < 1$, and the significant Type B difference, F (3,153) = 12.09, $p < .001$, simply reflected the same pattern as for the categorical choice data: Group 1 respondents scored lower on the secure attachment dimension than each of the other groups, while the latter three did not differ significantly.

5.2. Marital adjustment, Asperger diagnosis and adult attachment style

We explored the possibility of contrasts in subjective marital quality among Groups 1–4 on each of Norton's (1983) three marriage satisfaction indices. Table 2 shows mean scores for each of the diagnostic groups, subdivided by attachment status. To consider simple effects of AS diagnosis, we first computed one-way analyses of variance (ANOVAs) to compare the four groups on each marital quality dimension. For the single-item global marital satisfaction index, means for Groups 1 through 4 were 6.21, 5.09, 6.32 and 6.82, respectively, and these did not differ significantly from one another, F(3,153) = 2.18, $p > .09$,

Table 1
Numbers and percentages selecting each attachment style, and means on continuous attachment variables, by diagnostic group.

	Group 1 (self and child have AS)	Group 2 (spouse and child have AS)	Group 3 (child only has AS)	Group 4 (control: no AS)
Number of respondents	22	11	49	75
Type A (avoidant)	16 (73%)	1 (9%)	19 (39%)	14 (19%)
Type B (secure)	4 (18%)	10 (91%)	28 (57%)	59 (79%)
Type C (anxious)	2 (9%)	0 (0%)	2 (4%)	2 (3%)
Mean A score	5.50	1.82	3.69	2.93
Mean B score	3.23	5.56	4.52	5.56
Mean C score	2.50	1.82	2.09	2.36

Table 2
Mean marital and parenting satisfaction scores (and standard deviations) as a function of respondent's adult attachment style and diagnostic grouping.

	Group 1 (self and child have AS)		Groups 2 & 3 combined (child not self has AS)		Group 4 (control: no AS)	
Number of respondents	22		56		75	
Attachment style	Insecure (A + C)	Secure (B)	Insecure (A + C)	Secure (B)	Insecure (A + C)	Secure (B)
Global marriage satisfaction	6.18 (2.04)	6.50 (1.29)	5.74 (2.23)	6.11 (2.65)	5.07 (1.44)	7.22 (1.97)
Mean marital quality	13.59 (3.83)	15.00 (2.36)	13.30 (4.56)	13.51 (5.29)	12.44 (2.70)	15.89 (3.30)
Divorce cognitions	6.94 (4.97)	2.75 (.96)	5.56 (4.68)	4.94 (3.50)	6.40 (3.18)	3.75 (2.72)
Mean parenthood satisfaction	33.88 (8.53)	31.75 (9.22)	34.75 (6.55)	36.97 (8.24)	39.45 (3.75)	41.22 (6.81)

suggesting that marriage was equally satisfying to respondents overall irrespective of whether they, their spouse, their offspring, or no-one in the household had an AS diagnosis.

However, on the 6-item total satisfaction (TS) score, there was a statistically significant difference among diagnostic groups, $F(3,153) = 4.14$, $p < .02$. With a mean of 11.17, a post hoc Newman–Keuls test showed that those in Group 2 (neuro-typicals with an AS spouse and an AS child), scored significantly lower than the non-clinic control-group parents (Group 4). Those in Group 2 did not differ significantly from those in Group 3, suggesting that it was the child's and not the spouse's diagnosis that made the difference. Furthermore, respondents with AS themselves in Group 1 had TS scores that equalled those for Groups 2 and 3, further indicating parental AS status did not contribute over and above the child's to TS scores. Finally, on the composite index of divorce cognitions there were no statistically significant differences among Groups 1 through 4 (means = 6.30, 5.91, 5.02 and 4.27, respectively, $F(3,153) = 1.90$, $p > .10$).

In summary, these results reveal, surprisingly, that the husband's or wife's AS status had little impact upon any aspect of marital quality. Furthermore, even though having a child with AS was associated with lower total satisfaction scores than for non-clinic control couples, as in some previous research, the contrast from the control group reached statistical significance only for the small group of parents with a spouse and child who both had AS. Nor were there significant differences among any of the groups for the two remaining marital quality indices (global happiness with marriage and divorce cognitions). Thus, all in all, the results indicate little or no effect of parents' own AS status on marital quality and only a partial diminution when AS arises in both spouse and child generations.

Table 2 shows mean scores on the three marital quality indices for each diagnostic group subdivided by secure versus insecure romantic attachment. (Note that owing to the small numbers of Type C attachment classifications throughout the sample, we created secure/insecure dichotomy for these comparisons, based on respondents' choice of the secure Type B versus either the insecure Type A or Type C as per Hazan and Shaver (1987) and that, for similar reasons, we also collapsed diagnostic Groups 2 and 3 into a broader category of respondents without AS who had an AS child.)

Three separate 2 (attachment security) × 3 (diagnostic grouping) ANOVAs were performed to examine influences upon each of Norton's (1983) three indices of marital quality in turn. For the single-item global satisfaction index, there were no statistically significant main effects of attachment security, $F(1,151) = 3.72$, $p > .05$, or diagnostic grouping, $F < 1$, and their interaction was likewise non-significant, $F(2,151) = 2.37$, $p > .09$. Similarly, there were no significant main effects or interactions when the 6-item total satisfaction (TS) score was used as the dependent variable, all $Fs < 3.30$, all $ps > .07$. However, for frequency of divorce cognitions, there was a statistically significant main effect for adult attachment security, $F(1,151) = 9.33$, $p < .01$, though none for diagnostic grouping, $F < 1$, or the interaction, $F(2,151) = 1.75$, $p > .15$. Irrespective of AS diagnosis, spouses with a secure attachment style were less likely to have thought seriously about divorce than those with an insecure attachment.

5.3. Parenthood satisfaction, diagnosis and adult attachment style

Mean parenting satisfaction scores for Groups 1 through 4 were 34.29, 38.90, 35.59 and 40.87, respectively. A one-way ANOVA comparing the four diagnostic groups revealed a statistically significant difference, $F(3,153) = 7.14$, $p < .001$, and a post hoc Newman–Keuls test showed the non-clinic control parents in Group 4 gained significantly more satisfaction from parenthood than respondents with an AS child in Groups 1–3, who did not differ significantly.

In other words, it seemed to be the child's AS diagnosis (rather than one's own or one's spouse's) that made the difference. Indeed, the Newman–Keuls test showed that, despite having both an AS spouse *and* an AS child, respondents in Group 2 actually scored just as highly in parenthood satisfaction as non-clinic control parents in Group 4. However, lower statistical power (owing to Group 2's small size) suggests a need to treat this result cautiously pending replication with a larger sample.

To explore possible interactive influences of attachment security with family diagnostic status upon satisfaction with parenting, a 2 (secure/insecure) × 3 (diagnostic grouping) ANOVA was conducted on the parenthood satisfaction scores. Means appear in Table 2. There was no significant main effect of attachment security, $F < 1$, nor was the interaction significant, $F < 1$, even though the diagnostic grouping main effect remained significant in this analysis, $F(2,151) = 6.10$, $p < .01$, echoing the one-way ANOVA reported above. A post hoc Newman–Keuls test again showed that control parents in Group 4 were more satisfied with parenthood than the parents who had a child with AS in Groups 1–3 whereas even though most parents in Group 1 had insecure romantic attachment, this exerted no significant influence on the satisfactions they gained from parenthood.

6. Discussion

A number of the findings of the present study were both original and unexpected. In the first place, in studying romantic attachment style in married adults with an AS diagnosis for the first time, we discovered that these respondents were significantly more likely than their control-group counterparts to adhere to an insecurely avoidant (Type A) style of attachment in their orientations to couplehood. As might have been expected from their AS diagnostic profiles, they preferred self-sufficiency to intimacy and mistrusted own and partner's dependency. However, even though the Type A attachment is categorized as an insecure style, it is important to bear in mind that it is not unique to adults with AS, but is also quite common among adults in general. For example, Hazan and Shaver (1987) found that up to 30% of healthy, non-clinic young adults in dating, engaged and cohabiting premarital relationships reported this avoidant style.

Our discovery of elevated insecure adult attachment in married people with AS is interesting to compare with Taylor et al.'s (2008) previous finding that unmarried adults with autism-spectrum disorders were no less likely than non-clinic controls to recall secure parental attachments on the semi-projective AAI. While this could suggest a divergence between romantic versus parental attachment for individuals on the autism spectrum, there are several important qualifications regarding such a conclusion. First, the absolute percentage of adults with ASDs in Taylor et al.'s study with secure parental attachment (15%) was actually identical to the percentage of adults with AS in the present Group 1 with secure couple attachment (15%: see Table 1). Thus our results for the target population of adults with ASD were actually identical to Target et al.'s. It was only the behaviour of the non-clinic control groups that led the two studies to reach divergent conclusions regarding whether or not insecure attachment is more prevalent in adults with ASD than in the general population. Second, there were so many differences between the two studies not only in their respective operational definitions of attachment security but also in their emphases on couple versus parent-child attachment and their assessment methodologies that no overlap between their findings would necessarily have been expected.

In this context, perhaps our most notable finding was that, despite all these conceptual, methodological and sampling variations, each study reached the same overall conclusion that only a small minority (15%) of adults with ASD are securely attached. Yet even this shared conclusion must be tempered by consideration of some of the methodological limitations that both studies had in common. Both were selective in sampling from populations of adults with ASD who were highly intellectually and verbally adept. Both studies also sampled an unusually high frequency of women with ASD (40% in Target et al.'s study and 68% in our own) relative to the disproportionate population prevalence of ASD among males. In our study, the selective focus on married adults and our reliance on unpaid volunteers undoubtedly contributed to this sample bias. In fact, even in the general, non-clinic population (e.g., college students), female willingness to volunteer for unpaid, time-consuming questionnaire research is found to greatly outweigh males' (Coon & Mitterer, 2010). Clearly further research is needed with varied measures and larger samples before achieving fully generalizable conclusions about how an AS or ASD diagnosis may or may not influence adult attachment security.

Yet, pending such further investigation and replication, several aspects of the present findings regarding adult attachment remain notable. First, it was surprising how little influence romantic attachment security had over any of the standard dimensions of marital and parenthood satisfaction that we measured, and that these null effects were true of all the married parents in our sample, irrespective of whether they themselves, their spouse or their child had AS. Nor did the presence of a child with AS in the family elevate the prevalence of insecure adult romantic attachment in our study, in contrast to Kissgen et al.'s (2009) findings for AAI reminiscences of parental attachment in households with children with a different disability (ADHD). Indeed, we found that even respondents in Group 2 (with both a spouse and a child with an AS diagnosis) were as overwhelmingly securely attached as control parents of similar age, gender and family size in without ASD anywhere in the family. Perhaps it takes a person with an already highly secure attachment style to undertake and maintain a marriage to a spouse with AS. Alternatively, the positive qualities (e.g., loyalty, intelligence) that high-functioning spouses with AS may often bring into marriage (Attwood, 2007) may conceivably compensate for difficulties in such a way that internal working models and spousal interaction patterns are not disrupted in ways that might diminish the neuro-typical spouse's adult attachment security over time. Longitudinal and observational studies of couple communication and interaction in such couples would be useful to test these hypotheses.

In addition to exploring adult romantic attachment style, our study was novel in its systematic exploration, via widely-used standard instruments, of marital satisfaction, divorce-proneness and overall quality of marriage in families with varied generational distributions of AS diagnoses. Somewhat surprisingly, global satisfaction with marriage remained equally high irrespective of the presence versus absence of an AS diagnosis anywhere in the family and was likewise uninfluenced by spouses' attachment security. Thoughts of divorce were higher if the respondent had an insecure attachment style, but this was as true in the non-clinic control group as in families with AS and, indeed, there was no difference among any of the four diagnostic groups on this variable, nor did total marital quality show significant main effects or interactions due either to attachment security or the presence versus absence of an AS family member when these two potential predictors were considered in conjunction with one another. In other words, marital satisfaction seemed relatively robust against influences of AS in self, spouse or child in this admittedly atypical sample of unpaid volunteer families living with AS who had remained married long enough to be rearing a child aged 3–18.

Equally surprisingly, for parenthood satisfaction, results showed that parental AS diagnosis (either in the self or the spouse) did not significantly diminish the satisfactions and pleasures that respondents derived from their parenting roles. Nor did the security of respondent's adult attachment style. Yet AS in the offspring generation did make a difference. Those couples whose child had AS were less parentally satisfied than matched control parents of typical developers. These findings extend to the specific diagnosis of AS the results of several previous studies of parents of children with other disabilities (including undifferentiated ASD). Implications for counselling are clear. It seems, that, irrespective of the specific characteristics of their child's problems, many parents of children with disabilities may need help in learning how maintain a positive emotional balance in the face of the additional problems, challenges and demands on their time and energy that the rearing of a child with special needs inevitably imposes.

While highly optimistic in the overall picture they present of healthy personality (e.g., attachment), marital and parental functioning in married adults with AS and their neuro-typical spouses, an important caveat needs to be placed upon the present finding owing to sample selection factors, as noted in detail earlier. Parents of children with AS with enough motivation, ability and free time to volunteer for unpaid questionnaire research via announcements in the clinics and newsletters we used (most of which were directed at parents of children with ASD) may not be adequately representative of parents of children with AS in general. Our recruitment of the non-clinic unpaid volunteer control group via universities and similar sources may likewise have biased this comparison group. It will therefore be important in future research to test the generalizability of these results to other samples of less advantaged parents. Given their brevity, simple language and proven comprehensibility even by our group of respondents with AS the widely-used Hazan and Shaver (1987) attachment style measures recommend themselves for such future research either as an adjunct to, or replacement for in-depth semi-projective instruments like the AAI. In this way, it is hoped that future research will more fully clarify the extent and nature of the impact of parental and/or child AS diagnoses upon couples' and parents' levels of relationship wellbeing and functioning.

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Parents on the Autism Continuum: Self Perceived Autistic Traits and Parenting Efficacy

> *"I've always found it remarkable that in a professional career, there is often a requirement for a demanding amount of study and examinations, but to become a parent requires no special qualifications, no selection and no aptitude for the job. Yet the human damage that can be done by poor parenting far outweighs that which can be done by someone who is merely incompetent in their profession. For the incompetent employee, there is also the threat of unemployment, yet it seems to be a measure of last resort that children should be forcibly removed from their parents." (Slater-Walker et al., 2002, p. 116)*

6.1. Rationale

This study aimed to extent on the findings from Study 1 that parents of children with ASD reported lower parenting sense of satisfaction by including a sample that encompassed a broader range of tendency towards autism in parents. In addition, parents of both genders were recruited to allow analyses on gender effect. Corresponding to the new change in diagnostic taxonomy of ASD in DSM-5 (American Psychiatric Association, 2013), this study phased in a dimensional instead of categorical approach in defining parental tendency towards autism. The objective was to capture not only parents who had clinical range of traits of autism but also those of subclinical range in order to evaluate the effect of severity in parental traits of autism on their parenting sense of efficacy.

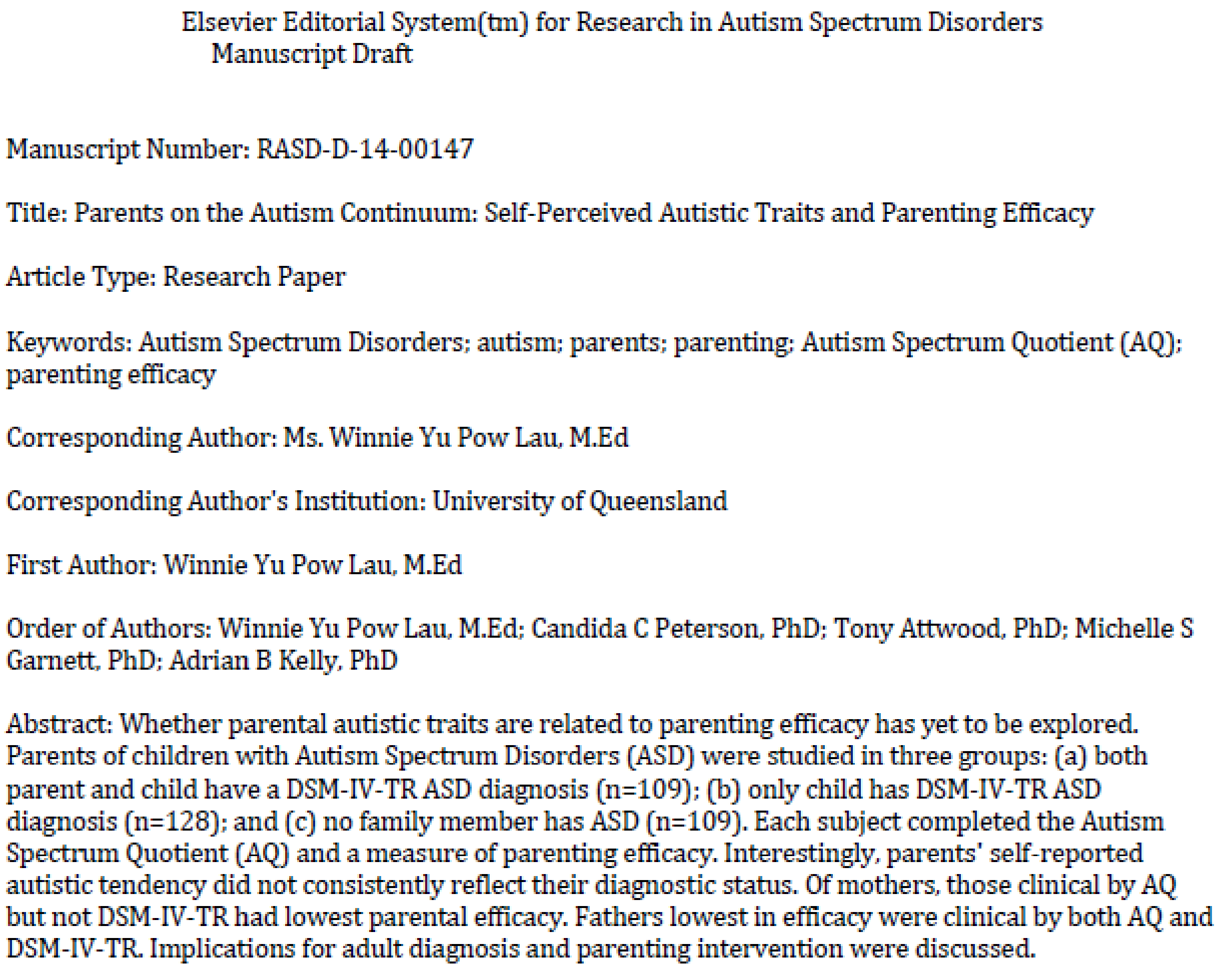
Information on parenting experience of adults with ASD was limited because most of the existing research only included participants who were in their 20s and 30s (Shattuck et al., 2012). Autobiographies of adults with ASD highlighted challenges in being a parent including not noticing their children's socio-emotional needs and neglecting to seek help for their children's challenges (Holliday-Wiley, 2001; Holliday Willey, 1999). Many also were described to possess excellent skills in specific areas but lack of common sense, making it difficult for them to cope with daily demands in their family lives (Slater-Walker et al., 2002). Existing research accentuated the lack of support and knowledge on the needs of adults with high functioning ASD due to their uneven profile of abilities. These individuals often possess skills and talents that can camouflage their socio-emotional deficits (Attwood, 2007) thus it has been a challenge for researchers and clinicians to recognize their needs (Jones et al., 2014). Yet, under-serving this population can lead to an overwhelmingly high prevalence of psychiatric illness (Hofvander et al., 2009). Researchers and clinicians needed to note that even intelligent, articulate, well-educated and professionally successful individuals in this population may lack some, many, or most core social, interpersonal and parenting skills. The objective of this purpose was to examine whether or not parenting sense of efficacy was compromised among those who fell within the high functioning end of the autism continuum.

6.2. Statement of Contributions of Joint Authorship

Lau, W. Y. P., Peterson, C. C., Attwood, T. J., Garnett, M. S. & Kelly, A. B. (under review). Parents on the Autism Continuum: Self-Perceived Autistic Traits and Parenting Efficacy. *(submitted on 17 May 2014).*

Contributor	Statement of Contribution
Winnie Yu Pow Lau (candidate)	Recruited sample Developed and chose measures Performed data analyses Prepared tables Wrote manuscript drafts
Prof. Candida Peterson (primary supervisor)	Supervised Revised and edited manuscript for publication

Prof. Tony Attwood (associate supervisor)	Assisted with data collection Commented on manuscript drafts
Dr Michelle Garnett (associate supervisor)	Assisted with data collection Commented on manuscript drafts
Ass. Prof. Adrian Kelly (associate supervisor)	Supervised Advised on statistical analyses Revised and edited manuscript for publication



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Abstract: Whether parental autistic traits are related to parenting efficacy has yet to be explored. Parents of children with Autism Spectrum Disorders (ASD) were studied in three groups: (a) both parent and child have a DSM-IV-TR ASD diagnosis (n=109); (b) only child has DSM-IV-TR ASD diagnosis (n=128); and (c) no family member has ASD (n=109). Each subject completed the Autism Spectrum Quotient (AQ) and a measure of parenting efficacy. Interestingly, parents' self-reported autistic tendency did not consistently reflect their diagnostic status. Of mothers, those clinical by AQ but not DSM-IV-TR had lowest parental efficacy. Fathers lowest in efficacy were clinical by both AQ and DSM-IV-TR. Implications for adult diagnosis and parenting intervention were discussed.

Parents on the Autism Continuum: Self-Perceived Autistic Traits and Parenting Efficacy

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RUNNING HEAD: Self-Perceived Autistic Traits and Parenting Efficacy

ABSTRACT

Whether parental traits of autism are related to parenting efficacy has yet to be explored. Parents of children with Autism Spectrum Disorder (ASD) were studied in three groups: (a) both parent and child have a DSM-IV-TR ASD diagnosis (*n*=109); (b) only child has DSM-IV-TR ASD diagnosis (*n*=128); and (c) no family member has ASD (*n*=109). Each subject completed the Autism Spectrum Quotient (AQ) and a measure of parenting efficacy. Interestingly, parents' self-reported tendency towards autism did not consistently reflect their diagnostic status. Of mothers, those clinical by AQ but not DSM-IV-TR had lowest parental efficacy. Fathers lowest in efficacy were clinical by both AQ and DSM-IV-TR. Implications for adult diagnosis and parenting intervention were discussed.

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KEYWORDS**:** Autism Spectrum Disorder (ASD), autism, parents, parenting, Autism Spectrum Quotient (AQ), parenting efficacy

Parents on the Autism Continuum: Self-Perceived Autistic Traits and Parenting Efficacy

Parents of children with Autism Spectrum Disorder (ASD) have consistently reported higher parenting stress than those with typically developing (TD) children and children with other developmental disorders, and the effect sizes are large (see Hayes & Watson, 2013 for a review). To date, high parental stress in ASD populations has been attributed to the child's ASD symptomatology (e.g., Estes et al., 2009; Hall & Graff, 2012; Lecavalier, Leone, & Wiltz, 2006; Tomanik, Harris, & Hawkins, 2004). Previous studies suggest that characteristics of ASD may exacerbate challenging behaviours in children (Kleinhans, Akshoomoff, & Delis, 2005; McCrimmon, Schwean, Saklofske, Montgomery, & Brady, 2012; Ozonoff, Pennington, & Rogers, 1991; Semrud-Clikeman, Walkowiak, Wilkinson, & Butcher, 2010), and that child behaviour problems are the most common reason for referral of children with ASD to mental health services (Mandell, Walrath, Manteuffel, Sgro, & Pinto-Martin, 2005). Demanding characteristics in children may not only cause stress to parents, but also influence parental sense of competency (Abidin, 1992). Indeed, in the ASD population, higher levels of parental stress have been associated with parents' negative perceptions of their own care-giving abilities (e.g., Hastings & Brown, 2002; Kuhn & Carter, 2006; Tomanik et al., 2004). For instance, mothers of children with ASD have reported a lower sense of efficacy in parenting than mothers of TD children (Giallo, Wood, Jellett, & Porter, 2013; Meirsschaut, Roeyers, & Warreyn, 2011). Hastings and Brown (2002) found lower parenting efficacy in parents of children with ASD compared to those with typically developing children, and that parenting sense of efficacy mediated the association of child misbehaviour and paternal anxiety, and maternal anxiety and depression. Similarly, Kuhn and Carter (2006) reported a negative correlation between maternal sense of efficacy and parenting stress and depression among those raising children with ASD. Not only can perceived self-efficacy in parenting buffer the stress of child rearing on parental psychological well-being (Bloomfield & Kendall, 2012), it is found to be amenable to brief parent-focussed intervention (Sofronoff & Farbotko, 2002). Thus, understanding of, and interventions to enhance parenting sense of efficacy could supply benefits for the mental health risks of parents of children with ASD and their offspring as well.

Gender effect on parental stress

Research on parenting experience with children with ASD has predominantly sampled mothers. A recent literature review (J. Lee, 2013) was able to retrieve 28 empirical studies examining well-being of mothers of children with developmental disorders published between year 2000-2012. Only 13 out of these 28 studies specifically included subjects diagnosed with ASD with the children's age widely ranged from 1.5 to 50 years old. Comparison groups were varied including parents of typically developing children, children with Down syndrome, Fragile X Syndrome and developmental delay. Despite the heterogeneous sample, findings were fairly consistent in that mothers of children with ASD (N=1,913) reported significantly higher parenting stress and more depressive symptoms than controls, including those with children with other developmental disabilities. Parenting sense of efficacy had not been considered in most of these studies with one exception (Giallo, Wood, Jellett, & Porter, 2013). In this study, fatigue was found to be significantly related to lower parenting efficacy and lower satisfaction along with stress, anxiety and depression in 50 mothers of children with ASD.

Very few studies on parenting with ASD have included both genders in their samples. Nonetheless, the few studies consistently found that mothers and fathers raising children with ASD are affected differently (Gray, 2003; Hartley, Barker, Seltzer, Greenberg, & Floyd, 2011; Lee, 2009). For example, using a multivariate model Kaniel and Siman-Tov (2011) analysed parenting experience of 88 pairs of parents raising children with ASD in Israel. Compared to fathers, mothers in their study felt more threatened and more stressed, which adversely impacted on their mental health and quality of marriage. Similarly, when Little (2002) examined parents of children with ASD and/or nonverbal learning disorders, it was found that mothers reported greater stress than fathers. In a more recent study (Kuusikko-Gauffin et al., 2013) investigating social anxiety among parents of children with ASD and parents with typically developing children, mothers (*n*=65 in ASD group and *n*=368 controls) reported significantly more anxiety symptoms than fathers (*n*=61 in ASD group and *n*=229) in both groups. Whilst mothers seemed more vulnerable to developing psychiatric symptoms, there are findings showing mothers to possess more adaptive coping skills and to perceive higher degrees of consensus between the couples than did the fathers (G. K. Lee, 2009).

Taken as a whole, findings about gender differences in parents of children with ASD are preliminary and contradictory. There is a scarcity of data from fathers. Parenting sense of efficacy of parents of children with ASD is yet to be more directly explored.

Parental traits of autism and parenting efficacy

Whilst caring for a child with ASD can be a significant challenge, it is possible that lower parenting sense of efficacy may not be directly linked to the child with ASD. For instance, Hodge, Hoffman, and Sweeney (2011) studied parents of children with ASD and found that the burden of care did not have a significant impact on parental psychopathology, whereas parents' genetic liability predisposed them to interpersonal sensitivity, paranoid ideation, depression and obsessive compulsive behaviours. In parents of children diagnosed with ASD there are elevated rates of a milder, subclinical autism-related phenotype termed the 'broad autism phenotype' (Gerdts &

Bernier, 2011), which can be manifested in the forms of aloofness and rigidity in personality (e.g., Baron-Cohen, 2006; Bernier, Gerdts, Munson, Dawson, & Estes, 2011; Bolte & Poustka, 2006; Bolton et al., 1994; De la Marche et al., 2011; Seidman, Yirmiya, Milshtein, Ebstein, & Levi, 2011; Scheeren & Stauder, 2008; Wheelwright, Auyeung, Allison, & Baron-Cohen, 2010), communicative difficulties (Ruser et al., 2007), alexithymia (Szatmari et al., 2008), and weak central coherence (Happé, Briskman, & Frith, 2001) The nature of these cognitive and behavioural phenotypes are likely to affect interpersonal relationships yet it is surprising that so little research has examined the effect of parental traits of autism and comorbidities on their experience in childrearing. Parents with a subclinical or clinical severity of autism profile may lack confidence in helping their child address difficulties that they also experience, such as social skills. Alternatively, parents' understanding of their own challenges with ASD may increase their sense of parenting self-efficacy. Personal accounts of adults diagnosed with ASD have depicted both of these experiences (e.g., Holliday Willey, 1999; Slater-Walker, Slater-Walker, & Attwood, 2002). However, the association between the severity of parental traits of autism and parenting efficacy are yet to be investigated empirically.

On the other hand, the phenomenon of the broad autism phenotype in parents of children with ASD is empirically evident (Bolte & Poustka, 2006). An earlier study on parents raising children with ASD in Australia was conducted by Bishop and colleagues (2004) who administered the Autism Spectrum Quotient (AQ) (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) to 121 parents with children with ASD and 89 matched parents with TD children. Subjects were recruited through newsletter, support groups and local schools. Verification of diagnostic status was conducted on the children using the Autism Diagnostic Interview – Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994). Data on parents relied on self-reported ratings on the AQ, and the Wechsler Adults Intelligence Scale (1997) was conducted to ensure autistic-like behaviours were not owing to intellectual impairments. Between the two groups, parents with children with ASD reported statistically significantly higher scores (p<.05) than parents with TD children on the *Social Skills* and *Communication* subscales of the AQ. Male subjects in this study scored substantially higher (p<.05) than the women in all subscales except in the *Attention to Details* domain where an opposite direction was observed. This is in synchrony with the findings of Baron-Cohen et al. (2001)'s original study on the AQ, where male and female university students differed on four of the five AQ subscales (*Social Skills, Communication, Attention Switching* and *Imagination*).

As there have been several other studies of this topic (N = 6) using the AQ, we summarize their findings in Table 1. These studies consistently showed that parents of children with ASD were more likely to score significantly higher on the AQ than parents with TD children, and there was also a consistent effect for fathers compared to mothers, with fathers reporting more traits of autism than mothers in general. Of note was 7-18% of parents of children with ASD in these studies obtained AQ scores that were higher than the diagnostic cut-off recommended in the original study of the AQ, implying some of these parents may be individuals with a clinical diagnosis of ASD based on DSM criteria (Baron-Cohen et al. 2001). A major caveat, however, was that none of these studies considered whether or not these parents had formally received a clinical diagnosis of ASD.

Rarely has research paid attention to higher functioning adults with ASD who are in a long-term relationship. When Lau and Peterson (2011) compared marital quality and parenting sense of satisfaction between parents of children with Asperger's Syndrome who had a clinical diagnosis themselves, versus those who did not, only the diagnosis in the child significantly lowered the parental sense of satisfaction. Whether or not parenting sense of efficacy is also related to diagnosis of ASD in parents is yet to be explored. In addition, this exploratory study of Lau and Peterson (2011) took a categorical approach in measuring parental tendency towards autism, which limited the interpretation of the findings. The authors proposed replicating the study by quantifying traits of autism in the parents in order to consider variables associated with the behavioural phenotype, such as the nature and severity of tendency towards autism. We do not yet know whether there are differences in parenting efficacy among the non-ASD affected, broad autism phenotype and clinically diagnosed parents. Comparisons between parents meeting the DSM diagnostic criteria and those falling within the subclinical range would have been theoretically informative.

[INSERT TABLE 1 ABOUT HERE]

The Present Study

Based on the considerations above, the aim of the present study is to explore self-reported traits of autism on the AQ measure together with parenting efficacy in a sample of parents representing a broad continuum of autism, ranging from normative to clinical levels of traits of autism. Uniquely, the sample includes parents who reported a subclinical profile of autism as measured by the AQ as well as those who had been clinically diagnosed with ASD by independent clinical teams based on the DSM-IV-TR criteria.

Three hypotheses were tested:

1. Parents who had been diagnosed with ASD based on DSM-IV-TR criteria would have higher AQ scores than parents of children with ASD who had no clinical diagnosis themselves, and the latter would have higher AQ scores than parents without ASD who have only of TD children.
2. Males will obtain higher AQ scores than females across all three comparison groups.
3. Parents who obtain high AQ scores will feel less efficacious in their parenting role.

To the authors' knowledge, this is the first study that explores parenting efficacy among parents of children with a clinical diagnosis of ASD and by quantifying parental traits of autism using the AQ scale. The theoretical and clinical significance of this study is especially pertinent to its sample that encompasses clinical, subclinical and community subjects. This dimensional approach in understanding the effect of autism is in accordance with the current conceptualisation of ASD, i.e., autism is a continuum of severity in symptomatology (Baron-Cohen et al., 2001), and is in synchrony with the recent change in the diagnostic criteria for ASD latest edition *of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; American Psychiatric Association, 2013).*

METHODS

Participants

A total of 346 Australian parents of children aged 3 to 18 years participated in this study, with a questionnaire return rate of 62%. The sample consisted of three groups. These were based on patterns of ASD diagnosis in both generations of the family. Group 1 consisted of 109 parents (29 fathers and 80 mothers) with ASD clinically diagnosed in both parent and child. These parents all had a clinically-confirmed ASD diagnosis and at least one child who also had been diagnosed with ASD. Group 2 consisted of 128 neurotypical parents (31 fathers and 97 mothers) with ASD in the child only. Group 3 was a community sample without a diagnosis of ASD suspected in either the parent's or the child's generations. It comprised 109 neurotypical parents (22 fathers and 87 mothers) of typically developing children without ASD or any other clinical diagnosis. Parents in Group 1 and Group 2 were recruited through databases of two psychology clinics in Queensland specializing in ASD. The Group 3 subjects were recruited via personal contacts, staff and student email and research participant pools at the University of Queensland, and anyone reporting suspected or diagnosed ASD or other disorder in any family member was excluded.

Each of the parents in Group 1 and Group 2 had at least one child diagnosed with ASD, including Autistic Disorder (Autism), Asperger Disorder (AS) and Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS). Diagnosis was made by an experienced registered psychologist using DSM IV-TR criteria (Robinson et al., 2011). In addition, in each case, this diagnosis was independently ascertained for meeting the DSM IV-TR criteria for ASD by a medically qualified professional (i.e., paediatrician, neurologist or psychiatrist). Parents who were categorized into Group 1 had to have received a clinically confirmed diagnosis of ASD (i.e., Autism, AS or PDD-NOS) conferred via DSM IV-TR (American Psychiatric Association, 2000) criteria by a registered psychologist, general practitioner or psychiatrist, independent of this research.

This study excluded families raising children with other developmental disorders such as Down syndrome or Fragile X Syndrome, even if the same child (or another in the family) also had ASD. To reduce the risk that low intellectual functioning would confound the results, only parents who had completed high school education were included in this study. In cases where both members of a particular couple volunteered, we ensured that only one respondent per couple was included in the present sample so as to maintain the statistical independence of all of the group comparisons. Twenty-five parents were excluded for this reason. Three couples where both parents had ASD were also excluded on the grounds that there were too few representatives of this couple constellation to permit statistical comparison. Demographic details for each group are presented in Table 2.

Measures

Each participant took two self-report measures detailed as follows:

Traits of autism: The Autism Spectrum Quotient (AQ) (Baron-Cohen, Wheelwright, Skinner, Martin & Clubley, 2001) is a 50-item self-report questionnaire consisting of five subscales, namely, *Social Skills*, *Attention Switching*, *Attention to Details*, *Communication* and *Imagination*. Sample items from the five subscales respectively are: “Other people frequently tell me what I have said is impolite, even though I think it is polite”, “I am good at social chit-chat”, “I prefer to do things over and over again”, “I often notice small sounds when others do not”, “I don’t particularly enjoy reading fiction”. The respondent rates to what extent s/he agrees or disagrees with each of the statements on a four-point scale, with answer categories “definitely agree”, “slightly agree”, “slightly disagree” and “definitely disagree”. In order to avoid response bias, about half of the statements are reverse-scored items. Every response that indicates an feature of autism is scored ‘1’ and otherwise ‘0’ leading to the total score of the AQ ranging from 0-50 where a higher score depicts the more autistic pole of the continuum. For example, on the item reflective of the trait of autism, “I prefer to do things over and over again”, a response of either “definitely agree” or “slightly agree” is scored as ‘1’, whereas “slightly disagree” or “definitely disagree” is scored as ‘0’. On the item “I am good at social chit-chat”, which depicts a tendency opposite to that which characterizes autism, a response of either “definitely agree” or “slightly agree”, is scored as ‘0’ whilst “slightly disagree” or “definitely disagree” is scored as ‘1’. In the original study, Baron-Cohen et al. (2001) reported that a total score of 32 or more is indicative of "clinically significant levels of traits of autism", based on data from 58 individuals diagnosed with AS in their sample

(M=35.8, range between 19-48). The average score for their control group, who consisted of 76 males and 98 females, was 16.4.

Parenting Sense of Efficacy: Parenting sense of efficacy denotes the belief that one will be able to play the role of parent successfully. Johnston and Mash (1989) devised the Parenting Sense of Competency (PSOC) questionnaire, which has two subscales: parenting sense of efficacy (PSOE) and parenting sense of satisfaction (PSOS). In the present study, only the first of these, the PSOE was used considering previous analyses (Lau & Peterson, 2011) found no difference in parenting satisfaction between adults with and without a diagnosis of ASD. The PSOE subscale consists of 8 items, including "My mother/father was better prepared to be a good mother/father than I am." All items are rated on a 6-point scale from 1 'strongly disagree'' to 6 ''strongly agree'. The total subscale scores can range from 8 (not confident at all in one's efficacy) to 48 (very confident). Rogers and Matthews (2004) previously validated this scale with a large Australian sample, and the internal consistency according to Cronbach's test was good (alphas were .77 for mothers and .80 for fathers).

RESULTS

Preliminary analyses were conducted to check the demographical match of the three groups. Table 2 shows that the groups did not differ in age, $F(2, 343) = 1.17$, $p = .312$, even when stratified by gender: $F(2, 343) = 1.42$, $p = .243$ for mothers; $\mathrm{F}(2, 343) = 1.74$, $p = .182$ for fathers. Likewise, no significant difference was found among the three groups in their marital status [married/cohabitate versus separated/divorced; χ^2 (2, N = 346) = 2.36, p = .307], ethnicity [Caucasian versus non Caucasian; χ^2 (2, N = 346) = 2.71, p = .258] and highest education level completed by the parents [high school only versus post secondary; χ^2 (2, N = 346) = 2.49, p = .288]. The category of post secondary denoted those who had completed a diploma, bachelor degree or higher. The majority of our sample had one (24.1%), two (33.8%) or three (18.8%) children, and the average number of offspring across the three comparison groups were comparable, $F(2, 343) = .767$, $p = .465$. Among the parents of children with ASD, six from Group 1 (5.5%) had more than one child with ASD, as did five from Group 2 (3.9%). We did not exclude multiplex families from this study given they only comprised of a small percentage of the total sample and that both Group 1 and Group 2 had a similar number of cases.

[INSERT TABLE 2 ABOUT HERE]

Table 3 details the means and standard deviations of traits of autism assessed by the AQ and parenting efficacy among the three diagnostic groups, subdivided by gender. To test the possible interactive influences between parental gender (male and female) and diagnostic group (Group 1, 2 and 3) on parental traits of autism and parenting efficacy, $2_{(gender)}$ x $3_{(group)}$ independent ANOVA was conducted (see Table 4). Eta^2 (η^2) was also calculated for ANOVAs results to indicate the strength of the main effect with η^2 value of .01 or greater suggesting a small effect, .06 or greater as medium and .14 or greater as large effect size (Fritz, Morris, & Richler, 2012).

[INSERT TABLES 3 AND 4 ABOUT HERE]

On the Total AQ, a main effect for ASD diagnosis in the family was found, $F(2, 340) = 46.18$, $p < .001$, $\eta^2 = .214$. There was also a significant main effect for gender, $F(1, 340) = 5.68$, $p = .018$, $\eta^2 = .016$, but the interaction effect was non-significant, $F(2, 340) = 1.61$, $p = .202$, $\eta^2 = .009$. Group differences were tested using Tukey HSD to determine the patterns among the three diagnostic groups that were not specified a priori (e.g., Bishop et al., 2004; De la Marche et al., 2012). Results supported Hypothesis 1 and 2 in that total AQ score was highest in Group 1, followed by Group 2, then Group 3, with a significant level of $p < .001$ for each pairwise comparison. Male subjects scored significantly higher on the Total AQ than female subjects. This means males consistently score higher on the AQ than females regardless of whether there is diagnosis of ASD in the adult or in the child.

In regard to parenting efficacy, a $2_{(gender)}$ x $3_{(group)}$ analysis of variance yielded a significant main effects for diagnostic group, $F(2, 340) = 4.83$, $p = .034$, $\eta^2 = .044$ but not for gender, $F(1, 340) = 2.41$, $p = .132$, $\eta^2 = .011$. The interaction effect was non-significant, ($p = .082$). This denoted that low parenting sense of efficacy was related to a diagnosis of ASD but not to parental gender. For group differences, post hoc Tukey HSD tests revealed that Group 1 had a significantly lower score when compared with Group 3 ($p = .018$). There was no significant differences between Group 1 and Group 2 ($p = .084$), and Group 2 and Group 3 ($p = .127$).

In order to explore the severity of the manifestation of tendency towards autism in the three groups, we tabulated (see Table 5) the proportion of samples who would meet the clinical cut-off score of Total AQ>32 as proposed for ASD diagnosis by Baron-Cohen et al. (2001). More than half of the fathers and mothers in Group 1 met this cut-off criterion, whilst none of the Group 3 parents did. Strikingly, as high as 22.6% of fathers and 15.4% of mothers from Group 2 obtained a total AQ score that surpassed the diagnostic cut-off recommended by Baron-Cohen et al. (2001), even though they had not been clinically diagnosed with ASD.

[INSERT TABLE 5 ABOUT HERE]

We further depict the severity of features of autism presented in the parents by assigning the subjects into three groups as proposed by Wheelwright, Auyeung, Allison and Baron-Cohen (2010): broad autism phenotype (BAP), medium autism phenotype (MAP) or narrow autism phenotype

(NAP). In Wheelwright et als. protocol, BAP was defined by Total AQ score of 1 to 2 standard deviations above the mean of their non-ASD subjects; MAP 2 to 3 standard deviations above the mean; and NAP 3 or more standard deviation above the mean. Next the percentage of subjects falling into the ranges of BAP, MAP and NAP was tested. As predicted in Hypothesis 1, Group 1 mainly congregated at the extreme high end of the AQ scores (48.3% fathers and 48.8% mothers fell within NAP) whereas Group 2 spread throughout the BAP, MAP and NAP ranges, with higher a density within the BAP range (22.6% fathers and 14.4% mothers). None of the Group 3 fathers scored beyond the BAP range but one Group 3 mother did (1.1%). Chi-square tests of independence together with Cramer's *V* (Cramer, 1946) were performed to examine the relationship between diagnostic group and self-rated traits of autism. A *V* value of .10 or greater indicates small, .30 or greater as medium and .50 or greater as large effect size (Klockars & Hancock, 2000). As expected, the relation between these variables was significant among male subjects, χ^2 (4, N = 346) = 11.24, p = .024, V = .353, and female subjects, χ^2 (4, N = 346) = 26.95, p < .001, V = .360.

