Factors Influencing Psychosocial Outcomes for High-Functioning Adults with Autism Spectrum Disorder

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Abstract

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition that is characterised by deficits in social interaction and communication as well as restricted behaviours or interests (American Psychiatric Association, 2013). Commonly referred to as high-functioning, adults with ASD with no co-occurring intellectual disability present with heterogeneous ASD characteristics and psychosocial profiles. While some individuals value specific characteristics associated with a diagnosis of ASD, others report feeling isolated and rejected by society. However, there is currently a poor understanding of the factors that account for variations in psychosocial outcomes, conceptualised in this research as mental health and social and adaptive functioning. Comprised of four main studies, the broad objective of this thesis was to advance understanding of factors influencing the psychosocial outcomes for this population.

Study 1 employed systematic review methodology to identify quantitative studies investigating factors associated with psychosocial outcomes for high-functioning adults with ASD. The findings of 27 studies published between 1989 and 2015 (\(N = 1398; M\) age = 28.54 years; 71.6% males) were qualitatively synthesised. The factors most consistently related to poorer psychosocial outcomes included: greater ASD symptom severity, lower childhood IQ, impaired non-verbal learning and cognitive shifting deficits. There was also preliminary support concerning associations between negative thinking styles, maladaptive coping, perceptions of low social support and poor mental health. Key gaps in the literature related to understanding the impact of higher-order cognitive abilities (i.e., cold and hot executive functions) and personal and social resources on psychosocial outcomes.

Guided by the findings of the review, the broad aim of study 2 was to clarify the nature of executive function impairments in high-functioning adults with ASD. Forty-two adults with ASD (64% male, aged 18-66 years) and 40 controls matched on age and gender
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were administered a battery of tests of cold and hot executive functions. The findings revealed that ASD participants demonstrated generalised executive impairments relative to controls. In addition, ASD participants performed more poorly on emotion recognition and social inference tasks than controls after controlling for cold executive functions.

Study 3 aimed to examine the associations between ASD characteristics, executive functions and psychosocial outcomes. The same 42 adults with ASD from study 2 were administered tests of cold and hot executive functions and self-report questionnaires. Greater social anxiety and circumscribed interests were found to be related to impaired cognitive flexibility and social inference (respectively). Individuals with very good social and adaptive outcomes showed better emotion recognition, non-verbal reasoning and cognitive flexibility than those with good outcomes. There were conflicting findings concerning the associations between executive functions and mental health. Specifically, stronger hot and cold executive functions were related to lower levels of anxiety but were also associated with more negative self-concept.

Study 4 primarily aimed to examine the role of personal and social resources as vulnerability or protective factors in the relationship between ASD characteristics and psychosocial outcomes. Using an online survey, 144 participants (43% male, aged 18-70 years) completed self-report measures of ASD characteristics, appraisals, coping, social support, mental health and questions related to social and adaptive functioning. Overall, there was support for the vulnerability hypothesis, whereby negative ASD appraisals and lower perceived social support significantly mediated the relationship between greater ASD characteristics and poorer mental health outcomes.

Overall, this thesis significantly extends the ASD literature in five main ways. First, study 1 highlighted that adults with greater ASD characteristics are most at risk for poor psychosocial outcomes. Second, study 2 demonstrated both the independence and inter-
relatedness of impairments in cold and hot executive functions for the ASD population, providing preliminary support for the functional modularity of social cognition. Third, study 3 findings indicate that ASD characteristics are largely unrelated to impairments in hot and cold executive function and that only certain indices of executive function help to distinguish between social and adaptive functioning outcomes. Fourth, adults with ASD with weaker executive functions may be more prone to anxiety, whereas those with stronger executive functions may experience poorer self-concept. Fifth, study 4 identified that negative ASD appraisals and lower perceptions of social support can explain why adults with greater ASD characteristics are more vulnerable to poor mental health outcomes. Collectively, these findings have important implications for assessment, intervention practices and future research for high-functioning adults with ASD.
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Statement of Originality

This work has not been previously submitted for a degree or diploma in any university. To the best of my knowledge and belief, the dissertation contains no material previously published or written by another person except where due reference is made in the thesis itself.