Our focal interest concerned the differences, if any, between Group 1 and Group 2. To this end, we calculated the frequency of occurrences in a 2(AQ $\geq$ 32 versus AQ < 32) x 2(DSM confirmed ASD versus no DSM confirmed ASD) cross-tabulation table for each gender (Table 6 and 7). We used the AQ diagnostic cut-off ascertained in the original study presenting the AQ measure (Baron-Cohen et al., 2001). Baron-Cohen et al. (2001) reported that 80% of the 58 adults who had previously been clinically diagnosed with AS/HFA in their sample met this cut-off on the AQ measure. In addition, they verified that 100% of their control subjects who scored higher than 32 on the AQ (n = 11) indeed met DSM-IV-TR diagnostic criteria for ASD, even though these adults had not been diagnosed clinically.

[INSERT TABLES 6 AND 7 ABOUT HERE]

The cross tabulation resulted in four groups of parents: (a) those without a DSM confirmed diagnosis of ASD who scored below 32 on the AQ (*consistently non-ASD*); (b) those without a DSM confirmed diagnosis of ASD but who scored higher than 32 on the AQ (*ASD by AQ*); (c) those with a DSM confirmed diagnosis of ASD but who scored below 32 on the AQ (*ASD by DSM*); and (d) those with a DSM confirmed diagnosis of ASD who also scored 32 or higher on the AQ (*consistently ASD*). Interestingly, about 1/5 male and female subjects who were diagnosed with ASD using the DSM-IV-TR criteria rated themselves below the AQ diagnostic cut-off that was described above. Conversely, approximately 1/9 of fathers and 1/12 of mothers in the group with an ASD child were determined as not ASD via DSM-IV-TR, yet on the AQ they scored themselves as having a clinical range of ASD. We labelled these groups "*ASD by DSM*" and *"ASD by AQ"* respectively.

We test again Hypothesis 3 by calculating the mean and standard deviation of total PSOE scores for the four groups (in Table 6 and 7). Significant differences in the PSOE were found among male subjects, F(3, 56) = 12.29, $p < .001$, $\eta^2 = .103$. Post hoc Tukey comparison confirmed that fathers who had clinically confirmed ASD, as well as meeting AQ's diagnostic cut-off (labelled "*consistently ASD"*), felt significantly less efficacious as parents compared to fathers from *ASD by DSM* ($p < .001$), *ASD by AQ* ($p = .004$) and labelled "*consistently non-ASD"* ($p < .001$). Among the mothers, significant differences in PSOE were also found, F(3, 173) = 6.59, $p < .001$, $\eta^2 = .086$. Post hoc Tukey HSD tests revealed that mothers who had no clinically confirmed ASD diagnosis, but who scored higher than 32 on the AQ (*ASD by AQ*), reported significantly lower PSOE compared to mothers from *consistently non-ASD* ($p < .001$) and *consistently ASD* ($p = .023$).

DISCUSSION

This study investigated the severity and patterns of manifestation of autism in parents of children with ASD and its association with their sense of efficacy as parents. The sample was large relative to other studies on parents of children with ASD. Comparisons were made among three groups: Group 1- ASD diagnosis in parents and in child; Group 2- ASD diagnosis in child only; and Group 3 - no ASD diagnosis in the family. Results supported Hypothesis 1 in that parents who had been clinically diagnosed with ASD reported highest AQ scores followed by non-diagnosed parents of children with ASD then parents of TD children. Males generally scored higher than females on the AQ thus Hypothesis 2 was supported. Hypothesis 3 was partially supported. In general, tendency towards autism affected parenting efficacy in fathers and mothers differently. Mothers who had never been diagnosed with ASD, yet who reported high AQ scores, felt least efficacious, whereas mothers who had been clinically diagnosed with ASD, regardless of their AQ scores, reported the same level of parenting efficacy as non-ASD controls. For the fathers, only those who had been clinically diagnosed with ASD in addition to attaining a high score on the AQ reported low parenting efficacy.

Previously established gender effects (see Table 1) are further substantiated in the present study. Males in our sample as a whole scored statistically higher on the AQ than females (see Table 4). Interestingly, however, we found this gender difference tended to dissipate in Group 1 subjects who had received a clinical diagnosis of ASD. These patterns concurred with the findings of Wakabayashi, Baron-Cohen, Wheelwright and Tojo (2006), who found males generally scored higher on the AQ than females. However, when they included only adults who had a clinical diagnosis of ASD, there was no gender effect. In fact, there is even a suggestion that females diagnosed with ASD report significantly more traits of autism than their male counterparts (Baron-Cohen et al., 2011). Whether there are substantial gender differences in the perception and manifestation of symptomatology of ASD, and what the impacts may be on the individual's functioning are certainly worthy of further investigation.

Interestingly, parental self-reported AQ scores did not necessarily correspond with clinicians' evaluations of the individual's ASD symptomatology in this study. Only 51.7% of fathers and 53.8% of mothers who had been clinically ascertained as meeting DSM-IV-TR criteria for ASD scored above the diagnostic cut-off on the AQ as recommended in the original study (Baron-Cohen et al., 2001). On the contrary, 22.6% of fathers and 15.4% of mothers who had no clinical diagnosis of ASD obtained an AQ total score that surpassed the measure's diagnostic cut-off. These figures are comparable to the findings of Wheelwright et al. (2010) on 1,582 families in the United Kingdom, where 33% of the fathers and 23% of the mothers reported total AQ scores above the BAP cut-off point. Comparable figures were also yielded by the studies of Ruta et al. (2012) and Mohammandi, Zarafshan and Ghasempour (2012). Whilst empirical evidence on the broad autism phenotype in parents is rapidly emerging, more research and clinical endeavours are necessary to demystify the inconsistency between the parents' self-reported traits of autism and their clinical status.

We know, however, that the issue of under-diagnosis among adults with ASD has been raised in several research studies (Baron-Cohen et al., 2011; Brugha et al., 2011; Fombonne, 2012; Punshon, Skirrow, & Murphy, 2009). Anecdotal accounts from clinical experts in this field have suggested that it is often through the diagnostic assessment for a child that a parent is led to a late diagnosis (Attwood, 2007). The challenge of recognizing adults with the profile of ASD arise from the unique profile of abilities where, in some, the special talents can mask the socio-emotional deficits and restrictive behaviours (Frith, 2004). Furthermore, the challenge is magnified when there is a lack of consensus in the diagnostic criteria of higher functioning ASD such as AS (Helles, Gillberg, Gillberg & Billstedt, 2015; King, Navot, Bernier & Webb, 2014). Studies on the experience of diagnosing adults with ASD portray a diverse range of practices in the diagnostic process (Bagatell, 2007; Ehlers & Gillberg, 1993; Mayes, Calhoun, & Crites, 2001). Even today, the diagnostic nomenclature is challenged by alternative diagnostic conceptualisation, such as those that are more reflective of the original accounts of Asperger (1944), and those that include the strengths as well as deficits that come with ASD, thus formulating an alternative experienced-based knowledge of this condition (Bertilsdotter Rosqvist, 2012; Brownlow, 2010; Matson & Neal, 2009).

Another possible reason for the inconsistency between self-reported AQ scores and the clinical diagnostic status of the parents can simply be that, though having an ASD profile, some of these parents had successfully accommodated the characteristics examined in a diagnostic assessment (Attwood, 2007). Possessing many traits of autism does not dictate a clinical diagnosis of ASD. Parents can have the signs but not the impairment in functioning. It is only when the individual suffers “clinically significant impairment in social, occupational or other important areas of current functioning” (DSM-5, pg. 50; DSM-IV-TR, pg. 84) as a result of symptomatology of ASD that a clinical diagnosis is warranted. In this light, more investigation is required to understand what actually contributes to the low parenting sense of efficacy among the fathers with a clinical diagnosis of ASD in our sample.

The discrepancy between AQ scores and clinically evaluated severity of autism can also be related to the reliability of self-report data. There is a risk of under-reporting in some individuals with ASD considering Theory of Mind (ToM) deficits are a hallmark of ASD (Baldwin, 2000). ToM refers to the ability to attribute independent mental states to self and others in order to predict and explain behaviours (Adler, Nadler, Eviatar, & Shamay-Tsoory, 2010). Hobson (1993) proposed that those with ASD have an impaired capacity for self-awareness and self-reflection. When adolescents and adults with ASD were assessed using the Self-Understanding Interview (Damon & Hart, 1988), they provided fewer self-conceptualisations framed within social and interpersonal contexts than the demographically matched subjects. Similarly, self-reports of children and adolescents with ASD tended to indicate higher social competency in themselves than did the reports provided by their parents (e.g., Farley, Lopez, & Saunders, 2010; Jackson, Skirrow, & Hare, 2012; Lee & Hobson, 1998). Likewise, their lack of awareness in respect to their ASD symptomatology was evident in the findings of Johnson, Filliter, and Murphy (2009). They found that the adolescents with ASD in their sample (n=20) reported significantly fewer traits of autism in themselves on the AQ than did their parents, whereas no difference was observed in their neurotypical (non-ASD) control group. Interestingly in our sample, fathers clinically diagnosed with ASD who scored low on the AQ reported a significantly higher parenting sense of efficacy compared to those whose AQ scores reflected their clinical diagnosis. Whilst yet to be empirically validated, these fathers may be under-reporting their traits of autism and parenting challenges. The next step for this research enquiry is to include multiple informants such as self- and spousal-report ratings on the AQ and parenting practices.

In the present study, not diagnostic status of ASD in parent nor in child predicts low parenting sense of efficacy. This finding is consistent with the results of a previous study (Lau & Peterson, 2011), where a parental diagnosis of ASD alone did not predict lower parenting satisfaction. The present study highlights that the parents’ ratings on their own traits of autism have to be taken into account as well. For instance, only fathers whose ratings on the AQ were consistent with their clinical diagnosis of ASD would perceive a lower sense of parenting efficacy. This new insight needs to be applied when supporting men diagnosed with ASD who are moving into parenthood.

It is intriguing that the mothers in this study showed a distinct pattern in the link between parental ASD and parenting efficacy. Mothers who had a clinical diagnosis of ASD and who scored highly on the AQ reported no difference in their sense of parenting efficacy compared to the non-ASD controls. In contrast, mothers who scored highly on the AQ (above diagnostic cut-off point) but who were not clinically diagnosed with ASD reported significantly lower parenting sense of efficacy compared to all other mothers in our sample.

Interestingly, mothers who reported high tendency towards autism in themselves, but who had never been clinically diagnosed, felt least efficacious in their parenting role. Our speculation is that females who have been recognised as having ASD are more accepting of their condition, hence better adjusted. Accounts from women who have been clinically diagnosed with ASD depict a keen motivation to find resources and support for their role as a mother (e.g., Holliday Willey, 1999). One of their strategies is to seek a diagnosis, learning how it affects their ability to parent, and thoroughly studying parenting skills using their strengths, such as sound logical thinking, attention to detail, persistence and so on. As a result, some women with ASD can develop remarkable parenting competency (Attwood, 2007). Future research can investigate the cognition and attitude of adults with ASD in regard to parenting.

Distinct strengths of this study are its focus on the unique challenges of parenting in families with ASD and it is the first time that parental tendency towards autism is tested based on a sample of parents of children with ASD, with and without clinical diagnosis of ASD in themselves, as well as parents of TD children. Such a sample pool is likely to encompass a broad variant of the ASD continuum. Furthermore, our sample also consisted of a heterogeneous group of ASD diagnoses of whom intensity and heritability of ASD symptomatology are likely to be diverse. The present study also benefited from having a substantial proportion of female participants in the ASD group. Data from women who have been diagnosed with ASD is scarce, yet imperative given their different clinical presentation compared to males with ASD are increasingly supported (Lau & Peterson, 2011).

This study is limited by its predominant reliance on parent self-report on the AQ. Whether the high AQ scores but low diagnostic phenomenon was due to measurement errors, under-reporting, or there was indeed an under-diagnosis in this population, remains unclear. Replicating this study and confirming the diagnostic status of these parents through clinical assessments or collateral information would add to the strength of the findings. In addition, a considerable proportion of the parents of children with ASD were recruited through the databases of two private specialist clinics. The findings may not generalize to samples from lower socioeconomic backgrounds. These families may have higher levels of stress, ASD severity, and family conflict, which may render lower parenting efficacy regardless of the parents' tendency towards autism.

Despite these shortcomings, this study has significant clinical and research implications. For instance, insights into the implications of broad autism phenotype on parenting efficacy of children with ASD can assist in developing therapy or parenting programs that best suit the unique profile of abilities of this population. Modifications to widely used cognitive behavioural therapy approaches could be necessary to match the cognitive patterns of young people with ASD (Attwood & Scarpa, 2013). Likewise, parents with ASD can present with processing style and clinical needs that are quite different to the problems that usually present among neurotypical parents thus modifications to the therapy approach may be required (Dingfelder & Mandell, 2011; Strauss et al., 2011). Such knowledge is particularly valuable given there is ample empirical and clinical evidence confirming that the outcome for children of any intervention is determined by parental well-being and involvement (Bolte, Duketis, Poustka, & Holtmann, 2011; Hartley & Sikora, 2009; Lai et al., 2011; Mandy et al., 2011). Another clinical contribution proffered by this study is the capturing of adults at the milder end of the spectrum. Mis- and under-diagnosis of ASD are common in adulthood due to ASD becoming standardized as a diagnosis only in the early 1990s. Knowing that ASD symptomatology is more likely to be camouflaged yet cause the greatest psychiatric problems in adulthood (Bernier et al., 2011; Ingersoll, Meyer, & Becker, 2011), the need to concentrate more fully on the manifestation of the diagnosis in higher functioning individuals is crucial. Its clinical implications will be especially important because knowledge of how to develop effective screening processes for this population is virtually nonexistent.

Several research proposals can be drawn from the findings of this study. First, a study that ascertains the diagnostic status of all parents of children with ASD will allow insight into the unique profile of clinical ASD. Second, incorporating spousal ratings of one’s features of autism as well as each other’s parenting practices will enrich our knowledge of the nature of self-report data from individuals with ASD. Third, future research can help deepen our understanding of the relationship between parental perception of their child’s ASD diagnosis and their rating of ASD symptomatology in themselves. Finally, delineating the possible mediating and/or moderating factors between parental traits of autism and parenting sense of efficacy (e.g., the presence of challenging behaviours in child(ren), the quality of the marriage, spousal support and parental alliance) will take us forward in understanding the mechanics in the parenting experience of people with ASD.

In conclusion, assessing traits of autism via the AQ in parents with children with ASD is likely to be useful, especially when designing family intervention programs. In addition, clinicians should note that parents who are themselves diagnosed with ASD, or who rate themselves to be autistic, may require support in their parenting sense of efficacy.

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Table 1 Previous studies on parents of children with ASD using the Autism Spectrum Quotient (AQ)

Authors (year)	**N (Parents)**	**Gender Distribution**	**Total AQ Score**	**Significant Effect Child Diagnosis (in which subscales)**	**Significant Effect Parent Gender (in which subscales)**
Kose et al. (2013)	100 ASD	47 Fathers	19.08 (4.4)	ASD > TDC	Male = Female
		53 Mothers	18.85 (6.5)		
Turkish sample					
	100 TDC	48 Fathers	17.50 (4.8)	(Social Skills, Communication)	
		53 Mothers	17.15 (5.7)		
Ruta et al. (2012)	245 ASD	115 Fathers	18.90 (9.16)	ASD > TDC	Male > Female
		130 Mothers	16.39 (7.30)		
Italian sample					
	300 TDC	150 Fathers	16.77 (4.61)	(Social Skills, Communication, Imagination)	(Social Skills, Attention to Details, Communication, Imagination)
		150 Mothers	14.51 (5.17)		
Mohammadi et al. (2012)	204 ASD	96 Fathers	23.43 (5.46)	ASD > TDC	Male > Female
		108 Mothers	20.75 (4.11)		
Iranian sample					
	210 TDC	108 Fathers	19.22 (2.13)	(Attention Switching, Communication)	(Attention to Details, Communication, Imagination)
		102 Mothers	18.25 (3.13)		
Wheelwright et al. (2010)	2000 ASD	571 Fathers	19.2 (9.5)	ASD > TDC	Male > Female
		1429 Mothers	16.4 (9.5)		
UK sample					
	1007 TDC	349 Fathers	17.7 (6.9)	(Social Skills, Communication, Imagination, Attention Switching)	(Social Skills, Attention Switching, Communication, Imagination)
		658 Mothers	13.1 (6.3)		

Scheeren and Stauder (2008)	25 ASD	13 Fathers	[†]102.6 (23.3)		
		12 Mothers	90.0 (13.9)	ASD > TDC	Male > Female
Netherlands sample					
	25 TDC	13 Fathers	96.1 (18.4)	(Attention to Details)	(Communication)
		12 Mothers	100.8 (14.8)		
Bishop et al. (2004)	121 ASD	52 Fathers	18.10		Male > Female
Australian sample		69 Mothers	13.80	ASD > TDC	
	89 TDC	37 Fathers	16.13	(Social Skills, Communication)	(Social Skills, Communication, Attention Switching, Imagination)
		52 Mothers	13.17		

Notes: ASD denotes parents of ASD; TDC denotes parents with typically developing children

[†] Scored using 4-point Likert scale instead of the conventional scoring protocol proposed by Baron-Cohen, Wheelwright, Skinner, Martin and Clubley (2001)

Table 2 Sample Characteristics (N=346)

Variables		**Group 1** **(*n* = 109)**	**Group 2** **(*n* = 128)**	**Group 3** **(*n* = 109)**
Age (yrs)	Mean	40.72	41.19	39.88
	SD/range	7.90/19-65	7.84/26-63	8.25/22-62
Gender	Male	29	31	22
	Female	80	97	87
Ethnicity	Caucasian	90	96	85
	Non Caucasian	19	32	24
Marital Status	Married/Cohabitate	88	93	87
	Divorced/Separated	21	35	22
Total No. of	Mean	2.01	2.14	2.19
Offsprings	SD	1.16	1.32	1.11
Education	High School Only	55	73	56
	Post Secondary†	54	55	53

Note: † Included diploma, bachelor degree and above

Table 3 Mean and Standard Deviation of Autism Spectrum Quotient (AQ) and Parenting Sense of Efficacy(PSOE) scores among three groups (N=346)

	Mean (SD)		
	Group 1	**Group 2**	**Group 3**
Males	***n* = 29**	***n* = 31**	***n* = 22**
Total AQ	32.07(10.84)	25.32(9.96)	16.55(7.65)
Parenting Efficacy	24.46(9.01)	31.40(8.49)	33.25(3.28)
Females	***n* = 80**	***n* = 97**	***n* = 87**
Total AQ	30.98(11.87)	18.94(10.69)	14.46(9.50)
Parenting Efficacy	31.07(9.15)	31.69(6.88)	33.11(6.46)

Table 4 Main effects of group, gender and group by gender interaction among the three groups (N=346)

	Main Effect (*F* value) and Effect Size (*partial eta squared*)					
	Group		**Gender**		**Group*Gender**	
	$F_{(340)}$	**Partial** η^2	$F_{(340)}$	**Partial** η^2	$F_{(340)}$	**Partial** η^2
Total AQ	46.18***	.214	5.68*	.014	1.61	.011
Parenting Efficacy	4.83**	.044	2.41	.011	2.44	.023

Note: *$p < .05$; **$p < .01$; ***$p < .001$

Table 5 Diagnostic approximation for present sample based on previous research (N= 346)

	Male			Female		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
	n = 29	*n* = 31	*n* = 22	*n* = 80	*n* = 97	*n* = 87
[†]Suspected ASD (total AQ ≥ 32)	51.7%	22.6%	0%	53.8%	15.4%	0%
No suspected ASD (total AQ < 32)	48.3%	77.4%	100%	46.2%	84.6%	100%
[ϕ]NAP (total AQ ≥ 35)	48.3%	9.7%	0%	48.8 %	5.2%	0%
MAP (total AQ 29-34)	31.0%	16.1%	0%	11.3 %	11.3%	1.1%
BAP (total AQ 23-28)	3.4%	22.6%	18.2%	5.0%	14.4%	10.3%

Notes: [†]Baron-Cohen et al. (2001) proposed a total AQ score ≥ 32 is indicative of clinical diagnosis of ASD;

[ϕ]As suggested in Wheelwright et al.(2010)'s large sample study, BAP = 1 to 2 SDs; MA P= 2 to3 SDs and NAP >3 SDs above mean score of TDC group (genders combined).

Table 6 DSM confirmed versus AQ defined ASD diagnosis and parental efficacy (PSOE) of fathers of children with ASD (N=60)

Fathers		Group 1 (DSM confirmed ASD) (*n*=29)	Group 2 (No DSM confirmed ASD) (*n*=31)
Suspected ASD by AQ[ϕ]	*n*	15	7
(*n* = 22)	% out of the 60 fathers	25.0%	11.7%
	Total PSOE Score	M = 23.33, SD = 4.37	M = 36.6, SD = 5.41
No suspected ASD by AQ	*n*	14	24
(*n* = 38)	% out of the 60 fathers	20.3%	40.0%
	Total PSOE Score	M = 30.79, SD = 9.01	M = 34.81, SD = 3.11

Note: [ϕ] Baron-Cohen et al. (2001) recommended a Total AQ score ≥ 32 is indicative of clinical diagnosis for ASD

Table 7 DSM confirmed versus AQ defined ASD diagnosis and parental efficacy (PSOE) of mothers of children with ASD (N=177)

Mothers		Group 1 (DSM confirmed ASD) (*n* = 80)	Group 2 (no DSM confirmed ASD) (*n* = 97)
Suspected ASD by AQ$^{\phi}$	*n*	43	15
(*n* = 58)	% out of the 177 mothers	24.3%	8.5%
	Total PSOE Score	M = 31.30, SD = 9.57	M = 31.07, SD = 5.93
No suspected ASD by AQ	*n*	37	82
(*n* = 119)	% out of the 177 mothers	20.9%	46.3%
	Total PSOE Score	M = 26.58, SD = 7.07	M = 33.00, SD = 6.30

Note: $^{\phi}$ Baron-Cohen et al. (2001) recommended a Total AQ score > 32 is indicative of clinical diagnosis for ASD

CHAPTER 7

STUDY THREE

Further Evidence on the Factorial Structure of the Autism Spectrum Quotient (AQ) for Adults with and without a Clinical Diagnosis of Autism

> *"Asperger had an idea of what these children would be like as adults. He was interested in the subtle, and possibly milder, manifestations of autism in more able children." (Frith, 1991a, p. 6)*

7.1. Rationale

Findings from Study 2 attested the occurrence of elevated traits of autism in parents of children with ASD, suggesting the needs for clinicians working with children with ASD to screen for broad autism phenotype as well as clinical diagnosis of ASD in parents when providing support to the family. To this end, an efficient tool for detecting non-clinical to clinical range of autism manifestation suitable for the parent population is called for.

Currently, there are several assessment tools widely used for diagnosing ASD in adults such as the Autism Diagnostic Interview-Revised (Lord, Rutter and Le Couteur, 1994), the Autism Diagnostic Observation Schedule (Lord, et al, 2000) and the Diagnostic Interview for Social and Communicative Disorders (Wing, Leekam, Libby, Gould and Larcombe, 2002). There are also questionnaires designed for screening traits of autism (non-clinical to clinical range) in adults. These include the AQ (Baron-Cohen et al., 2001), the Krug Asperger Disorder Index (Krug, 2003), the Broader Phenotype Autism Symptom Scale (Dawson et al., 2007), the Broad Autism Phenotype Scale (Hurley, Losh, Parlier, Reznick, & Piven, 2007) and the newly published Ritvo Autism Asperger Diagnostic Scale-Revised (Ritvo et al., 2011). All of these measures are still being tested and validated, with only limited evidence to date of their psychometric and criterion validity.

Among the screening tools, the AQ has been most widely used, and is freely available for research and clinical use. It is playing a crucial role in a broad range of investigations into the underlying basis for ASD. For example, several studies have relied on the AQ to investigate the notion of ASD as a continuum in the general population (Hoekstra et al., 2007; Hurst et al., 2007) and others have used it to discriminate the ASD profile from other mental health conditions such as schizophrenia (Naito et al., 2010; Wouters, 2011), attention deficit hyperactivity disorder (Sizoo et al., 2009) and anxiety disorders (Cath et al., 2008). Still, other researchers have used the AQ to explore the conceptualisation of autism as a personality type rather than a disorder or disability (Wakabayashi, Baron-Cohen, & Wheelwright, 2006). The studies of the cognitive manifestations of ASD (Sutherland & Crewther, 2010; Wheelwright et al., 2006) have also relied on the AQ. Whilst the AQ shows promise and potential, its use in research and clinical works has outstripped the validation evidence for its psychometric coherence, validity and reliability. More specifically, when the AQ was developed, no factor analysis was conducted to clarify whether the five subscales postulated by the authors reflected the best reduction of the item set, or whether a different structure exists. In response to these shortcomings, several factor analytical studies have been conducted over the past decade to verify the factor structure and reliabilities of the AQ. However, there was still no study that included a sample representative of the ASD continuum (ranging from non-clinical to subclinical to clinical) which was vital for the utility of the AQ. Such a sample needed to encompass adults diagnosed with ASD, adults liable to broad autism phenotype and neurotypical adults, a premeditated strength of this research. The purpose of this study was to examine psychometric and clinical utility using such a sample with an ultimate aim to find a tool suitable for parents of children with ASD.

7.2. Statement of Contributions of Joint Authorship

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Contributor	Statement of Contribution
Winnie Yu Pow Lau (candidate)	Recruited sample Developed and chose measures Performed data analyses Prepared tables Wrote manuscript drafts
Prof. Candida Peterson (primary supervisor)	Supervised Revised and edited manuscript for publication
Ass. Prof. Adrian Kelly (associate supervisor)	Supervised Revised and edited manuscript for publication

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ORIGINAL PAPER

Further Evidence on the Factorial Structure of the Autism Spectrum Quotient (AQ) for Adults With and Without a Clinical Diagnosis of Autism

Winnie Yu Pow Lau · Adrian B. Kelly · Candida Clifford Peterson

Abstract The Autism Spectrum Quotient (AQ) has been widely used for measuring autistic traits however its factor structure has been primarily determined from nonclinic populations. This study aimed to establish an internally coherent and reliable factor structure for the AQ using a sample of 455 Australian adults of whom 141 had autism spectrum disorder (ASD) diagnoses. Principal component analysis revealed a 39-item questionnaire with five-factors: *Sociability*, *Social Cognition*, *Interest in Patterns*, *Narrow Focus* and *Resistance to Change*. The revised AQ-39 had sound goodness-of-fit indices, good-to-excellent internal consistency and test–retest reliability, and scores for ASD and non-ASD participants were significantly different. The AQ-39 may be useful in screening and for guiding the focus of therapy.

Keywords Autism Spectrum Quotient · Factor analysis · Autism spectrum disorders · Measure · Adult

Introduction

Autism Spectrum Disorders (ASD) encompass a range of clinically-diagnosed disorders including autism, Asperger Syndrome (AS) and PDD-NOS (pervasive developmental disorders not otherwise specified). According to standard diagnostic systems like DSM-IV (APA 2000), cardinal markers of ASD are serious impairments in social understanding and communication. Rigid, repetitive behaviours and impaired imagination are also common, as are language delays in those with a specific diagnosis of autism (APA 2000). Autistic characteristics are often considered to be on a continuum of abilities (e.g. Baron-Cohen 2008b; Robinson et al. 2011) ranging from (a) impairment meeting the criteria for a clinically significant ASD diagnosis through (b) normative, non-clinical personality types involving low social motivation, narrow interests and poor communication to (c) normative personalities with exceptionally few ASD features and exceptionally high empathy and social aptitude (e.g. Ritvo et al. 2011). The notion that ASD characteristics are continuously represented through nonclinical and clinical populations highlights the need for a psychometric tool that can capture continuous profiles and potentially be sensitive to clinically significant ASD-related symptomatology.

To date, the most widely-used general-population-oriented ASD self-report measure is the Autism-Spectrum Quotient (AQ: Baron-Cohen et al. 2001). This 50-item questionnaire has shown great potential, but further work on the factor structure of this questionnaire is needed. In the original development of the AQ, factor analysis was not used. Instead, items were devised and grouped into five subscales based on the 'triad' of autistic symptoms (e.g. Wing and Gould 1979) and empirical research on other areas of cognitive non-normality in people with autism. The five domains on the original AQ were social skills, attention switching, attention to detail, communication, and imagination. The relatively low internal consistency of items within each of the domains (less than .70 for four out of five scales) in the original study points to the need for further psychometric refinement.

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In recent years, several factor-analytic studies have been conducted to verify AQ factor structure and reliabilities, and key findings for available studies are summarized in Table 1. Most of the listed studies involve nonclinical samples (primarily university students), and results show divergence in identified factor from a priori scales proposed by Baron-Cohen et al. (2001). In particular, most studies have identified between two and four factors, and only one of the studies identified five discrete factors (Kloosterman et al. 2011). The latter study reported mostly suboptimal alphas, suggesting relatively poor internal consistency of scales. The reviewed studies relatively consistently identify discrete factors involving social skills and attention to detail, but on other potential dimensions, there is relatively little consistency across studies. Other challenges for the AQ as originally formulated are (a) many of the original 50 AQ items failed to load on any of the factors identified in past factorial solutions (see Table 1), (b) the "goodness of fit" of structural models is in some cases limited or not reported (see Table 1 footnote), and (c) little evidence is available on the extent to which scales arising from factor analysis are useful in distinguishing people on the autism spectrum from nonclinical samples. An important priority for AQ factor analytic studies is the inclusion of substantial numbers of people on the autism spectrum. Only one of the reviewed studies contained people with any autism spectrum disorder (Hoekstra et al. 2008) and this study had a comparatively low representation of people in this group ($n = 12$: less than .01 % of the sample). Conceivably, factorial structures based on non-ASD individuals may fail to generalise adequately to the unique profile of clinically significant ASD.

The key aim of this study was to arrive at an internally coherent and reliable factor structure for the AQ based on a sample representing a wider continuum of the autism spectrum than has previously been studied. The ultimate objective of the study was to develop a brief and coherent tool that could be easily administered and potentially assist in screening and therapeutic planning for people with ASD. In this study, we evaluated the factorial structure of the AQ using a large sample ($n = 455$) of adults of whom 141 (31 %) had confirmed ASD diagnoses. In addition, we aimed to assess how well the resulting factorial model would discriminate adults with a DSM-IV ASD diagnosis from non-ASD controls.

Method

Participants

The participants were 455 Australian men and women aged 19–71 years (mean = 40.6 years, standard deviations 7.8 and 8.8 years for ASD and non-ASD participants respectively). They were recruited over a period of 18 months through a variety of sources including (a) personal contacts, (b) staff and student mailing and email lists at a large university, (c) students volunteering from a large first-year psychology class, (d) parents attending play groups in the local community, and (e) adults listed (as parents and/or clients) on the databases of two specialist clinics in Queensland with a predominantly ASD clientele. Among the 455 respondents, 141 had received a confirmed clinical diagnosis of ASD (i.e. HFA, AS or PDD-NOS). We required that this be conferred, using DSM-IV (APA 2000) criteria, by a clinical psychologist, psychologist, general practitioner or psychiatrist operating independently of this research.

To exclude any risk biasing results by inclusion of adults with low intellectual functioning, we required all participants to be high-school graduates (i.e. they had completed 12 years of compulsory schooling). An exclusion criterion was that participants with ASD had received co-diagnoses of schizophrenia, personality disorders or other neuropsychological conditions (e.g. traumatic brain injury, Alzheimer's disease). Further demographic details are presented in Table 2. In summary, most participants were Caucasian (78 and 86 % for ASD and non-ASD participants respectively), most were married or in a de facto relationship (77 % for both groups), and about half of participants had a university degree (55 and 51 % for ASD and non-ASD participants respectively). There were no significant differences between ASD and non-ASD participants on these demographic variables.

Measures and Scoring

We used Baron-Cohen et al. (2001) original AQ, a self-report questionnaire consisting of 50 items describing behaviors, habits and preferences relevant to a clinical presentation of ASD. Half the items are formulated so that agreement indicates an autistic feature, the others are the reverse. On a priori grounds, Baron-Cohen et al. (2001) proposed five subscales (*Communication*, *Social Skills*, *Attention Switching*, *Imagination*, and *Attention to Details*), each with 10 items. Examples include: "Other people frequently tell me what I have said is impolite, even though I think it is polite" (*Communication*), "I am good at social chit-chat" (*Social Skills*), "I don't particularly enjoy reading fiction" (*Imagination*), and "I often notice small sounds when others do not" (*Attention to Details*). Respondents rate their levels of agreement with each statement on a four-point Likert scale ("definitely agree" to "definitely disagree"). Scoring is such that higher scores depict closer proximity to prototypical ASD. Baron-Cohen et al. (2001) dichotomously scored responses "agree" (slightly or definitely) versus "disagree" (slightly or

Table 1 Summary of previous factor-analytic AQ studies

Reference	Sample	Model (total items; total variance explained)[a]	Factors (with Cronbach Alpha)	Goodness of Fit Indices[b,c]
Austin (2005)	201 non-ASD university students (age M = 20.9 years) U.K. sample	PCA; 26 items; 3 factors; 28 %	Social skills (.85) Attention to details/patterns (.70) Communication/mindreading (.66) Three-factor AQ total (.82)	Not reported
Hurst, Mitchell, Kimbrel, Kwapil and Nelson-Gray (2007)	1,005 non-ASD university students (age M = 19.36 years) American sample	PCA; 26 items; 3 factors; 29 %	Social skills (.75) Attention to details/patterns (.55) Communication/mindreading (.40) Three-factor AQ total (.66)	Not reported
Hoekstra, Bartels, Cath and Boomsma (2008)	961 non-ASD university students 302 parents of non-ASD twin families 36 teen and adult psychiatric patients (age M = 24.65 years) Dutch sample	CFA; 50 items; 2-hierarchical factors;	Social interaction (.84/.77) Attention to details (.63/.68)	χ^2/df = 8.75 SRMR = .095 GFI = .681 ECVI = 2.19
Stewart & Austin (2009)	536 non-ASD university students (age M = 24.3 years) Scottish sample	EFA & CFA; 43 items; 4 factors; 29 %	Socialness (.83) Patterns (.69) Understanding others/communication (.71) Imagination (.55)	SRMR = .072 RMSEA = .055
Kloosterman, Keefer, Kelley, Summerfeldt and Parker (2011)	522 non-ASD university students (age M = 21 years) American sample	PCA & CFA; 28 items; 5 factors; 45 %	Social Skills (.85) Communication/mindreading (.65). Restrictive/repetitive behaviour (.40). Imagination (.57) Attention to details (.59)	χ^2/df = 5.42 RMSEA = .052 SRMR = .074 CFI = .827 ECVI = 4.59

[a] Type of factor analysis conducted (summed variance explained by all factors in model); *PCA* principal component analysis, *CFA* confirmatory factor analysis, *EFA* exploratory factor analysis

[b] Goodness-of-fit indices include Chi square (χ^2/df); *SRMR* standardised root-mean-square residual, *RMSEA* root-mean-square-error of approximation, *GFI* goodness-of-fit index, *ECVI* expected cross validation index, *CFI* comparative fit index

[c] A value of χ^2/df between 1 and 3 indicates the model fits the data well (Gable and Wolf 1993); a value of SRMR lass than .08 is generally considered good fit (Hu and Bentler 1999); a RMSEA value ranging from .05 to .08 indicates fair fit while ≥.10 indicates poor fit (Browne and Cudeck 1993); a value of CFI or GFI above .95 indicates adequate fit (Browne and Cudeck 1993)

definitely) to yield a possible score range of 0–50. They proposed, based on their validation sample, that an AQ total score of 32 or higher indicates "clinically significant levels of autistic traits" (p. 12). The average score for their U. K. non-ASD community control group was 16.4. This was significantly lower than the diagnosed ASD group's mean of 35.8. Following the precedent of past factor-analytic studies (e.g. Austin 2005; Hoekstra et al. 2008), we implemented a continuous scoring scheme (4 = definitely agree, 3 = slightly agree, 2 = slightly disagree to 1 = definitely disagree) to maximise sensitivity and likelihood of obtaining the continuous distribution as recommended for factor analysis (e.g. Gorsuch 1983; Swygert et al. 2001).

Overview of Statistical Analyses

The main factor-analytic analyses were conducted in two steps. Using LISREL 8.54, we used Principal Component Analysis (PCA) to establish the factor structure for a

Table 2 Sample demographics ($N = 455$)

Variables	Clinically-confirmed ASD ($n = 141$)	Non-ASD group ($n = 314$)	Significance of group difference (p value)[a]
Mean age (years)	$M = 40.56$ ($SD = 7.80$)	$M = 40.74$ ($SD = 8.84$)	ns (.10)
Gender			
Male	43 (30.5 %)	71 (22.6 %)	ns (.86)
Female	98 (69.5 %)	243 (77.4 %)	
Ethnicity			
Caucasian	110 (78.0 %)	270 (86.0 %)	ns (.13)
Non-caucasian	31 (22.0 %)	44 (14.0 %)	
Marital status			
Single	12 (8.5 %)	17 (13.9 %)	ns (.96)
Married/de facto	108 (76.6 %)	95 (76.9 %)	
Divorced/separated	21 (14.9 %)	11 (9.3 %)	
Education attainment[b]			
High school	64 (45.4 %)	154 (49.0 %)	ns (.25)
University degree	77 (54.6 %)	160 (51.0 %)	

[a] ANOVA for age; χ^2 for remainder of variables

[b] Highest educational level completed

randomly selected sample of 300 participants, which permitted an adequate sample based on participant/item ratios. Oblique rotation was used to allow for the probability of significant correlations between factors, and the Scree plot was used to confirm an appropriate number of factors. Goodness-of-fit indices were based on Pearson's Chi square (χ^2) values and Root-mean-square-error of approximations (RMSEA). The χ^2/df index is appropriate for models with relatively small sample size with normally distributed variables (MacCallum et al. 1996). As the χ^2 is often sensitive to trivial deviations in model fit for samples over 100, the 'normed' χ^2 [namely χ^2/df (degree of freedom)] was also examined. A value of χ^2/df between 1 and 3 indicates the model fits the data well (Gable and Wolf 1993). The RMSEA index measures the error of approximation in the population and determines whether the model, with unknown but optimally chosen parameter values, fits the population correlation matrix or covariance matrix (Byrne 1998). We adhered to Browne and Cudeck's (1993) suggestions that a RMSEA value ranging from .05 to .08 is an adequate to fair fit, while values greater than .10 indicate poor fit. These fit indices were selected based on their frequent use and demonstrated robust performance under various data and model misspecification conditions (Bollen and Long 1993). The RMSEA was also chosen because it is the most widely used fit index in extant factor analytic studies of the AQ.

Cronbach's alpha test of internal consistency was also computed for each derived factor. As in previous research, we interpreted α value of .70 or greater as indicating acceptable internal consistency (Kline 2005). Finally, Pearson correlations among the five subscales were computed to explore latent factors' associations with one another. To confirm test–retest reliability, a random subsample of 67 adults (19 from the ASD group) completed the AQ for a second time 4 weeks after the first administration. Intra-class correlations (ICC) and paired t test (t) were calculated for the test–retest reliability checks. The ICC was chosen as it evaluates both correlations of the subscales with total scores and shifts in overall means across the test–retest interval (Koch 1982).

Results

For the principal component factor analysis, the Kaiser–Meyer–Olkin test for sampling adequacy produced a value of .948, indicating high adequacy (.90 or greater is deemed "extremely good"). Bartlett's Test of Sphericity indicated that the rotated solution was significant at $p < .0001$. In the rotated solution, nine factors emerged as having eigenvalues greater than 1.00. However, since the weakest four factors together explained only a further 9.01 % of the total variance, and respective eigenvalues were just over 1, we elected to discard these in favour of an initial five-factor solution. We used a combination of two tests to confirm the number of factors (Turner 1998). The first was the Scree test (Cattell 1966), which showed discontinuity between five factors and subsequent factors (Tabachnick and Fidell 2007). The second was Parallel Analysis (Horn 1965), which revealed four factors (factor 1—eigenvalue 19.17, random data eigenvalue 2.05; factor 2—eigenvalue 2.55, random data eigenvalue 1.93; factor 3—eigenvalue 2.40, random data eigenvalue 1.84; factor 4—eigenvalue 1.90, random data eigenvalue 1.77). Given that the scree test and parallel analysis may result in overfactoring and underfactoring respectively (Hayton et al. 2004), we retained a five-factor solution with the proviso that the fifth factor may or may not be replicable in subsequent research. Items that had a factor loading of less than .32 and/or strong cross-loadings were discarded. Only factors with three or more strongly loading items were accepted (Costello and Osborne 2005).

The five-factor model (see Table 3) explained 48.1 % of the total variance, and consisted of 41 items (See Table 3). To maximize the clinical utility of the scale, two of the 41 items were discarded because they had both very low loadings on their respective scale (marginally over the a priori cut-off of .32), had cross-loadings on other factors that were comparable in magnitude), and had clear conceptual incongruity with the other items on the respective scale. These items were (a) "I am often the last to understand the point of a joke" and (b) "I tend to have very strong interests which I get upset about if I can't pursue" (see Table 3). The first item had its highest loading for *Resistance to change* (.35), but also loaded on *Sociability* (.33) and a low order factor that was discarded because of insufficient eigenvalues. This item was conceptually unrelated to the *Resistance to Change* factor, and the internal consistency of this factor was not meaningfully different when this item was excluded (α with this item = .810, α without this item .82). The second item loaded on *Interest in Patterns* but was only marginally over the cut-off of .32, and it loaded almost as well on other *Social Cognition*, the dropping of this item did not affect the internal consistency of the subscale in a meaningful way, and the item appeared conceptually unrelated to the *Interest in Patterns* subscale. The final number of items for the scale was 39.

Factor 1 consisted of 13 items depicting one's interest in socializing with others as well as self-perceived social competency. This factor had an eigenvalue of 19.17, and accounted for 19.54 % of total variance. This factor was interpreted as *Sociability*. Factor 2 had an eigenvalue of 2.55, consisted of 11 items which explained 8.84 % of total variance. Focal items in this domain were: "I find it difficult to work out people's intentions." "I find it easy to 'read between the lines' when someone is talking to me." This factor was interpreted as *Social Cognition*. Factor 3 consisted of 7 items, including "I frequently get so strongly absorbed in one thing that I lose sight of other things" and "I often notice small sounds when others do not." These items were interpreted as having a *Narrow Focus*. This factor had an eigenvalue of 2.40 and accounted for 7.77 % of total variance. Factor 4 consisted of 4 items that described *Interest in Patterns*, including "I am fascinated by dates", "I like to collect information about categories of things", and "I usually notice car number plates or similar strings of information". The eigenvalue was 1.89, and explained 7.02 % of total variance. Factor 5 consisted of 4 items that together accounted for 4.90 % of total variance and had an eigenvalue of 1.50. Items within Factor 5 included "I prefer to do things the same way over and over again" and "It does not upset me if my daily routine is disturbed" (reverse scored), and this factor was interpreted as *Resistance to Change*. The internal consistencies for each scale based on the five factors all exceeded $\alpha = .70$ (see Table 3), indicating sound to excellent internal consistency (Kline 2005). Furthermore, examination of skewness and kurtosis statistics indicated that there were no significant departures from normality for any of the subscales or the total score for the 39 items. We ran a confirmatory factor analysis on the 5-factor solution separately for the ASD and non-ASD groups to test relative model fit. The fit of the model for the ASD group was good ($\chi^2 = 305.61$, χ^2/df = .44, RMSEA = .001, CFI = 1.00, AIC = 538.65). The fit of the model for the non-ASD group was poorer but still acceptable ($\chi^2 = 1{,}861.28$, χ^2/df = 2.92, RMSEA = .07, CFI = .97, AIC = 1,940.15). The coefficient of congruence across ASD and non-ASD groups was high (.99), indicating high factorial similarity (Van de Vijver and Leung 1997).

To cross-validate the five-factor solution we used CFA drawing upon the remaining 155 participants whose data had not been included in the original PCA. The smaller sample for the CFA was justified on the basis that the number of items had been substantially reduced from the original 50 items. Basic model-fitting techniques were applied. First, our iterative process of variable selection was performed in steps. We used Wald's *t* test to drop non-significant structural parameters. Then we used the Modification Index (MI) to allow for the addition of meaningful structural parameters. As described in the procedure section above, the χ^2/df, RMSEA and CFI were then examined. The measurement model based on 39 items (five factors) had a χ^2/df was less than 3 (2.78), the RMSEA was less than .08 (it equalled .070), the CFI exceeded .95 (.977). These statistics indicated that the new factorial model for the AQ-39 represented the data very well, and fit indices were generally strong relative to reviewed studies where fit indices were reported (see Table 1).

Latent factors were expected to display some associations, given their communalities in clinical and research-based depictions of ASD symptomatology. Correlations between subscales were, as expected, significant, with all correlations differing significantly from zero ($p < .001$). The magnitude of inter-scale correlations was generally in the high range (.6–.7), suggesting high relatedness (see Table 4). Our repeat testing of a subgroup of the sample showed high test–retest reliability, with ICC indices greater than .86 for all factors. We also explored the discriminant validity of the AQ-39 subscale and total scale scores by comparing the ASD-diagnosed subset of our sample ($n = 141$) with the non-ASD control group ($n = 314$). Table 5 reports the means and the results of analyses of

Table 3 Factor loadings for principle component analysis (n = 300) and confirmatory factor analysis (n = 155) of the new model (AQ-39)

Item number and wording from original AQ		PCA					CFA
		Fac 1	Fac 2	Fac 3	Fac 4	Fac 5	
Fac 1	Sociability (*Cronbach α = .906*)						
11[a]	I find social situations easy	.785	.054	.087	−.072	.002	.920
44[a]	I enjoy social occasions	.782	−.023	.034	−.084	.086	.907
47[a]	I enjoy meeting new people	.751	.028	−.119	−.048	.101	.842
38[a]	I am good a social chit-chat	.736	.148	−.011	.162	−.013	.917
17[a]	I enjoy social chit-chat	.694	.184	.083	.157	−.045	.852
13	I would rather go to a library than a party	.625	−.241	.102	−.054	.294	.757
26	I frequently find that I don't know how to keep a conversation going	.549	.053	−.005	.105	−.186	.761
46	New situations make me anxious.	.512	.038	.190	−.066	.153	.820
22	I find it hard to make new friends	.484	.051	.133	−.059	−.074	.784
48[a]	I am a good diplomat	.454	.050	−.114	.145	−.130	.669
1[a]	I prefer to do things with others rather than on my own	.342	.075	.305	−.062	−.104	.630
15[a]	I find myself drawn more strongly to people than to things	.325	.275	.033	−.059	−.029	.728
50[a]	I find it very easy to play games with children that involve pretending	.318	.303	−.031	.027	.070	.678
Fac 2	Social Cognition (*Cronbach α = .867*)						
42	I find it difficult to imagine what it would be like to be someone else	.006	.615	.205	−.172	.011	.743
27[a]	I find it easy to 'read between the lines' when someone is talking to me	.162	.601	−.047	−.146	.073	.815
8[a]	When I'm reading a story, I can easily imagine what the characters might look like	−.109	.566	−.196	−.002	−.007	.399
36[a]	I find it easy to work out what someone is thinking or feeling just by looking at their face	.080	.547	−.044	.131	−.035	.798
10[a]	In a social group, I can easily keep track of several different people's conversations	.304	.544	−.056	−.042	.104	.736
28[a]	I usually concentrate more on the whole picture, rather than the small details	−.002	.512	.091	−.015	.048	.638
31[a]	I know how to tell if someone listening to me is getting bored	.071	.471	−.040	.163	.142	.718
32[a]	I find it easy to do more than one thing at a time	.133	.452	.068	.121	.028	.744
37[a]	If there is an interruption, I can switch back to what I was doing very quickly	.231	.412	.153	.010	.046	.774
45	I find it difficult to work out people's intentions	.303	.411	.054	.019	.078	.829
20	When I am reading a story, I find it difficult to work out the characters' intentions	−.082	.404	.055	.034	.001	.707
Fac 3	Narrow Focus (*Cronbach α = .773*)						
12	I tend to notice details that others do not	.036	−.137	.660	−.008	−.008	.613
16	I tend to have very strong interests which I get upset about if I can't pursue	−.018	.091	.655	.030	.055	.766
5	I often notice small sounds when others do not	.017	−.065	.555	−.028	.140	.775
4	I frequently get so strongly absorbed in one thing that I lose sight of other things	.156	.198	.530	.100	.013	.863
23	I notice patterns in things all the time	.163	−.055	.454	.305	.040	.750
7	Other people frequently tell me that what I've said is impolite, even though I think it is polite	.107	−.018	.372	.182	−.064	.840
39	People often tell me that I keep going on and on about the same thing	.098	.256	.318	.033	−.035	.720
Fac 4	Interest in Patterns (*Cronbach α = .705*)						
9	I am fascinated by dates	−.075	.001	.083	.715	.083	.713
19	I am fascinated by numbers	.061	−.049	.018	.673	.012	.683
41	I like to collect information about categories of things (e.g. types of cars, birds, trains, plants, etc.)	.031	.025	.211	.449	.109	.816
6	I usually notice car number plates or similar strings of information	−.034	−.031	.035	.319	.164	.790
16[b]	I tend to have very strong interests which I get upset about if I can't pursue	−.231	.289	.058	.348	.192	–
Fac 5	Resistance to Change (*Cronbach α = .733*)						
43	I like to plan any activities I participate in carefully	−.046	.175	.145	.086	.567	.692
34[a]	I enjoy doing things spontaneously	.183	.119	−.076	.169	.453	.786

Table 3 continued

Item number and wording from original AQ		PCA					CFA
		Fac 1	Fac 2	Fac 3	Fac 4	Fac 5	
2	I prefer to do things the same way over and over again	.122	.227	.091	.082	.376	.801
25[a]	It does not upset me if my daily routine is disturbed	.142	.278	.194	−.028	.319	.788
35[b]	I am often the last to understand the point of a joke	.330	.213	.198	−.140	.360	–

[a] Reverse-scored items

[b] Item discarded on the basis of conceptual incongruity

Table 4 Pearson correlations for the 39-item AQ factor solution

	Sociability	Social cognition	Narrow focus	Interest in patterns
Sociability	1.0			
Social cognition	.759*	1.0		
Narrow focus	.751*	.665*	1.0	
Interest in patterns	.631*	.582*	.753*	1.0
Resistance to change	.710*	.720*	.692*	.624*

** $p < .001$

variance (ANOVA) and Cohen's effect size analyses. As expected, the ASD group scored significantly higher on each subscale score and the total score (effect sizes in the medium range), suggesting that the AQ-39 subscales may be useful in distinguishing the two groups.

Discussion

The primary aim of this study was to examine factor-analytic structure of the AQ using a large sample that included a substantial proportion of people with an ASD diagnosis. This is one of the first factor analytic studies to achieve this. We took the conservative approach of initially developing a factor model using PCA with a subgroup of our sample and then cross-validating it with the remainder using CFA. The outcome was a 39-item, five-factor structure that had favourable psychometric properties, including high internal consistency, semantic consistency, good distributional properties, and good test–retest reliability. There was evidence yielded that the scale produced significantly different scores across clinic and nonclinical samples in the expected directions. The internal consistencies of the subscales derived in the present study were substantially higher than those reported in previous studies, and the proportion of variance accounted for appeared higher than most other studies that were reviewed in this area of research. Goodness-of-fit indices were comparable and in some cases notably improved relative to solutions derived in other studies.

The five factors derived in the present study mapped well onto some of the factors derived in earlier studies. In the present study, the five derived factors were *sociability*, *social cognition*, *narrow focus*, *interest in patterns*, and *resistance to change*. These partly mapped onto domains proposed in the original Baron-Cohen et al. (2001)—*social skills*, *attention switching*, *attention to detail*, and *communication*. The factors from the present study also consistently mapped onto some of the domains identified in available factor analytic studies subsequent to Baron-Cohen et al. (2001)'s study. Notably, the factors *sociability* and *social cognition* related well to *social skill* and *communication/mindreading* factors derived in the five prior studies (Table 1). The identification of the factor *social cognition* is consistent with earlier research showing that children and adults with ASD have difficulties with 'theory of mind', or the ability to infer the beliefs, desires and intentions of others (e.g. Baron-Cohen 2000, 2008a; Brown and Klein 2011; Peterson et al. 2012). The factors *attention to detail* and *interest in patterns* mapped onto related factors derived by Austin (2005), Hurst et al. (2007), Hoekstra et al. (2008), Stewart and Austin (2009), and Kloosterman et al. (2011). The similarity of these factors across the reviewed studies suggests a high level of consistency in ASD symptomatology across industrialized countries, notably Britain (Baron-Cohen et al. 2001), the Netherlands (Hoekstra et al. 2008) and the United States (Kloosterman et al. 2011).

Future research is needed on the extent to which the AQ-39 may be useful as a tool for assisting in screening, diagnosis, and early intervention for people on the autism spectrum. The AQ-39 factors resembled widely-used diagnostic guidelines for ASD, including the Diagnostic Criteria for Asperger's Syndrome (DCAS; Gillberg 1991; Gillberg and Gillberg 1989). In the DCAS taxonomy, the five diagnostic criteria are social interaction impairment, all-absorbing narrow interest, imposition of routines, atypical speech and language profile, and non-verbal communication problems. Four of the five DCAS taxonomy map onto the AQ-39 factors, and the variation across the two measures related to atypical speech and language

Table 5 Means (and SDs) on new AQ-39 factors for participants with and without formal diagnosis of ASD

	ASD			Control			Group comparisons	
	Male ($n = 43$)	Female ($n = 98$)	Combined ($n = 141$)	Male ($n = 71$)	Female ($n = 243$)	Combined ($n = 314$)	Comparisons F value	Cohen's d^a
Sociability (13 items)	37.65 (8.71)	34.37 (9.72)	35.44 (9.50)	29.36 (10.45)	29.39 (10.68)	29.38 (10.61)	31.96*	.557
Social cognition (11 items)	27.30 (7.89)	25.18 (8.44)	25.86 (8.50)	23.44 (7.21)	21.32 (7.50)	21.83 (7.48)	25.24*	.503
Narrow focus (7 items)	20.81 (5.26)	18.25 (5.65)	19.07 (5.64)	16.74 (4.92)	17.09 (5.40)	17.01 (5.29)	13.66*	.377
Interest in patterns (4 items)	10.53 (3.04)	9.02 (3.50)	9.51 (3.42)	7.81 (3.27)	7.70 (3.09)	7.73 (3.13)	28.38*	.543
Resistance to change (4 items)	11.55 (2.50)	10.43 (2.92)	10.78 (2.83)	9.67 (3.00)	8.91 (3.34)	9.09 (3.27)	26.80*	.552
Total AQ-39	108.00 (22.46)	97.38 (27.03)	100.86 (26.02)	87.13 (25.46)	84.41 (26.17)	85.06 (25.99)	33.87*	.608

* $p < .001$

[a] An effect size of .5 is considered large, .3 is moderate, and .1 is small (Cohen 1988)

profile, a feature for which there is continuing debate on whether this a distinguishing feature of autism spectrum presentations (Gillberg and Ehlers 1998). The AQ-39 is likely to be a valid and reliable tool for quantifying the key dimensions of ASD, and it is quick and easy to use, making it useful in a busy clinical setting. This may be helpful in guiding the focus of therapeutic intervention for people with ASD. For example, a profile of factors that denotes particular challenges or relative assets in *sociability*, *social cognition*, *narrow focus*, *interest in patterns*, and *resistance to change* may guide the strategic focus of therapy. Further research on the potential utility of the AQ-39 as an indicator of clinical change during therapy is needed. The results of this study suggest that the AQ-39 factors are stable over time, so they should be able to pick up clinically reliable change in response to therapy.

Relative to earlier factor analytic studies on the AQ, a key strength of the study is its large sample of people with ASD. Nevertheless, the study has limitations. The number of factors varied across tests (Scree versus Parallel Analysis), and further research is needed to verify the fifth factor *resistance to change*. We relied on formal diagnostic information supplied to participants by health and medical professionals, rather than our own diagnostic interviews, and we did not screen for clinically significant problems in the nonclinical group. Generalizability to other sample populations may be restricted because of a reliance on convenience sampling in the nonclinical group. Participants were all unpaid volunteers and, given the length and content of the questionnaires, a certain level of interest and dedication was needed to complete them. This may have biased the sample towards those with less significant problems. The clinical group was recruited from two private clinics specializing in ASD, and this may have attracted a different population from that which might present at a nonspecialist clinic or community health services. The sample was relatively affluent and well-educated, potentially limiting generalization to people from lower socioeconomic backgrounds.

Conclusion

The AQ-39 had strong psychometric properties, including discrete factors that mapped onto earlier research, high internal consistency, and test–retest reliability. Next steps for research on the refined AQ might include an assessment of its capacity to capture clinical change, and the utility of targeting presenting problems drawing on AQ-39 profiles.

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CHAPTER 8

STUDY FOUR

Psychometric properties of the Chinese version of the Autism Spectrum Quotient (AQ)

> *"Autism...knows no racial, ethnic, or social boundaries."*
>
> *(Autism Society of America, 2000, p. 3)*

8.1. Rationale

Study 3 validated the utility of the AQ in quantifying tendency towards autism across the non-clinical to clinical range in an Australian sample. There is a need to ascertain the AQ's efficacy cross-culturally given the general consensus is that characteristics of autism are a continuum of abilities found in all human race (e.g., Ritvo, Ritvo, Guthrie, Ritvo, Hufnagel, McMahon et al., 2011). To date, we know that the AQ not only is being widely used in English speaking countries, it has been administered efficiently to culturally diverse samples over the years, demonstrating stable internal consistency on Cronbach's alpha test for population including Japanese (Wakabayashi et al., 2007; Wakabayashi, Baron-Cohen, Wheelwright, et al., 2006; Wakabayashi et al., 2004), Austrian (Voracek & Dressler, 2006), Italian (Ruta et al., 2011), Dutch (Hoekstra et al., 2008), Scottish (Steward and Austin, 2009) and French-Canadian (Lepage et al., 2009). The efficiency of the AQ when used for the Chinese population is yet to be established. The main goal of Study 4 is to explore the validity of the AQ in the context of Chinese families.

In Taiwan, the prevalence of ASD is rising and the phenomenon of broad autism phenotype in parents of children with ASD has not been investigated. As previously learnt, establishing a psychometrically sound measure is the first step towards this goal. This study was hence brought forth to test, for the first time, the psychometric properties of the Chinese version of the AQ when fitted to a sample of Taiwanese parents. It was expected that further insights into the nature of autism traits could be drawn when comparing the results of this study to the findings of Study 3.

8.2. Statement of Contributions of Joint Authorship

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Contributor	Statement of Contribution
Winnie Yu Pow Lau (candidate)	Designed the study Performed data analyses Prepared tables Wrote the manuscript drafts Revised and edited manuscript for publication
Prof. Susan Shur-Fen Gau (associate supervisor)	Supervised Recruited sample
Dr Yen-Nan Chiu (colleague)	Assisted with data collection
Dr Yu-Yu Wu (colleague)	Assisted with data collection
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Psychometric properties of the Chinese version of the Autism Spectrum Quotient (AQ)

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ABSTRACT

The Autism Spectrum Quotient (AQ) has been widely used for measuring autistic characteristics in parents of children with autism spectrum disorders (ASD). Nonetheless, its psychometric validity is yet to be justified. This study tested the factor structure of the AQ by means of principal component analysis and confirmatory factor analysis using, for the first time, data from 4192 Taiwanese parents (1208 with ASD children and 2984 with typically developing children). Results yielded a 35-item, 5-dimensional factor solution that had favorable psychometric characteristics (RMSEA = .054; NNFI = .962; CFI = .969) than any of the previously-published AQ factor solutions. Subscales of this new AQ-Chinese model were statistically and semantically coherent, namely: *Socialness*, *Mind-reading*, *Patterns*, *Attention to Details* and *Attention Switching*. The psychometric properties of the AQ-Chinese did not change between clinic-based and community-based data suggesting good fitting for a continuum of autistic expression. Furthermore, the considerable overlap between the AQ-Chinese and the AQ factor structures derived previously using student samples indicated consistency in the manifestation of the autistic profile across different cultures and age groups. Group differences in the AQ-Chinese scores were in line with previous studies, i.e. males generally scored radically higher than females except in *Attention to Details*. Interestingly, mothers of ASD children reported lower total AQ scores than community mothers yet no significant group difference for the fathers. Important research and clinical implications pertinent to parents with children with ASD and the utility of the AQ were drawn.

1. Introduction

Autism spectrum disorders (ASD; encompassing Autistic Disorder, Asperger's Syndrome [AS] and Pervasive Developmental Disorder-Not Otherwise Specified [PDD-NOS]) are a group of neurodevelopmental disorders characterized

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by: (a) particular deficits in social reasoning skills, (b) marked verbal and/or nonverbal communication skills impairments and, (c) stereotyped patterns of behaviors or interests (American Psychiatric Association, 1994). Though not exclusively determined by heredity, there is compelling evidence that ASD is genetically related (e.g. Eapen, 2011; Folstein & Rutter, 1977; Folstein & Piven, 1991; Ronald & Hoekstra, 2011). Studies on relatives of people with ASD have reliably found normative variants of full-blown autistic profile, known as broader autism phenotype (BAP; e.g. Le Couteur et al., 1996; Pickles et al., 2000; Sucksmith, Roth, & Hoekstra, 2011). There is now a clear recognition of BAP in parents of children with ASD (e.g. Bernier, Gerdts, Munson, Dawson, & Estes, 2011; Bolte & Poustka, 2006; Dawson et al., 2007; Happe, Briskman, & Frith, 2001; Pisula, 2002; Piven, Palmer, Jacobi, Childress, & Arndt, 1997), drawing research and clinical attention towards the effect of ASD symptomatology on these parents' well-being (e.g. Ingersoll, Hopwood, Wainer, & Brent Donnellan, 2011).

Although several questionnaires are currently used to measure BAP, to our best knowledge, only limited psychometric data have been published. Among them, the Autism Spectrum Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) has been most widely used for ascertaining BAP in parents of children with ASD. The AQ consists of five subscales: *Social Skills*, *Communication*, *Attention Switching*, *Attention to Details* and *Imagination* (Baron-Cohen et al., 2001). In an Australian study of 111 parents of children with ASD and 88 parents of typically developing (TD) children, parents of ASD children reported significantly higher autistic traits in the *Social Skills* and *Communication* subscales of the AQ (Bishop et al., 2004). These significant findings were supported by two recent studies in Sicily (Ruta, Mazzone, Mazzone, Wheelwright, & Baron-Cohen, 2012) and in U.K. (Wheelwright, Auyeung, Allison, & Baron-Cohen, 2010) but not supported by one conducted in Netherlands (Scheeren & Stauder, 2008). In view of inconsistent findings across different ethnic groups, whether parents of children with ASD in another ethnic group such as Chinese will exhibit higher autistic trait as measured by the AQ than those of TD children therefore, warrants further investigation.

In fact, the AQ has been administered efficiently to culturally diverse samples over the years demonstrating stable internal consistency on Cronbach's alpha test for population. For instance, cross-cultural comparisons by replicating Baron-Cohen et al. (2001)'s original U.K. study had been conducted in Japan (Wakabayashi, Baron-Cohen, Uchiyama, Yoshida, Kuroda, et al., 2007; Wakabayashi, Baron-Cohen, Uchiyama, Yoshida, Tojo, et al., 2007; Wakabayashi, Baron-Cohen, & Wheelwright, 2006; Wakabayashi, Baron-Cohen, Wheelwright, & Tojo, 2006; Wakabayashi, Tojo, Baron-Cohen, & Wheelwright, 2004), Austria (Voracek & Dressler, 2006), Italy (Ruta et al., 2012), Netherlands (Hoekstra, Bartels, Cath, & Boomsma, 2008), Scotland (Stewart & Austin, 2009) and Canada (Lepage, Lortie, Taschereau-Dumouchel, & Théoret, 2009). Each of these studies validated the usefulness of the AQ in quantifying autistic characteristics in their local general population. A dilemma at hand, nonetheless, is that whilst the AQ shows promise and potential, its use in research and clinical endeavors has outstripped the validation evidence for its psychometric coherence. Indeed, fully convincing evidence of the psychometric validity of the AQ has yet to be demonstrated whether specifically in the context of Taiwanese sample or other ethnic samples. This is particularly true of its factor structure.

Originally, five dimensions were postulated to be discrete subscales within the AQ on purely conceptual ground. Yet no factor analysis was reported to clarify whether these subscales reflected the best reduction of the item set, or whether a different structure exists. Furthermore, the test–retest reliability and internal consistency coefficients (Cronbach's alpha, α, ranging from .63 to .77) on the five domains in the original study (Baron-Cohen et al., 2001) were suboptimal. In response to these shortcomings, several factor analytical studies have been conducted over the past decade to verify the factor structure and reliabilities of the AQ (e.g. Austin, 2005; Hoekstra et al., 2008; Kloosterman, Keefer, Kelley, Summerfeldt, & Parker, 2011). These studies revealed 2–5-factor models of the AQ, suggesting that the AQ is multifactorial and encompasses at least one factor relevant to social behaviors and another cognitive pattern. More specifically, two consistently verified constructs were 'Social Skills/Sociability' and 'Pattern/Attention to Details' (Austin, 2005; Hoekstra et al., 2008). Internal consistencies of the subscales in each model were varied (α ranging from .40 to .86).

All in all, several limitations regarding the structural validation of the AQ remain. First, none of the existing factorial models has achieved adequate goodness of fit indices as recommended for confirmatory factor analysis (CFA; see Browne & Cudeck, 1993; Hu & Bentler, 1999) suggesting the factor solution of the AQ requires further exploration. Second, internal consistencies of the subscales in each model were incongruent, with some as poor as $\alpha = .40$. Third, none of the factorial studies included Asian samples, albeit its radical role in ASD research in this region. Given high AQ scores have been shown to be positively correlated with neuroticism whilst negatively associated with extraversion and conscientiousness (Austin, 2005; Wakabayashi, Baron-Cohen, & Wheelwright, 2006; Wakabayashi, Baron-Cohen, Wheelwright, & Tojo, 2006), and that these personality traits are influenced by culture (Stevens, Kwan, & Graybill, 1993), we cannot disregard latent cultural effect by assuming the existing factor solutions for the AQ fit ethnic Chinese sample adequately. Fourth, the existing models were predominantly built on data from university students who are relatively young among the adult population and prone to higher academic caliber. Parents of children with ASD not only are comparatively older than university students, they probably would exhibit more autistic characteristics compared to the general population, as asserted by the theory of BAP. Collectively, their profile may present with unique ASD pertinent constructs as depicted by the items in the AQ hence require a further factorial analysis. In brief, the factorial validity of the AQ for Chinese parents warrants exploration especially if the AQ is increasingly relied on for genetic and endophenotype studies in ASD in ethnic Chinese population.

In light of the aforementioned gaps in the AQ literature, the present study aims to: 1) build on previous research by assessing the factor structure and internal consistency of existing factor solutions for the Chinese version (Traditional Mandarin) of the AQ using data from Taiwanese population; 2) develop and validate an alternative factor model (if indeed distinct from the existing models) that will fit data from a sample of parents of children with and without ASD. Such a group is likely to include individuals with BAP and to encompass the autism spectrum more entirely; and 3) test if the AQ shows sensitivity in discriminating parents of children with ASD from their counterpart, and to check if any particular domains of the AQ are more potent in portraying BAP.

2. Methods

2.1. Participants

The sample consisted of two groups: 1) clinic-based group: parents of 604 children with a clinical diagnosis of DSM-IV autistic disorder or Asperger's disorder ($N = 1208$; mean age of fathers, 43.05 ± 6.34 years; mean age of mothers, 40.13 ± 5.81 years), and 2) community-based group: parents of 1492 TD children ($N = 2984$; mean age of fathers, 43.59 ± 5.58 years; mean age of mothers, 40.53 ± 5.10 years). The clinic-based sample was recruited through the National Taiwan University Hospital in Taipei ($n = 367$, 60.8%), the Chang Gung Children's Hospital in Taoyuan ($n = 146$, 24.2%) and several other regional hospitals and schools ($n = 91$, 15.0%) nationwide.

Among the 1208 parents of ASD children, 23.3% were high school graduates, 55.9% obtained a bachelor degree and 19.9% postgraduate degree; 90% were married or in a de facto relationship whereas the remaining either separated or divorced. The clinical diagnoses of ASD in the children were made by board-certified child psychiatrists conversant with clinical and research expertise in the assessment and treatment of ASD. The diagnostic procedures involved clinical interviews with primary caregivers, collateral information from teachers and other professionals, and direct observation and interaction with the children. The clinical diagnoses of ASD were also confirmed by structured interviews using the Chinese version of the *Autism Diagnostic Interview-Revised* (ADI-R; Chien et al., 2010; Gau et al., 2012, 2010, 2011).

The community-based group was parents of an age matched TD sample to children with ASD recruited through randomly selected primary and junior high schools of the same neighborhoods of children with ASD. In this group, about 9% of the couples were separated or divorce and the rest married or in a de facto relationship; 39% were high school graduates, 47.8% obtained a bachelor degree and 13.1% postgraduate degree. To exclude any risk of low intellectual functioning, only participants who had completed junior high school education were included in this study. Parents who have diagnosis of schizophrenia, schizoaffective disorder, or organic psychosis were excluded.

2.2. Instruments

2.2.1. The Chinese version of the AQ

The AQ is a self-report questionnaire developed to quantify autistic traits in adults with normal intelligence. It consists of 50 theoretically-derived statements depicting personal views, habits and preferences pertinent to the unique profile of ASD. The items are equally divided into five subscales: ***Communication***, ***Social Skills***, ***Attention Switching***, ***Imagination***, and ***Attention to Details***. Sample items from the first two subscales respectively are: "***Other people frequently tell me what I have said is impolite, even though I think it is polite***" and "***I am good at social chit-chat***". Each statement is rated on a four-point scale, with answer categories "definitely agree", "slightly agree", "slightly disagree" and "definitely disagree". Every response that indicates autistic feature is scored '1' if "definitely agree" or "slightly agree", and otherwise '0' if "slightly disagree" or "definitely disagree" leading to the total score of the AQ ranges from 0 to 50 where higher score depicts the autistic end of the continuum. In order to avoid response bias, about half of the statements were reversal items. As in previous studies (Austin, 2005; Hoekstra et al., 2008; Stewart & Austin, 2009), this study first employed an ordinal (4-point Likert) scale (ranging from 1 to 4 for items portraying autistic feature, and inverted for the reversal items) instead of the original dichotomous scale for responses to the AQ so to obtain a better approximate of continuous distribution in order to provide more information for procedures such as factor analysis (Gorsuch, 1983; Swygert, McLeod, & Thissen, 2001). The original scoring protocol was subsequently applied when performing group comparisons.

2.2.2. The Chinese version of the ADI-R

The Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994) is a standardized, comprehensive, semi-structured, investigator-based interview of caregiver covering most developmental and behavioral aspects of ASD, including reciprocal social interaction, communication, and repetitive behaviors and stereotyped patterns, for children with a mental age from about 18 months into adulthood. Gau SS and colleagues have prepared the Chinese version of the ADI-R, which was approved by the Western Psychological Services (WPS) in May 2007, for the use in this study (Chien et al., 2010; Gau et al., 2012, 2010, 2011).

2.3. Procedures

The Chinese AQ was prepared with culture-relevant colloquial expressions and two-way translation by Gau and colleagues after permission was granted by Baron-Cohen et al. to ascertain the linguistic and content validity of this measure. Protocol of this research was approved by the Research Ethics Committee of the National Taiwan University Hospital (IRB ID: 201005041R; ClinicalTrials.gov number, NCT01247662) prior to data collection. Each parent participant was informed with the objectives and procedures of the study, including issues of confidentiality and volunteering nature of this study. Upon parent participants' consent, parents of children with ASD completed the Chinese AQ and ADI-R interview at the Laboratory of National Taiwan University Hospital and parents of TD children completed the Chinese AQ at home, which was mailed to the researchers via a sealed envelope. Return rate of school-based sample was 81.16%. Of all the returned AQ from clinic- and school-based recruitment, 4192 had complete responses for data analysis.

2.4. Statistical analysis

Data analyses were conducted using Predictive Analytics SoftWare Statistics (PASW), SAS 9.2 (SAS Institute Inc, Cary NC, USA), and LISREL 8.8 (SSI Inc., Chicago, IL, USA) software. First, the existing factor models were examined using confirmatory factor analyses (CFA) in LISREL 8.54 software (Jöreskog & Sörbom, 2002) to determine which of these best fits the data. The 5-subscale model proposed in the original study (Baron-Cohen et al., 2001) was first fitted on the total sample of 3434 parents. A diagonally weighted least square procedure was used considering that each item in the AQ was measured on an ordinal scale. We applied a promax/oblique rotation to allow correlations between the factors assuming various aspects of autistic characteristics measured by the AQ were related. The goodness of fit was tested austerely using χ^2 test statistic, root-mean-square-error of approximation (RMSEA) and non-normed fit index (NNFI). We chose these fit indices based on their demonstrated robust performance under various data and model misspecification conditions. As the χ^2 is often sensitive to trivial deviations in model fit in large samples ($N > 100$), emphasis were placed on the other four indices. The RMSEA index measures the error of approximation in the population and determines whether the model, with unknown but optimally chosen parameter values, fits the population correlation matrix or covariance matrix (Byrne, 1998). The value of this fit index is expected to better approximate or estimate the population and not be affected by sample size. A RMSEA value less than .06 indicates good fit; values ranging from .08 to .10 indicate a mediocre fit; and those greater than .10 indicate poor fit (Hu & Bentler, 1995). In addition to comparing a proposed model's fit to a nested baseline or null model, the NNFI measures parsimony by assessing the degrees of freedom from the proposed model to the degrees of freedom of the null model. The NNFI was also chosen owing to its resilience against variations in sample size. The usual cut-off value for well-fitted factor models are >.90 for NNFI (Bentler, 1990).

In order to draw comparisons among the existing models, same procedures were repeated individually with the 2- (Hoekstra et al., 2008), 3- (Austin, 2005), 4- (Stewart & Austin, 2009) and 5- (Kloosterman et al., 2011) factor models to determine if any of them would exhibit better psychometric properties. Then, we compared the comparative fit index (CFI) and Akaike information criterion (AIC) among the five existing models as well as the newly-established factor solution from the present study. The CFI was estimated to indicate whether complete covariation in the data was achieved (Tabachnick & Fidell, 2007). It is generally considered an acceptable fit to the data when the value of CFI exceeds .95 (Browne & Cudeck, 1993). As for the AIC, no convention cut-off has been specified. Instead, smaller values indicate the model is more parsimonious and provides better fit to the data (Akaike, 1987). Finally, model diagnosis was conducted by examining the estimated factor loadings, the estimated correlations between latent variables and between measurement errors, and the standardized residual variance-covariance matrix.

To examine test-retest reliability, a random subsample of 136 parents completed the AQ for a second time after the first administration (8 weeks). Intra-class correlations (ICC) and paired t-test were calculated for agreement and difference between the two measurements, respectively. ICC was employed because this method not only assessed the correlations of the subscale and total scores, but also assessed shifts in the grand mean of scores across the test-retest time interval (Koch, 1982).

Cronbach's alpha (α) was calculated for the internal consistency of the total and five subscales of the AQ derived from CFA. An α of .70 or greater is generally considered acceptable in social science (Kline, 2005). Finally, Pearson correlations (γ) among the five subscales were computed to explore the association between the latent factors.

For evaluating discriminative validity, analysis of covariance (ANCOVA) was used to compare the mean score of the five subscales of the AQ as well as the total score between the parents of children with ASD and the community-based counterparts controlling for children's gender and age. The linear mixed model with both fixed and random effects was used to address the lack of independence within the same family when analyzing the differences between fathers and mothers in the AQ scores, controlling for the children's gender and age. Cohen's d (d) was tabulated manually to determine effect size of the different scores between clinic-based and community-based groups. If the d value is approximately .50, the effect size is regarded as medium whereas .80 or larger implies a large effect size (Cohen, 1988).

3. Results

3.1. Testing of Hypothesis 1: Goodness of Fit for existing factor models

Table 1 presents the CFA results of model fit for the five competing models. All of the models, as hypothesized, did not meet the recommended criteria for good fit, i.e. RMSEA < .06 (Hu & Bentler, 1995), NNFI > .90 (Bentler, 1990) or CFI > .95 (Browne & Cudeck, 1993). Internal consistencies as measured with Cronbach's alpha for each of the subscales in all the five models were mostly poor, ranging from .28 to .71.

Table 1
CFA goodness of fit statistics for previous AQ factor models and AQ-Chinese using a Taiwanese sample ($n = 1374$).

Model	# of items	# of factors	Alpha Cronbach	χ^2	RMSEA [90% CI]	NNFI	CFI	AIC
Baron-Cohen et al. (2001)	50	5	Social Skills (.56) Attention Switching (.42) Attention to Details (.45) Communication (.49) Imagination (.39)	10316.43	.108 (.106–.109)	.849	.857	15471.51
Austin (2005)	26	3	Social Skills (.68) Attention to Details/Patterns (.58) Communication/Mindreading(.41)	2642.08	.089 (.085–.091)	.893	.903	2773.34
Hoekstra et al. (2008)	50	2	Social Interaction (.79) Attention to Details (.45)	11035.19	.114 (.112–.115)	.839	.845	17272.22
Stewart and Austin (2009)	43	4	Socialness (.60) Patterns (.55) Understanding Others/ Communication (.54) Imagination (.53)	3207.83	.089 (.086–.092)	.870	.883	3290.85
Kloosterman et al. (2011)	28	5	Social Skills (.71) Communication/Mindreading (.58) Restrictive/Repetitiv Behavior (.28) Imagination (.47) Attention to Details (.60)	8088.31	.099 (.097–.100)	.868	.875	9707.78
AQ-Chinese	35	5		1889.30	.054 (.052–.57)	.962	.969	2242.25

Note: χ^2 = Chi-square test statistics; RMSEA: root-mean-square-error of approximation; 90% CI: 90% confidence interval for RMSEA; NNFI: non-normed fit index; CFI: comparative fit index; AIC: Akaike information criteria.
$^*p < .001$.

3.2. *Testing of Hypothesis 2: the alternative model*

3.2.1. *Principal component analysis*

Given that none of the existing models fitted the data fully convincingly, the sample was randomly split into two sub-samples to derive and test an alternative model for the factor structure of the AQ.

First, an exploratory principal component analysis (PCA) and factor extraction by the scree criterion in the first sub-sample ($n = 2060$ parents) was conducted. Again, promax rotation was applied to allow correlation because personality characteristics such as depicted in the AQ would unlikely be totally discrete components. The Kaiser–Meyer–Olkin Measure of Sampling Adequacy was .948 indicating high sampling adequacy of the model (.90 or greater is extremely good). Bartlett's Test of Sphericity indicated that the rotated solution was significant at the $p < .0001$ level, confirming significant correlations among a number of the variables and that factor analysis was suitable for the data.

In the rotated solution, 11 factors had eigenvalues greater than one. A 5-factor solution was chosen instead because the last six factors explained only a further 14.2% of the variance. Utility of this model was confirmed by a Scree test (Cattell, 1966). This 5-factor model explained 42.3% of the total variance (Table 2). Item elimination was then performed in an iterative fashion based on theoretical and empirical reasons. Theoretically, items were discarded if not conceptually congruent with the theme of their designated factor. Empirically, items with a factor loading of less than .32 and/or items with strong crossloadings (loaded $\geq$.50 in more than one factor) would be dropped (Tabachnick & Fidell, 2007). Only factors with three or more strongly loading items ($\geq$.50) were considered solid thus justifiable factors (Costello & Osborne, 2005).

3.2.2. *Confirmatory factor analysis*

For cross validation, this 5-factor solution from PCA was then taken as the initial model for confirmatory factor analysis (CFA) of the ratings of all 50 AQ items in the second sub-sample ($N = 1374$ parents). Basic model-fitting techniques were applied to assure the quality of analysis results. First, with the aid of knowledge and insight, stepwise variable selection was performed by iterating the following two actions: (i) using the Wald's *t*-test to drop insignificant structural parameter and (ii) using the Modification Index (MI) to add additional meaningful structural parameter. As shown in Table 1, the newly found 5-factor model was by far a favorable fit compared to the existing factor models, meeting the recommended criteria for good fit (RMSEA = .054, NNFI = .962, CFI = .969).

Factorial analyses confirmed this 5-factor solution had reasonably high coherence with factor loadings typically above .50 (see Table 2). Indeed, there were no significant crossloadings between items. Correlations between each factor and the measure as a whole were significantly different from zero ($p < .001$) and the magnitude was generally in the moderate range ($\gamma = .54–.79$) suggesting high internal relatedness in this alternative model. Table 3 presents correlations of the five factors stratifying by gender. For both fathers and mothers, *Socialness* and *Mindreading* appeared subjective to *Attention Switching* ($\gamma = .38–.59$, $p < .001$) possibly explainable by the mental flexibility the socio-cognitive process entail. As predicted, *Socialness* was strongly correlated with *Mindreading* ($\gamma = .43$ and $\gamma = .46$, $p < .001$) in both genders assuming someone who is

Table 2
Factor loadings for principle component analysis ($n = 2060$) and confirmatory factor analysis ($n = 1374$) of AQ-Chinese.

Factors and items		Factor loadings PCA	Factor loadings CFA[a]	Original subscale
Factor 1 Socialness				
48[*]	I am a good diplomat.	.826	.839	SS
11[*]	I find social situations easy.	.801	.805	SS
44[*]	I enjoy social occasions.	.789	.839	SS
38[*]	I am good a social chit-chat.	.779	.873	CO
10[*]	In a social group, I can easily keep track of several different people's conversations.	.768	.820	AS
17[*]	I enjoy social chit-chat.	.764	.722	CO
47[*]	I enjoy meeting new people.	.669	.759	SS
22	I find it hard to make new friends.	.588	.685	SS
13	I would rather go to a library than a party.	.412	.462	SS
26	I frequently find that I don't know how to keep a conversation going.	.401	.678	CO
46	New situations make me anxious.	.396	.533	AS
1[*]	I prefer to do things with others rather than on my own.	.350	.442	SS
Factor 2 Mindreading				
45	I find it difficult to work out people's intentions.	.748	.762	SS
35	I am often the last to understand the point of a joke.	.696	.525	CO
27[*]	I find it easy to 'read between the lines' when someone is talking to me.	.694	.750	CO
36[*]	I find it easy to work out what someone is thinking or feeling just by looking at their face.	.680	.701	SS
31[*]	I know how to tell if someone listening to me is getting bored.	.655	.605	CO
33	When I talk on the phone, I am not sure when it's my turn to speak.	.524	.698	CO
20	When I am reading a story, I find it difficult to work out the characters' intentions.	.505	.588	IM
7	Other people frequently tell me that what I've said is impolite, even though I think it is polite.	.331	.447	CO
Factor 3 Patterns				
19	I am fascinated by numbers.	.795	.735	AD
41	I like to collect information about categories of things (e.g. types of cars, birds, trains, plants, etc.).	.636	.389	IM
9	I am fascinated by dates.	.628	.692	AD
6	I usually notice car number plates or similar strings of information.	.570	.630	AD
29[*]	I am not very good at remembering phone numbers.	.314	.289	AD
Factor 4 Attention to Details				
12	I tend to notice details that others do not.	0.787	.776	AD
5	I often notice small sounds when others do not.	.735	.618	AD
28[*]	I usually concentrate more on the whole picture, rather than the small details.	.608	.370	AD
23	I notice patterns in things all the time.	.527	.416	AD
Factor 5 Attention Switching				
34[*]	I enjoy doing things spontaneously.	.657	.424	AS
4	I frequently get so strongly absorbed in one thing that I lose sight of other things.	.589	.407	AS
37[*]	If there is an interruption, I can switch back to what I was doing very quickly.	.434	.633	AS
16	I tend to have very strong interests which I get upset about if I can't pursue.	.391	.292	AS
32[*]	I find it easy to do more than one thing at a time.	0.382	.558	AS
39	People often tell me that I keep going on and on about the same thing.	.360	.590	CO

Note: CO: Communication; SS: Social Skills; AS: Attention Switching; IM: Imagination; TD: Attention to Details.
[a] Completely standardised solution.
[*] Reversed items.

competent in taking others' perspective would be more confident and motivated to socialize. Similarly, *Patterns* and *Attention to Details* were closely related in both genders ($\gamma = .41$ and $\gamma = .44$, $p < .001$), both constructs pertinent to obsessive tendency in work or interests commonly reported by people with ASD (Attwood, 2007; Baron-Cohen & Wheelwright, 1999). Fisher's exact test revealed no significant difference in any subscale correlations between fathers and mothers (all $p > .05$).

Finally, we ascertained if there was divergent AQ factor structure between parents of children diagnosed with ASD ($N = 1045$ parents) and parents with TD children ($N = 2389$ parents). To this end, we conducted three separate CFAs: the 5-factor model fitted to the clinic-based sample only, to the community-based sample only, and to the total sample ($N = 3434$ parents). Factor loadings and goodness-of-fit indices of the three were comparable thus confirming the unassailability of the final, 35-item, 5-factor solution which we henceforth refer to as the AQ-Chinese (Fig. 1).

3.2.3. *Test–retest reliability and internal consistency*

Table 4 shows that the AQ-Chinese demonstrated good test-retest reliability (ICC = .40–.72). There was no significant difference between the two measurements across all the domains implying sufficient constancy. Internal consistency for the total scale was excellent ($\alpha = .84$) and were somewhat mixed for the subscales (α ranging from .54 to .88) though significantly improved compared to previous models.

Table 3
Pearson correlations between subscales of the AQ-Chinese stratifying by gender.