David Zimmerman
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List of Abbreviations

AD  Autistic Disorder
ADHD  Attention Deficit Hyperactivity Disorder
AS  Asperger’s Syndrome
ASD  Autism Spectrum Disorder
CCS  Cybernetic Coping Scale
DASS  Depression, Anxiety and Stress Scales
DKEFS  Delis-Kaplan Executive Function System Sorting Test
DSM  Diagnostic Statistical Manual
ERQ  Emotion Regulation Questionnaire
FSIQ  Full Scale Intelligence Quotient
HFASD  High-Functioning Autism Spectrum Disorder
ICD  International Classification of Diseases
ICF  International Classification of Functioning, Disability and Health
ICQ  Illness Cognition Questionnaire
IQ  Intelligence Quotient
ISEL  Interpersonal Support Evaluation List
LNS  Letter Number Sequencing
MR  Matrix Reasoning
PDD  Pervasive Developmental Disorders
QoL  Quality of Life
RSES  Rosenberg Self-Esteem Scale
SFSCS  Six Factor Self-Concept Scale
RAADS-R  Ritvo Autism Asperger’s Diagnostic Scale – Revised
SPSS  Statistical Package for Social Sciences
TAS  Toronto Alexithymia Scale
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<td>WAIS</td>
<td>Wechsler Adult Intelligence Scale</td>
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<td>WISC</td>
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Section 9.1 of the Griffith University Code for the Responsible Conduct of Research (“Criteria for Authorship”), in accordance with Section 5 of the Australian Code for the Responsible Conduct of Research states:

To be named as an author, a researcher must have made a substantial scholarly contribution to the creative or scholarly work that constitutes the research output, and be able to take public responsibility for at least that part of the work they contributed. Attribution of authorship depends to some extent on the discipline and publisher policies, but in all cases, authorship must be based on substantial contributions in a combination of one or more of:

- Conception and design of the research project
- Analysis and interpretation of research data
- Drafting or making significant parts of the creative or scholarly work or critically revising it so as to contribute significantly to the final output.

Section 9.3 of the Griffith University Code (“Responsibilities of Researchers”), in accordance with Section 5 of the Australian Code, states: Researchers are expected to:

- Offer authorship to all people, including research trainees, who meet the criteria for authorship listed above, but only those people.
- Accept or decline offers of authorship promptly in writing.
- Include in the list of authors only those who have accepted authorship.
- Appoint one author to be the executive author to record authorship and manage correspondence about the work with the publisher and other interested parties.
- Acknowledge all those who have contributed to the research, facilitates, or materials but who do not qualify as authors, such as research assistants, technical
staff, and advisors on cultural or community knowledge. Obtain written consent to name individuals.

Included in this thesis are published papers (Chapters 3 and 4) which are co-authored with other researchers. My contribution to each co-authored paper is outlined at the front of each relevant chapter. The bibliographic details for these papers are:


The following published paper represents the confirmation document submitted as partial requirement for the degree of Doctor of Philosophy at Griffith University, Mount Gravatt campus, and was not incorporated into the thesis.

International Presentation Relevant to the Thesis

The following platform presentation was conducted by the author based on the findings of Chapter 4:

Chapter 1: Thesis Introduction

Chapter 1 outlines the main aims and rationale of this thesis, which is presented in a thesis-with-publication format. Specifically, the present chapter provides an overview of the thesis topic and structure with respect to the seven chapters.