Males Females	Socialness	Mindreading	Patterns	Attention to Details	Attention Switching
Socialness		0.43****	-0.18****	-0.11****	0.39****
Mindreading	0.46****		-0.02	-0.10****	0.52****
Patterns	-0.09***	0.06**		0.41****	-0.04
Attention to Details	-0.03	-0.02	0.44****		-0.06*
Attention Switching	0.38****	0.59****	0.08***	0.04	

* $p < .05$.
** $p < .001$.
*** $p < .001$.
**** $p < .0001$.

Table 4
Test–retest reliability and internal consistency of the AQ Taiwan ($N = 136$).

Scale (# of items)	Correlations		Test–retest reliability				Internal consistency
	γ	ICC	1st Mean ± SD	2nd Mean ± SD	t	p	Cronbach α
Socialness (12)	.725**	.724	33.259 ± 5.65	33.47 ± 6.02	−7.80	.436	.880
Mindreading (8)	.606**	.605	24.64 ± ± 3.48	24.45 ± 3.33	.989	.324	.767
Patterns (5)	.609**	.608	13.88 ± 2.62	13.70 ± 2.59	1.20	.233	.629
Attention to Details (4)	.399**	.400	9.63 ± 1.98	9.63 ± 1.98	.00	1.00	.543
Attention Switching (6)	.544**	.536	17.69 ± 2.55	17.38 ± 2.24	2.04	.430	.602
Total AQ-Chinese (35)	.648**	.647	99.25 ± 9.52	98.54 ± 9.30	1.35	.179	.836

Note: γ: Pearson correlation; ICC: intraclass correlation; validity: discriminating between clinical and community sample.
** $p < .001$.

3.3. Testing of Hypothesis 3: group differences

3.3.1. Gender and age effects

We first explored gender and age effect on self-reported autism characteristics taking the sample as a whole and confirmed these factors accounted for a large amount of the overall variance. Among the 3434 respondents, age effect was considerable with *Socialness*, *Mindreading*, *Patterns*, *Attention to Details* and total AQ-Chinese scores increased with age [($F_{(1,3434)} = 32.69$, $p < .0001$), ($F_{(1,3434)} = 5.28$, $p < .05$), ($F_{(1,3434)} = 4.27$, $p < .05$), ($F_{(1,3434)} = 13.80$, $p < .001$) and ($F_{(1,3434)} = 6.17$, $p < .05$) respectively]. In terms of gender effect, fathers scored significantly higher than mothers only in the *Mindreading* subscale ($F_{(1,3434)} = 18.85$, $p < .001$). To further stratify by child's diagnostic grouping (i.e. clinic-based versus community-based parents), there was more significant gender difference (Table 5). As expected, fathers generally reported higher scores than mothers on the AQ-Chinese with an exception in the *Attention to Details* subscale in both clinical and community groups. The community fathers and mothers also did not differ in the *Socialness* domain.

3.3.2. Discriminative validity

In order to test the discriminative validity of the AQ between parents of ASD children (previously found to manifest BAP) and parents of TD children, subscale and total scores of the AQ-Chinese were compared, stratified by gender (Table 5). Contrary to previous findings, mothers of ASD children reported significantly lower scores in *Patterns* ($d = -.641$), *Attention to Details* ($d = -.381$) and the total score ($d = -.205$) than mothers of school controls. Fathers of ASD children reported significantly higher scores, though very small effect sizes, in *Socialness* ($d = .297$) and *Attention Switching* ($d = .161$) but lower scores in *Patterns* ($d = -.529$) and *Attention to Details* ($d = -.270$) than fathers of TD children. There was no statistically significant difference between the fathers in their total AQ-Chinese scores.

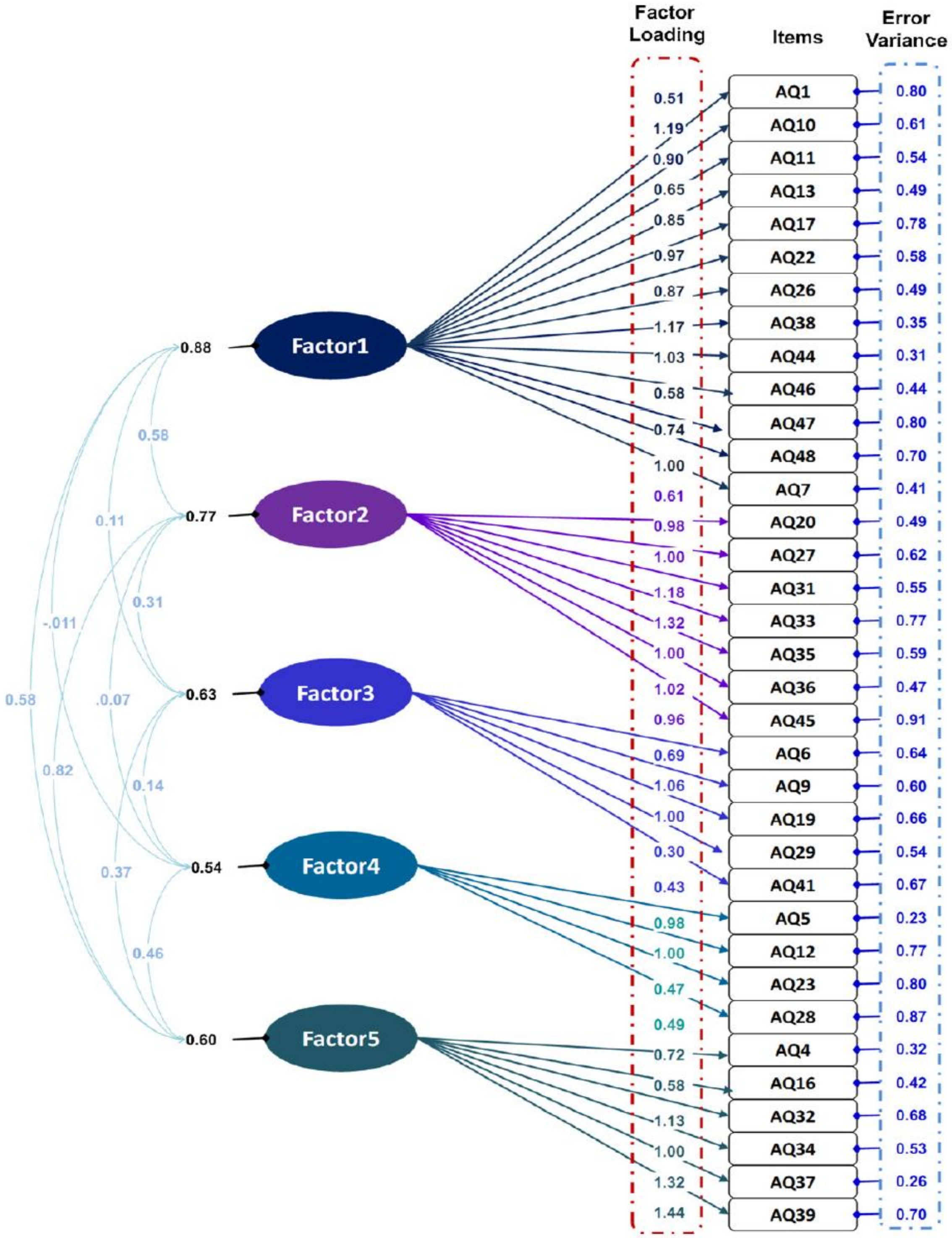

Fig. 1. Factor model of the Chinese version of the Autism Spectrum Quotient.

4. Discussions

The present study examined the factor-analytic structure of the AQ and tested its discriminant validity between parents of children with ASD and those with TD children. None of the existing factorial models fitted our Taiwanese data adequately. As a result, a 35-item, 5-dimensional factor solution that had favorable psychometric characteristics than any of the previously-published AQ factor solutions was developed. This new AQ-Chinese model consisted of five tightly statistically

Table 5
Comparisons of AQ-Chinese scores between clinic-based and community-based subjects.

Variables	Clinical	Community	Cohen's *d*	Clinical vs. community	Mothers vs. fathers	
	Mean ± SD	Mean ± SD			Clinical	Community
Mothers	$N = 542$	$N = 1252$				
Socialness	26.75 ± 6.78	26.70 ± 5.98		$F_{1,1792} = .03$, $p = .868$	$F_{1,1043} = 13.90$, $p = .002$	$F_{1,2387} = 1.31$, $p = .252$
Mindreading	14.65 ± 3.89	14.80 ± 3.58		$F_{1,1792} = .61$, $p = .434$	$F_{1,1043} = 13.39$, $p = .003$	$F_{1,2387} = 21.24$, $p < .001$
Patterns	8.89 ± 2.46	10.52 ± 2.62	−.641	$F_{1,1792} = 151.32$, $p < .001$	$F_{1,1043} = 53.18$, $p < .001$	$F_{1,2387} = 68.20$, $p < .001$
Attention to Details	9.61 ± 2.07	10.38 ± 1.97	−.381	$F_{1,1792} = 56.05$, $p < .001$	$F_{1,1043} = 2.81$, $p = .094$	$F_{1,2387} = .00$, $p = .973$
Attention Switching	11.96 ± 2.74	11.79 ± 2.55		$F_{1,1792} = 1.44$, $p = .230$	$F_{1,1043} = 24.69$, $p < .001$	$F_{1,2387} = 30.27$, $p < .001$
Total scores	71.87 ± 12.29	74.20 ± 10.41	−.205	$F_{1,1792} = 17.47$, $p < .001$	$F_{1,1043} = 38.63$, $p < .001$	$F_{1,2387} = 20.62$, $p < .001$
Fathers	$N = 503$	$N = 1137$				
Socialness	28.32 ± 6.77	26.42 ± 5.99	.297	$F_{1,1638} = 32.26$, $p < .001$		
Mindreading	15.52 ± 3.77	15.47 ± 3.47	–	$F_{1,1638} = .08$, $p = .777$		
Patterns	10.03 ± 2.59	11.39 ± 2.55	−.529	$F_{1,1638} = 98.37$, $p < .001$		
Attention to Details	9.83 ± 2.15	10.38 ± 1.92	−.270	$F_{1,1638} = 26.37$, $p < .001$		
Attention Switching	12.79 ± 2.66	12.37 ± 2.55	.161	$F_{1,1638} = 9.12$, $p = .003$		
Total scores	76.49 ± 11.70	76.03 ± 9.51		$F_{1,1638} = .71$, $p = .401$		

and semantically coherent subscale constructs named as *Socialness*, *Mindreading*, *Patterns*, *Attention to Details* and *Attention Switching*. Statistically, these five factors loaded relatively cleanly on their respective domains, and factors were highly correlated within the subscales. Semantically, the items clustered in a fashion that depicted distinctive dimensions of ASD symptomatology. As a whole, the AQ-Chinese model demonstrated adequate goodness of fit (RMSEA = .054; NNFI = .962; CFI = .969), the internal consistencies although were mix (α ranged from .54 to .88) yet radically enhanced compared to the existing models.

The psychometric properties of the AQ-Chinese did not change between clinic-based and community-based data suggesting the AQ-Chinese model is fitting for a continuum of autistic expression. Group differences in the AQ-Chinese scores were in line with previous studies, i.e. males generally scored radically higher than females (Austin, 2005; Baron-Cohen et al., 2001; Hoekstra et al., 2008; Wakabayashi, Baron-Cohen, Uchiyama, Yoshida, Kuroda, et al., 2007; Wakabayashi, Baron-Cohen, Uchiyama, Yoshida, Tojo, et al., 2007) with an exception in *Attention to Details*. This gender effect dissipated in the *Socialness* domain within the community group. The considerable overlap between the AQ factor structure derived from the present study and previous studies indicated that symptom manifestation of the autistic profile in our Taiwanese parent sample is not overtly different from that in university students and suggested consistency in autistic traits across different cultures.

4.1. Factorial structure

Structurally, this Taiwanese, exclusively parent-based, AQ-Chinese model synchronized with Baron-Cohen et al. (2001)'s original factor formulation using a UK sample. The new *Socialness* and *Attention Switching* and *Attention to Details Mindreading* were essentially a subset of the original *Social Skills*, *Attention Switching* and *Attention to Details* subscales respectively. The AQ-Chinese, however, contributed by refining the conceptual constructs on the original AQ. More specifically, items of the original *Imagination* and *Communication* subscales were dispersed to fortify a more distinct and condensed subscale, namely *Mindreading*. The *Imagination* subscale evidently had had an ambivalent status within the AQ literature including failing to be cross-validated in follow-up CFA (Kloosterman et al., 2011) and attaining dissatisfactory Cronbach alpha's coefficient (Hurst, Mitchell, Kimbrel, Kwapil, & Nelson-Gray, 2007; Stewart & Austin, 2009). The newly formed construct of *Mindreading* depicts difficulty in perspective-taking, or in other words deficit in theory of mind which is the hallmark of ASD (Baron-Cohen, Leslie, & Frith, 1985). In the AQ literature, the concept of *Mindreading* first emerged as *Communication/Mindreading* in Austin (2005)'s 3-factor model. Hoekstra et al. (2008) later in their two-factor hierarchical model asserted the same impression by clustering the *Social Skills*, *Communication*, *Attention Switching* and *Imagination* subscales to make a higher order *Social Interaction* factor. The AQ-Chinese advanced by consolidating this supposition.

Nominating *Mindreading* as a factor in the AQ is not only theoretically meaningful but clinically eminent for two reasons. First, it captures the complex yet subtle social difficulties in higher functioning ASD, commonly presented in adults seeking late-diagnosis. Secondly, it will help distinguish social competency (or incompetency) from interest/motivation in relating to others. The latter is depicted by another subscale in the AQ-Chinese, namely *Socialness*. Social competency and social motivation are two discrete entities; usually stern from distinctive pathology hence can have different clinical implications. Many people with ASD, even socially challenged, are described to be socially interested however could become withdrawn and de-motivated owing to developing secondary mood disorders (Cederlund, Hagberg, & Gillberg, 2010; Punshon, Skirrow, & Murphy, 2009). With these assets, the *Socialness* and *Mindreading* subscales can be used jointly to inform intervention goals.

4.2. Diagnostic nomenclature of ASD

Theoretically, the five factors of AQ-Chinese resembled closely with the diagnostic criteria of ASD. The imminent DSM V (www.dsm5.org) has proposed to characterize ASD with two behavioral dimensions: 1) social/communication deficits

(Criterion A) and 2) fixated interests and repetitive behaviors (Criterion B). Elegantly, the first and second factors in AQ-Chinese (*Socialness* and *Mindreading*) correspond to Criterion A whilst the sequential three (*Patterns*, *Attention to Details* and *Attention Switching*) depict Criterion B. The AQ-Chinese is the first to have had the two diagnostic criterions so precisely and holistically sub-categorized even though '*Social Skills/Sociability*' and '*Pattern/Attention to Details*' have always been the two most palpable and robust facets extracted from the AQ in previous studies (Austin, 2005; Hoekstra et al., 2008).

In view of the compatibility between AQ-Chinese and the ASD diagnostic guidelines, we suggest future factor analytical studies on the AQ tryout a 2-factor model corresponding to the proposed diagnostic criteria in DSM-V. This can be implemented by merging *Socialness* and *Mindreading* as defined in the AQ-Chinese to make one factor then the remaining to compose another. We can also consider adding items that exemplify the newly identified, diagnostically relevant, constructs in the latest models (e.g. *Mindreading*, *Patterns*) to consolidate the underlying factors intended for this measure. These items can be drawn from the descriptions in commonly used diagnostic protocols for adults with ASD (e.g. tendency for literal interpretation, strict adherence to rituals, special interests and the like). In conjunction with adding new items, items that have consistently been found to be redundant in previous studies (e.g. "I would rather go to the theatre than a museum") should be abandoned, so is the feeble subscale of *Imagination*.

4.3. Discriminative validity

Like previous findings (e.g. Austin, 2005; Hoekstra et al., 2008; Kloosterman et al., 2011), the subscales derived from the AQ-Chinese were stable over time. Mothers of children with ASD in this study reported either no difference or lower scores than mothers with school controls. This was consistent with a Dutch study (Scheeren & Stauder, 2008) which found no distinction between mothers of these two populations. In fact, their mothers of children with ASD even reported significantly lower score on the *Attention to Details* domain. Likewise, previous studies showed fathers of children with ASD reported distinctively higher AQ scores in the *Social Skills* and *Communication* domains (e.g. Bishop et al., 2004), the present study also demonstrated higher scores on the *Socialness* subscale in fathers of the ASD group. There were, however, different directions found in the subscales of *Attention to Details* and *Patterns*, leading to no distinction in the total scores between the two groups.

On the whole, the extent of relatively low AQ scores among parents with children with ASD in relation to the community sample was somewhat atypical from the AQ literature. Several speculations could be drawn based on our clinical observations on parents of our clinical sample with ASD. First, since the patients with ASD derived from a cohort of ASD families for clinical and genetic study established by the corresponding author, they are knowledgeable about high heritability in ASD and the typical symptoms and behavioral patterns of different levels and stages of ASD. There may be a conscious avoidance from being labeled as autistic or being responsible for heritability, thus bias towards under-reporting autistic feature on themselves. Second, having a child diagnosed with ASD is likely to increase the parents' knowledge about this condition leading to taking a clinical interpretation on the AQ items. For instance, items denoting attention to details could well be interpreted as competency among mothers of the community group where as mothers of children with ASD would take as connotation of pedanticity. Third, there may be a fear of having passed on the ASD genes leading to a lifelong diagnosis in their child. Stigma towards having a child with special needs in the Chinese society and the guilt incurred in the parents have long been recognized (e.g. McCabe, 2007; Wang, Michaels, & Day, 2011). Each of these three conditions potentially lowers the AQ scores among parents with children with ASD in our sample. The community-based sample on the contrary, is likely to be 'naive' of ASD connotation hence inclined to report more freely and honestly. Indeed, in comparison with findings from another large scale study (Wheelwright et al., 2010), mean AQ total scores reported by our community-based mothers was considerable higher than theirs (17.4 as opposed to 13.1). The same pattern was observed in the fathers' scores (18.2 as opposed to 17.7). Likewise, the clinical sample in our study reported lower, though marginally, total AQ scores compared to Wheelwright et al. (2010)'s sample (18.9 as opposed to 19.2 in fathers and 16.5 as opposed to 16.4 in mothers). More scholastic and clinical endeavors are necessary to demystify the specific explanation to our observations such as exploring the dynamic between parental perception on child's ASD diagnosis and their rating on ASD symptomatology in themselves.

4.4. Methodological considerations

The novelty of this study is two-fold: First, it is for the first time that the factorial structure of the AQ is tested based on a sample of parents of children with and without ASD, a group likely to encompass a full variant of the ASD continuum. Secondly, it is the first to examine the properties of the AQ in an Asian context. Methodologically, this study has employed a rigorous factor analytic procedure involving both PCA and CFA. The PCA was based on a sample size sufficient for statistical power for a 50 item measure with a subject to item ratio of 1:5 (Arrindell & van der Ende, 1985) despite the intricacy of recruiting parents of children with ASD. Finally, our sample consisted of a heterogeneous group of ASD diagnoses in the children of whom intensity and heritability of ASC symptomatology are likely to be diverse and all-encompassing.

There are, on the other hand, inevitable caveats in this study ought to be addressed. Firstly, autistic characteristic in the parents was fully reliant on self report. Whether the relatively low AQ scores in parents of children with ASD reflects that they are actually not having autistic feature, or their behaviors have been modified for the compensation for their children's autistic behavioral problems or to be a competent trainer for their children with ASD, or lastly, had under-report bias, warrants further investigation. Besides, without cross-validating the diagnostic status of the sample, the cut-off points of the

AQ-Chinese cannot be determined. Given the AQ has never been intended to be a standalone diagnostic tool but to be administered in ancillary to clinical assessments (Baron-Cohen et al., 2001), future studies need to incorporate clinical diagnostic procedure on these parents in order to cross-examine reliability of self-report data and sensitivity of the AQ. Secondly, we relied on convenient sample where parents who received the paper questionnaires took the initiative to complete and return their responses via mail. Albeit extensive effort was put in to make the process most convenient possible, certain level of dedication was needed to participate in this study. Hence, the sample pool was self-selected. Finally, our sample only included the parent population which though covered a relatively wide age range and social status, is exclusive. Owing to these plausible sampling biases, generalization of our findings warrants precautions.

5. Conclusions

Our findings confirm that the 35-item AQ-Chinese has good test and retest reliability, comprises of items corresponding to the diagnostic criteria of ASD, can be therapeutically informative, is robust to cultural differences and last but importantly, is quick, easy and economical to use in clinical and community settings. There is, nonetheless, a need for improvement in its psychometric properties, especially in its factor structure and discriminative validity. The factorial analysis in the present study shed lights for future revisions of the AQ, particularly in restructuring the items to depict factors directly correspond with the diagnostic taxonomies of ASD.

Conflicts of interest

All the authors reported no biomedical financial interests or potential conflicts of interest related to this work.

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CHAPTER 9

STUDY FIVE

Autism Traits in Couple Dyads as a Predictor of Anxiety Spectrum Symptoms

> *"The father was said to be very highly strung and irritable. By profession he was a tailor's assistant. Although we had known the boy for many years, we had seen the father only once. He was clearly eccentric and a loner. The mother did not like to talk about her domestic circumstances. However, it was plain that her life could not have been very happy due to the husband's difficult character." (Asperger & Frith, 1991, p. 60)*

9.1. Rationale

Both mothers and fathers raising children with ASD reported three to five times higher rates of anxiety than the typical population (Bitsika, Sharpley, & Bell, 2013). Contributing factors for anxiety in these parents are likely to be multifaceted. This study focussed on whether or not parental tendency towards autism was associated with their elevated parental anxiety, irrespective of child's autism. There are emerging studies reporting that characteristics of autism in parents themselves (Levin-Decanini et al., 2013) are related to their higher prevalence of social anxiety (Kuusikko-Gauffin et al., 2013). This link between tendency towards autism and social anxiety has also been found in the general population (Freeth, Bullock, & Milne, 2013; White, Bray, & Ollendick, 2012). This is not surprisingly given the condition of autism, including its subphenotype, is characterised by social difficulties. Nonetheless, in addition to social anxiety, studies also found a link between traits of autism and other dimensions of anxiety such as generalised anxiety, panic disorders and obsessive compulsive disorder (Hallett et al., 2013; van Steensel, Bögels, & Perrin, 2011) in the general population. Whether or not these links are applicable to parents of children with ASD is yet to be tested. To this end, the new factor solution well-fitted for Chinese parents, AQ-Chinese (from Study 4), was utilised to examine the association between parental traits of autism and the anxiety spectrum among 491 Taiwanese couples who were raising children with ASD. This study extended on existing literature by considering a wide range of anxiety disorders, and taking into account the effect of couple compatibility in their tendency towards autism.

9.2. Statement of Contributions of Joint Authorship

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Contributor	Statement of Contribution
Winnie Yu Pow Lau (candidate)	Designed the study Performed data analyses Drafted the manuscript Revised and edited manuscript for publication
Prof. Susan Shur-Fen Gau (associate supervisor)	Supervised Recruited sample Advised on data analyses
Dr Yen-Nan Chiu (colleague)	Assisted with data collection
Dr Yu-Yu Wu (colleague)	Assisted with data collection

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ORIGINAL PAPER

Autistic Traits in Couple Dyads as a Predictor of Anxiety Spectrum Symptoms

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Abstract The link between parental autistic tendency and anxiety symptoms was studied in 491 Taiwanese couples raising biological children with autism spectrum disorders (ASDs). Parental autistic tendency as measured by Autism Spectrum Quotient (AQ) was associated with anxiety symptoms across all domains. Large effect sizes were found in social phobia and post traumatic stress disorders for both parents, and in general anxiety disorder and agoraphobia for mothers. These associations were irrespective of child's autistic tendency, spouse's AQ scores and the couples' compatibility in their autistic tendency. Perceived family support and parental education moderated the link but not child's autistic severity. Research and clinical implications regarding psychiatric vulnerability of parents of children with ASD were drawn and discussed.

Keywords Autism spectrum disorders · Couple dyads · Parents · Anxiety symptoms · Taiwanese

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterised by deficits in socio-communication abilities and restrictive or repetitive behaviours (American Psychiatric Association 2013). The syndrome of autism manifests in varying degrees of severity. The diagnostic nomenclature of autism in the past distinguished these variants into distinct categories—namely, autistic disorder (AUT), Asperger's disorder (AD), Rett's syndrome (RS), childhood disintegrative disorder (CDD), and pervasive developmental disorder not otherwise specified (PDD-NOS). In the recently published fifth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-5*; American Psychiatric Association 2013), there is a shift from this categorical approach of diagnosing autism to a dimensional approach. This means that instead of having distinct diagnostic categories, such as AUT versus PDD-NOS or AD, affected individuals will be referred to as

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having one of three severity levels of ASD according to the extent of their need for intervention. This new dimensional approach helps to draw attention to those who manifest subclinical levels of autistic tendencies, such as parents of children with ASD. There is a need for further investigation and clarification of the relationship between autistic traits and anxiety symptoms in parents of children with ASD. To contribute to the scholarship in this area, this research studied this connection in 982 parents, with a wide variety of anxiety disorders, of 491 biological children with ASD, and took into account not only couple compatibility, but the effects of autistic traits in both parents and children.

Autistic Tendency in Parents of Children with ASD

Previous research has consistently found parents of children with ASD to have elevated autistic traits. For instance, Bishop et al. (2004) administered the Autism Spectrum Quotient (AQ) to an Australian sample and found that parents of children with ASD ($n = 69$) reported significantly more autistic traits than parents of typically developing children ($n = 52$). The same pattern was subsequently replicated in studies involving samples from the United Kingdom (Wheelwright et al. 2010), Italy (Ruta et al. 2012), Iran (Mohammadi et al. 2012), and Turkey (Kose et al. 2013), indicating that parents across diverse ethnic backgrounds who have children with ASD commonly manifest more autistic characteristics than does the general population.

Psychiatric Risk of Parents of Children with ASD

Parents of children with ASD have also been reliably found to have higher levels of stress (Johnson et al. 2011; Rao and Beidel 2009) and an increased risk of psychiatric problems (Ingersoll et al. 2011; Lee 2009; Piven and Palmer 1999) even when compared with parents of children with other developmental disabilities (Dabrowska and Pisula 2010; Griffith et al. 2010). Although many studies have identified a strong positive correlation between parental stress and the severity of ASD symptoms in children (Davis and Carter 2008; Ekas and Whitman 2010), there are substantial findings suggesting that having a child with ASD does not sufficiently explain higher psychiatric risks in these parents. For example, some parents reported the onset of anxiety and depressive symptoms even prior to becoming a parent (Bolton et al. 1998; Micali et al. 2004). Furthermore, increased rates of major depressive disorders (MDDs) and social phobia (SP) were found in relatives of individuals with ASD who had never had to bear the burden of caring for someone with ASD, but were nevertheless genetically liable (Smalley et al. 1995). A meta-analysis of relevant research between 1973 and 2003 (Yirmiya and Shaked 2005) compared parents of (a) typically developing children, (b) children with Down syndrome, (c) children with intellectual impairment of unknown aetiology, and (d) children with ASD. The group of parents with ASD was more vulnerable to anxiety, depression, and thought disorders; however, when compared with parents of children with learning disabilities, who were genetically liable like the ASD group of parents, parents of children with ASD reported fewer psychiatric symptoms. Genetic liability was therefore considered to be a major factor in the incidence of psychiatric illness. Kanai et al. (2011) found a significant association between comorbid depression or anxiety in adolescents with ASD and maternal depression and anxiety. Although none of these studies were designed to factor out environmental versus genetic influences, the results alluded to the genetic nature of depression and anxiety susceptibilities in individuals with ASD. It appears that genetic disposition could be another explanation for the high occurrence of psychiatric symptoms among parents of children with ASD and this assumption needs to be further investigated.

The Link Between Autistic Traits and Mood Symptoms/Disorders

There is emerging evidence on the connection between autistic traits and psychiatric symptoms. In a study on two nationwide twin cohorts from Sweden ($n = 11{,}222$ children and 18,349 adults), Lundström et al. (2011) found positive correlations between autistic characteristics and, anxiety and depression symptoms. Concentrating more specifically on parents, Ingersoll and Hambrick (2011) examined stress and depression in 149 parents of children with ASD and found that the child's ASD severity and parental autistic traits independently predicted depressive symptoms in parents. The same findings were yielded when Ingersoll et al. (2011) extended their investigation to parents of non-ASD children. Even after controlling for parenting stress and child ASD severity, they found that increased depressed mood in mothers of children with ASD was predicted by mothers' autistic characteristics. Taken together, these results support the argument that parental autistic traits account for parental mood symptoms above and beyond a child's ASD-related challenges.

Lundström et al. (2011) specifically pointed out that further studies on the link between autistic-like traits and the wider range of mental health disorders were necessary because their findings indicated that even the sub-clinical level of ASD was relevant to several clinical heterotypical mental health problems. Of note is that several studies could only confirm increased depressive symptoms (Bolte et al. 2007) or MDDs and not anxiety symptoms or disorders in the first-degree relatives of children with ASD (Bolton et al. 1998; Piven and Palmer 1999). Despite evidence for an increased prevalence of anxiety in parents of children with ASD (Conner et al. 2013), the link between autistic tendency and anxiety symptoms is less consistently supported than it is with depressed mood (Baker et al. 2011; Ingersoll et al. 2011; Kuusikko-Gauffin et al. 2013). In addition, there is yet to be a study that encompasses the wide spectrum of anxiety disorders. There is hence a need for further clarification on the connection between autistic tendency and anxiety symptoms in parents of children with ASD.

Gender Effect on Anxiety Symptoms

It is not difficult to notice that the literature on parents of children with ASD is currently dominated by accounts from mothers. More data from fathers are needed. This is particularly important when we know that gender plays a crucial role in the occurrence of anxiety disorders. Baxter et al. (2013) conducted a global systematic review on prevalence studies of anxiety disorders published between 1980 and 2009. Analyses were conducted based on a sample of 456,012 individuals from 44 countries. Gender explained the greatest variance in estimates (25.1 %) compared to the other six substantive factors for anxiety included in their regression model. Thus gender effect must be taken into account in studies pertinent to anxiety disorders.

Gender also plays a role in coping with the stress of parenting. In the few studies that included both genders in their samples, different reactions were noted between mothers' and fathers' reactions towards the challenge of raising a child with ASD (Gray 2003; Hartley et al. 2011; Lee 2009). Lee (2009) found mothers to have more adaptive coping skills and to perceive higher degrees of consensus between the couples than fathers. On the contrary, when Kaniel and Siman-Tov (2011) analysed the parenting experiences of 88 pairs of parents with children with ASD in Israel using a multivariate model, mothers in their study felt more threatened and more stressed than fathers, which adversely impacted on their mental health and the quality of their marriage. In a study investigating social anxiety among parents of children with ASD and parents with typically developing children, mothers ($n = 65$ in the ASD group and $n = 368$ in the controls) reported significantly more anxiety symptoms than fathers ($n = 61$ in the ASD group and $n = 229$ in the controls) in both groups (Kuusikko-Gauffin et al. 2013).

Gender was likewise found to affect the parenting experience in the Chinese population. In a study conducted on parents of 34 children with ASD and 35 typically developing children in China, mothers reported higher levels of interpersonal sensitivity, anxiety, and psychotic symptoms than did fathers in both groups (Ou et al. 2010). A larger scale study conducted in Taiwan ($n = 151$ families of children with ASD and 113 families of typically developing children) found that mothers of children with ASD displayed more symptoms of somatisation, obsession, interpersonal sensitivity, depression, anxiety, phobia, and marital maladjustments than fathers (Gau et al. 2012).

Based on these studies one may conclude that gender difference is undoubtedly present in parental reactions to the raising of children with ASD, although the actual dynamic is yet to be completely understood. This paper will explore whether or not parental anxiety symptoms are associated with autistic traits in parents as well as gender effect.

The Present Study

This study aimed to clarify the relationship between autistic traits and anxiety symptoms in parents of children with ASD. We extended on previous studies by exploring the full range of anxiety-related psychiatric conditions, including generalised anxiety disorder (GAD), specific phobia (SpP), panic disorder (PD), social phobia, agoraphobia (Ag), and post-traumatic stress disorder (PTSD). We tested the association between parental autistic traits and anxiety symptoms in general as well as specific anxiety sub-types.

In order to address gaps in the existing literature, three methodological considerations were incorporated. First, autistic traits both in parents and children were measured simultaneously to allow testing for independent and/or joint effects of parental versus children's autistic tendency on parental anxiety symptoms. Second, we recruited both mothers and fathers of children with ASD to further explicate gender effects. Third, we took into account, for the first time, parental autistic traits at an individual as well as at a dyadic level. This couple-centred approach was employed to preliminarily test if the advantages of couple similarity apply to couple dyads with autistic-like personalities. In other words, we explored whether or not compatibility of autistic tendency between two partners would alter one's anxiety symptoms. Conventionally, personality similarity between partners, as opposed to contrasting personalities, has been found to be an important factor in achieving and maintaining couple wellbeing (e.g., Antill 1983; Gattis et al. 2004). Whether this concept could be extended to the ASD-affected population is uncharted territory.

Several hypotheses were drawn based on previous findings. We hypothesised that parental autistic traits, gender, and child ASD symptoms would each have an independent effect on parental anxiety. We expected to find stronger self-effect than spousal effect of parental autistic traits on one's anxiety symptoms. Furthermore, we predicted that parental autistic traits have stronger associations with the subtypes of anxiety disorders that are related to socialisation, such as social phobia. In terms of couple compatibility, given that autism negatively affects interpersonal skills, we speculated that an individual with high autistic traits whose spouse also has strong autistic tendency would report high anxiety symptoms despite the similarity in their personality profiles. We correspondingly predicted that low autistic traits in both self and spouse would predict better wellbeing.

Methods

Participants and Procedure

Participants were both mothers (40.03 ± 5.84 years) and fathers (43.05 ± 6.23 years) of 491 children with a diagnosis of ASD based on *DSM-IV* criteria for autistic disorder or Asperger's disorder ($n = 982$). Children with ASD aged 2 years or older were recruited through the National Taiwan University Hospital in Taipei ($n = 298$, 60.7 %), the Chang Gung Children's Hospital in Taoyuan, Taiwan ($n = 120$, 24.4 %), and several other regional hospitals and schools ($n = 73$, 14.9 %). The parents of each child provided their written informed consent and completed the assessments. The children with ASD had either received or were receiving early interventions before recruitment.

Among the parents of the ASD children, 97.35 % were either married or in a de facto relationship; 79.02 % (fathers) and 72.10 % (mothers) had obtained a bachelor's degree or postgraduate degree; and 90.63 % (fathers) and 46.23 % (mothers) were employed in either professional or skilled occupations.

The clinical diagnoses of ASD were made by experienced child psychiatrists based on clinical interviews with primary caregivers, collateral information from teachers and other professionals, and direct observation of the children. Each of these diagnoses of ASD was confirmed by structured interviews with parents using the Chinese version of the *Autism Diagnostic Interview-Revised* (*ADI-R*), which was approved by Western Psychological Services in 2007 and has been widely used in ASD research in Taiwan (Chien et al. 2011a, b; Gau et al. 2011; Gau et al. 2013; Lin et al. 2013). In addition, each mother and father participanting completed a questionnaire that included demographics, the *Adult Self-Report Scale Inventory-4* (*ASRI-4*), the Autism Spectrum Quotient (AQ), and the Family APGAR about themselves as well as the Social Responsiveness Scale (SRS) about their child.

Measures

Anxiety Spectrum Symptoms

The *ASRI-4* is a self-administered rating scale, which includes 136 items about a wide range of psychiatric symptoms of *DSM-IV* diagnosis (Gadow et al. 2004). Items bear one-to-one correspondence with *DSM-IV* symptoms (i.e., high content validity). Each item is rated on a 4-point scale (0 = never, 3 = very often). The *ASRI-4* has two scoring measures: the Symptom Count score (categorical) and the Symptom Severity score (dimensional). Previous studies using the *ASRI-4* have demonstrated satisfactory reliability and convergent and discriminant validity (Gadow et al. 2004; Sprafkin et al. 2007). The *ASRI-4* has been validated with several self-reported rating scales: the Conners' Adult ADHD Rating Scale Self-Report, the Long Version (Conners et al. 1999), and the Wender Utah Rating Scale (Gadow et al. 2004) for the ADHD subscale; the depression scale scores on the SCL-90-R (Derogatis 1994), the Brief Symptom Inventory (Derogatis 1993), the Beck Depression Inventory (Beck and Steer 1993), and the Hamilton Depression Scale (Hamilton 1960) for the depression symptom severity scores; the anxiety subscale of the Brief Symptom Inventory (Derogatis 1993), the post-traumatic stress disorder checklist for the *ASRI-4* PTSD scores (Blanchard et al. 1996); and the Social Phobia Inventory scores for the *ASRI-4* social phobia scores (Connor et al. 2000).

The Chinese translation of the *ASRI-4* was prepared with relevant cultural colloquial expressions and two-way translation by S. S. Gau et al. with the permission of its developers (Gadow et al. 2004; Sprafkin et al. 2007). The psychometric properties of the *ASRI-4* was established in a sample of 5,921 young adults with moderate to high test–retest reliability as dimensional ($r = 0.59$–1.00, ICC = 0.57–0.86) or categorical analysis (*kappa* = 0.25–0.71) and moderate to high internal consistency of each psychiatric symptom (Cronbach $\alpha = 0.37$–0.83) (Chien et al. 2011). This Chinese *ASRI-4* has been used in studies on gender dysphoria (Lai et al. 2010); gender differences on psychopathology (Chien et al. 2011a); chronotypes and psychopathology (Hsu et al. 2012); compulsive internet use (Lin and Gau 2013); eating disorders and psychopathology (Tseng et al. 2013); parenting style of children with ADHD (Chang et al. 2012; Gau and Chang 2013); and the mediation effect of anxiety/depression on the link between childhood ADHD and adult quality of life (Yang et al. 2013).

The Symptom Severity (dimensional) scoring approach was used in this study (i.e., the sum score of each category of anxiety spectrum symptoms) to obtain the quantitative descriptions of the symptom severity of GAD (8 items, 0–24), SP (3 items, 0–9), SpP (1 item, 0–3), PD (1 item, 0–3), Ag (1 item, 0–3), and PTSD (11 items, 0–33). The subtype of PTSD was particularly examined as a distinct category due to the different nature of its psychopathology. A total score of symptoms of anxiety disorders was later generated for the analyses to enhance the reliability and validity of findings. The score of anxiety disorders (0–42) was the sum score of GAD, SP, SpP, PD, and Ag. The test–retest reliability of all of the subscales included in this study (correlation coefficient, $r = 0.57$–0.83, intraclass correlation coefficient, ICC = 0.68–0.86) and the internal consistency of the GAD (Cronbach *alpha,* $\alpha = 0.73$), SP (Cronbach $\alpha = 0.60$), PTSD (Cronbach $\alpha = 0.66$) and anxiety disorders (Cronbach $\alpha = 0.76$) were moderate to high.

Autistic Characteristics of the Participants

The AQ-Chinese (Lau et al. 2013) is a self-report questionnaire adapted from the original 50-item AQ (Baron-Cohen et al. 2001) developed to quantify autistic traits in adults with normal intelligence. The psychometric properties of the AQ-Chinese have been established in a sample of 4,192 Taiwanese parents of whom 1,208 had children with ASD (Lau et al. 2013). It consists of 35 statements depicting personal views, habits, and preferences pertinent to the unique profile of ASD (e.g., "I find it hard to work out people's intentions"). The measure comprises five subscales: socialness, mindreading, patterns, attention to details, and attention switching). Respondents rate to what extent they agree or disagree with each of the statements on a four-point scale (1 = definitely disagree, 4 = definitely agree) for items portraying autistic features, and inverted for the reversal items, leading to the total score of the AQ-Chinese, which ranges from 35 to 170, where the higher score depicts the autistic end of the continuum.

Autistic Characteristics of the Child

The SRS (Constantino and Gruber 2005) was used to assess the severity of autistic characteristics in children. Mothers completed this 65-item rating scale designed for individuals aged 4–18 years. Items were rated on a four-point scale (0 = not true, 3 = almost always true). The Chinese SRS was prepared with relevant cultural expressions and two-way translation by the corresponding author and colleagues, and was officially approved by Dr. Constantino in 2008 (Gau et al. 2013). Exploratory and confirmatory factor analyses indicated that the Chinese SRS, after removing five items, has a four-factor structure (social communication, stereotyped behaviours/interest, social awareness, and social emotion); however, it is better conceptualised as a one-factor model (Gau et al. 2013). Higher score on the SRS indicates more severe autistic social deficits.

Perceived Family Support

The five-item Family APGAR measure is designed to assess five dimensions of perceived family support: adaptation, partnership, growth, affection, and resolve (0 = hardly ever, 2 = almost always). Higher scores indicate a more highly functioning family (Smilkstein 1978; Smilkstein et al. 1982). Our previous study using a representative sample of the parents of 673 junior high school students showed satisfactory internal consistency (Cronbach $\alpha = 0.89$) and 4-week test–retest reliability (ICC = 0.69) for maternal report. The internal consistency of APGAR-C was high (Cronbach $\alpha = 0.88$) in this study. The Chinese Family APGAR has been used in assessing perceived family support in clinic-based (Gau et al. 2012; Gau 2007; Gau et al. 2006; Lin et al. 2012) and in community-based studies (Kawabata et al. 2012; Lai et al. 2010).

Statistical Analysis

In order to investigate if compatibility in autistic characteristics within a couple dyad correlated with anxiety symptoms, we split each of the gender group using cut-off scores of 56 (father) and 51 (mother) (Lau et al. 2013) to form two groups: low AQ total score (L) and high AQ total score (H). The 491 couples were subsequently reassigned into four comparison groups: (1) HH (both parents reported high AQ total scores; $n = 66$ couples), (2) HL (father reported high while mother reported low AQ total scores; $n = 95$ couples), (3) LH (father reported low while mother reported high AQ total scores; $n = 103$ couples), and (4) LL (both partners reported low AQ scores; $n = 227$ couples). Later, we conducted further analyses to explore both the self-effect and spousal effect of autistic traits on anxiety symptoms severity by reassigning the sample into three groups according to the *sex-specific* t-score of their AQ scores based on a norm of 2,984 parents of typically developing children aged 6–16 years (Lau et al. 2013). These three groups were defined as High (t score of AQ ≥ 60), Middle ($40 \leq t$-score of AQ < 60) and Low (t score of AQ < 40) autistic groups.

All analyses were conducted using SAS 9.3 (SAS Institute, Cary NC, USA). ANOVA was used to assess group differences in age and other key determinants (i.e., SRS, family APGAR, AQ, and symptoms of the anxiety spectrum and PTSD). Cohen's d (d) was tabulated manually to determine effect sizes of the different scores between groups. Three sets of linear regression models were conducted to investigate the associations between

Table 1 Demographics, child autistic traits, and perceived family support among four mating groups

	Mean ± SD or %				*F* statistics	*P*
	HH (*n* = 66)	HL (*n* = 95)	LH (*n* = 103)	LL (*n* = 227)		
Father						
Age (in years)	43.09 ± 6.17	43.78 ± 7.26	42.06 ± 5.79	43.17 ± 5.95	1.34	.262
Educational level						
College or higher	72.73	83.16	76.70	80.18	3.08	.380
Senior high school or lower	27.27	16.84	23.30	19.82		
Family APGAR (0–10)	6.55 ± 2.67	6.52 ± 2.63	6.55 ± 2.83	6.99 ± 2.67	1.15	.328
Mother						
Age (in years)	40.50 ± 5.63	40.17 ± 6.34	39.52 ± 6.32	40.07 ± 5.47	0.42	.740
Educational level						
College or higher	63.64	78.95	70.87	72.25	4.64	.200
Senior high school or lower	36.36	21.05	29.13	27.75		
Family APGAR (0–10)	6.14 ± 2.95	6.99 ± 2.83	6.28 ± 2.93	7.12 ± 2.75	3.48	.016
Child						
Age (in years)	9.98 ± 4.18	9.27 ± 4.43	9.16 ± 3.93	9.25 ± 4.12	0.63	.598
Sex (male)	90.91	89.47	89.32	90.75	0.26	.967
Social Responsiveness Scale						
Social communication	40.33 ± 15.07	36.55 ± 12.96	40.12 ± 13.10	35.83 ± 14.26	3.38	.018
Stereotyped behaviors/interest	19.42 ± 7.30	18.46 ± 6.77	19.84 ± 6.40	18.09 ± 7.15	1.79	.148
Social awareness	21.86 ± 5.15	21.82 ± 4.92	22.85 ± 4.51	21.31 ± 5.39	2.17	.091
Social emotion[a]	12.33 ± 5.04	11.46 ± 4.19	12.25 ± 4.08	10.82 ± 4.64	3.40	.018
Total score[a]	93.95 ± 28.50	88.29 ± 24.45	95.07 ± 23.28	86.05 ± 27.15	3.60	.014

HH = high autistic tendency in both parents; HL = high autistic tendency in father only; LH = high autistic tendency in mother only; LL = low autistic tendency in both parents

[a] LH > LL in post hoc analysis

autistic traits and anxiety and PTSD symptoms and how age, sex, educational level (college degree and above or not), family support (Family APGAR), and child autistic-like social deficits (SRS) influenced these associations. The score of each anxiety subtype (GAD, PD, SpP, SP, Ag, and PTSD) and later the total anxiety symptom scores (anxiety disorders) served as dependent variables. The total anxiety symptom score was the sum of GAD, SpP, SP, PD, and Ag combined, and was referred to as anxiety disorder. Total scores of the AQ, the child SRS, and the Family APGAR were entered to examine the main effects of these variables, while demographic variables that were significantly different among groups (i.e., age, sex, and education level) were included in the models as covariates. Two-way interaction terms (AQ × Sex, AQ × Age, AQ × Education, AQ × SRS, and AQ × Family APGAR) and three-way interaction terms (AQ × Sex × SRS, AQ × Sex × Family APGAR, AQ × Age × SRS, AQ × Age × Family APGAR, AQ × Education × SRS, and AQ × Education × Family APGAR) were then entered to examine the moderation effects from these variables on the associations between autistic characteristics and symptoms of anxiety disorders and PTSD. We conducted a backward elimination method to exclude the interaction terms that were not statistically significant (i.e., *p* value > .05).

Results

Demographic Characteristics

As expected for a non-clinical sample, there were more couples where both partners scored low on the AQ (LL; $n = 227$) than scored high (HH; $n = 66$). The four mating groups (HH, HL, LH, and LL), however, were comparable in age, education levels, and employment status in both genders ($p > .05$; see Table 1).

There were significant group differences in maternal ($p = .016$), but not paternal ($p = .328$), perceived family support assessed by the Family APGAR. Mothers of the HH group reported less family support than the HL and LL groups (Cohen's $d = .294$ and Cohen's $d = .344$, respectively). Interestingly, mothers of the LH group also reported less family support compared to LL (Cohen's $d = .296$). These results partially supported our hypothesis that compatibility of autistic traits in couples does not enhance family adaptability, partnership, growth, and affection. In particular, we found that when mothers had higher autistic traits, family APGAR decreased regardless of spousal compatibility in autistic characteristics. Thus, high autistic traits in self affected family dynamics more for women than for men.

Children across the four groups were comparable in age and sex ($p > .05$) and at least 89 % of each group was boys. Given the heterogeneity of ASD diagnoses among children in our sample, we expected variation in their social responsiveness scores. Indeed, parents of the HH and LH groups reported more difficulties for children in the areas of social communication ($p = .018$), social emotion ($p = .018$), and overall social responsiveness ($p = .014$). Thus, subsequent analyses controlled for SRS scores of the children.

Symptoms of Anxiety in Four Mating Groups

Table 2 details results from the comparisons of anxiety symptoms among the four mating groups stratified by gender. The one-way Analysis of Variance (ANOVA) analyses supported our hypothesis that parents with more autistic traits would exhibit higher levels of anxiety symptoms. Fathers in the HH and HL groups (total AQ t-score > 51; Lau et al. 2013) reported significantly more GAD, SpP, SP, PD, and PTSD symptoms with large effect sizes in SP symptoms between fathers in the HH and LL (Cohen's $d = .91$), HH and LH (Cohen's $d = 1.04$), and HL and LH (Cohen's $d = .88$) groups. We conclude that stronger autistic tendency in fathers make them more susceptible to SP. PTSD also yielded large effect size (Cohen's $d = .82$) between fathers in HH and LH, and HH and LL groups (Cohen's $d = .78$).

A similar pattern was observed in SP among mothers. Those with elevated autistic traits had higher SP symptoms regardless of their spouse's autistic tendency. The effect sizes were substantial (Cohen's d between 0.80 and 1.09). Similar to the fathers' ratings were the mothers' ratings in PTSD symptoms between the HH and LL (Cohen's $d = .96$) and the LH and LL (Cohen's $d = .80$) groups. In addition to SP and PTSD, mothers with higher autistic traits (LH) reported more symptoms than those of LL for GAD and Ag (Cohen's $d = .80$ and Cohen's $d = .86$, respectively). A larger effect size (Cohen's $d = .79$) was obtained from HH's higher scores compared to LL in Ag.

Autistic Traits and Symptoms of Anxiety in Self and Spouse

In order to distinguish between self- and spousal effects of autistic characteristics on anxiety symptoms, we conducted another series of one-way ANOVAs. This time the participant's self-rated AQ scores were used as the independent variable and the self and spousal anxiety symptoms as the dependent variables. Data were again stratified by gender. As previously discussed, we converted the participants' AQ scores into High ($n = 64$ for women, $n = 92$ for men), Middle ($n = 297$ for women, $n = 310$ for men), and Low ($n = 130$ for women, $n = 89$ for men) autistic groups. Results of analyses supported our hypothesis that high autistic traits in self contributed to parental anxiety symptoms more substantially than high autistic traits in spouse (see Table 3). A consistent pattern was found: elevated autistic traits were associated with high anxiety symptoms only in self but not in spouse. This was true for both genders and was consistent across all anxiety subtypes. Within the self-effect, parental anxiety symptoms increased significantly among Low, Middle, and High autistic groups in a stepwise fashion, even after controlling for the child's autistic severity. There was, however, one exception: mothers in Middle and Low autistic groups were comparable in their self-reported SP symptoms. A two-way ANOVA was conducted to examine the main effect of autistic tendency in parents (High, Middle, and Low) and sex (male and female) on parental anxiety symptoms. There were significant interactions between group (AQ t-score > 60 versus AQ t-score < 40) and sex (male versus female) on GAD, SP, Ag, and PTSD (see Table 3). The associations between high autistic tendency and the above-mentioned anxiety symptoms were stronger in women. These findings supported our hypothesis that female subjects would be more susceptible to anxiety symptoms than male subjects; however, only for those who have elevated autistic traits.

Predicting Symptoms of Anxiety in Parents from Demographic Characteristics, and Parental and Child Autistic Traits

Table 4 summarises the results of the main analyses in prediction of parents' sex, age, education level, autistic traits, perceived family support, and their child's autistic traits to anxiety symptoms. Covariates (i.e., sex, age, education, family APGAR, and child SRS) and total score of the AQ were entered first in the models to examine the main effects of these variables. Two-way interaction terms (AQ × education; AQ × APGAR; AQ × child SRS) and three-way interaction terms (AQ × sex × child SRS) were then entered to examine moderation effects of sex and/or child autistic traits. Eta^2 (η^2) was also calculated for ANOVA results to indicate the strength of the main effect.

Results demonstrated that parental autistic tendency was significantly associated with all anxiety subtypes (GAD, SpP, PD, SP, Ag, and PTSD) and total anxiety symptoms (anxiety disorders). There was a strong main effect for total

Table 2 Symptoms of anxiety disorders among four mating groups

Mean (SD)	HH ($n = 66$)	HL ($n = 95$)	LH ($n = 103$)	LL ($n = 227$)	F[†]	p	Post-hoc comparisons	Cohen's d					
								HH/ LL	HL/ LL	LH/ LL	HH/ HL	HH/ LH	HL/ LH
Father													
Generalized anxiety disorder	9.36 (3.96)	9.83 (4.15)	7.57 (3.49)	7.19 (3.47)	14.68	<.001	HH, HL > LH, LL	0.58	0.69	0.11	−0.11	0.48	0.59
Specific phobia	0.76 (0.75)	0.80 (0.78)	0.39 (0.61)	0.52 (0.70)	7.69	<.001	HH, HL > LH, LL	0.33	0.38	−0.20	−0.06	0.54	0.59
Panic disorder	0.65 (0.67)	0.58 (0.54)	0.35 (0.55)	0.36 (0.53)	7.53	<.001	HH, HL > LH; HL > LL	0.48	0.41	−0.02	0.12	0.49	0.42
Social phobia	2.61 (1.94)	2.23 (1.70)	0.97 (1.09)	1.12 (1.24)	31.53	<.001	HH, HL > LH, LL	0.91	0.74	−0.13	0.21	1.04	0.88
Agoraphobia	0.29 (0.49)	0.32 (0.59)	0.09 (0.35)	0.11 (0.37)	7.95	<.001	HH, HL > LH, LL	0.41	0.42	−0.06	−0.05	0.47	0.47
Post-traumatic stress disorder	7.39 (3.80)	6.61 (3.72)	4.59 (3.01)	4.64 (3.21)	13.74	<.001	HH, HL > LH, LL	0.78	0.57	−0.02	0.21	0.82	0.60
Mother													
Generalized anxiety disorder	10.56 (4.09)	8.09 (3.94)	11.49 (5.10)	7.86 (3.85)	19.36	<.001	HH, LH > HL, LL	0.68	0.06	0.80	0.61	−0.20	−0.74
Specific phobia	0.85 (0.77)	0.65 (0.87)	0.93 (0.82)	0.61 (0.73)	4.05	.007	HH, LH > HL, LL	0.32	0.06	0.42	0.24	−0.11	−0.33
Panic disorder	0.85 (0.53)	0.58 (0.68)	0.88 (0.77)	0.47 (0.57)	11.82	<.001	LH > LL	0.69	0.18	0.61	0.44	−0.05	−0.42
Social phobia	2.30 (1.49)	1.17 (1.36)	2.76 (2.03)	0.96 (1.12)	40.34	<.001	HH, LH > HL, LL	1.02	0.16	1.09	0.80	−0.26	−0.92
Agoraphobia	0.48 (0.73)	0.09 (0.33)	0.49 (0.67)	0.05 (0.27)	28.40	<.001	HH, LH > HL, LL	0.79	0.15	0.86	0.69	0.00	−0.74
Post-traumatic stress disorder	8.76 (3.94)	5.71 (3.98)	8.95 (5.58)	5.25 (3.38)	24.97	<.001	HH, LH > HL, LL	0.96	0.12	0.80	0.77	−0.04	−0.67

HH = high autistic tendency in both parents; HL = high autistic tendency in father only; LH = high autistic tendency in mother only; LL = low autistic tendency in both parents

[†] Controlling for child autistic trait measured by the Social Responsiveness Scale

Table 3 Individuals' and spouses' psychiatric symptoms severity among the high, middle, low autistic groups for fathers and mothers

Mean (SD)	Women			Post-hoc comparison†	Men			Post-hoc comparison†	Interaction† group*sex $F_{(2,486)}$
	1.AQ 60 <=T ($n = 64$)	2.AQ 40 <=T < 60 ($n = 297$)	3.AQ T < 40 ($n = 130$)		1.AQ 60 <=T ($n = 92$)	2.AQ 40 <=T < 60 ($n = 310$)	3.AQ T < 40 ($n = 89$)		
Individuals' ASRI									
Generalized anxiety disorder	13.09 (5.46)	9.14 (3.90)	6.78 (3.55)	1 > 2 > 3	10.20 (4.28)	8.11 (3.45)	5.74 (3.31)	1 > 2 > 3	§3.06[a]
Specific phobia	1.05 (0.90)	0.71 (0.76)	0.56 (0.77)	1 > 2,3	0.86 (0.79)	0.56 (0.71)	0.34 (0.56)	1 > 2 > 3	0.21
Panic disorder	1.02 (0.77)	0.65 (0.62)	0.38 (0.57)	1 > 2 > 3	0.64 (0.64)	0.45 (0.55)	0.21 (0.44)	1 > 2 > 3	1.31
Social phobia	3.53 (2.09)	1.52 (1.35)	0.68 (1.05)	1 > 2 > 3	2.65 (1.96)	1.45 (1.35)	0.51 (0.80)	1 > 2 > 3	§4.27[a]
Agoraphobia	0.64 (0.84)	0.20 (0.46)	0.02 (0.15)	1 > 2 > 3	0.38 (0.61)	0.15 (0.42)	0.01 (0.11)	1 > 2 > 3	§3.79[a]
Post-traumatic stress disorder	11.08 (6.06)	6.47 (3.57)	4.62 (3.67)	1 > 2 > 3	7.50 (4.12)	5.29 (3.18)	3.51 (2.80)	1 > 2 > 3	§5.94[b]
Spouses' ASRI									
Generalized anxiety disorder	8.89 (3.73)	7.94 (3.81)	7.97 (3.92)	–	9.60 (4.43)	8.82 (4.31)	9.17 (4.94)	–	0.11
Specific phobia	0.64 (0.72)	0.57 (0.72)	0.56 (0.72)	–	0.78 (0.77)	0.69 (0.81)	0.73 (0.77)	–	0.12
Panic disorder	0.47 (0.62)	0.42 (0.56)	0.46 (0.56)	–	0.65 (0.64)	0.62 (0.66)	0.64 (0.68)	–	0.06
Social phobia	1.66 (1.84)	1.49 (1.50)	1.44 (1.52)	–	1.59 (1.56)	1.58 (1.64)	1.47 (1.66)	–	0.03
Agoraphobia	0.16 (0.41)	0.17 (0.42)	0.17 (0.50)	–	0.23 (0.49)	0.21 (0.51)	0.18 (0.51)	–	0.39
Post-traumatic stress disorder	6.31 (3.39)	5.30 (3.59)	5.12 (3.40)	–	7.36 (4.39)	6.34 (4.30)	6.65 (4.85)	–	0.45

† Controlling for child autistic trait measured by the Social Responsiveness Scale; AQ = Autism Spectrum Quotient

[a] $p < 0.05$

[b] $p < 0.01$

§: beta = −1.65, t = −2.03, p = .043 for AQ T > 60 versus T < 40 and beta = 0.03, t = 0.05, p = .961 for AQ 60 > T > 40 versus T < 40 for generalized anxiety disorders

beta = −0.63, t = −2.13, p = .034 for AQ t > 60 versus t < 40 and beta = 0.11, t = 0.49, p = .627 for AQ 60 > t > 40 versus t < 40 for social phobia

beta = −0.24, t = −2.51, p = .012 for AQ t > 60 versus t < 40 and beta = −0.03, t = 0.07, p = .651 for AQ 60 > t > 40 versus t < 40 for Agoraphobia

beta = −0.20, t = −2.87, p = .004 for AQ t > 60 versus t < 40 and beta = −0.001, t = −0.01, p = .989 for AQ 60 > t > 40 versus t < 40 for post-traumatic stress disorder anxiety symptoms ($\beta = 0.22$, $p < .001$). These main effects dissipated when family APGAR was controlled for, indicating perceived family support strongly moderated the associations between parental autistic traits and anxiety symptoms. Significant main effects of age were found on Anxiety Disorders ($\beta = -0.06$, $p = .019$) and GAD ($\beta = -0.04$, $p = .032$). No main effect of sex was found on any of the anxiety domains. Parental education level had significant simple main effects on anxiety disorders ($\beta = 5.30$, $p = .032$) and PTSD ($\beta = 3.42$, $p = .045$). In addition, the associations of parental autistic traits with anxiety disorders and PTSD symptoms were moderated by parental education. Despite no significant main effect of child autistic traits, a stronger link between parental autistic traits and parental anxiety disorders, GAD, Ag, and PTSD symptoms was found when child SRS scores were high. The moderation effect of child autistic traits was greater on the relationship of maternal AQ than paternal AQ with their own anxiety disorders, GAD, Ag, and PTSD symptoms (see Table 4).

Discussion

The present study is one of only a few studies that have investigated the associations between parental autistic characteristics and anxiety symptoms by taking a couple-centred approach in a large sample of couple dyads with children diagnosed with ASD. To the best of our knowledge, this study is new in four ways. It is the first study to link the notion of couple compatibility to research on parents of children with ASD. Second, the effects of autistic traits in child and in parent are taken into account simultaneously. Third, this study explores the association between parental autistic traits and their psychological wellbeing in an Asian population. Finally, no study has investigated the range of anxiety disorders in parents of children with ASD to such an extent. Results from our analyses supported our hypothesis that high parental autistic traits were positively associated with symptoms of anxiety, especially in SP and PTSD, and only self-effect, as opposed to spousal effect, was found. As predicted, the associations between high autistic tendency and anxiety symptoms were stronger in women; however, only when autistic traits were high. Child autistic symptoms did not independently contribute to parental anxiety symptoms; however, child autistic symptoms could *intensify* the link between parental autistic tendency and anxiety symptoms, especially in mothers. Our results supported the hypothesis that despite autistic tendency being regarded as a personality quality (Austin 2005), couple similarity in terms of autistic traits did not enhance couple wellbeing.

Autistic Traits and Anxiety Symptoms in Parents of Children with ASD

Our findings validated previous observations that parents of children with ASD exhibit high levels of ASD symptoms (e.g., Bernier et al. 2012; De la Marche et al. 2012; Scheeren and Stauder 2008) and fathers typically score higher on the AQ than mothers (Bishop et al. 2004; Wheelwright et al. 2010). The prevalence of broader autism phenotype (BAP) in our sample reflected findings from previous research. For instance, Wheelwright et al. (2010) reported 33 % of the fathers and 23 % of the mothers obtained total AQ scores above the BAP cut-off point. Twenty-eight percent of the fathers and 16.3 % of the mothers met the criteria when we applied the same arbitrary cut-off point (i.e., AQ total score $\geq$23) to our sample. Thus, it is further substantiated that the implications of BAP on the high psychiatric problems among parents of children with ASD need to be understood.

Although there is emerging evidence showing that parental autistic traits predict depressed mood (Ingersoll and Hambrick 2011; Ingersoll et al. 2011), findings for anxiety symptoms are scarce and inconsistent. Our data, drawn from a relatively large sample, showed a clear association between maternal and paternal autistic traits and anxiety symptoms. This was even after controlling for a child's ASD severity; although, when the child's SRS was high, the link between parental autistic tendency and anxiety symptoms also intensified. In addition, we found that a child's social responsiveness has a moderating rather than a main effect on parental anxiety symptoms. It therefore appears that a child's ASD symptomatology is a perpetuating factor rather than a precipitating factor. If this is indeed true, we need to review the widespread belief that children's ASD symptomatology explains parental mood disorders in the ASD population. To this end, future studies on parental functioning in ASD need to consider ASD symptoms in both parents *and* children.

Family adaptability was another effectual moderator for anxiety symptoms among parents who had elevated autistic traits in our sample. This is in concert with the growing evidence that social support is one of the strongest protective factors against the stress of caring for children with developmental disorders (Weiss et al. 2013). Studies of families affected by ASD using the double ABCX model of family adaptation (McCubbin and Patterson 1983) have identified not only the child's ASD severity but also parents' coping styles and resourcefulness to be factors underlying family outcomes (Manning et al. 2011; Paynter et al. 2013). Parents of children with ASD can attain satisfying life quality when having the capacity to capitalise on available internal and external resources (Weiss et al. 2013). As with many psychosocial variables, the mechanism between family adaptability and parental wellbeing are likely to be multidirectional and this requires continuous research to

Table 4 Prediction of individuals' sex, age, educational level, autistic trait, perceived family support and their child's autistic trait to the symptoms of anxiety disorders and post-traumatic stress disorder

	Generalized anxiety disorder		Social phobia		Panic disorder		Agoraphobia		Post-traumatic stress disorder		Anxiety disorders (GAD, SP, SpP, PD, and Ag combined)	
	β	*p*	*β*	*p*	*p*	*p*	*β*	*p*	*β*	*p*	*β*	*p*
AQ scores	0.07	.029	0.10	<.001	<.001	<.001	0.01	.101	0.11	.002	0.22	<.001
Sex	0.32	.653	−0.36	<.001	.955	<.001	0.08	.339	0.06	.922	0.06	.955
Age	−0.04	.032	−0.01	.177	.019	.056	−0.001	.689	−0.03	.131	−0.06	.019
Education (college)	0.02	.940	1.28	.050	.032	.011	0.04	.210	3.42	.045	5.30	.032
Family APGAR	−0.19	<.001	0.19	.040	<.001	.021	−0.0004	.943	−0.25	<.001	−0.27	<.001
Child SRS	−0.03	.192	0.01	<.001	.333	.066	−0.005	.120	−0.02	.352	−0.03	.333
AQ*education	–	–	−0.02	.049	.032	.006	–	–	−0.05	.044	−0.07	.032
AQ*APGAR	–	–	−0.003	.011	–	–	–	–	–	–	–	–
AQ*child SRS	0.001	.018	–	–	.035	–	0.0001	.030	0.001	.044	0.001	.035
AQ*sex*child SRS	−0.0003	.007	–	–	.009	–	−0.00003	.020	−0.0003	.004	−0.0004	.009

AQ = Autism Spectrum Quotient; SRS = Social Responsiveness Scale; Family APGAR = Family Adaptability, Partnership, Growth, Affection, and Resolve

explicate. One implication we can draw from this study is the necessity to enhance family adaptability when servicing children with ASD in our community. This is especially important when BAP is present in the parents.

As we considered the wide spectrum of anxiety disorders, we were able to distinguish the differences in the links between autistic tendency and the various subtypes of anxiety. We found the connection between autistic traits and anxiety to be particularly strong in the domains of SP and PTSD for males, and SP, PTSD, GAD, and Ag for females. In contrast, the association between parental autistic traits and PD only yielded small effect sizes. These differences might explain the inconsistent findings in previous research where only one or two specific domains of anxiety were considered. The vulnerability of autistic tendency seems to lie particularly within SP and PTSD.

The link between parental autistic traits and SP seems explicable given that autism by definition involves social difficulties. However, it is interesting that autistic tendency is also strongly associated with symptoms of PTSD. To the authors' knowledge, no scientific research has investigated this connection thus far. We speculate based on clinical observations that hypersensitivities in people with ASD might have led to their susceptibility for PTSD. People with an autistic mindset may have lower tolerance for traumatic situations. Adults with ASD often noted traumatic reactions towards certain sensory stimuli in their experience (e.g., Grandin 2010).

Gender Differences in the Effect of Autistic Traits

One of the methodological strengths of this study was the inclusion of both partners, which allowed us to examine the influence of parental autistic traits in fathers as well as in mothers and the differential susceptibility each has for anxiety disorders. This is particularly relevant as convergent evidence highlights gender differences in how parents of children with ASD react to parenting stress. Mothers have generally been found to experience greater distress and subsequently more depressive and anxiety symptoms than fathers (Hastings 2003; Meltzer 2011; Olsson and Hwang 2001). Likewise, we found that gender is related to the link between high parental autistic tendency and anxiety symptoms. Our findings extended existing knowledge by distinguishing the various subtypes of anxiety disorders; that is, mothers have a greater susceptibility to experiencing anxiety than fathers, particularly in GAD, SP, Ag, and PTSD. Furthermore, our results found the moderation effect of child autistic traits was greater on the relationship of maternal than on paternal autistic tendency with their own anxiety symptoms. This is in concert with previous research which concluded that mothers experienced more stress related to the challenges of parenting a child with ASD than fathers. A topic for future research is to examine and explain why mothers are particularly susceptible to GAD and Ag whereas fathers are not. It will also be interesting to explore whether this difference is related to gender effect in general or to autistic traits in particular.

The Effect of Autistic Traits in Couple Context

Our results denote that the challenges associated with autistic characteristics override the benefits of compatibility in couples with an autistic mindset. There was no difference in anxiety symptoms for parents with high AQ scores despite their spouse having a similar AQ score. Instead, it was apparent that individual autistic traits were associated with high anxiety regardless of their spouse's AQ scores. Thus, we conclude that self-effect, but not spousal effect, was evident in the relationship between parental autistic traits and anxiety.

This study is unique in its couple-centred approach, which leads to other preliminary but fascinating observations. Baron-Cohen (2006) proposed that autism could be the genetic result of assortative mating; that is, a tendency for an individual to mate with another who has similar genotypes and/or phenotypes. In our sample, of the 491 couples, 59.6 % were compatible in autistic traits (13.4 % both high in autistic traits and 46.2 % both low in autistic traits). When stratified by gender, only 41 % of the men with high autistic traits coupled with women who also had high autistic traits. The same pattern emerged only in 39.1 % of the women. In contrast, 68.8 % of the men and 70.5 % of the women with low AQ scores in our sample married a partner with similar autistic tendency. Thus, assortative mating seems to be more relevant when BAP is not in effect. Although it is yet to be validated empirically, experienced clinicians (e.g., Aston 2003; Attwood 2007) have noted that individuals with high ASD traits tend to be attracted to those of the opposite end of the spectrum. At this stage, our data appears to support this speculation; however, results are only preliminarily. Further studies involving a more heterogeneous distribution of AQ scores are necessary to elicit a deeper understanding in this regard.

Limitations

This study has many methodological strengths, such as using data from a large sample size, including both mothers' and fathers' accounts, employing a couple-centred approach, and focusing on a heterogeneous range of anxiety symptoms. Nonetheless, there are inevitable limitations that need to be considered. First, our sample is exclusive to parents of children with ASD. It would be informative in future studies to compare these subjects against parents with typically developing children or to those with children with other developmental disorders. In addition, having restricted our subjects to only couples who are in intact relationships in order to decrease effects of other psychosocial variables, these findings need to be interpreted with caution especially in relation to single parents or couples who are separated. Of note is that the majority of our subjects have obtained high levels of education, although we did not make this part of our inclusion criteria and our places of recruitment were widespread. It might be the case that in Taiwan, ASD services remain only accessible to families who are of higher socioeconomic status. Considering these characteristics of our sample, results from our analyses need to be interpreted with caution. Second, as with other cross-sectional studies, there is a restriction in the interpretability of cause and effect relationships among our variables. A follow-up study on these parents in the future will allow more conclusive findings. Collecting data on anxiety symptoms of a parent before and after a child is born would also allow further discussion on the genetic aspects of autistic tendency and parental anxiety symptoms. Third, there are the limitations of self-report data, especially from subjects who are struggling with anxiety. Future studies could include collateral information, such as ratings from general practitioners or therapists when applicable. Finally, in this study parental anxiety was measured using a tool designed for clinical symptoms. Future studies might utilise tools sensitive to even subclinical traits in order to capture a wider dimension of anxiety tendency in this population.

Implications

Our findings clearly demonstrate that parents of children with ASD exhibit elevated autistic traits, and that high autistic traits are associated with increased symptoms of GAD, Ph, SpP, PD, SP, Ag, and PTSD. These patterns are applicable to both genders; however, the correlation was particularly strong in SP and PTSD for men and in GAD, SP, Ag, and PTSD for women. These findings suggest that research on parental mental health in the ASD field should consider parental personality, in addition to a child's ASD-related challenges, as a risk factor that contributes to parental stress. Future research and clinical work with children with ASD and their families therefore needs to pay more attention to parental psychiatric vulnerabilities related to BAP. Screening for BAP and anxiety disorders among parents of children with ASD is necessary for early detection and risk management. Helping parents to maintain or regain psychological wellbeing would in turn enhance treatment efficiency, and enhancing family adaptability would buffer the psychiatric vulnerability of parents with elevated autistic traits.

More specifically targeted research questions can be drawn from the findings of this study. For example, the link between autistic traits and PTSD symptoms needs to be explored in greater depth. Whether there are differences in the mechanisms between autistic traits and PTSD compared to autistic traits and SP is worthy of investigation. The nature of the differences, if any, can potentially shed light on our understanding of the emotional experience of people living with autism.

Another implication of the current findings is to place more attention on the genetic predisposition for mood disorders in parents of children with ASD. This proposition builds on the fact that autistic-related impairments are often present in other psychiatric disorders, such as schizophrenia (Russell-Smith et al. 2011; Spek and Wouters 2010), personality disorders (Lugnegård et al. 2012; Soderstrom et al. 2002), and attention deficit/hyperactivity disorder (Bolte and Poustka 2006), suggesting an epigenetic overlap exists. A family aggregation analysis of the transmission patterns between ASD and mood disorders can assist to further examine the genetic association between ASD traits and mood disorders.

As one of the first empirical studies in ASD to explore the association between parental autistic traits and anxiety symptoms using a couple-centred approach, this study has led to several important pointers for future research. These include the strong link between autistic traits and anxiety disorders, the difference between the effect of self versus the effect of spousal autistic characteristics, the genetic contribution to parental mood disorders in the ASD population, and the "law" of attraction in adults with ASD tendency.

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CHAPTER 10

GENERAL DISCUSSION

10.1. Summary of Research and Key Findings

This research was instigated by three caveats in the existing literature on Autism Spectrum Disorder (ASD): 1) No previous research has been devoted to understanding the experience of adults with ASD who have found partners and become parents; 2) Despite consistent findings of the broad autism phenotype in parents of children with ASD, the implications of characteristics of autism on parental psychosocial functioning are rarely addressed; and 3) The Autism Spectrum Quotient (AQ) has been widely used for screening traits of autism in parents of children with ASD; however, the AQ's psychometric properties are yet to be validated.

In order to address these gaps, five consecutive studies were developed. Study 1 preliminarily examined adult attachment style, and marital and parenting satisfaction in individuals where a clinical diagnosis of Asperger's Disorder/Asperger's Syndrome (AS, a higher functioning of ASD) was present in self and/or in the child. Results showed a surprisingly high proportion (82%) of adults with ASD had an insecure attachment style. Yet interestingly, their marital satisfaction was no different compared to those with secure attachment style. A diagnosis of AS in either the child or the parent made no difference to marital satisfaction; however, parenting satisfaction was significantly lower when there was a diagnosis of AS in the child. To the author's knowledge, this was the first empirical study that considered attachment style of adults affected by ASD. Being exploratory in nature, it involved a smaller sample size (N=157 parents), mainly female participants and considered only the AS subtype of ASD.

Study 2 involved measuring traits of autism in 346 parents using the AQ to test the association between parental traits of autism and parenting sense of efficacy. This study was unique in that it quantified traits of autism in three groups of subjects: 1) parents who had been clinically diagnosed with ASD in themselves as well as in their child; 2) non-diagnosed parents who had children with ASD; and 3) non-ASD parents of typically developing children. Key findings included a substantial proportion of non-diagnosed parents (especially fathers) of children with ASD (22.6% fathers; 15.4% mothers) who scored within the clinical range on the AQ. Of the fathers, only those whose self-reported AQ scores reflected their clinical diagnosis of ASD reported lower parenting sense of efficacy. As for the mothers, those who had no clinical diagnosis of ASD but scored highly on the AQ reported low parenting sense of efficacy. These findings confirmed the necessity to screen for broad autism phenotype, and in some cases, diagnosis of ASD, among parents of children with ASD. Intervention programs for families affected by ASD should address parenting sense of efficacy when elevated traits of autism are present in the parents.

Knowing the importance of screening for characteristics of autism in parents, Study 3 and Study 4 were devoted to substantiating the clinical utility of the AQ, a tool widely used by researchers and clinicians in relation to adults with autism. These two studies validated the factor structure of the AQ and its reliability across clinical and non-clinical subjects in two culturally diverse groups, namely Australian and Taiwanese. Data were analysed by means of principal component analysis followed by confirmatory factor analysis. Novel to the AQ literature, about a third of the participants in Study 3 (n= 141) had a clinical diagnosis of ASD, making the sample (N= 455) more likely to be representative of the whole autism continuum. Study 4 was the first factor analytical study on the AQ using a Chinese sample (N= 4,192). The two factor solutions developed (AQ-39 and AQ-Chinese respectively) were comparable, indicating the AQ was culturally robust. Both AQ-39 and AQ-Chinese demonstrated markedly improved internal consistency and goodness of fit indices compared to the original AQ-50 as well as other previous factor analytical studies for the AQ. In addition, their psychometric qualities did not vary notably between clinical and community samples, further validating the AQ's utility for screening and diagnostic purposes.

The final project of this research, Study 5, employed the AQ-Chinese to test the association between parental tendency towards autism and anxiety symptoms in a Taiwanese sample. A novel aspect of this study was its couple-centred approach in analysing the effect of traits of autism, that is, whether or not a couple's compatibility in tendency towards autism affects their anxiety symptoms. Results showed that, irrespective of the couple's compatibility in their tendency towards autism, the AQ-Chinese scores of self, but not of spouse were positively correlated with anxiety symptoms across all domains (general anxiety disorder, specific phobia, panic disorder, social phobia, agoraphobia and post traumatic stress disorder). Furthermore, the same patterns were observed even after controlling for the child's tendency towards autism and parental demographics. Child's severity of autism did not moderate the link between parental tendency towards autism and anxiety symptoms; however, perceived family support and parental education did. Findings from this study again highlighted the necessity for services to address the psychiatric vulnerability of parents raising children with ASD, especially when elevated traits of autism and high anxiety are present in the parent.

Results from these five studies partially supported the conceptual framework (*Figure 3*) proposed at the beginning of this research (see *section 4.3*). More specifically, the links between marital satisfaction and characteristic of autism in child or/and in parent had not been supported. Lower marital satisfaction was only reported by spouses of individuals with AS whose children also had AS. On the other hand, the links between autism in parent or/and in child and parenting experience were substantiated. Tendency towards autism in child was related to parenting sense of satisfaction whereas parental self-reported traits of autism was associated with low parenting sense of efficacy, especially among the fathers. The association between parental traits of autism and parental anxiety symptoms was also found for both mothers and fathers. A revised conceptual framework based on findings of this research is depicted in *Figure 4*.

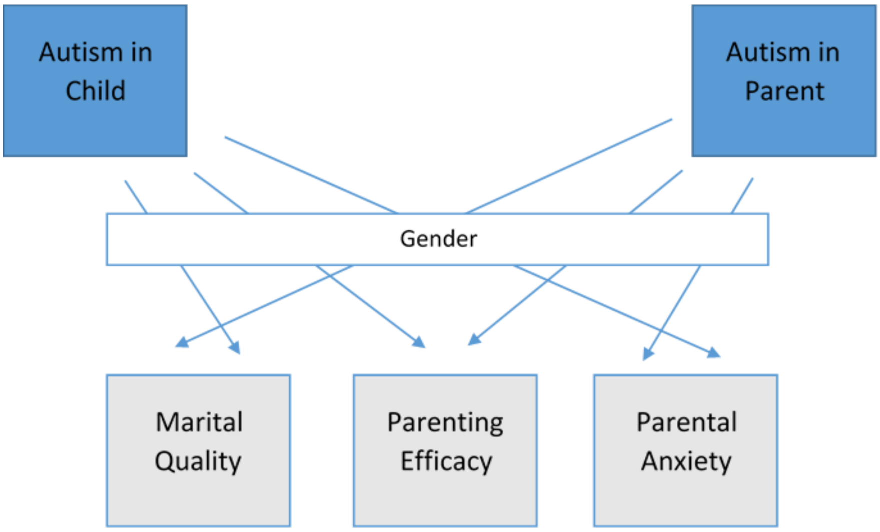

Figure 3 Proposed Conceptual Framework

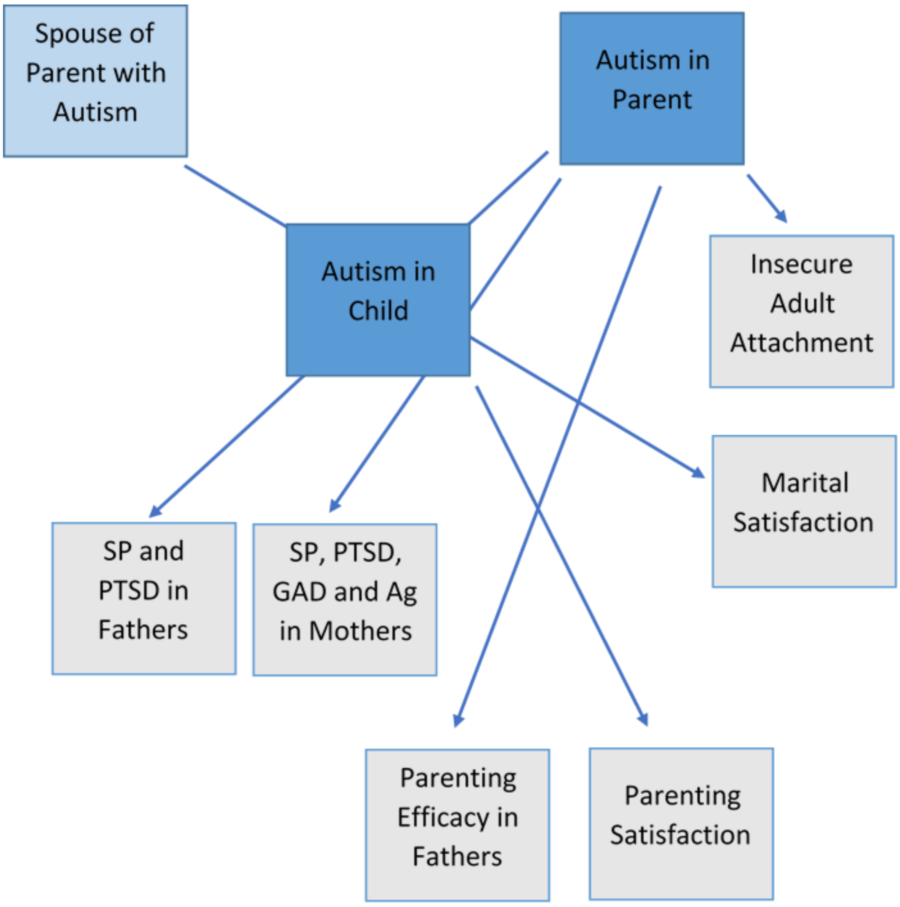

Figure 4 Revised Conceptual Framework

10.2. Clinical and theoretical implications of the present research

This thesis delves into uncharted territory of ASD, namely, how adults diagnosed with ASD experience long-term relationships and parenting, and how they are different from those parents who have no diagnosis of ASD themselves but have children with ASD. Each of the five studies in this project added novel aspects to research on ASD. The findings, though requiring replication and extension, are intriguing and promising, as discussed at the end of each study (chapters 5 to 9). To summarize here, Study 1 shed light on the atypical dynamic between romantic attachment style and, parenting and marital satisfaction in adults with ASD that warrants further investigation. The insights can enhance relationship counselling for this population. Study 2 highlighted the discrepancy between self-rated traits of autism and one's ASD diagnostic status among parents of children with ASD. This is a vital discovery because, in mothers and fathers, self-perceived tendency towards autism has different implications on parental sense of efficacy than being formally diagnosed with ASD. Study 3 and Study 4 provided evidences for the clinical utility of the AQ. The newly developed factorial models, AQ-39 and AQ-Chinese, can be employed to further investigate implications of characteristics of autism in parents of children with ASD, which is important knowledge for the benefit of the ASD population in general. Study 5 substantiated the link between parental traits of autism and anxiety symptoms. This finding challenges the long-standing perception that poor parental mental-health is solely because of having child(ren) with ASD. It also explains the contradictory findings on marital quality and stress in parents of children with ASD in previous studies.

The following are more specific theoretical and clinical inferences drawn from the findings of this research:

10.3. The Relationship Experience of Adults Diagnosed With Autism Spectrum Disorder

10.3.1. Prospect for long-term relationships

Previous longitudinal studies on adults with ASD by and large conclude that the social outcome for ASD in adulthood is poor, with examples of long-term relationships few and far between (Howlin et al., 2013). Observations in the present research give an inkling that it may not be the case. Whilst this research had not ascertained the actual prevalence of adults with ASD who were in long-term relationships we knew that as many as 272 adults clinically diagnosed with ASD in this research were married and had children. Moreover, these individuals and their spouses reported marital satisfaction that was comparable to their non-ASD counterparts. Such an occurrence shows that autism does not preclude long-term relationships and parenthood, and that the pessimistic view about this condition is to be questioned.

One reason for the mismatch between the results from this research and those previously published is obviously the different recruitment methods. In the present research, the participants had several distinctive characteristics compared to those in previous studies. For instance, they were relatively older in age (mean age=42.8 years), whereas participants in previous outcome studies were mostly in their 20s at the time of follow-up. Information about marital and parenting experiences was likely to be limited in a younger age group. Indeed, more than half of the previous studies (51.5%) included only living arrangement, adaptive functioning and employment as the outcome criteria. Strikingly, 201 out of 272 (73.9%) of participants in the present research did not receive their diagnosis of ASD until after their mid-20s, suggesting a substantial proportion of them would be missed by the recruitment procedure in previous longitudinal studies. There is, however, one very recent study that is in synchrony with this finding. When Jones and colleagues (2014) surveyed 128 adults with ASD, the average age when receiving a diagnosis of ASD in their sample was 34.4 years (range eight to 78 years) suggesting late diagnosis is not uncommon in the ASD population.

All but 12 of the 272 ASD participants in this research (95.6%) received a diagnosis of high functioning ASD (i.e., AS or PDD-NOS), whereas previous studies predominantly included subjects with classic autism, who often suffer more severe symptomatology of ASD have less verbal capacity (Magiati et al., 2014). The different subgroups within the autism spectrum can present with a wide range of social outcomes, with long-term relationships more common among individuals with higher functioning ASD (Cederlund et al., 2008; Howlin et al., 2013). Indeed, in this research a relatively large number of participants were diagnosed with AS. This verified the incidence of higher functioning adults with ASD who often received a late diagnosis, and highlighted the need to conceptualize their social experiences distinctive from the lower functioning ASD subgroups who were likely to receive a diagnosis earlier in life. As highlighted by Jones and colleagues (2014), it took an average of 5.2 years after concern was first raised, and up to six referrals for their sample to obtain a diagnosis of ASD. More training on the diagnosis of higher functioning ASD in adulthood is desperately needed among medical and allied health professionals (Fombonne, 2012; Fraser et al., 2012). In addition, this population may require psychosocial interventions that address more advanced interpersonal skills than those designed for adults with lower functioning ASD subgroups, such as parenting efficacy (Lau, Peterson, Attwood, Garnett, & Kelly, under review) and social skills relevant to life events (Griffith, Totsika, Nash, & Hastings, 2012). Future research can contribute by specifically targeting adults with high functioning ASD, and examining more closely the gaps in their social skills and their relationship dynamic, such as communication patterns, stress and coping.