Overview of Thesis Topic

It has been estimated that approximately 97,000 Australian adults experience an autism spectrum disorder (ASD) with no co-occurring intellectual disability (Autism Spectrum Australia, 2013). Often referred to in the literature as high-functioning (see Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Wing, 1988), these individuals present with a unique profile of strengths and challenges (Attwood, 2007). A number of studies indicate that individuals may value certain characteristics associated with a diagnosis of ASD, such as attention to detail, ability to identify errors quickly and extensive knowledge in a particular area or topic (Haertl, Callahan, Markovics, & Sheppard, 2013; Smith & Sharp, 2013). In contrast, studies have also documented that individuals report feeling helpless, anxious, estranged and rejected by society, and that many experience co-occurring mental-health conditions, reduced quality of life and poor social and adaptive functioning (Attwood, 2007; Autism Spectrum Australia, 2013; Haertl et al., 2013; Howlin, 2000; Smith & Sharp, 2013; Townson et al., 2007; Trembath, Germano, Johanson, & Dissanayake, 2012). However, there is a poor understanding of the factors that can account for variations in individuals’ psychological and social and adaptive functioning.

Evident from early childhood, ASD is described as a neurodevelopmental condition that is characterised by deficits in social and communication skills and restricted/repetitive interests and behaviours (American Psychiatric Association, 2013). A review of large scale estimates of global prevalence rates of ASD identified 7.6 per 1,000 individuals or one in 132 persons (Baxter et al., 2015). However, the severity and expression of characteristics
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associated with a diagnosis of ASD are highly variable (Randall et al., 2015). To date, there has been considerable focus on understanding the aetiology and characteristics of ASD in children and adolescents (Chiang & Wineman, 2014; Developmental Disabilities Monitoring Network Surveillance, 2014; Levy & Perry, 2011). Further, reviews of the empirical literature indicate a main emphasis on investigating the neuro-cognitive, social and adaptive outcomes of individuals with ASD irrespective of their intellectual functioning (e.g., Magiati, Tay, & Howlin, 2014; Tobin, Drager, & Richardson, 2014). Overall, there is a limited understanding of factors that influence psychosocial outcomes of adults with ASD who are considered high-functioning. In this context, psychosocial outcomes broadly incorporate aspects of mental health (e.g., depression, anxiety, stress, self-esteem, psychological disorders and symptoms, and quality of life) and social and adaptive functioning (e.g., levels of independence, vocational, academic and interpersonal functioning). To guide support interventions specific to high-functioning adults with ASD, it is important to understand both risk factors and protective factors impacting long-term psychosocial outcomes for this population.

Given the diverse characteristics of ASD, a single theory is unlikely to account for the varying psychosocial outcomes experienced by high-functioning adults with ASD. A biopsychosocial framework (Anderson, 1998; Engel, 1977) is considered a useful guide for identifying key factors likely to influence psychosocial outcomes for this population. This broad framework underscores the dynamic interactions between biological factors (e.g., neurocognitive functioning, gender and age), psychological processes (e.g., self-appraisals, emotion regulation and coping) and the social environment (e.g., friends and family, aspects of the workplace and perceptions of social support) that influence health outcomes. Consistent with the biopsychosocial model, the International Classification of Functioning, Disability and Health (ICF; World Health Organization [WHO], 2005) framework highlights the potential for personal and environmental factors to influence the health outcomes and
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wellbeing of individuals with an illness or condition. In particular, personal and social resources refers to the individual characteristics and social capital (e.g., coping styles, self-appraisals, and social support systems) drawn upon to make sense of and adapt to characteristics associated with functional limitations (Hobfoll, 2002). Differences in personal and social resources may account for why individuals with the same or similar health condition can experience varying psychosocial outcomes (MacKinnon & Luecken, 2008).

Furthermore, specific to ASD, the dynamic model of autism (Bartak, Bottroff, & Zeitz, 2006) emphasises the complex relationships between characteristics of ASD and stress. This model advances that stress interacts with core features of ASD (e.g., deficits in processing information and social cues) to influence secondary characteristics of ASD (e.g., ritualistic behaviours, poor sensory integration and unusual social behaviour). In turn, these \textit{autism-environment} interactions influence behavioural functioning and mental health; for example, aggression, depression and anxiety may develop as a stress response. (Bartak et al., 2006). Therefore, the underlying characteristics of ASD increase individuals’ vulnerability to stress, which in turn exacerbates the features of ASD. Common sources of stress for people with ASD include social contact and communicating with others, unexpected or sudden change, crowds, bullying or perceived injustice to self or others (Trembath et al., 2012).

As proposed by the dynamic model of autism, the bi-directional relationships between characteristics of ASD (i.e., the autism-environment interaction) and stress are acknowledged. To investigate these complex relationships prospective longitudinal research is considered optimal. For the present thesis, it was important to develop a set of testable predictions that were feasible to investigate within the scope of a PhD. Accordingly, the broad objective of this thesis was to improve understanding of factors influencing psychosocial outcomes of high-functioning adults with ASD. In this context, ASD characteristics, neuro-cognitive functions and personal and social resources were
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categorical as independent variables or factors, whereas mental health and social and
adaptive functioning (i.e., psychosocial outcomes) represented the dependent variables.
Guided by a biopsychosocial framework, the focus, sequence and primary aims of each study
are summarised in Table1.1.

Chapters and Aims of the Thesis

This thesis consists of seven chapters: A thesis introduction (Chapter 1), general
introduction (Chapter 2), four studies including a systematic review (Chapter 3) and three
empirical studies involving primary data collection (Chapters 4-6), and a general discussion
(Chapter 7). To keep the format consistent for the reader, all chapters have been written in
accordance with the Publication Manual of the American Psychiatric Association Sixth
edition (American Psychological Association, 2009), with tables and figures embedded in the
text. Copies of published articles in the format of the journal are included in the Appendices.

Chapter 2: General Introduction

Chapter 2 provides an overview of key literature relevant to ASD and psychosocial
outcomes of high-functioning adults. The chapter includes a general introduction to ASD that
covers important conceptual issues and terminology, a summary of the prevalence and
aetiology of ASD, neuroanatomical evidence, functional deficits and theories relevant to
ASD. Finally, studies highlighting the variable psychosocial outcomes of high-functioning
adults with ASD are summarised, which justify the need for a systematic review to identify
factors related to these outcomes.
### Factors Influencing Psychosocial Outcomes in ASD

#### Table 1.1

**Focus and Sequence of Studies Comprising the Thesis**

<table>
<thead>
<tr>
<th>Factors examined</th>
<th>Study 1 (Chapter 3) Aims</th>
<th>Study 2 (Chapter 4) Aims</th>
<th>Study 3 (Chapter 5) Aims</th>
<th>Study 4 (Chapter 6) Aims</th>
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<td><strong>Biological</strong></td>
<td>Study 1: Systematic Review - Identify studies investigating factors associated with psychosocial outcomes - Appraise the research methodology, synthesise key findings, and identify gaps in the literature to guide future research</td>
<td>Study 2: Independence of Hot and Cold Executive Function Deficits - Investigate the profile of hot and cold executive function impairments for high-functioning adults with ASD relative to matched controls - Examine the independence of deficits in hot and cold executive functions</td>
<td>Study 3: ASD characteristics, executive function and psychosocial outcomes - Investigate associations among ASD characteristics and hot and cold executive functions - Examine associations between hot and cold executive functions and psychosocial outcomes</td>
<td>Study 4: Investigation of the Vulnerability and Stress-Buffer Hypotheses - Investigate reliability and validity of measures of personal and social resources for adults with ASD - Examine the role of personal and social resources as vulnerability or protective factors in the relationship between ASD characteristics and psychosocial outcomes.</td>
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Chapter 3: Systematic Review (Study 1)

Chapter 3 consists of an accepted (in press) peer-reviewed systematic review article that aims to identify factors related to psychosocial outcomes for high-functioning adults with ASD. A further aim of study 1 was to appraise the research methodology and identify gaps in the literature. Factors associated with psychosocial outcomes are broadly categorised into biological (e.g., neurocognitive functioning, gender and age characteristics), psychological (e.g., self-appraisals and coping skills) and social and environmental domains (e.g., social support). The findings of the review highlight key gaps in the literature related to understanding: a) the impact of higher-order cognitive abilities (cold and hot executive functions) on psychosocial outcomes; and b) the role of personal and social resources (appraisals, coping and social support) as potential mediators or moderators of the relationship between ASD characteristics and psychosocial outcomes.