10.3.2. Quality of couple relationship

Findings from this research (especially Lau & Peterson, 2011) suggest that adults with ASD are likely to experience intimacy in a unique way. In the present research, an atypical pattern of association between adult attachment style and marital satisfaction was observed among adults diagnosed with AS, suggesting this population may require a distinct conceptualisation of intimacy. Strikingly, as high as 73% of the subjects diagnosed with AS in Study 1 reported an avoidant attachment style, which is overwhelmingly higher than the average of 30% reported in the general married adult population (Hazan & Shaver, 1987). Insecure attachment (avoidant or anxious) is typically characterised by fear of intimacy, difficulty in bonding, not sharing one’s deepest feelings with a partner, emotional highs and lows, possible obsession with the intimate partner, more jealousy, and preoccupation with the security of the relationship (Lemay Jr & Dudley, 2011; Pietromonaco & Barrett, 2000; Simpson, 1990; Simpson & Overall, 2014). In contrast, securely attached adults tend to be more open, have more constructive ways of resolving conflicts and are generally happier, more confident and more satisfied with their romantic relationships (Clark, Lemay Jr, Graham, Pataki, & Finkel, 2010; Feeney, Noller, & Roberts, 2000; Iboro & Akpan, 2011). As found in the seminal paper of Hazan and Shaver (1987), an adult with insecure attachment is predicted to be susceptible to poorer marital quality. The same pattern has been further validated in a series of papers on adult attachment style and quality of marital relationships (e.g., Alexandrov et al., 2005; Feeney & Noller, 2004; Fuenfhausen & Cashwell, 2013; Holland, Fraley, & Roisman, 2012; Noller & Feeney, 1994; Pielage, Luteijn, & Arrindell, 2005). Yet surprisingly, adults with ASD in this research reported an insecure attachment style but high marital satisfaction. More specifically, their reported global happiness in their couple relationships was as high as the neurotypical controls who reported a secure attachment style.

Being one of the first studies on adult attachment style in the field of ASD, there is no existing knowledge to compare with. Further studies are necessary to demystify this peculiar pattern between adult attachment style and marital quality reported by the subjects with ASD. One of the avenues towards this goal may involve understanding the implication of self-rating attachment style in the context of peculiarities of autism. It is possible that to an individual with ASD, to intermittently retreat from a romantic partner is merely a coping mechanism for their socio-emotional exhaustion rather than a dysfunctional internal working model for interpersonal connectedness. In order to test this hypothesis, observations on how adults with ASD respond to threats of losing a romantic partner may be a more accurate evaluation of their attachment style. In addition, future research can enrich the analysis by incorporating viewpoints of their partners. Secondly, studies have reported that sensory perception may be different in individuals with ASD (Blakemore et al., 2006; Rogers et al., 2003), with hypersensitivities in many sensory modalities, including tactile. Hypersensitivities to touch can lead to discomfort when in close proximity with a romantic partner, without implying psychological insecurity. This is commonly highlighted in autobiographies of adults with ASD (Grandin, 2010; Holliday Willey, 1999; Robison, 2008; Shore, 2003; Simone, 2010). This may explain the high prevalence of avoidant attachment style and an atypical pattern with marital quality among the ASD subjects, especially considering how avoidant attachment style was depicted in the questionnaire: "*I am somewhat uncomfortable being close to others; I find it difficult to trust them completely, difficult to allow myself to depend on them. I am nervous when anyone gets too close, and often, others want me to be more intimate than I feel comfortable being."* There is room for the discomfort due to sensory sensitivities to be interpreted into this description, bearing in mind that individuals with ASD can have a tendency to take words literally (Hobson, 2012). Further investigation on how individuals with ASD understand the description of each attachment category is warranted. Even without the concern of interpretation, the overlap between the manifestation of an avoidant adult attachment style and autistic behavioural responses needs to be cautiously acknowledged. According to Bowlby (1973), individuals with avoidant or anxious attachment style as opposed to those with secure attachment style are hypothesized to 1) hold more negative self-views (Bartholomew & Horowitz, 1991; Mikulincer, 1998a, 1998b); 2) react to stressful events with higher levels of distress (Berant et al., 2001; Feeney, 1996); 3) hold more negative expectations about their partners (Collins, 1996; Collins & Read, 1990); 4) be less responsive and sensitive towards their partner's needs (Feeney, 1996; Mikulincer, 1997; Mikulincer & Selinger, 2001); and 5) be less likely to cope with stress by relying on support-seeking (Fraley & Shaver, 2008; Simpson et al., 1992). These responses, especially 2, 4, and 5 are common responses of individuals with ASD due to their social communication deficits, a hallmark of the condition. Thus, the ASD diagnosis is likely to predispose to this style in all interpersonal relationships, not just the married and parental ones studied in this thesis.

One more important consideration is that adult attachment is not static but is developed through a developmental progression over life, beginning with infant bonding with caregivers, then the quality of relationships with peers in childhood, before the involvement with romantic partners in adolescence and adulthood. The few studies on the attachment style of young children with ASD (Rutgers, Bakermans-Kranenburg, van Ijzendoorn, & van Berckelaer-Onnes, 2004; Yirmiya, Shaked, Koren-Karie, & Oppenheim, 2013) found that about half of the children with ASD were securely attached to their caregivers, although there was a lower frequency of secure attachment behaviours compared to typically developing children (two thirds). This lower prevalence of secure attachment in the ASD group was later found to be negatively correlated with jealous verbalizations and jealous eye gazes for the ASD group (Bauminger-Zvieli & Kugelmass, 2013) hinting that the developmental complexity and the socio-emotional deficit found in ASD may play a significant role in the attachment style of the ASD population.

Attachment orientations are traditionally believed not to be impervious to change (Rholes & Simpson, 2004). Nonetheless, a recent longitudinal study on 1,364 non-ASD specific families in the United States showed that adult attachment style can be traced to variations in the quality of the individuals' caregiving environments, their emerging social competence, and the quality of their best friendship (Fraley, Roisman, Booth-LaForce, Owen, & Holland, 2013). This is essential information for future research, given social deficits are often believed to be the core aspect of autism, and are most persistent across lifetimes (Volkmar, 2011). This is information useful also for addressing concerns over a lower prevalence of friendships, poorer quality of relationships with peers and higher levels of victimization in children with ASD compared to those without, concerns which have also been raised by parents and teachers (Kasari et al., 2011; Rowley et al., 2012).

The lack of friendships continues to negatively affect some people with ASD even later in adolescence and adulthood (Stokes et al., 2007). It was found in a more recent study (Mazurek, 2013a) that loneliness was associated with increased depression and anxiety, and a decrease in life satisfaction and self-esteem in 108 adults with ASD. The fact that more than 50% of adults with ASD in the present research reported an avoidant adult attachment style may be a reflection of the impact of the lack of social success and negative peer relationships whilst growing up with ASD. This speculation may be tested through considering friendship experience as a moderating factor in the formation of adult attachment style. In the same vein, how the avoidant attachment responses of adults with ASD would affect their spouse’s perception of an intimate relationship is another future research question that could yield significant theoretical and clinical implications.

The atypical pattern of adult attachment style in adults with ASD has significant clinical implications. For instance, attachment theory has been heavily relied upon in conventional couple therapy models, such as Emotion-Focused Therapy (Johnson & Sims, 2000) and Schema Therapy (Atkinson, 2012). Couples with ASD warrant a tailor-made counselling model, which may be fundamentally different from existing couple therapy models that assume secure adult attachment style as the basis for good marital quality. Future research is encouraged to further explore romantic attachment security of both adults with ASD and their spouses. Particularly, whether adult attachment style of spouses of people with ASD would change over time is a fascinating topic for future research.

Although some research has indicated that having a child with ASD can adversely affect marital quality, some has found no association between the two variables. In the present study, not only is the self-perceived marital quality unaffected by avoidant adult attachment style, it was robust against the effect of an AS diagnosis in both the child and the parent. This was somewhat surprising, given the nature of the condition. Nonetheless, it is reasonable when taking into account the sample characteristics. The ASD proband in this research was drawn from private clinics, where clients were predominantly of higher socio-economic status. These families, though affected by AS, had good incomes, and intact couple relationships where the partners had been together long enough to raise children aged 3-18 years, and were committed to seeking psychological assessment and/or intervention for their child with AS. In other words, the findings may only apply to a particular subgroup of adults with ASD. Moreover, there was a possibility that many parents from the control group, though not diagnosed with ASD themselves, actually had elevated traits of autism. We knew subsequently from Study 2 that whether or not a parent had clinical diagnosis of ASD, it did not necessarily reflect the severity of their manifestation of autism. Thus, there is a need to replicate Study 1 in future research by employing a dimensional approach in measuring parental characteristics of autism instead of relying on a categorical diagnostic status in order to draw conclusions about the association between parental traits of autism and marital quality.

10.3.3. Parenting experience

Having autism does not preclude becoming a parent, although results from this research (particularly Study 1 and Study 2) suggest that autism affects the parenting experience more than it affects the couple relationship. Interestingly, adults who were diagnosed with ASD and/or reported a clinical range of tendency towards autism, felt less confident being a parent despite feeling satisfied in their parenting role. This insight is fairly new to the literature of ASD, therefore little can be drawn from existing research to explain this observation. Nonetheless, several speculations can be made based on theories relevant to the parenting experience:

In the original version of the Parenting Sense of Competence Scale (Gibaud-Wallston & Wandersaman, 1978) *competence* was conceptualized as a composition of *knowledge/skill* and *valuing/comfort*. The *knowledge/skill* subscale assesses the parental perception of the degree to which skills and understanding as a parent have been acquired. The *valuing/comfort* subscale measures the degree to which the individual values and is comfortable in the parent role. Later, Johnston and Mash (1989) translated the scale based on a normative sample of parents with older children. Whilst they preserved the original items, the two subdimensions of *competence* were renamed as *satisfaction* and *efficacy*. *Satisfaction* encapsulates the affective aspect of parenting, such as feelings of frustration, anxiety and poor motivation versus joy and pride. It has been described as the ‘liking’ or ‘contentment’ towards the parenting role (Ohan, Leung, & Johnston, 2000). *Efficacy*, on the other hand, refers to one’s self-perceived competency in the parenting role. It incorporates a parent’s beliefs and judgement of his/her capacities to plan and execute a parenting-related task, including problem-solving ability, goal setting and other central skills and strategies in parental capacity (Montigny & Lacharite, 2005; Ohan et al., 2000). Whilst a sense of satisfaction and efficacy of a parent are often strongly correlated, they are different constructs with distinct dispositions (Gilmore & Cuskelly, 2012; Ohan et al., 2000). For instance, in a sample of 1,178 Australian parents (849 mothers and 329 fathers) recruited from medical clinics, health care centres, kindergartens and community services, but not specifically including those with ASD, (Rogers & Matthews, 2004), parenting sense of satisfaction, but not efficacy, was found to be strongly correlated with child behaviour, parent well-being and parenting style. In the original study of parenting sense of competency in the United States (Johnston & Mash, 1989), perceived child behaviour problems were negatively correlated with the *Satisfaction* subscale for both parents, whilst the *Efficacy* subscale was negatively correlated only for fathers. Similarly, in the present research, parenting sense of satisfaction was associated with the child’s ASD but not the parents’ ASD. However, interestingly, parenting sense of efficacy was related to characteristics of autism in the parents.

Parenting sense of efficacy in adults with ASD may be related to how competent one feels about meeting parenting requirements. Coleman and Karraker (1998) proposed that the four possible mechanisms through which parenting sense of efficacy develops are: 1) general relationships with others and attachment style received from the primary caregiver during childhood; 2) learning from cultures and communities; 3) encounters with young children; and 4) degree of cognitive or behavioural preparation for the parental role. For someone affected by ASD, each of these four mechanisms can be difficult due to the nature of this condition. The profile of ASD often involves particular deficits in socio-emotional reasoning skills, obsessive tendencies, black-and-white mindset, executive dysfunction and sensory sensitivities (American Psychiatric Association, 2013; Attwood, 2007). These challenges, irrespective of the individual’s intelligence, can manifest as difficulties in reciprocating social interactions, a failure to maintain a close relationship, communication breakdown and inability to show empathy in the way expected (Koegel, Ashbaugh, Koegel, Detar, & Regester, 2013; Müller, Schuler, & Yates, 2008). A parent with strong tendency towards autism may have difficulty in interpreting a child’s mental state in order to respond accordingly, or in picking up emotional cues from the tone of voice to offer affection when necessary (Berthoz et al., 2013; Tajmirriyahi et al., 2013).

These difficulties can potentially interfere with the ability to predict or make sense of a child's behaviours. Similarly, lacking in social pragmatic skills (Lewis, Woodyatt, & Murdoch, 2008) can make it difficult to adjust one's responses according to the context and developmental level of a child (Jackson, Skirrow, & Hare, 2012).

In addition to socio-emotional competency, parenting involves complex multi-tasking (Lambert & Franssen, 2013). Barrett and Fleming (2011) argued that parenting appropriately *"requires the action of multiple systems in the domains of sensation, perception, affect, reward, executive function, motor output and learning" (p. 369).* A parent is most likely to rely on his/her ability to plan, organize and prioritize in order to perform parenting tasks efficiently whilst drawing from theory of mind to respond to the child's socio-emotional needs. Yet, executive dysfunction is as commonly discussed as theory of mind deficits among individuals with ASD (McCrimmon et al., 2012; Sachse et al., 2013). In research on adults with Attention Deficit Hyperactivity Disorder, executive dysfunction has been associated with deficits in parenting control behaviours, including less monitoring of child behaviour, less effective parental problem solving, and more inconsistent discipline (Johnston, Mash, Miller, & Ninowski, 2012). In a study involving 216 mothers of no specific diagnosis, poor working memory was associated with increased negative reactivity, possibly due to their lower ability to cognitively control their emotions and behaviours during interactions with their children (Deater-Deckard, Sewell, Petrill, & Thompson, 2010). Even though these patterns have not been tested specifically in parents with ASD, the manifestation of executive dysfunction is likely to be similar across different populations. Thus, the way executive dysfunction affects parenting sense of efficacy in individuals with ASD warrants investigation.

In summary, adults with a diagnosis of ASD and/or who scored within the clinical range on the AQ felt less efficacious as a parent. This is not surprising considering parenting requires skills that are often challenging to individuals with ASD such as multitasking. It is important to highlight that despite having ASD, these adults experienced parenting and marital satisfaction similar to their non-ASD counterparts. The connection between parental traits of autism and parenting sense of efficacy observed in this research offers a promising beginning and clearly justifies a call for expanded work in this area. The author suggests that future studies could include measures of common challenges related to ASD (e.g., poor attention switching and working memory) and focus on how parenting functioning would be related to these symptoms.

10.3.4. Desirability versus competency in being a parent and a spouse

Parenting behaviour has been a sensitive topic in the ASD literature following Bettelheim (1967)'s proposal that autism is caused by the “schizophrenic mother”, or a lack of warmth in the parents. This “bad parenting” hypothesis has evoked much controversy with several subsequent studies. There are studies reporting that maternal warmth, praise and quality of the parent-child relationship are associated with fewer behavioural problems in and abatement of autism symptoms in the child (Smith, Greenberg, Seltzer, & Hong, 2008; Midouhas, Yogaratnam, Flouri & Charman, 2013). On the other hand, there is ample empirical evidence that the warmth among parents of children with ASD is equal to that of controls (Cox, Rutter, Newman, & Bartak, 1975; Siller & Sigman, 2002). A recent study (Boonen, Esch, Lambrechts, Maljaars, Zink, Leeuwen & Noens, 2015) compared mothers of children with ASD (n=30) with mothers of typically developing children (n=36) in Belgium found the ASD group scored significantly lower on Sensitivity and Provision of structure in their parenting behaviours. However, when controlling for parenting stress, this group difference became insignificant.

Findings from this thesis may be able to shed some light regarding responses of parents affected by ASD. According to the study reported in Chapter 5 of this thesis, parents of children with ASD are not different compared to parents of typically developing children in their interest in parenting or the couple relationship. More specifically, possession of many characteristics of autism does not imply a lack of desire to participate in familial roles; however, confidence in one's capacity for these roles can be hampered. These patterns are in agreement with previous findings that individuals with ASD have a longing for interpersonal relationships and a desire to contribute to their community, but often their social deficits may interfere with their engagements in these roles (Howlin, Mawhood, & Rutter, 2000; Mazurek, 2013a; Müller et al., 2008). Thus, we may infer that the difference parental traits of autism make is in confidence, not interest. Future research may further consider this hypothesis.

Differentiating desire from sense of competency in a family role is crucial for cultivating positive attitudes toward individuals with ASD. By understanding that it is due to a lack of confidence or skills that an adult with ASD struggles in a relationship will be likely to evoke compassion in others, whereas a parent who is perceived to be uninterested in his/her child is likely to attract criticism.

Having the desire to be in long-term relationships but lack competency to do so can lead to grief and loss. Future research for high functioning adults with ASD is encouraged to explore the association between interpersonal skills and loneliness. One study that assessed the quality of the life of 12 men with higher functioning ASD concluded that intervention for this population should address more sophisticated abilities than just survival skills, especially in their connectedness with others (Jennes-Coussens, Magill-Evans, & Koning, 2006). Another study (Mazurek, 2013b), involving 108 higher functioning adults diagnosed with ASD, found 79.6% of the sample relied on social media as a means of social connection. Among those who did not use social media, only 33.3% reported having a close friend as opposed to 66.3% of those who utilised social media. Studies on non-ASD users of the social media have found social media empowers users to take an active role in their own socialisation process and in constructing their own self-identity (Davis, 2010; Urista, Dong, & Day, 2009), and to facilitate self-disclosure (Jiang, Bazarova, & Hancock, 2011; Pempek, Yermolayeva, & Calvert, 2009). It appears that social media has much to offer for those who are socially interested, yet feel less competent in their social skills. This is especially if the aforementioned benefits of social media can be translated to real life situations. Future research on psychosocial interventions for adults with higher functioning ASD might draw insights from the use of social media and its generalisability to foster relationship closeness for this population.

10.4. Implications of Traits of Autism on Parental Psychosocial Functioning

10.4.1. Effects of autism in parents versus in child

Parenting a child with ASD undoubtedly requires an inordinate amount of time and energy and may have detrimental effects on the parents' psychological wellbeing. Nonetheless, to find that elevated parental traits of autism predicted anxiety symptoms across all domains, even after controlling for the child's ASD severity, is of particular importance for clinical practice. Interventions for families of children with ASD need to acknowledge that the high levels of anxiety disorders among the parents are not necessarily due to challenges relating to childrearing, as commonly perceived. Rather, tendency towards autism in the parents themselves seems to be a core compound of the anxiety related to ASD.

Findings from this research are in agreement with previous published works on the association between traits of autism and anxiety symptoms. For instance, a population-based twin study (consisting of 11,222 children and 18,349 adults) found that an increase in traits of autism, whether in child or adult subjects, monotonically increases the risk for both depression (Hansson et al., 2005) and anxiety (Lundström et al., 2011). This pattern was identified even in subjects with one or two traits of autism. More specifically, the risk of anxiety and depression in the ASD group was 21-22 and 12 times greater respectively compared to subjects without autistic-like traits. Similarly, when Ingersoll, Meyer and Becker (2011) examined comorbid depression in mothers (71 mothers of children with ASD and 94 with non-ASD children) they found a higher rate of depressed mood in the ASD group, and found that the depressed mood was predicted by their characteristics of autism, even after controlling for parenting stress and child ASD severity. The present research further substantiates the interconnectedness between autism and anxiety symptoms. It expands on previous findings by including all major anxiety subtypes in the analyses.

To date, there is limited agreement regarding which subtypes of anxiety disorders most commonly co-exist with ASD (Kerns & Kendall, 2012). However, previous research has predominantly been focussing on social anxiety (Kuusikko-Gauffin et al., 2013; White et al., 2012), obsessive compulsive disorder (Cath et al., 2008), specific phobia and generalised anxiety disorder (Hofvander et al., 2009). In the present research there is a high prevalence of PTSD symptoms found among parents of children with ASD. To the author's knowledge, the possibility that PTSD in parents of children with ASD may be related to traits of autism in themselves, is previously unreported. Somewhat related is a recent study which examines the association between symptoms of autism in the child and parental post-traumatic stress symptoms (PTSS) in 265 parents of children with ASD (Casey et al., 2012). Twenty percent of these parents reported elevated PTSS (i.e., "moderately distressed" range as measured by Impact of Events Scale-Revised). Interestingly, these parents were also reported to have problems in finding and holding a job, momentary blackouts, hostility/violence, drug abuse, sexual problems, and problems with authority. These features seemed to be more pertinent to the personal characteristics of the parents than to the child's ASD. Whether parental traits of autism can explain these associations has not been explored. Nor have we understood whether PTSD is a sequela of ASD, a covariant, or both. If parental tendency towards autism indeed is a risk factor for PTSD, how traits of autism may alter the course of the prognosis of PTSD in parents of children with ASD, or vice versa, is yet to be understood. These are interesting topics for future research.

In the interim, support for families of children with ASD ought to take into account the parent's own tendency towards autism and the relevant psychiatric vulnerabilities. Susceptibility to mood disorders does not help with confidence in parenting. Parenting training for those raising children with ASD may need to include anxiety management modified to suit parental tendency towards autism, if present. To the author's knowledge, there is no evidence-based treatment program in this area. However, a limited number of studies have investigated treatment strategies for anxiety in adults affected by ASD, including psychopharmacology and psychological interventions (White, Scarpa, & Attwood, 2013). The most studied intervention for anxiety in ASD to date is cognitive behavioural therapy, although data on treatment efficacy is only available for children or adolescents with ASD (Bauminger-Zviely, 2013; Lopata, Thomeer, Volker, & Nida, 2006; White et al., 2010), not for adults. Knowledge on treatment efficacy for adults with ASD in general is scarce, let alone for parents with ASD who also have an ASD child. Thus, to develop psychotherapeutic approaches suitable for parents who have a tendency towards autism is another needed future endeavour for researchers and clinicians in the field of ASD.

10.4.2. Autistic manifestation beyond broader autism phenotype in parents

The findings of this research further substantiated that parents of children with ASD manifest broad autism phenotype as measured on the AQ (Baron-Cohen et al., 2001). In addition, the findings also showed that about a quarter of the fathers (22.6%) and one fifth of the mothers (15.4%) in Study 2 scored within the clinical range for ASD as measured by the AQ [with Baron-Cohen et al. (2001)'s cut-off criteria], even though they had never been clinically diagnosed with ASD. Moreover, about half of the fathers (48.3%) clinically diagnosed with ASD did not meet the diagnostic cut-off on the AQ. There was obviously a mismatch between clinical diagnosis of ASD based on DSM and AQ scores. Whilst using a lower diagnostic cut-off of 26 for the AQ as proposed in a later study (Woodbury-Smith, Robinson, Wheelwright & Baron-Cohen, 2005) may resolve this discrepancy, there are several issues to be discussed in regard to making a diagnosis of ASD. First and foremost, it is crucial to bear in mind that having many traits of autism does not necessarily warrant a clinical diagnosis, unless impairments severe enough to hamper daily functioning are present. Albeit some of the parents in this study reported having clinical range AQ scores, they were maintaining intact couple relationships and raising children at the time of participation. The fact that they were capable of accessing services from a private clinic likewise hinted at stable financial circumstances suggesting many, if not all, were employed. These parents were likely to have successfully accommodated their symptomatology of autism, hence a clinical diagnosis for ASD would not be relevant, even though symptom frequency as reported on the AQ might seem to warrant it.

Then again, the question of where to draw the line in detecting ASD in high functioning adults arises. Jones and colleagues (2014) highlighted that only 26.6% of adults with ASD received their diagnosis via the first assessment, and 14.1% were told there was no problem despite the fact that these individuals were experiencing significant social difficulties. It is not uncommon for an adult affected by ASD to be functioning remarkably well in certain aspects of their lives (e.g., vocational attainment). However, this may be at the expense of high levels of anxiety, loneliness and other problems leading to psychological breakdowns (Aston, 2003; Attwood, 2007). Research studies on the diagnostic experience of adults with ASD have titles such as *'we are just silently coping'* (Griffith, Totsika, Nash, Jones, et al., 2012) and *'I just don't fit anywhere'* (Griffith, Totsika, Nash, Jones, et al., 2012), *"the not guilty verdict'* (Punshon et al., 2009) hinting loudly that better identification of clinical needs of this population is vital. When adults with ASD were interviewed in a previous study, the majority of them reported negative life experience prior to the diagnosis (Punshon et al., 2009). In many cases, a contributing cause seemed to be a lack of recognition of their different diagnostic and/or neurological make-up from the population norm (Jones et al., 2014). In the present research, the 272 subjects with ASD obtained their diagnosis between the ages of 24 and 48. More interestingly, 43% of them (118 participants) remarked in the open-ended questions of the survey that their diagnostic assessment was instigated by their becoming aware of their child's diagnosis, even though they had felt being different much earlier in life. Sixty-seven percent of adults with ASD in this subgroup (79 participants) perceived their difference as both strengths (e.g., analytical mind, ability to retain detailed information) and weaknesses (e.g., social difficulties and low tolerance for unpredictability).

Indeed, the profile of ASD brings with it talents as well as challenge, which often makes it difficult to decipher the clinical picture of the individual. Miller and Ozonoff (1997) observed that the original cases presented by Asperger (1944) would not have met the DSM-IV criteria for AS, suggesting that the actual profile of AS may not be captured by the diagnostic manual. Alternative diagnostic standards for AS have been proposed, such as Gilberg's (1991) criteria which is considered more reflective of the original accounts by Asperger (1944) (Fitzgerald & Corvin 2001). Other researchers even suggest including the strengths that come with ASD as well as the deficits, formulating an alternative experience-based knowledge of this condition (Bertilsdotter Rosqvist, 2012; Brownlow, 2010; Matson & Neal, 2009). Studies on experience of adults diagnosed with ASD portray a diverse range of practices in the diagnostic process (Bagatell, 2007; Matson & Neal, 2009) and consensus on the diagnostic algorithm of ASD for adults is yet to be achieved (Helles, Gillberg, Gillberg & Billstedt, 2015; King, Navot, Bernier & Webb, 2014). The present study contributes by highlighting the need to not only measure specific features of autism in individuals, but more importantly to assess how well they adapt their unique profiles of abilities versus how severely impaired they are in daily life. Particularly, aspects to be assessed are anxiety symptoms and sense of efficacy in parenting and family roles. Recruitment procedures for future research on adults with ASD cannot rely on the presence of a clinical diagnosis, at least based on present findings for this Australian adult sample in Study 2 (Chapter 6). A more accurate means to identify higher functioning adults with ASD that considers the new multidimensional diagnostic approaches including behavioural self-reports like the AQ is clearly required.

10.4.3. Self-reported traits of autism: Future implications of current findings

As mentioned earlier, nearly half (48%) of 29 fathers who had received a formal clinical diagnosis of ASD by a health or medical professional rated themselves below the diagnostic cut-off score on the AQ measure as per Baron-Cohen and colleagues (2001)'s original published criteria. Bearing in mind that the AQ was never proposed to be a stand-alone diagnostic tool, the mismatch between self-reported AQ scores and participants' clinical diagnostic status requires attention in any future research. It may be found to be related to both poor self-reflection in individuals with ASD and insight into their difficulties. One of the hallmarks of ASD in childhood is theory of mind deficits (Adler, Nadler, Eviatar, & Shamay-Tsoory, 2010; Peterson, Garnett, Kelly, & Attwood, 2009) which hinders the ability to attribute independent mental states to self and others in order to predict and explain behaviours (Premack & Woodruff, 1978). As a result, individuals with ASD can have an impaired capacity for self-awareness and self-reflection (e.g., Farley, Lopez, & Saunders, 2010; Jackson et al., 2012; Lee & Hobson, 1998). When Johnson, Filliter and Murphy (2009) tested a group of adolescents with ASD (n= 20) using the AQ, these adolescents reported significantly fewer traits of autism in themselves compared to their parents' AQ ratings on them, whereas no difference was observed in the non-ASD controls. Although yet to be empirically validated, the 48% of fathers who were diagnosed with ASD but scored <32 on the AQ in the present thesis research could be under-reporting their traits of autism owing to a lack of self-insight. Future research can extend current observation by collecting collateral information such as comparing self- and spousal-report ratings on the AQ.

A crucial point to consider is that the parents' AQ scores, but not their diagnostic status of ASD, were found here to be more predictive of their parenting sense of competency. Findings from Study 1 (Chapter 5) indicated that low parenting sense of satisfaction was associated with a diagnosis of ASD in the child but not in the parent. Yet, when all the parents, whether or not diagnosed with ASD, were assessed using the AQ in Study 2, traits of autism in parents were found to be associated with their sense of efficacy as a parent. If under-reporting is indeed the case, the lack of self-awareness about one's own idiosyncrasies of autism can have a critical implication for future treatment efficacy. It may be necessary that during the diagnostic and intervention process for an adult with ASD and his/her family, the first issue to address is the perception and acceptance of the ASD profile among the stakeholders. This is supported by clinical notes by experts in the field who often start counselling with couples where one has ASD by facilitating their understanding of each other's differences (Aston, 2012; Attwood, 2007). In fact, Attwood in his widely referenced textbook on AS listed three requisites for a successful couple relationship for this population to be: 1) both partners acknowledge the diagnosis; 2) motivation for both partners to change and learn; and 3) access to relationship counselling modified to accommodate the profile of abilities and experiences of the partner with AS (Attwood, 2007). To this end, an understanding of the common reactions to a late diagnosis of ASD will be helpful to clinicians. This is a research area imperative in the field of ASD. Another imperative step for future research on couples affected by ASD is to compare the accounts of both partners. Couple analyses can assist with detecting bias of self-report, if presence.

10.5. The Autism Quotient (AQ) as a diagnostic tool: Methodological issues

10.5.1. Comparing non-clinical and clinical groups

The notion of an autism continuum implies that individuals clinically diagnosed with ASD are simply those falling at the extreme end of a normal distribution of traits and abilities related to social adaptations and communication (Constantino & Todd, 2003). It also implies a blurring of the divide between non-clinical to subclinical to clinical ranges of manifestation of autism (Robinson et al., 2012). The AQ was designed by Baron-Cohen and colleagues (2001) for ascertaining an individual's self-reported position on this continuum. It has been widely used by research on clinical or non-clinical populations; however, whether its meaning and measurement properties remain consistent across the autism continuum had not previously been tested. Therefore, Study 3 (Chapter 7) and Study 4 (Chapter 8) in the present research aimed to examine the AQ's psychometric properties in samples which consisted of non-clinical, subclinical and clinical manifestation of autism simultaneously. The results showed that the new AQ factor solutions, AQ-39 and AQ-Chinese retained its psychometric qualities across the three groups, thus is a suitable tool for measuring traits of autism, for screening autism in the general population, for identifying the broad autism phenotype and for diagnostic purposes. As researchers and clinicians seek new screening tools for parents of children with ASD who could fall into any of these categories, the AQ-39 and AQ-Chinese are recommended for increasing utilization. The research in this thesis adds to past research literature by establishing the factorial validity and psychometric properties of AQ-39 and AQ-Chinese when administered to adults susceptible to the broad autism phenotype. This is a significant contribution likely to benefit future research on parents of children with ASD. Future studies should be encouraged to expand the clinical utility of the AQ-39 and AQ-Chinese in regard to identifying ASD tendency in parents of children with ASD, and to explore how specific areas of difficulty identified by the AQ-39 and AQ-Chinese can assist in designing treatment programs for families of children with ASD.

10.5.2. Comparing diverse cultural groups

The factorial analyses on the AQ in this research are based on two culturally distinct samples. This is another unique aspect of this thesis. Structurally, the AQ-Chinese synchronized with Baron-Cohen, et al. (2001)'s original factor formulation. The AQ-Chinese's new *socialness* and *attention switching* and *attention to details* were essentially a subset of the original AQ's *social skills*, *attention switching* and *attention to details* subscales respectively. The AQ-Chinese, however, contributed by refining the conceptual constructs on the original AQ. More specifically, items of the original *imagination* and *communication* subscales were dispersed to fortify a more distinct and condensed subscale, namely *mindreading*. The *imagination* subscale evidently had had an ambivalent status within the AQ literature including failing to be cross-validated in follow-up CFA (Kloosterman et al., 2011) and attaining dissatisfactory Cronbach alpha's coefficient (Hurst, Mitchell, Kimbrel, Kwapil, & Nelson-Gray, 2007; Stewart & Austin, 2009). The newly formed construct of *mindreading* depicts difficulty in perspective-taking, or in other words deficit in theory of mind which is the hallmark of ASD (Baron-Cohen, Leslie, & Frith, 1985). In the AQ literature, the concept of *mindreading* first emerged as *communication/mindreading* in Austin (2005)'s 3-factor model. Hoekstra, et al. (2008) later in their two-factor hierarchical model asserted the same impression by clustering the *social skills*, *communication, attention switching* and *imagination* subscales to make a higher order *social interaction* factor. The AQ-Chinese advanced by consolidating this supposition.

In terms of cultural difference, results from this thesis research attest that traits of autism are human traits impervious to cultural effect. The two factor solutions yielded from Study 3 and Study 4 (AQ-39 and AQ-Chinese, respectively) are conceptually comparable, albeit the Australian and Taiwanese communities are fairly distinct cultural groups. Both the AQ-39 (see Chapter 7) and the AQ-Chinese (see Chapter 8) encompass five, almost identical, domains: *sociability/socialness*, *social cognition/mindreading, narrow focus/attention to details, interest in patterns/patterns* and *resistance to change/attention switching,* suggesting the underlying constructs of autism do not vary between the European-descent and the Asian ethnic groups. Furthermore, these two models are also commensurate with other factor solutions of the AQ based on samples from the United Kingdom (Austin, 2005), Scotland (Stewart & Austin, 2009), the United States of America (Hurst et al., 2007; Kloosterman et al., 2011) and the Netherlands (Hoekstra et al., 2008), and further confirm it is not nationally specific or specific to particular language groups.

Being culturally robust is an advantageous quality of the AQ given there is a growing awareness among non-Western countries of the need to develop research on ASD pertinent to their local communities (Koh & Milne, 2012; Matson et al., 2011; Norbury & Sparks, 2013). When Zaroff and Uhm (2012) in a literature review attempted to illuminate the disparate prevalence of ASD across countries, they concluded that methodological factors were largely responsible for the differences, and that a culturally robust tool was called for to allow systematic comparison of ASD between countries. The AQ, with its comparable factor solutions across different nationalities, has the potential to become a standardized tool for cross-cultural research on autism in adults.

10.5.3. Implications for the diagnostic process

The AQ-39 and AQ-Chinese both demonstrated sound goodness-of-fit indices, good-to-excellent internal consistency and test-retest reliability, and adequate sensitivities for discriminating between ASD and non-ASD populations. However, the findings also highlighted the necessity to collect ancillary information along with the AQ score when diagnosing ASD. Subjects who scored highly in the AQ did not necessarily meet DSM-5 diagnostic criteria for ASD. This can be explained by the fact that traits of autism, as defined by the AQ, do not necessarily mean diagnosis of ASD. The AQ simply consists of statements that describe behavioural or cognitive features commonly observed in individuals with ASD, without determining the implications of these features or the severity of their impediments to the respondent’s daily functioning and quality of life. Individuals falling within the clinical diagnosis of ASD cross a threshold beyond which functioning is significantly impaired, whereas those high on traits of autism but without a clinical diagnosis of ASD remain able to cope with the demands of living in the society (Frazier et al., 2012; Lundström et al., 2011).

The distinction between adults with a high number of traits of autism who either do or do not have a diagnosis of ASD appears to lie within each person’s level of adaptability.

For instance, analyses on pathways to an adulthood ASD diagnosis in a sample of 125 adults (18 to 82 years old) revealed that social problems, feelings of anxiety and mood disturbances were the most common reasons for clinical referrals (Geurts & Jansen, 2012). Literature reviews on studies on young adults diagnosed with ASD found that despite compatibility between their goals and their skills and abilities, individuals with ASD reported a significantly lower quality of life compared to their non-ASD peers (Ikeda, Hinckson, & Krägeloh, 2014), and that social adaptation was a strong predictor of quality of life in this population (Tobin, Drager, & Richardson, 2014).

In light of these observations, two suggestions can be drawn for future research. First, even though the AQ was not intended to be used as a self-sufficient diagnostic tool, its discriminant validity can be improved significantly by adding items that depict how well the respondents adapt their idiosyncrasies of autism to domains such as marital functioning or parenting competency. Future studies might aim to effectively incorporate a brief adaptive functioning measure into the AQ in order to add to its screening value for adults with ASD. Second, research on traits of autism in adults without serious intellectual impairment needs to place more weight on the adaptability of the subjects in social situations.

The conceptualisation of the AQ items is consistent with the new diagnostic criteria for ASD in the DSM-5 (American Psychiatric Association, 2013). The subscales of *sociability/socialness/social skills/social interaction,* and *narrow focus/attention to details* appear to be the most stable constructs underlying the AQ measure, just as the DSM-5 distinctively defined the core dimensions of ASD to be a) persistent deficits in social communication skills; and b) restricted, repetitive patterns of behaviours, interests, or activities. Follow-up studies on AQ-39 and AQ-Chinese should trial a two-factor model by merging *Sociability/Socialness* and *Social Cognition/Mindreading* to make one factor that depicts criteria (a) for ASD in DSM-5, then the remaining to compose another dimension portraying criteria (b) for ASD in DSM-5. Future research of this kind can focus on improving content validity and specificity of the AQ as a diagnostic tool for ASD in adults, a much needed instrument in both research and the clinical field of autism.

10.5.4. Capturing autism qualities among the higher functioning ASD population

Another interesting function of the AQ measure that research in this thesis helped to validate is the ability of the AQ to differentiate between *sociability/socialness* and *social cognition/mindreading*. The *sociability/socialness* subscale consists of statements that capture one's interest in socialising with others, e.g., *"I enjoy social chit-chat."* and *"I prefer to do things with others rather than on my own."* The new constructs of *social* *cognition/mindreading* have been discovered in AQ-39 and AQ-Chinese to recognize the distinction between social desirability and social competency. This new *social cognition/mindreading* subscale is comprised by items that depict one's social reasoning abilities, e.g., *"I find it difficult to work out people's intention."* and *"I am often the last to understand the point of a joke."* Differentiating the desire to socialise from social competency is potentially a vital contribution to the understanding of adults with ASD who are higher functioning because often they struggle with the latter but not the former (Bishop-Fitzpatrick et al., 2013).

The present research adds to the limited yet growing evidence that for people with ASD, the concern is not a lack of satisfaction in the quality of the relationship but a lack of confidence in the process of developing or maintaining the relationship (*see section 10.3.4*). In a case study of three male college students diagnosed with AS (aged 21 to 23 years) at the University of California (Koegel et al., 2013), all three students reported a significant improvement in their life satisfaction and each was satisfied with their interaction with peers after receiving a 33-week structured social planning program to assist with developing friendships with their peers. In Mazurek's (2013b) sample of adults with ASD, it was not social media use, but greater offline friendship quantity and quality that were associated with less sense of loneliness. This implies a desire for 'in-person' connection in this population. There is a need for further research to delineate the mechanism underlying the high prevalence of social media use among adults with ASD in order to discriminate, if possible, between an insecure internal working model and social challenges related to autism. The distinction between *socialibility/socialness* and *social cognition/mindreading* in the AQ-39 and AQ-Chinese can assist with this goal. Further evidence on the discriminant validity of this tool is another prospective project for any future empirical endeavour.

10.5.5. The issues of gender differences

Gender seems to play a role in how characteristics of autism in oneself are reported by adults, at least those in the present sample. The present research concurs with existing literature (Lai et al., 2011) in that women who have a clinically confirmed diagnosis of ASD tend to report higher AQ scores than men with ASD. Data from the present research even showed no difference between fathers diagnosed with ASD themselves and non-diagnosed fathers of children with ASD on AQ subscales of *Attention Switching, Attention to Details* and *Imagination*. As suggested earlier, men with ASD may have a tendency to under-report traits of autism in themselves due to difficulties in self-reflection. Second, many fathers of children with ASD though manifesting elevated traits of autism, do not attract a clinical diagnosis. This can be simply because men in general, even the non-ASD affected individuals, by and large manifest more features of autism than women, as asserted by the extreme male brain theory of autism (Baron-Cohen et al., 2011). Subsequently, there is a smaller difference between men diagnosed with ASD and other men, especially those with children with ASD. Third, high AQ scores do not necessarily signify clinical impairment, as mentioned earlier. Fathers who reported clinical range AQ scores may not have enough impairment in their functioning to warrant a clinical diagnosis. If this is true, we may speculate that autism, as captured by the AQ, is less discriminative between clinical and non-clinical manifestation for men than for women. Interestingly, Study 2 shows that difficulties in *Attention Switching* or *Social Skills* do not affect a man's parenting sense of efficacy to the same degree as they affect a woman's, yet conversely, high parenting sense of efficacy was observed among women who had been diagnosed with ASD. It is unclear whether or not fathers are more susceptible to the effect of traits of autism than mothers. In previous research, fathers of children with ASD perceived there to be less support from family and friends than their partners perceived (Altiere & von Kluge, 2009), and demonstrated fewer adaptive coping skills than did mothers (Lee, 2009). Perhaps men and women experience autism differently, and we are yet to capture features of autism that affect men's functioning more directly. Further studies on manifestations of autism in male versus female are necessary to demystify these seemingly contradictory findings. Two implications to draw from this research, in the meantime are: 1) the need to support mothers who have no diagnosis of ASD but score highly on the AQ measure; and 2) insights can be drawn from mothers diagnosed with ASD in regard to factors that contribute to high parenting sense of efficacy.

10.6. Theoretical And Practical Significance Of The Present Thesis Findings

This research contributes to the body of scholastic work on parents of children with ASD by shifting from the conventional focus, that is, the impact of the child's ASD on parenting, to more broadly exploring the probable effect of parental characteristics of autism on the parents' own psychosocial functioning. To the author's knowledge, it is the first to systematically explore the relationship and parenting experience of adults who had a clinically-confirmed ASD diagnosis. There are four main reasons why this project is important to the field:

10.6.1. The economic implications

The astonishing twentyfold increase of ASD prevalence in Australia over the past decade (Parner et al., 2011) means the health care costs for this population is estimated to be between $4.5 to $7.2 billion per annum, projecting this condition to become the second greatest cause of disease or injury in Australia (Synergies Economic Consulting, 2011). Moreover, the reported cost, which includes reduced employment, carer costs and some social services, is likely to be a gross underestimate. The average annual incremental cost for each person with ASD equates to $87,000 as estimated in a consultation paper by Dignity for Disability investigating experiences with autism services in South Australia (Neagle, 2012). With the knowledge of these data, the Australian government is increasingly aware of the future costs if we do not pay attention to the needs of people with ASD. This is evident from the mental health initiatives such as the Helping Children with Autism Program (i.e., a fund of $190 million from 2008-2012, and a further $30 million which has been committed and is now ongoing) specifically made available for young children with ASD to access early intervention (ARTD Consultants, 2012). Whilst this is a remarkable step by our welfare system, this initiative precludes the needs of adults with ASD in our community. This can be a severe oversight, because adults with ASD can potentially incur even more sociological costs to our community due to their propensity for psychiatric illness (Hofvander et al., 2009; Joshi et al., 2013). Not only so, they are also the population that prospectively can make a significant difference to the society with their talents if supported adequately (Boso, D’Angelo, & Barale, 2013; Markram & Markram, 2010). Socio-psychological services for adults with ASD are far from adequate (Shattuck et al., 2012). Moreover, as with any welfare resources, funding will serve its purpose only if informed by sound knowledge. It is imperative that the commitment of the Australian government to provide services for the ASD population be guided by empirical data. Diagnostic information on adults is often lacking or contradictory, as these findings show. Based on these considerations, the present research sheds light on the experience and needs of adults affected by ASD, and it is hoped future studies will build on them to do likewise.

10.6.2. Treatment efficacy

Family plays a vital role in treatment efficacy for individuals with ASD (Rogers & Vismara, 2008). Yet the primary focus of welfare service initiatives in the area of has been the assessment and diagnosis of the child, with a continuing debate regarding the most effective approaches to individual intervention (Francis, 2005). In their widely cited textbook on children with special needs, Greenspan, Weider and Simons (1998) argued that family relational health is imperative to a child's successful development, and highlighted the importance of parent care and marital health. This proposition has consistently been confirmed over the last two decades. If parents are emotionally drained due to difficult spousal interactions and a sense of poor parenting efficacy, their capacity to engage with their avoidant and seemingly uninterested children will understandably be hindered.

Specific to the ASD population, there are evidences showing that the links between family relationship quality and ASD symptoms in children are bidirectional. For instance, family conflict has been found to be strongly correlated with anxiety and depression, which is associated with increased ASD symptomatolology of children and adolescents with ASD (Kelly et al., 2008). The degree of ASD severity in children in turn is related to lower family adaptability and cohesion (Gau et al., 2012). Of concern is that there remains a lack of guidelines for practitioners showing how to provide best practice for not just the child but the family as a whole unit. This phenomenon is likely to result from the heavy emphasis on the individual's symptomatology of ASD in past research while underestimating the impact of parental well-being on the outcome of our ASD population in the long-run.

The divorce rate for parents raising a child with autism has been estimated to be as high as 80%, which is double the average for first time marriage in the general population (Bolman, 2006). In Australia, the estimated cost of family breakdown related to ASD is as high as $ 2,771 million per annum (Synergies Economic Consulting, 2011), and there is still very little attention paid to the needs of families with children with ASD, or to ways of enhancing the parents' couple relationship quality through provision of services. There is, however, enough information to raise concerns that couple dynamic, in turn, can affect the outcome of children with ASD (Baker, Mailick, Seltzer, & Greenberg, 2011; Kelly et al., 2008), parenting sense of efficacy (Hartley et al., 2011), and increased physical and mental health problems in parent and child (Giallo, Wood, Jellett, & Porter, 2013; Karst & Van Hecke, 2012).

It is debatable which factors contribute to the high divorce rate in the ASD population. However, the literature suggests attributing this phenomenon to the child's symptomatology of ASD, even though parents of children with ASD have consistently been found to share features of autism termed as broad autism phenotype. In addition, adults diagnosed with ASD are likely to have children affected by ASD. To date, no empirical data are available to differentiate between the effects of child and parental tendency towards autism on the parents' psychosocial functioning. The different clinical presentation of ASD in adulthood and in children suggests that stressors in families where one of the parents also has elevated symptomatology of ASD can be both qualitatively and quantitatively different from families where only the child has ASD. There are definite gaps in the literature on marital and parenting experiences of parents of children with ASD, and there is a desperate need for insights to guide the treatment models for families living with ASD. This is another significant need that instigated this research. To the author's knowledge, this research is the first in the field to take into account the effect of ASD in both the child and the parent generations.

10.6.3. Couple counselling for adults affected by ASD

Aston (2012) conducted research on couples where one or both had a diagnosis of ASD, and stated that for many of them, finding out about the diagnosis can mean the difference between staying together or separating. Yet many adults with higher functioning ASD in this thesis and in past research have reported encountering numerous barriers for them to obtain the diagnosis (Jones et al., 2014; Punshon et al., 2009). The high incidence of mis- or non-diagnoses in adults with higher functioning ASD (Fraser et al., 2012) means that there remains a lack of awareness among couple therapists about the probable effect of traits of autism on couples in distress. This is especially so among parents of children with ASD whose parental traits of autism may overwhelm their abilities to cope with the demands of parenting a child with ASD. In personal accounts, spouses with ASD often ascribe more stressors to one another's symptoms of autism rather than to those of their child (e.g., Aston, 2003; Slater-Walker et al., 2002).

Many researchers have devoted their time to investigating the effectiveness of existing couple therapy models (e.g., Christensen, Baucom, Vu, & Stanton, 2005; Halford, Sanders, & Behrens, 2001); however, to date no study has focused on how these models meet the needs of couples where ASD may be an influence. Relationship problems encountered by couples affected by ASD or its broader phenotype are likely to be quite different from the more common presenting problems in couples without ASD in either spouse or any child. In another study on couples affected by ASD, Aston (2003) found that 75% of the sample had sought couple counselling, but unfortunately the majority terminated their counselling dissatisfied due to the counsellors' lack of knowledge about the unique profile of ASD in adults. Couples therapists need to increase their understanding of ASD and its implication to both the couple and the parent-child dynamic in order to work effectively with couples where either formal diagnoses of ASD have been made, or traits of ASD have been identified (Attwood, 2007). To this author's knowledge, this research is one of the pioneering works on adult attachment style, marital satisfaction, parenting sense of competency and couple compatibility of adults affected by ASD.

10.6.4. Clinical utility of the Autism Spectrum Quotient (AQ)

Unless a screening tool is easily accessible to services, it is unlikely that traits of autism in parents of children with ASD will be checked. To this end, this research contributes by validating psychometric properties of the AQ, a measure which is quick to administer, and freely available to services. The AQ is increasingly used in research across disciplines and is likely to become one of the primary tools for understanding autism in adults. To the author’s knowledge, this research is the first to develop factor solutions for the AQ fitted to a sample consisting of clinical, subclinical and non-clinical subjects.

10.7. Overall Methodological Considerations

This research is innovative in its methodology in several ways. It is the first to consider the effect of child and parental traits of autism simultaneously. It explores a relatively new topic in the field using samples from two distinct cultural groups. Another important strength of this study is the inclusion of adults who had been clinically diagnosed with ASD who were also parents of children with ASD. It was indeed a challenge to recruit families where clinical diagnoses of ASD were present in both generations. Yet the arduous effort to find a relatively large sample made this study a major contribution to the ASD literature. The differentiation between the effects of parental and child characteristics of autism is possible only with this approach.

There are inevitable limitations in the methodology of this research to be addressed. First, the data are based on subjective reports thus the validity of objective approaches cannot necessarily be taken for granted. Subjective reports are generally considered less reliable (Strauss & Corbin, 1994). Furthermore, it can be argued that those affected by ASD are unable to subjectively evaluate their psychosocial experience. Theories about a lack of theory of mind in this population suggest that people with ASD, including those without intellectual impairment, are poor at introspection about their own thoughts and experience (Chaput et al., 2013; Hurlburt, Happé, & Frith, 1994). It is important to note, however, that the main interest of this research was the personal experience of the respondents, therefore self-rated scores, whether objective or not, were appropriate.

Second, the clinical groups in this research were predominantly adults with higher functioning ASD. All of the subjects had completed at least high school, and the majority were in intact marital relationships. Results from such a sample group may not be generalisable to more severe levels of autism or to parents who have lower psychosocial functioning. Yet, it was intentional that this research concentrated on those with a subtle presentation of ASD, because this is the population most underserviced.

10.8. Overall Conclusions

Autism does not preclude one from having a satisfying marital or parenting relationship, although the nature of the couple's or parent connection may be different from what is commonly observed in the general population. Modifications to couples counselling and parental education models are necessary for the ASD population. Diagnosis of ASD in the child can negatively affect parenting sense of satisfaction, whereas ASD in the parents can hamper parenting sense of efficacy, perhaps especially in fathers. Intervention for families affected by ASD will need to consider parents' tendencies towards autism (as assessed by the AQ as well as clinically), and how to boost confidence in parenting skills and roles accordingly. Research programs and welfare or clinical services should be encouraged to utilise the AQ for screening traits of autism in parents of children with ASD. The AQ is a culturally robust tool, sensitive for identifying both a subclinical and clinical range of ASD expression in adults. This research draws attention to the psychosocial risks for those higher functioning adults with ASD who have been inadequately identified, understood and serviced. More specifically, findings from this research point future studies towards traits of autism or diagnoses among parents of children with ASD in several different cultures. Effects of multi-generational ASD diagnostic status on parenting experience and anxiety symptoms, and gender effects on the expressions of ASD need further investigation to build on promising present findings. Moving forward, it will be essential that ASD researchers pay greater attention to the psychosocial experiences of the young, middle-aged and elderly of the ASD population in order to provide more appropriate and effective services and support systems for these often troubled, though equally often, talented and committed individuals.

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Appendix A:

Ethical Clearance

Subject:	Ethics Clearance - Winnie Yu Pow Lau
From:	Ann Lee (a.lee@psy.uq.edu.au)
To:	wyplau@yahoo.com;
Cc:	candi@psy.uq.edu.au;
Date:	Wednesday, 14 May 2008 9:07 AM

Dear Winnie

Your PhD ethics application has been reviewed and conditionally cleared.
The clearance condition is that the Information sheets are to be on UQ School of Psychology letterhead.
The Ethics Clearance Number is: 08-PSYCH-PHD-39-JM
Best wishes with your research project.

John McLean
School of Psychology
Ethics Review Officer

Ann Lee
School of Psychology
Administrative Officer

Appendix B:

Letter of Invitation (ASD Group)

THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

Winnie Lau

Telephone: 0421 680 658

Fax: 07 3844 9533

Email: wyplau@yahoo.com

Letter of Invitation to Participate

Dear Parent,

This is an invitation to parents of individuals identified with Asperger's Syndrome (AS) or Autism Spectrum Disorders (ASD) to take part in a study that focuses on your experience.

Why do we conduct this study?

As clinicians working with families with children with AS or ASD, we have come to appreciate the complex and crucial roles parents play in their children's live. To date, most information and resources available have been focused on the child with AS or ASD but little is known about the parents' experience.

This study purposes to gather the perspectives of both fathers and mothers of individuals with AS or ASD, specifically in their experience in their couple relationship and as a parent.

The value of this study

The results of this research are likely to be helpful to parents, couples, researchers, clinicians and people with AS and ASD, and are likely to lead to better understanding and more effective strategies for coping in families. We aim to draw knowledge and understanding from this study to design parenting and couple workshops for parents with children with AS and ASD in the future.

What does this study involve?

This study involves a questionnaire with questions about:

- your experience in relationships in general as well as your relationship with your partner;
- your experience being a parent to the child with AS or ASD;
- your perspective on parenting practices.

Each questionnaire will take about 50 minutes of your time to complete.

Will my privacy be protected?

Confidentiality of your responses will be strictly maintained by the anonymous submission of all information directly into the secure database. Participation in this study is voluntary and you may withdraw at any time or not answer any question you prefer not to answer without any prejudice or penalty. This study has been cleared in accordance to the ethical review process of the University of Queensland and within the guidelines of the National Health and Medical Research Council (Ethical Clearance No: 08-PSYCH-PHD-39-JM).

Thank you for your willingness to participate in this research. Your contribution is significant to our research and invaluable for our future understanding of families of children with AS or ASD.

Winnie Yu Pow Lau Psychologist PhD Candidate	**Prof Candida Peterson** Senior Lecturer PhD Supervisor	**A/Prof Adrian Kelly** Researcher PhD Supervisor
Prof Tony Attwood Clinical Psychologist PhD Supervisor		**Dr Michelle Garnett** Clinical Psychologist PhD Supervisor

THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

Winnie Lau

Telephone: 0421 680 658

Fax: 07 3844 9533

Email: wyplau@yahoo.com

Letter of Invitation to Participate

Dear Parent,

This is an invitation to parents of children aged 2 to 18 year to take part in a study that focuses on your marital and parenting experience.

Why do we conduct this study?

We are clinicians working with families with children with Asperger's Syndrome (AS) or Autism Spectrum Disorder (ASD). In order to assist us to understand better the complex and crucial roles parents play in their children's live, we are conducting this study to investigate experiences of parents of children with AS or ASD as well as those with typical developing children. This study purposes to compare the differences in the parents' experiences in order to improve the parenting program we are offering to these families.

The value of this study

The results of this research are likely to be helpful to parents, couples, researchers, clinicians and people with AS and ASD, and are likely to lead to better understanding and more effective strategies for coping in families.

What does this study involve?

This study involves a questionnaire with questions about:

- your experience in relationships in general as well as your relationship with your partner;
- your experience being a parent
- your perspective on parenting practices.

Each questionnaire will take about 50 minutes of your time to complete.

Will my privacy be protected?

Confidentiality of your responses will be strictly maintained by the anonymous submission of all information directly into the secure database. Participation in this study is voluntary and you may withdraw at any time or not answer any question you prefer not to answer without any prejudice or penalty. This study has been cleared in accordance to the ethical review process of the University of Queensland and within the guidelines of the National Health and Medical Research Council (Ethical Clearance No: 08-PSYCH-PHD-39-JM).

Thank you for your willingness to participate in this research. Your contribution is significant to our research and invaluable for our future understanding of families of children with AS or ASD.

Winnie Yu Pow Lau
Psychologist
PhD Candidate

Prof Candida Peterson
Senior Lecturer
PhD Supervisor

A/Prof Adrian Kelly
Researcher
PhD Supervisor

Prof Tony Attwood
Clinical Psychologist
PhD Supervisor

Dr Michelle Garnett
Clinical Psychologist
PhD Supervisor

Appendix D:
Study 1 Questionnaire

ALL INFORMATION REMAINS STRICTLY CONFIDENTIAL

Demographic Information

This section is about you

1. Your Gender: ☐ Male ☐ Female 2. Your Age:___________________

3. Your marital status: ☐Single ☐Married ☐De facto ☐Separated ☐Divorced

4. Your ethnic background: ☐Caucasian ☐Aboriginal ☐Pacific Islander ☐Asian ☐Other:____________________________

5. Are you currently working / studying?

☐No ☐Part-time ☐Full-time (40 hrs/wk) ☐>60 hrs/wk

If yes, what is your present occupation____

6. What is your highest academic level of achievement?

☐ Primary School
☐ Secondary School
☐ Bachelor Degree
☐ Master's Degree
☐ PhD
☐ Other_________________________

This section is about your partner

1. Your partner’s gender: ☐Male ☐Female

Your partner’s age:____________________

2. Your partner’s ethnic background: ☐Caucasian ☐Aboriginal ☐Pacific Islander

☐Asian ☐Other:__________________________

3. Is your partner currently working / studying?

☐No ☐Part-time ☐Full-time (40 hrs/wk) ☐>60 hrs/wk

If yes, what is your partner’s present occupation? _______________________________

4. What is your partner’s highest academic level of achievement?

☐	Primary School	☐	Master’s Degree
☐	Secondary School	☐	PhD
☐	Bachelor Degree	☐	Other________________________

This section is about your household

1. What is your current living arrangement? (Check all with whom you live)

☐Spouse/Partner ☐Child(ren) ☐Parent(s) ☐Live alone ☐Other relative(s)_____

2. Which of the following best describes your family’s annual gross income?

☐Under $15,000 ☐$30,001-$50,000 ☐$75,001-$100,000

☐$15,000-$30,000 ☐$50,001-$75,000 ☐$100,000 and above

This section is about your relationship with your partner

1. If married or living together, how long have you been married or living together? _______

2. If separated or divorced, how long have you been apart?_________________________

Information on Diagnosis

This section is about your children

1. Have you had any biological children with your partner?

☐Yes ☐No If yes, how many biological children do you have?____________

What are their ages in years (from oldest to youngest ___________________________

Have any of these children been diagnosed with:

☐Autism ☐Asperger's Syndrome

☐High Functioning Autism ☐Pervasive Developmental Disorder Not Otherwise Specified

If yes, please indicate age(s) here____

2. Do you have any step-children?

☐Yes ☐No If yes, how many step-children do you have? ______________

What are their ages in years (from oldest to youngest)___________________________

Have any of these children been diagnosed with:

☐Autism ☐Asperger's Syndrome

☐High Functioning Autism ☐Pervasive Developmental Disorder Not Otherwise Specified

If yes, please indicate age(s) here____

3. How many of your biological or/and step-children are currently living with you?_______

This section is about you

1. Have you been identified with:

☐Asperger's Syndrome ☐ Chronic Fatigue Syndrome

☐Autism

☐High Functioning Autism

☐Pervasive Developmental Disorder-NOS

☐ Depression

☐ An Anxiety Disorder

☐ Eating Disorder

☐ Attention Deficit Hyperactivity Disorder

☐ Bipolar Disorder

☐ Immune Deficiency Disorder

☐ Muscular problems

☐ Fibromyalgia

☐ Skin Disorders

☐ Tourette's Syndrome

☐ Insomnia

☐ Migraine

☐ Other condition (please specify)_____

If you have indicated any of the above, have formal diagnoses being made?

☐Yes ☐No

How long ago were the diagnoses made (in years)? ____________________________

This section is about your partner

1. Has your partner been identified with:

☐Asperger's Syndrome

☐ Chronic Fatigue Syndrome

☐Autism

☐High Functioning Autism

☐Pervasive Developmental Disorder-NOS

☐ Depression

☐ An Anxiety Disorder

☐ Eating Disorder

☐ Attention Deficit Hyperactivity Disorder

☐ Bipolar Disorder

☐ Immune Deficiency Disorder

☐ Muscular problems

☐ Fibromyalgia

☐ Skin Disorders

☐ Tourette’s Syndrome

☐ Insomnia

☐ Migraine

☐ Other condition (please specify)_____

If you have indicated any of the above, have formal diagnoses being made?

☐Yes ☐No

How long ago were the diagnoses made (in years)? ___________________________

Future Studies

Are you happy for us to contact you for our follow-up studies?

☐Yes ☐No

If yes, please provide your contact details below:

Your postal address: ______________________________

____

Your name (if desired): ______________________________

Your email address (if desired): ______________________________

Your phone number (if desired): ______________________________

(Note: The information in this section will be detached before the data are coded or analyzed so as to safeguard your privacy and confidentiality)

This section refers to your experiences in romantic love relationships <u>in general</u>

*Read each of the three self-descriptions below (A, B, and C) and then tick **ONE** alternative that best describes how you feel in romantic relationships or is nearest to the way you feel. (Note: The terms "close" and "intimate" refer to psychological or emotional closeness, not necessarily to sexual intimacy.)*

[ ]A I am somewhat uncomfortable being close to others; I find it difficult to trust them completely, difficult to allow myself to depend on them. I am nervous when anyone gets too close, and often, others want me to be more intimate than I feel comfortable being.

[ ]B I find it relatively easy to get close to others and am comfortable depending on them and having them depend on me. I don't worry about being abandoned or about someone getting too close to me.

[ ]C I find that others are reluctant to get as close as I would like. I often worry that my partner doesn't really love me or won't want to stay with me. I want to get very close to my partner, and this sometimes scares people away.

Now please rate each of the relationship styles above to indicate how well or poorly each description corresponds to your general relationship style. Please circle the number.

Style A

1 2 3 4 5 6 7

Strongly Disagree Neutral/Mixed Strongly Agree

Style B

1 2 3 4 5 6 7

Strongly Disagree Neutral/Mixed Strongly Agree

Style C

1 2 3 4 5 6 7

Strongly Disagree Neutral/Mixed Strongly Agree

This section refers to your child with Asperger's Syndrome/Autism. If you have more than one child with Asperger's Syndrome/Autism, please answer in relation to one of them.

Each question has a rating scale from "1" to "5". Rate each item using the scale to indicate the frequency with which the child you are rating shows the behaviour described. The scale is shown below:

1	2	3	4	5
Very much less than a typical child this age		Above average/as much as a typical child this age		Very much more than a typical child this age

How old is the child you are rating for:___________

1.	Does the child have difficulty understanding others' thoughts?	1	2	3	4	5
2.	Does the child expect you to know things you couldn't know (e.g. events at home when you weren't there?)	1	2	3	4	5
3.	Does the child adapt his/her behaviour appropriately to people and social situations (e.g. speaks differently to a classmate than the Principal)?	1	2	3	4	5
4.	Is the child good at picking up the emotional messages in someone's tone of voice or facial expression?	1	2	3	4	5
5.	Does the child often switch or omit topics in a conversation so that others get confused?	1	2	3	4	5
6.	Does the child have difficulty explaining his/her thinking in words?	1	2	3	4	5
7.	Does the child usually seem uninterested in your side of the conversation?	1	2	3	4	5
8.	Is the child inflexible (seems to have a one-track mind)?	1	2	3	4	5

This section refers to your relationship with your partner. Please circle the answers that come closet to what you think.

		Strongly Disagree						Strongly Agree
1.	My partner and I have a good relationship	1	2	3	4	5	6	7
2.	My relationship with my partner is very stable	1	2	3	4	5	6	7
3.	Our relationship is strong	1	2	3	4	5	6	7
4.	My relationship with my partner makes me happy	1	2	3	4	5	6	7
5.	I really feel like part of a team with my partner	1	2	3	4	5	6	7
6.	On the scale below, indicate the point which best describes the degree of happiness, everything considered, in your relationship with your partner. The middle point "Happy", represents the degree of happiness which most people get from marriage. 1 2 3 4 5 6 7 8 9 10 Very Unhappy Happy Perfectly Happy							
7.	How often have you and your partner seriously discussed ending your relationship? 1 2 3 4 5 6 7 8 Never Once Twice Three Times Four Times Five Times Ten Times More than Ten Times							
8.	I have so often seriously considered ending my relationship with my partner	Strongly Disagree 1	2	3	4	5	6	Strongly Agree 7

This section refers to your personal parenting experiences. If you feel you respond differently to your child(ren) with Asperger's Syndrome/Autism compared to the other child(ren), please answer these questions in relation to your child(ren) with Asperger's Syndrome/Autism.

		Strongly Disagree					Strongly Agree
1.	The problems of taking care of a child are easy to solve once you know how your actions affect your child, an understanding I have acquired.	1	2	3	4	5	6
2.	Even though being a parent could be rewarding. I am frustrated now while my child(ren) are at their present age.	1	2	3	4	5	6
3.	I go to bed the same way I wake up in the morning, feeling I have not accomplished a whole lot	1	2	3	4	5	6
4.	I do not know why it is, but sometimes when I'm supposed to be in control. I feel more like the one being manipulated.	1	2	3	4	5	6
5.	My mother/father was better prepared to be a good mother/father than I am.	1	2	3	4	5	6
6.	I would make a fine model for a new mother/father to follow in order to learn what she/he would need to know in order to be a good parent.	1	2	3	4	5	6
7.	Being a parent is manageable and any problems are easily solved.	1	2	3	4	5	6
8.	A difficult problem in being a parent is not knowing whether you're doing a good job or a bad one.	1	2	3	4	5	6
9.	Sometimes I feel like I'm not getting anything done	1	2	3	4	5	6
10.	I meet my own personal expectations for expertise in caring for my child(ren).	1	2	3	4	5	6
11.	If anyone can find the answer to what is troubling my child(ren), I am the one.	1	2	3	4	5	6
12.	My talents and interests are in other areas, not in being a parent.	1	2	3	4	5	6
13.	Considering how long I've been a mother/father. I feel thoroughly familiar with this role.	1	2	3	4	5	6
14.	If being a mother/father of a child were only more interesting. I would be motivated to do a better job being a parent.	1	2	3	4	5	6

15.	I honestly believe I have all the skills necessary to be a good mother/father to my child(ren).	1	2	3	4	5	6
16.	Being a parent makes me tense and anxious.	1	2	3	4	5	6
17.	Being a good mother/father is a reward in itself.	1	2	3	4	5	6

If you have any further comments on your role as a parent, spouse or family member, please write them below:

____

____

____

____

____

____

____

____

____

____

Thank you for your participation!

We really appreciate your help and input!!

THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

Winnie Lau

Telephone: 0421 680 658

Fax: 07 3844 9533

Email: wyplau@yahoo.com

Letter of Invitation to Participate

Dear Parent,

This is an invitation to parents of individuals identified with Asperger's Syndrome (AS) or Autism Spectrum Disorders (ASD) to take part in a study that focuses on your personality characteristics.

This study involves a questionnaire that will take about

20 minutes of your time to complete.

The results of this research are likely to be helpful to parents, couples, researchers, clinicians and people with AS and ASD, and are likely to lead to better understanding in the family dynamic of individuals with ASD. We aim to draw knowledge and understanding from this study to design parenting and couple workshops for parents with children with AS and ASD in the future.

Will my privacy be protected?

Confidentiality of your responses will be strictly maintained by the anonymous submission of all information directly into the secure database. Participation in this study is voluntary and you may withdraw at any time or not answer any question you prefer not to answer without any prejudice or penalty. This study has been cleared in accordance to the ethical review process of the University of Queensland and within the guidelines of the National Health and Medical Research Council (Ethical Clearance No: 08-PSYCH-PHD-39-JM).

Thank you for your willingness to participate in this research. Your contribution is significant to our research and invaluable for our future understanding of families of children with AS or ASD.

Winnie Yu Pow Lau	**Prof Candida Peterson**	**A/Prof Adrian Kelly**
Psychologist	Senior Lecturer	Researcher
PhD Candidate	PhD Supervisor	PhD Supervisor

Prof Tony Attwood	**Dr Michelle Garnett**
Clinical Psychologist	Clinical Psychologist
PhD Supervisor	PhD Supervisor

Appendix F:
Letter of Invitation (Control Group)

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

Winnie Lau

Telephone: 0421 680 658

Fax: 07 3844 9533

Email: wyplau@yahoo.com

Letter of Invitation to Participate

Dear Parent,

This is an invitation to parents of individuals aged 2 to 18 years to take part in a study that focuses on your personality characteristics.

This study involves a questionnaire that will take about

20 minutes of your time to complete.

The results of this research are likely to be helpful to parents, couples, researchers, clinicians and people with Autism Spectrum Disorders (ASD), and are likely to lead to better understanding in the family dynamic of individuals with ASD. We aim to draw knowledge and understanding from this study to design parenting and couple workshops for parents with children with ASD in the future.

Will my privacy be protected?

Confidentiality of your responses will be strictly maintained by the anonymous submission of all information directly into the secure database. Participation in this study is voluntary and you may withdraw at any time or not answer any question you prefer not to answer without any prejudice or penalty. This study has been cleared in accordance to the ethical review process of the University of Queensland and within the guidelines of the National Health and Medical Research Council (Ethical Clearance No: 08-PSYCH-PHD-39-JM).

Thank you for your willingness to participate in this research. Your contribution is significant to our research and invaluable for our future understanding of families of children with ASD.

Winnie Yu Pow Lau
Psychologist
PhD Candidate

Prof Candida Peterson
Senior Lecturer
PhD Supervisor

A/Prof Adrian Kelly
Researcher
PhD Supervisor

Prof Tony Attwood
Clinical Psychologist
PhD Supervisor

Dr Michelle Garnett
Clinical Psychologist
PhD Supervisor

Appendix G:

Study 2 Questionnaire

ALL INFORMATION REMAINS STRICTLY CONFIDENTIAL

Demographic Information

This section is about you

1. Your Gender: ☐ Male ☐ Female 2. Your Age:___________________

3. Your marital status: ☐Single ☐Married ☐De facto ☐Separated ☐Divorced

4. Your ethnic background: ☐Caucasian ☐Aboriginal ☐Pacific Islander

☐Asian ☐Other:____________________________

5. Are you currently working / studying?

☐No ☐Part-time ☐Full-time (40 hrs/wk) ☐>60 hrs/wk

If yes, what is your present occupation____

6. What is your highest academic level of achievement?

☐ Primary School

☐ Secondary School

☐ Bachelor Degree

☐ Master's Degree

☐ PhD

☐ Other_________________________

This section is about your partner

1. Your partner’s gender: ☐Male ☐Female Your partner’s age:_______________

2. Your partner’s ethnic background: ☐Caucasian ☐Aboriginal ☐Pacific Islander ☐Asian ☐Other:__________________________

3. Is your partner currently working / studying?

☐No ☐Part-time ☐Full-time (40 hrs/wk) ☐>60 hrs/wk

If yes, what is your partner’s present occupation? _______________________________

4. What is your partner’s highest academic level of achievement?

☐ Primary School
☐ Secondary School
☐ Bachelor Degree
☐ Master’s Degree
☐ PhD
☐ Other________________________

This section is about your household

1. What is your current living arrangement? (Check all with whom you live)

☐Spouse/Partner ☐Child(ren) ☐Parent(s) ☐Live alone ☐Other relative(s)_____

2. Which of the following best describes your family’s annual gross income?

☐Under $15,000 ☐$30,001-$50,000 ☐$75,001-$100,000

☐$15,000-$30,000 ☐$50,001-$75,000 ☐$100,000 and above

This section is about your relationship with your partner

3. If married or living together, how long have you been married or living together? _______

4. If separated or divorced, how long have you been apart?_________________________

Information on Diagnosis

This section is about your children

4. Have you had any biological children with your partner?

☐Yes ☐No If yes, how many biological children do you have?____________

What are their ages in years (from oldest to youngest ___________________________

Have any of these children been diagnosed with:

☐Autism ☐Asperger's Syndrome

☐High Functioning Autism ☐Pervasive Developmental Disorder Not Otherwise Specified

If yes, please indicate age(s) here____

5. Do you have any step-children?

☐Yes ☐No If yes, how many step-children do you have? ______________

What are their ages in years (from oldest to youngest)___________________________

Have any of these children been diagnosed with:

☐Autism ☐Asperger's Syndrome

☐High Functioning Autism ☐Pervasive Developmental Disorder Not Otherwise Specified

If yes, please indicate age(s) here____

6. How many of your biological or/and step-children are currently living with you?_______

This section is about you

2. Have you been identified with:

☐Asperger's Syndrome ☐ Chronic Fatigue Syndrome

☐Autism

☐High Functioning Autism

☐Pervasive Developmental Disorder-NOS

☐ Depression

☐ An Anxiety Disorder

☐ Eating Disorder

☐ Attention Deficit Hyperactivity Disorder

☐ Bipolar Disorder

☐ Immune Deficiency Disorder

☐ Muscular problems

☐ Fibromyalgia

☐ Skin Disorders

☐ Tourette's Syndrome

☐ Insomnia

☐ Migraine

☐ Other condition (please specify)_____

If you have indicated any of the above, have formal diagnoses being made?

☐Yes ☐No

How long ago were the diagnoses made (in years)? ____________________________

This section is about your partner

2. Has your partner been identified with:

☐Asperger's Syndrome

☐ Chronic Fatigue Syndrome

☐Autism

☐High Functioning Autism

☐Pervasive Developmental Disorder-NOS

☐ Depression

☐ An Anxiety Disorder

☐ Eating Disorder

☐ Attention Deficit Hyperactivity Disorder

☐ Bipolar Disorder

☐ Immune Deficiency Disorder

☐ Muscular problems

☐ Fibromyalgia

☐ Skin Disorders

☐ Tourette’s Syndrome

☐ Insomnia

☐ Migraine

☐ Other condition (please specify)_____

If you have indicated any of the above, have formal diagnoses being made?

☐Yes ☐No

How long ago were the diagnoses made (in years)? ___________________________

Future Studies

Are you happy for us to contact you for our follow-up studies?

☐Yes ☐No

If yes, please provide your contact details below:

Your postal address: ______________________________

____

Your name (if desired): ______________________________

Your email address (if desired): ______________________________

Your phone number (if desired): ______________________________

(Note: The information in this section will be detached before the data are coded or analyzed so as to safeguard your privacy and confidentiality)

Please indicate how true each statement is to you.

		Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
1.	I prefer to do things with others rather than on my own.	1	2	3	4
2.	I prefer to do things the same way over and over again.	1	2	3	4
3.	If I try to imagine something, I find it very easy to create a picture in my mind.	1	2	3	4
4.	I frequently get so strongly absorbed in one thing that I lose sight of other things.	1	2	3	4
5.	I often notice small sounds when others do not.	1	2	3	4
6.	I usually notice car number plates or similar strings of information.	1	2	3	4
7.	Other people frequently tell me that what I've said is impolite, even though I think it is polite.	1	2	3	4
8.	When I'm reading a story, I can easily imagine what the characters might look like.	1	2	3	4
9.	I am fascinated by dates.	1	2	3	4
10.	In a social group, I can easily keep track of several different people's conversations.	1	2	3	4
11.	I find social situations easy.	1	2	3	4
12.	I tend to notice details that others do not.	1	2	3	4
13.	I would rather go to a library than a party.	1	2	3	4
14.	I find making up stories easy.	1	2	3	4
15.	I find myself drawn more strongly to people than to	1	2	3	4

		Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
	things.				
16.	I tend to have very strong interests which I get upset about if I can't pursue.	1	2	3	4
17.	I enjoy social chit-chat.	1	2	3	4
18.	When I talk, it isn't always easy for others to get a word in edgeways.	1	2	3	4
19.	I am fascinated by numbers.	1	2	3	4
20.	When I'm reading a story, I find it difficult to work out the characters' intentions.	1	2	3	4
21.	I don't particularly enjoy reading fiction.	1	2	3	4
22.	I find it hard to make new friends.	1	2	3	4
23.	I notice patterns in things all the time.	1	2	3	4
24.	I would rather go to the theatre than a museum.	1	2	3	4
25.	It does not upset me if my daily routine is disturbed.	1	2	3	4
26.	I frequently find that I don't know how to keep a conversation going.	1	2	3	4
27.	I find it easy to "read between the lines" when someone is talking to me.	1	2	3	4
28.	I usually concentrate more on the whole picture, rather than the small details.	1	2	3	4
29.	I am not very good at remembering phone numbers.	1	2	3	4

		Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
30.	I don’t usually notice small changes in a situation, or a person’s appearance.	1	2	3	4
31.	I know how to tell if someone listening to me is getting bored.	1	2	3	4
32.	I find it easy to do more than one thing at once.	1	2	3	4
33.	When I talk on the phone, I’m not sure when it’s my turn to speak.	1	2	3	4
34.	I enjoy doing things spontaneously.	1	2	3	4
35.	I am often the last to understand the point of a joke.	1	2	3	4
36.	I find it easy to work out what someone is thinking or feeling just by looking at their face.	1	2	3	4
37.	If there is an interruption, I can switch back to what I was doing very quickly.	1	2	3	4
38.	I am good at social chit-chat.	1	2	3	4
39.	People often tell me that I keep going on and on about the same thing.	1	2	3	4
40.	When I was young, I used to enjoy playing games involving pretending with other children.	1	2	3	4
41.	I like to collect information about categories of things (e.g. types of car, types of bird, types of train, types of plant, etc.).	1	2	3	4
42.	I find it difficult to imagine what it would be like to be someone else.	1	2	3	4
43.	I like to plan any activities I participate in carefully.	1	2	3	4

		Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
44.	I enjoy social occasions.	1	2	3	4
45.	I find it difficult to work out people's intentions.	1	2	3	4
46.	New situations make me anxious.	1	2	3	4
47.	I enjoy meeting new people.	1	2	3	4
48.	I am a good diplomat.	1	2	3	4
49.	I am not very good at remembering people's date of birth.	1	2	3	4
50.	I find it very easy to play games with children that involve pretending.	1	2	3	4

ALL INFORMATION REMAINS STRICTLY CONFIDENTIAL

Demographic Information

This section is about you

1. Your Gender: ☐ Male ☐ Female

2. Your Age:___________________

3. Your marital status: ☐Single ☐Married ☐De facto ☐Separated ☐Divorced

4. Your ethnic background: ☐Caucasian ☐Aboriginal ☐Pacific Islander ☐Asian ☐Other:____________________________

5. Are you currently working / studying?

☐No ☐Part-time ☐Full-time (40 hrs/wk) ☐>60 hrs/wk

If yes, what is your present occupation____

6. What is your highest academic level of achievement?

☐	Primary School	☐	Master's Degree
☐	Secondary School	☐	PhD
☐	Bachelor Degree	☐	Other_________________________

This section is about your household

1. What is your current living arrangement? (Check all with whom you live)

☐Spouse/Partner ☐Child(ren) ☐Parent(s) ☐Live alone ☐Other relative(s)_____

2. Which of the following best describes your family's annual gross income?

☐Under $15,000 ☐$30,001-$50,000 ☐$75,001-$100,000

☐$15,000-$30,000 ☐$50,001-$75,000 ☐$100,000 and above

This section is about your relationship with your partner (if applicable)

5. If married or living together, how long have you been married or living together? _______

6. If separated or divorced, how long have you been apart?________________________

Information on Diagnosis

This section is about your children (if applicable)

7. Have you had any biological children with your partner?

☐Yes ☐No If yes, how many biological children do you have?____________

What are their ages in years (from oldest to youngest ___________________________

Have any of these children been diagnosed with:

☐Autism ☐Asperger's Syndrome

☐High Functioning Autism ☐Pervasive Developmental Disorder Not Otherwise Specified

If yes, please indicate age(s) here____

8. Do you have any step-children?

☐Yes ☐No If yes, how many step-children do you have? ______________

What are their ages in years (from oldest to youngest)___________________________

Have any of these children been diagnosed with:

☐Autism ☐Asperger's Syndrome

☐High Functioning Autism ☐Pervasive Developmental Disorder Not Otherwise Specified

If yes, please indicate age(s) here____

9. How many of your biological or/and step-children are currently living with you?_______

This section is about you

10. Have you been identified with:

☐Asperger’s Syndrome

☐Autism

☐High Functioning Autism

☐Pervasive Developmental Disorder-NOS

☐ Depression

☐ An Anxiety Disorder

☐ Eating Disorder

☐ Attention Deficit Hyperactivity Disorder

☐ Bipolar Disorder

☐ Chronic Fatigue Syndrome

☐ Immune Deficiency Disorder

☐ Muscular problems

☐ Fibromyalgia

☐ Skin Disorders

☐ Tourette’s Syndrome

☐ Insomnia

☐ Migraine

☐ Other condition (please specify)_____

If you have indicated any of the above, have formal diagnoses being made?

☐Yes ☐No

How long ago were the diagnoses made (in years)? ____________________________

Future Studies

Are you happy for us to contact you for our follow-up studies?

☐Yes ☐No

If yes, please provide your contact details below:

Your postal address: ____________________________________

____

Your name (if desired): ____________________________________

Your email address (if desired): ____________________________________

Your phone number (if desired): ____________________________________

(Note: The information in this section will be detached before the data are coded or analyzed so as to safeguard your privacy and confidentiality)

Please indicate how true each statement is to you.

		Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
1.	I prefer to do things with others rather than on my own.	1	2	3	4
2.	I prefer to do things the same way over and over again.	1	2	3	4
3.	If I try to imagine something, I find it very easy to create a picture in my mind.	1	2	3	4
4.	I frequently get so strongly absorbed in one thing that I lose sight of other things.	1	2	3	4
5.	I often notice small sounds when others do not.	1	2	3	4
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7.	Other people frequently tell me that what I’ve said is impolite, even though I think it is polite.	1	2	3	4
8.	When I’m reading a story, I can easily imagine what the characters might look like.	1	2	3	4
9.	I am fascinated by dates.	1	2	3	4
10.	In a social group, I can easily keep track of several different people’s conversations.	1	2	3	4
11.	I find social situations easy.	1	2	3	4
12.	I tend to notice details that others do not.	1	2	3	4
13.	I would rather go to a library than a party.	1	2	3	4
14.	I find making up stories easy.	1	2	3	4
15.	I find myself drawn more strongly to people than to	1	2	3	4

		Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
	things.				
16.	I tend to have very strong interests which I get upset about if I can't pursue.	1	2	3	4
17.	I enjoy social chit-chat.	1	2	3	4
18.	When I talk, it isn't always easy for others to get a word in edgeways.	1	2	3	4
19.	I am fascinated by numbers.	1	2	3	4
20.	When I'm reading a story, I find it difficult to work out the characters' intentions.	1	2	3	4
21.	I don't particularly enjoy reading fiction.	1	2	3	4
22.	I find it hard to make new friends.	1	2	3	4
23.	I notice patterns in things all the time.	1	2	3	4
24.	I would rather go to the theatre than a museum.	1	2	3	4
25.	It does not upset me if my daily routine is disturbed.	1	2	3	4
26.	I frequently find that I don't know how to keep a conversation going.	1	2	3	4
27.	I find it easy to "read between the lines" when someone is talking to me.	1	2	3	4
28.	I usually concentrate more on the whole picture, rather than the small details.	1	2	3	4
29.	I am not very good at remembering phone numbers.	1	2	3	4

		Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
30.	I don’t usually notice small changes in a situation, or a person’s appearance.	1	2	3	4
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32.	I find it easy to do more than one thing at once.	1	2	3	4
33.	When I talk on the phone, I’m not sure when it’s my turn to speak.	1	2	3	4
34.	I enjoy doing things spontaneously.	1	2	3	4
35.	I am often the last to understand the point of a joke.	1	2	3	4
36.	I find it easy to work out what someone is thinking or feeling just by looking at their face.	1	2	3	4
37.	If there is an interruption, I can switch back to what I was doing very quickly.	1	2	3	4
38.	I am good at social chit-chat.	1	2	3	4
39.	People often tell me that I keep going on and on about the same thing.	1	2	3	4
40.	When I was young, I used to enjoy playing games involving pretending with other children.	1	2	3	4
41.	I like to collect information about categories of things (e.g. types of car, types of bird, types of train, types of plant, etc.).	1	2	3	4
42.	I find it difficult to imagine what it would be like to be someone else.	1	2	3	4
43.	I like to plan any activities I participate in carefully.	1	2	3	4

		Definitely Agree	Slightly Agree	Slightly Disagree	Definitely Disagree
44.	I enjoy social occasions.	1	2	3	4
45.	I find it difficult to work out people’s intentions.	1	2	3	4
46.	New situations make me anxious.	1	2	3	4
47.	I enjoy meeting new people.	1	2	3	4
48.	I am a good diplomat.	1	2	3	4
49.	I am not very good at remembering people’s date of birth.	1	2	3	4
50.	I find it very easy to play games with children that involve pretending.	1	2	3	4

Appendix I:

Chinese Version of the Autism Spectrum Quotient

成人自閉症狀量表

(The Adult Autism Spectrum Quotient)

請仔細閱讀每一個敘述，並請在右側適當的□勾選您認為最適合的答案。

不用花很多時間在問題上，請您快速並誠實的回答。

		絕對同意	有一點同意	有一點不同意	絕不同意
1.	我比較喜歡與人共事，而不是獨自工作。	□	□	□	□
2.	我喜歡一再地用相同的方法做事。	□	□	□	□
3.	如果我嘗試去想像某件事物，可以很輕易地在腦中浮現圖像。	□	□	□	□
4.	我經常因為被一件事物強烈吸引，以致於忽略了其他的事物。	□	□	□	□
5.	我經常注意到別人沒注意到的微小聲響。	□	□	□	□
6.	我時常會注意車牌號碼、或類似的一串訊息。	□	□	□	□
7.	雖然我覺得我所說的話是禮貌的，但其他人仍然經常告訴我，我說的話不太禮貌。	□	□	□	□
8.	當我閱讀故事時，可以很輕易地想像書中角色的模樣。	□	□	□	□

9.	我對日期著迷。	□	□	□	□
10.	在一個社交團體中，我可以輕鬆地跟上幾個不同人的對話。	□	□	□	□
11.	我在社交場合中覺得輕鬆自在。	□	□	□	□
12.	我傾向於去注意別人不會注意的細節。	□	□	□	□
13.	我寧願去圖書館，而不去派對。	□	□	□	□
14.	我覺得編故事是容易的。	□	□	□	□
15.	我覺得自己更容易被人、而非事物所吸引。	□	□	□	□
16.	我容易產生非常強烈的興趣，當我不能投入去作的時候，我就會心煩不高興。	□	□	□	□
17.	我喜歡社交閒談。	□	□	□	□
18.	當我說話時，別人常不容易插話。	□	□	□	□
19.	我對數字著迷。	□	□	□	□
20.	當我閱讀故事時，我覺得很難猜測出書中角色的意圖。	□	□	□	□
21.	我不會特別喜歡閱讀小說。	□	□	□	□
22.	我發現要交新朋友是很困難的。	□	□	□	□
23.	我總是會注意到事物當中的樣式類型。	□	□	□	□
24.	我寧願去電影院，而不去博物館。	□	□	□	□
25.	當我每日的例行作息被打亂時，我不會心煩不高興。	□	□	□	□
26.	我常發現我不知道如何讓對話持續下去。	□	□	□	□

27.	當別人跟我說話時，我覺得要了解其中的弦外之音是容易的。	□	□	□	□
28.	我經常比較專注於整體，而不是小細節。	□	□	□	□
29.	我不擅於記住電話號碼。	□	□	□	□
30.	我經常不能注意到環境中，或是別人外觀上的小變化。	□	□	□	□
31.	我知道如何分辨正在聽我說話的人是否感到無趣。	□	□	□	□
32.	我覺得同時作超過一件以上的事情是容易的。	□	□	□	□
33.	當我在講電話時，我不確定何時輪到我開口。	□	□	□	□
34.	我喜歡自動自發地做事情。	□	□	□	□
35.	我通常是最後一個知道笑話中笑點的人。	□	□	□	□
36.	我發現僅由看對方的臉、就弄清楚他們在想什麼或有什麼感覺是容易的。	□	□	□	□
37.	假如被打斷，我也可以很快地回到剛剛正在做的事。	□	□	□	□
38.	我很擅於社交閒談。	□	□	□	□
39.	人們常說我一直都在做同一件事。	□	□	□	□
40.	當我年紀還小時，我樂於和其他孩子一起玩假扮的遊戲。	□	□	□	□
41.	我喜歡收集關於事物分類的資訊（例如：汽車、鳥、火車、植物的種類等。）	□	□	□	□

42.	我很難想像自己變成另外一個人會是什麼樣子。	□	□	□	□
43.	我喜歡小心地計畫任何我所參與的活動。	□	□	□	□
44.	我享受社交場合。	□	□	□	□
45.	我覺得要弄清楚別人的意圖是困難的。	□	□	□	□
46.	新的情境令我焦慮。	□	□	□	□
47.	我喜歡認識新的人。	□	□	□	□
48.	我是個擅於交際的人。	□	□	□	□
49.	我不是很擅長記得別人的生日。	□	□	□	□
50.	我覺得和小孩子玩假扮的遊戲是很容易的。	□	□	□	□

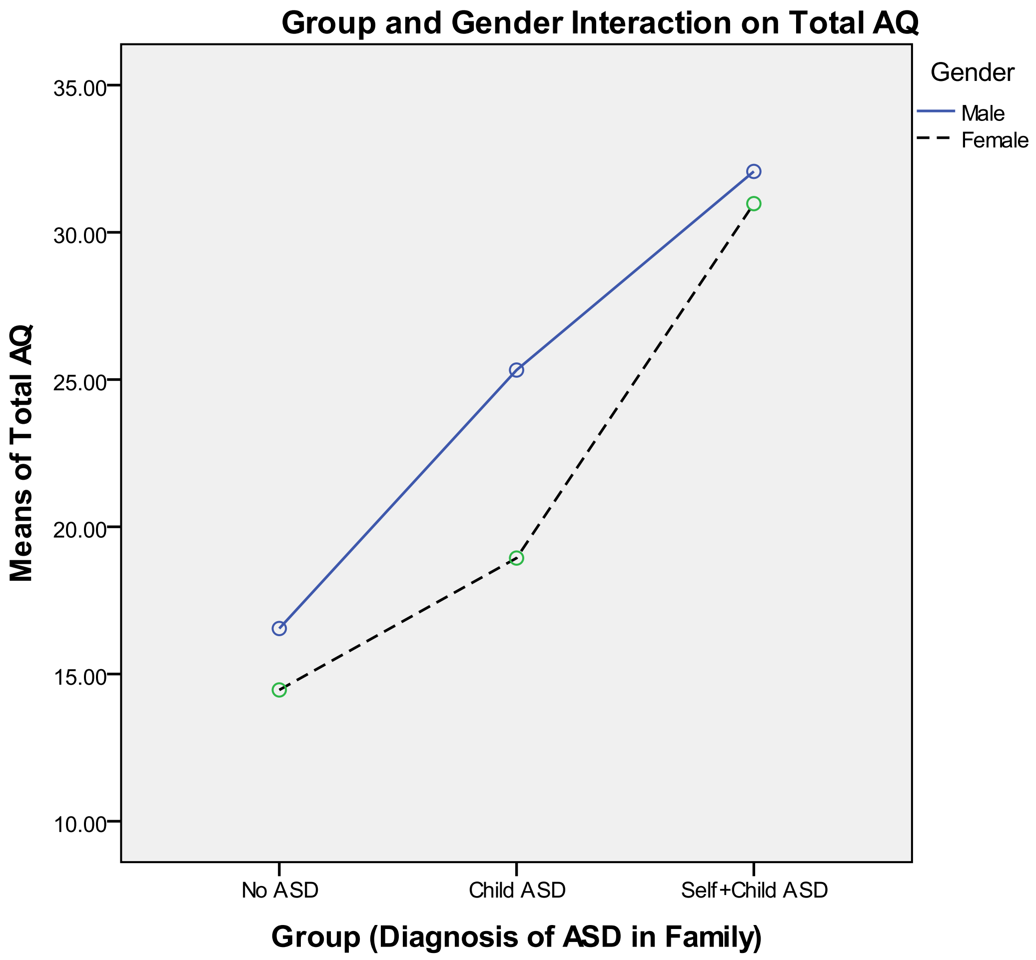

Figure 5 Group and Gender Effect for Total AQ

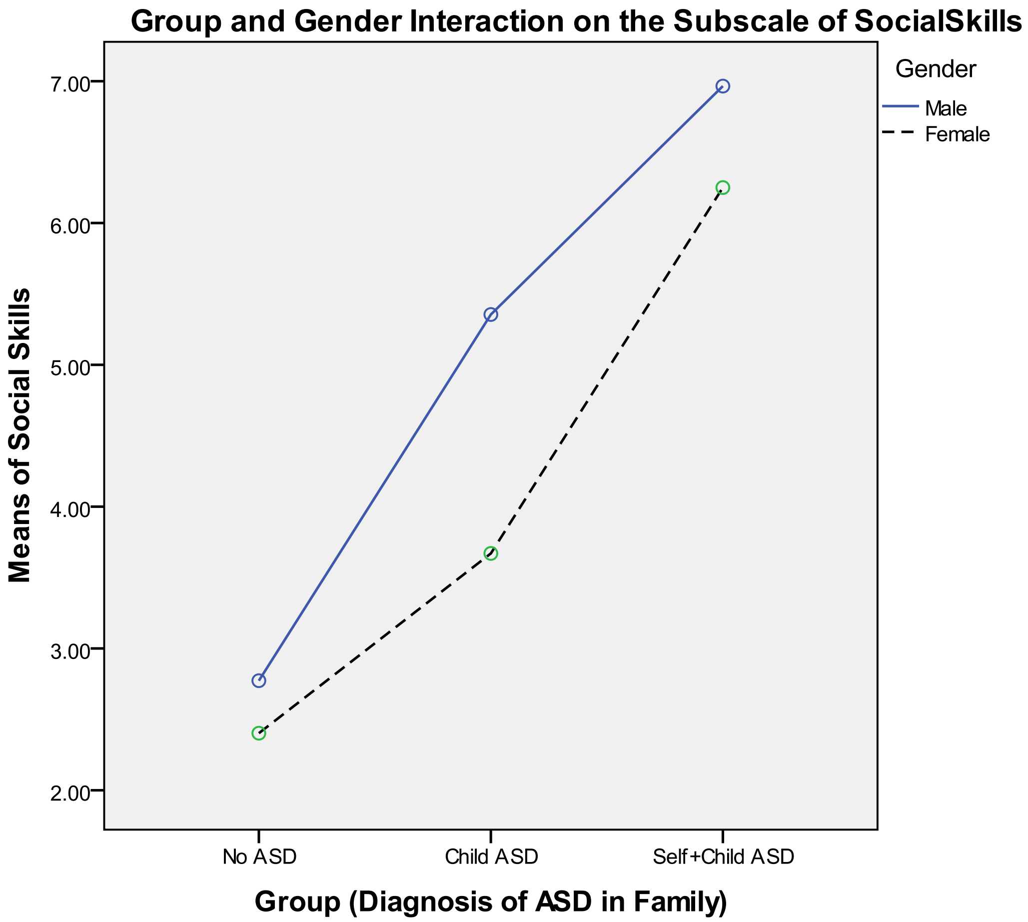

Figure 6 Group and Gender Effect for the Subscale of Social Skills

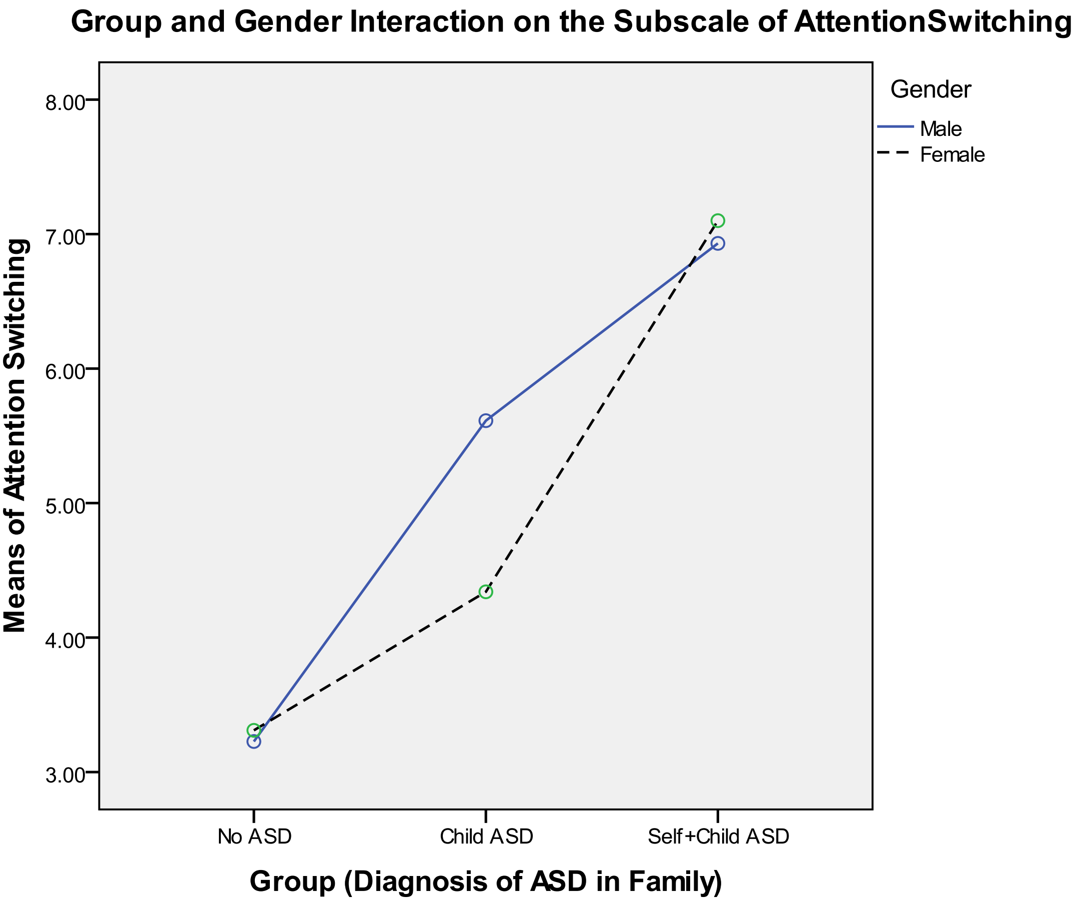

Figure 7 Group and Gender Effect for the Subscale of Attention Switching

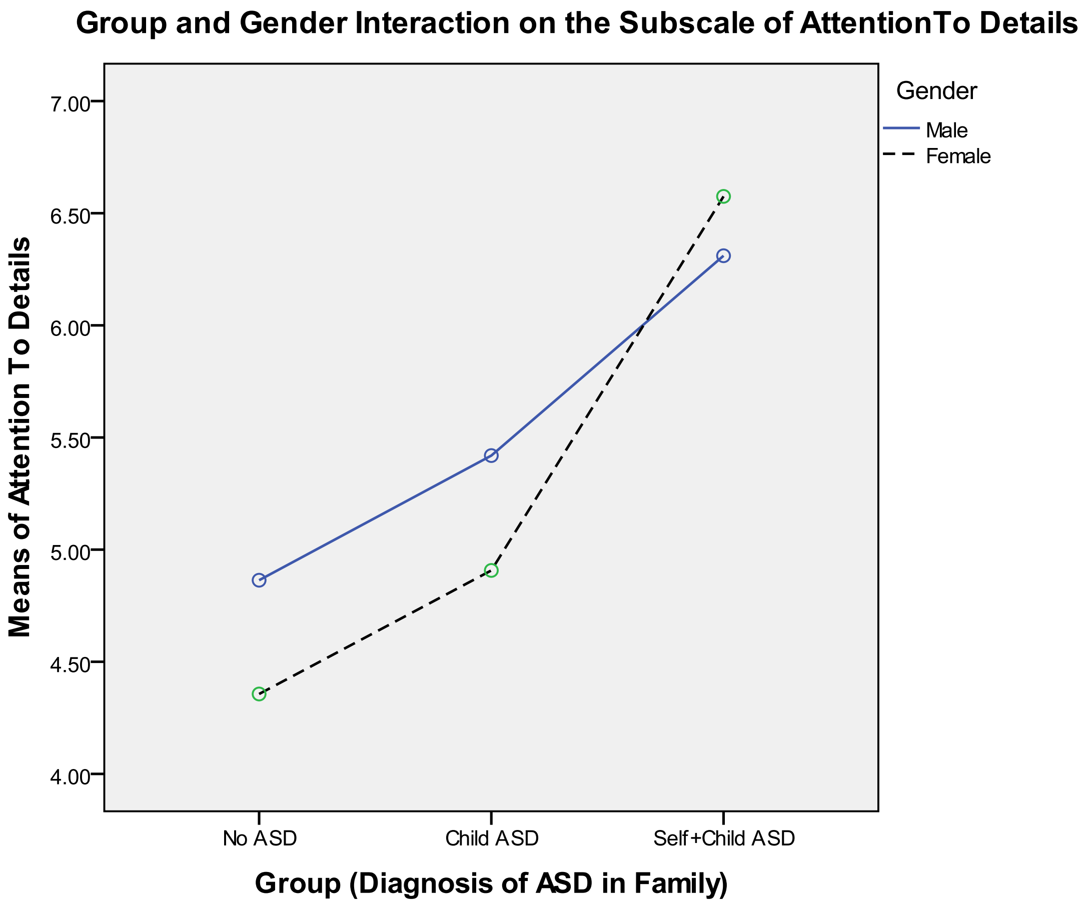

Figure 8 Group and Gender Effect for the Subscale of Attention To Details

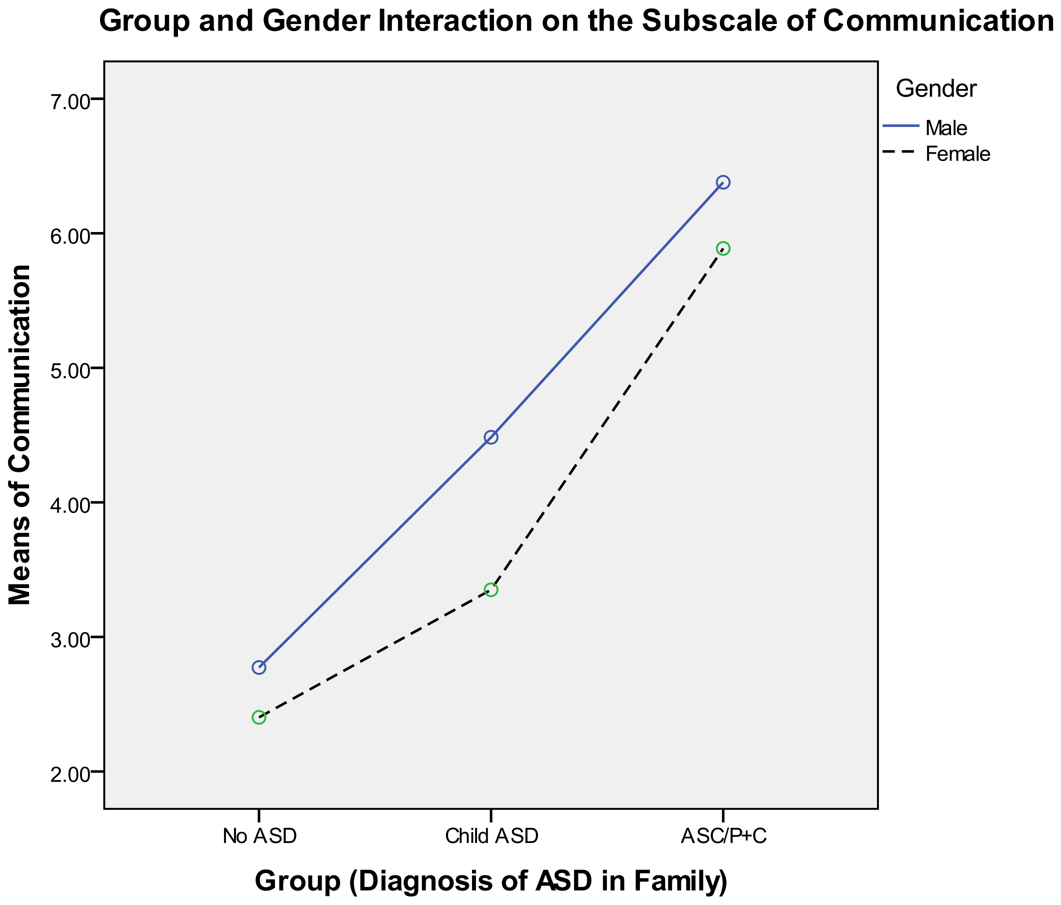

Figure 9 Group and Gender Effect for the Subscale of Communication

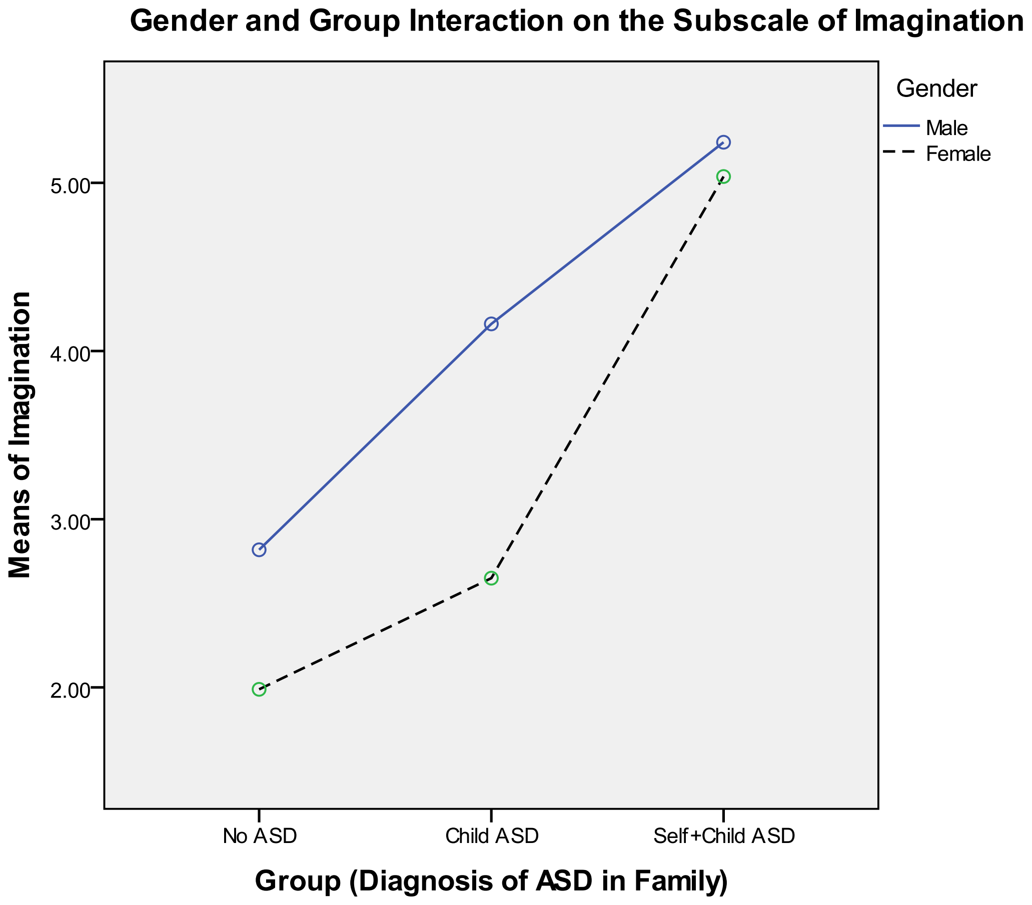

Figure 10 Group and Gender Effect for the Subscale of Imagination

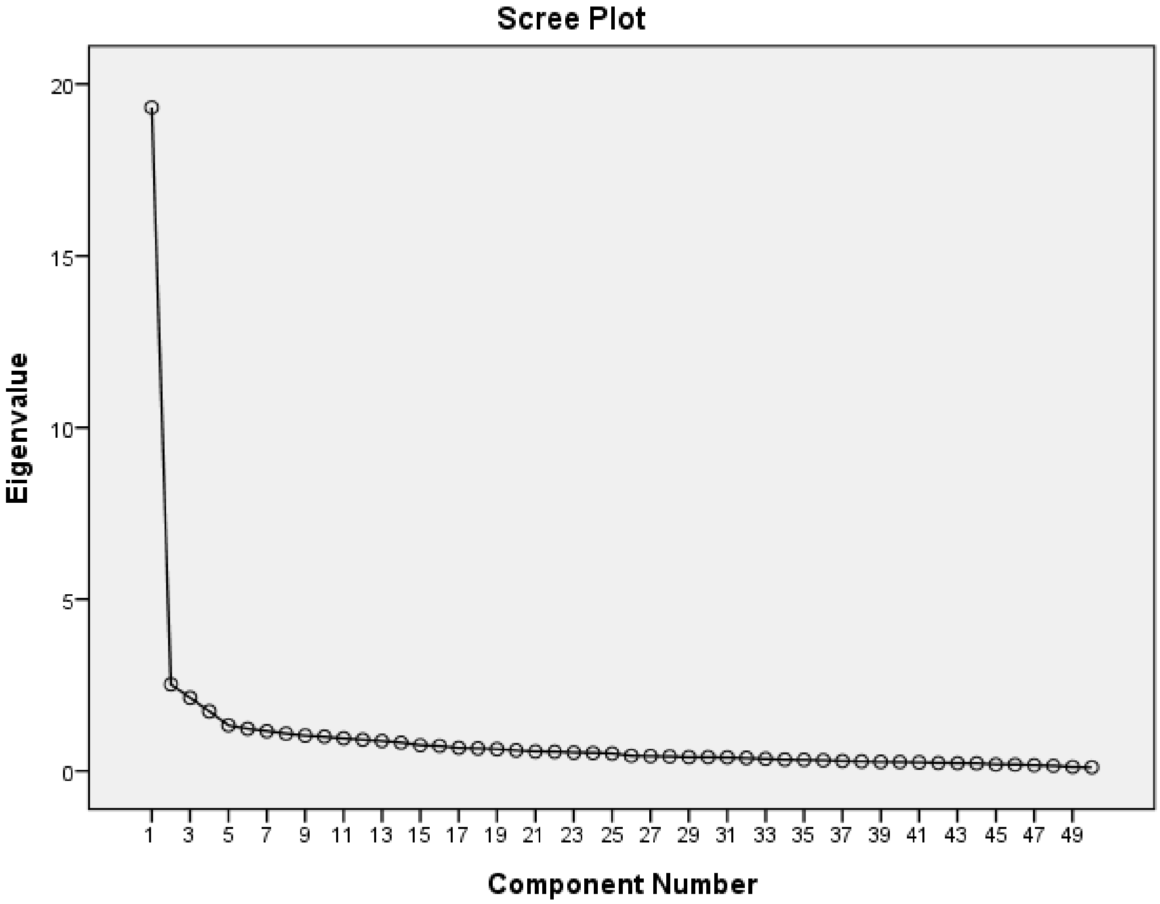

Figure 11 Scree plot for AQ-39

Parallel Analysis:

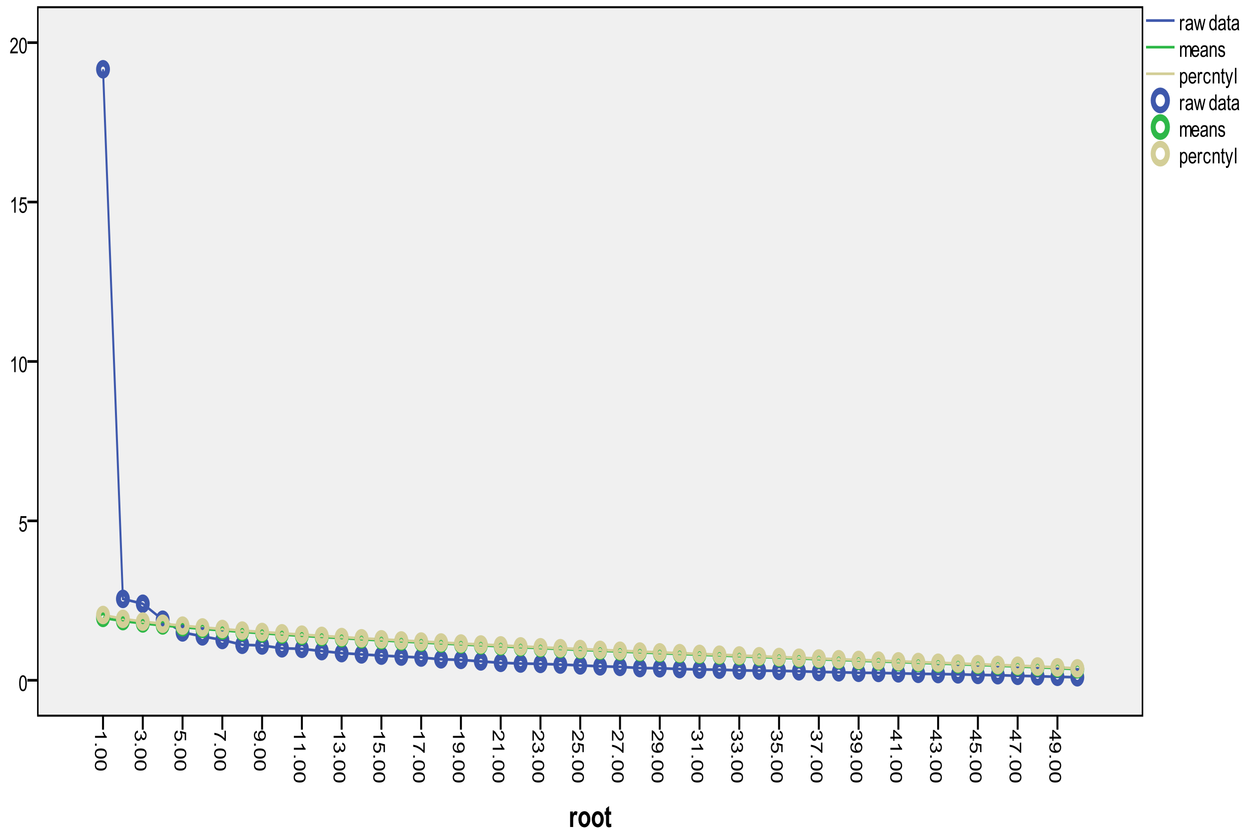

Figure 12 Horn's parallel analysis using total sample

Principal Components & Random Normal Data Generation

Raw Data Eigenvalues, & Mean & Percentile Random Data Eigenvalues

Root	Raw Data	Means	Percentile
1.000000	19.165600	1.956467	2.046750
2.000000	2.552292	1.856034	1.926744
3.000000	2.399851	1.783414	1.840510
4.000000	1.899128	1.719991	1.772846
5.000000	1.501569	1.664269	1.713259
6.000000	1.377014	1.612214	1.656865
7.000000	1.263779	1.564079	1.608008
8.000000	1.113500	1.518056	1.558003
9.000000	1.091109	1.474606	1.514258
10.000000	1.002868	1.433654	1.472981

Table 2 Variance Explained for AQ-39 Responses

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	19.268	38.536	38.536	9.768	19.536	19.536
2	2.690	5.380	43.916	4.417	8.835	28.371
3	2.225	4.450	48.366	3.885	7.771	36.142
4	1.794	3.588	51.954	3.512	7.024	43.166
5	1.399	2.799	54.753	2.452	4.903	48.069

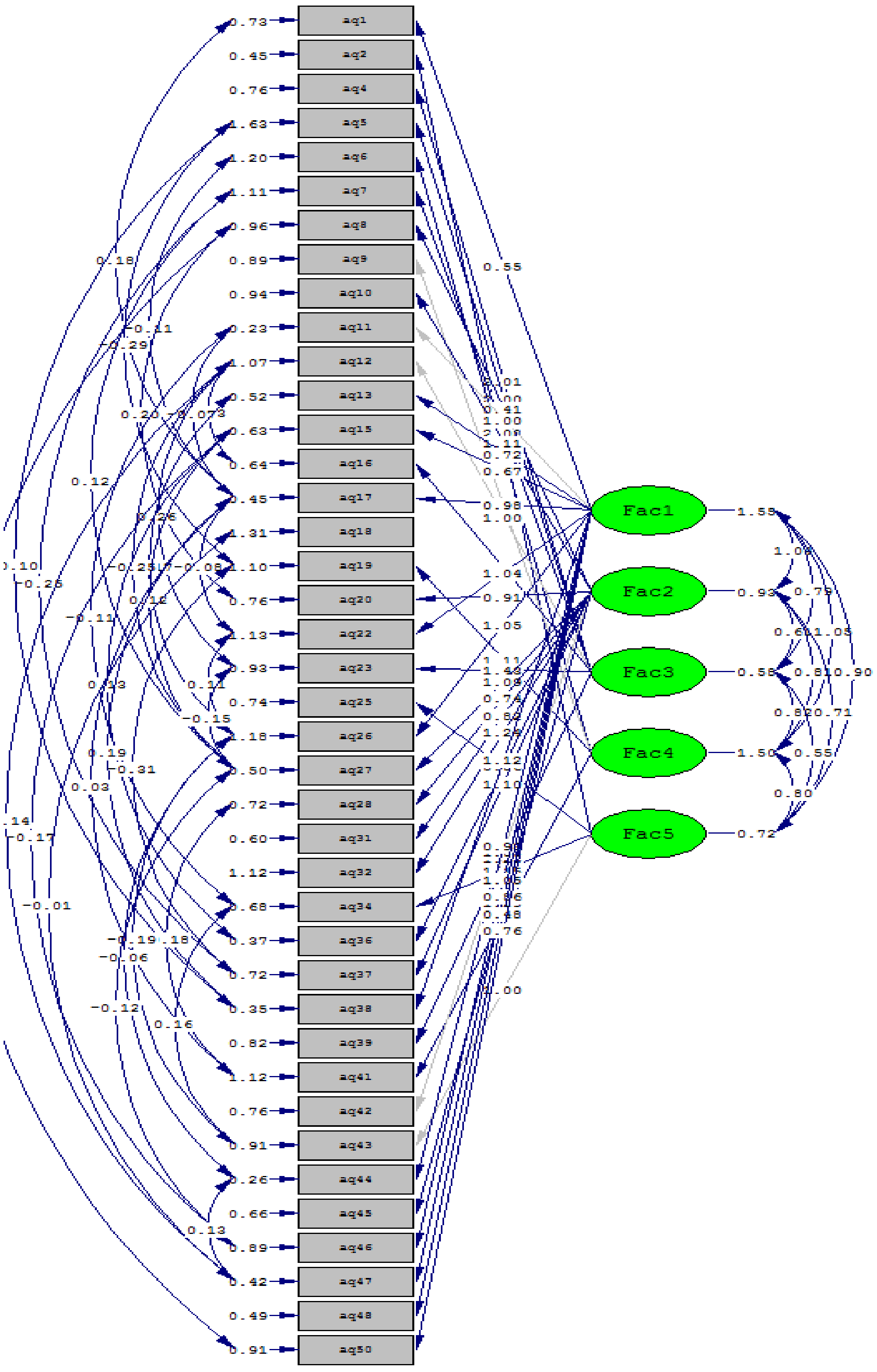

Figure 13 AQ-39

Table 3 Multi-group confirmatory factor analysis goodness of fit statistics for AQ-39 using the ASD group and non-ASD group

Sample Group	N	χ^2	χ^2/df[1]	RMSEA[2] [90% CI]	CFI[3]	AIC[4]
ASD group	141	305.61*	0.44	.000(.000-.000)	1.00	538.65
Non-ASD group	314	1828.14*	2.92	.0733(.069-.078)	.974	1940.15
Original sample for CFA	155	1861.28*	2.82	.071(.066-.075)	.976	1763.05

Notes:

*p<.001;

χ^2=Chi-square test statistics;

df=degrees of freedom;

RMSEA=root-mean-square-error of approximation;

90% CI=90% confidence interval for RMSEA;

CFI=comparative fit index;

AIC=Akaike information criteria.

---

[1] A value of χ^2/ df between 1 and 3 indicates the model fits the data well (Gable & Wolf, 1993).

[2] A RMSEA value less than .06 indicates good fit; values ranging from .08 to .10 indicate a mediocre fit; and those greater than .10 indicate poor fit (Hu & Bentler, 1995).

[3] A value of CFI exceeds .95 indicates adequate fit (Browne & Cudeck, 1993).

[4] The smaller the AIC value indicates the model is more parsimonious and provides better fit to the data (Akaike, 1987).

Table 4 Congruence coefficients across factors

	ASC Group (X)	non-ASC Group (Y)	XY	X^2	Y^2
Fac 1	1.089	1.246	1.357	1.186	1.553
Fac 2	0.826	1.050	0.867	0.682	1.103
Fac 3	0.689	0.700	0.482	0.475	0.490
Fac 4	0.819	0.878	0.719	0.671	0.771
Fac 5	0.528	0.711	0.375	0.279	0.506
			$\sum XY = 3.800$	$\sum X^2 = 3.293$	$\sum Y^2 = 4.423$

Coefficient of Congruence

$$r_c = \frac{\sum XY}{\sqrt{\sum X^2 \sum Y^2}}$$

$$= 3.800/\sqrt{14.565}$$

$$= 0.996$$[5]

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[5] Van de Vijver and Leung (1997, p. 92) argue that values greater than 0.95 provide evidence for factorial similarity, whereas values smaller than 0.85 indicate non-negligible incongruities.

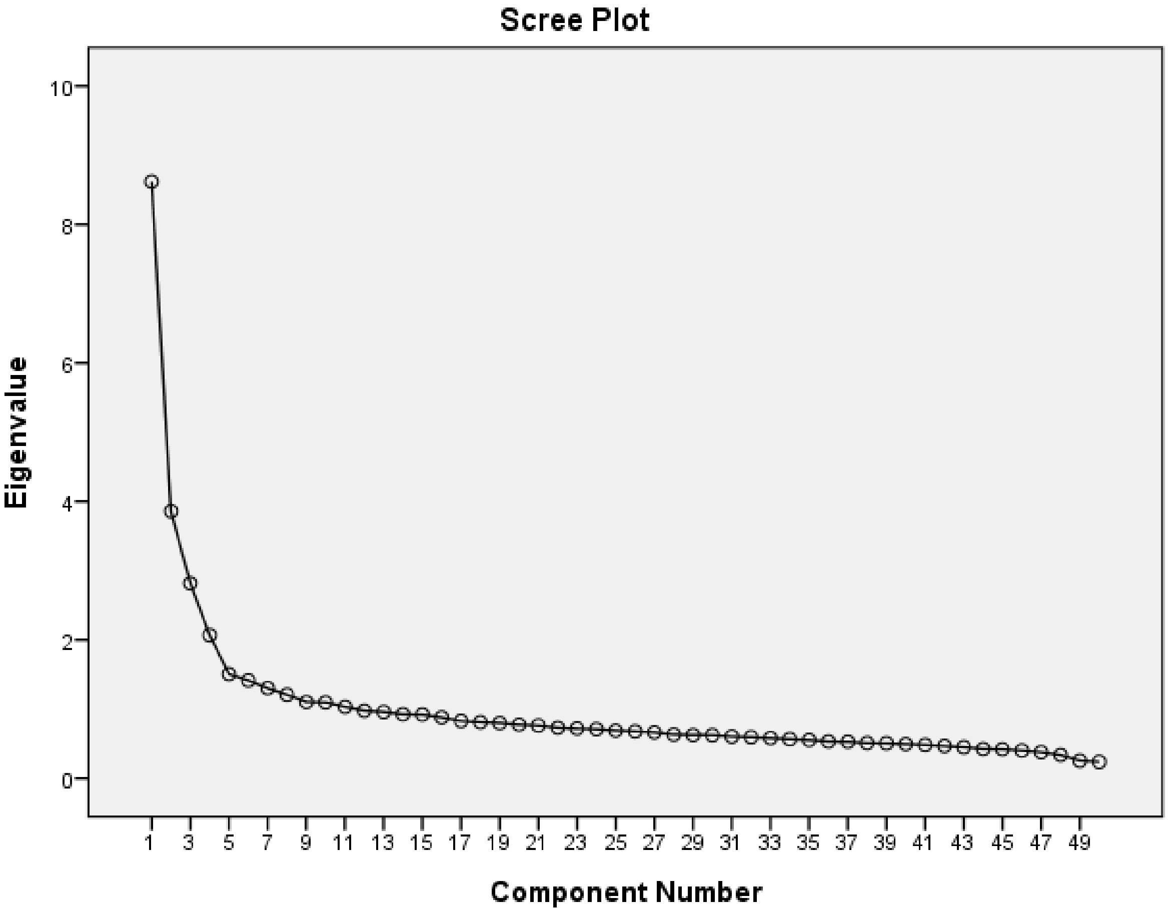

Figure 14 Scree plot for AQ-Chinese

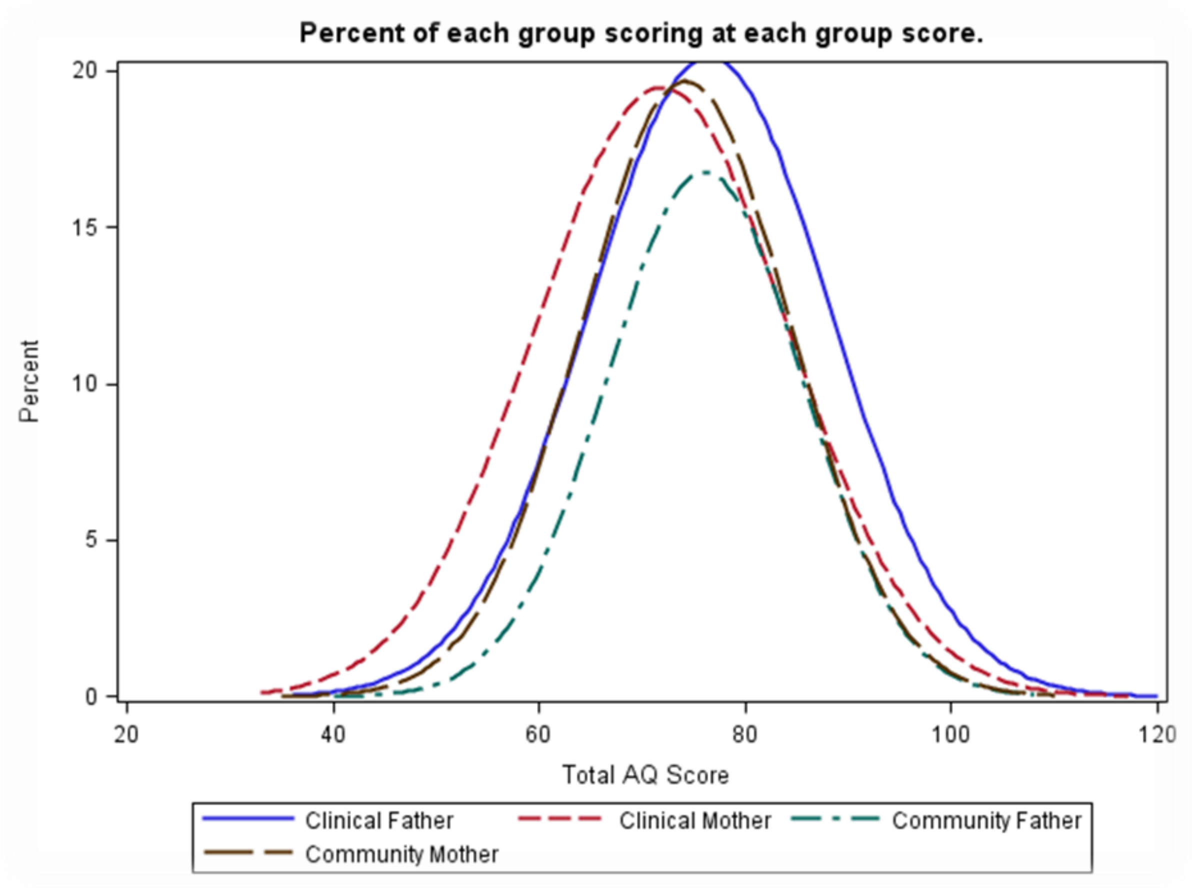

Figure 15 Distribution of Total AQ-Chinese Scores of Clinical and Community Sample Stratified by Gender