Chapter 4: Independence of Hot and Cold Executive Function Deficits in High-Functioning Adults with ASD (Study 2)

Chapter 4 comprises a published peer-reviewed article (Zimmerman, Ownsworth, O'Donovan, Roberts, & Gullo, 2016). Guided by the findings of the systematic review in Chapter 3, study 2 aims to investigate the profile of hot and cold executive function impairments for high-functioning adults with ASD relative to matched controls, and to examine the independence of deficits in hot and cold executive functions.

Chapter 5: Associations among ASD Characteristics, Executive Functions and Psychosocial Outcomes (Study 3)

The first aim of study 3 (Chapter 5) is to examine the associations among hot and cold executive functions and core ASD characteristics. Secondly, the study aimed
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to investigate associations between hot and cold executive functions and psychosocial outcomes.

Chapter 6: The Relationship between ASD Characteristics and Psychosocial Outcomes: Investigation of the Vulnerability and Stress-Buffer Hypotheses (Study 4)

Guided by theories on stress, coping and social support, study 4 broadly aimed to investigate the influence of personal and social resources on the relationship between ASD characteristics and psychosocial outcomes. An initial aim was to examine reliability and validity of measures of personal and social resources for high-functioning adults with ASD. Secondly, this study aimed to examine the role of personal and social resources as vulnerability or protective (stress-buffers) factors in the relationship between ASD characteristics and psychosocial outcomes.

Chapter 7: General Discussion

Chapter 7 synthesises the key findings of each study and highlights the ways in which the present research has advanced the field, including the clinical and theoretical implications of the findings. Additionally, this chapter discusses the methodological limitations and recommendations for future research.
Chapter 2: General Introduction

Conceptual Issues and Terminology

Historically, ASD was referred to as a Pervasive Developmental Disorder (PDD), one of a group of disorders largely characterised by deficits in social interaction, communication difficulties and a restricted range of behaviours or interests (American Psychiatric Association, 1994, 2000). There were five disorders that comprise PDD as described by the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition-Text Revision (DSM-IV-TR; American Psychiatric Association, 2000) and the International Classification of Diseases (ICD-10; World Health Organization, 1993) which include: autistic disorder (AD; i.e., those with and without intellectual disability); Asperger Syndrome (AS; i.e., those individuals without an intellectual disability); pervasive developmental disorder not otherwise specified (PDD-NOS); Rett syndrome; and childhood disintegrative disorder. Both Rett syndrome and childhood disintegrative disorder were considered rare conditions with very specific onset criteria (Fombonne, 2002; Tsai, 1992). An important distinction made between AD and AS was that individuals with AS developed age appropriate language abilities (American Psychiatric Association, 2000). As such, AD, AS and PDD-NOS were considered more closely associated than Rett syndrome and childhood disintegrative disorder, and were referred to collectively as autistic spectrum disorders (Filipek et al., 1999).

The growing body of evidence suggesting that AS and AD were more similar than different (Gilchrist, Green, Cox, Rutter, & Le Couteur, 2001) led to significant changes in the DSM 5 (American Psychiatric Association, 2013). In essence, the diagnostic subcategories of AS and AD were collapsed into a broader category of ASD with two diagnostic criteria domains: social communication and restricted and fixated interests (see Appendix A for the diagnostic criteria outlined in DSM-IV-TR, ICD-10 and DSM 5). The term spectrum is used to reflect the varied nature and degree of ASD.
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characteristics and describes the heterogeneous presentation of the condition (Wilson et al., 2014). According to the DSM 5 (2013), conceptualising the characteristics of ASD along a continuum of mild to severe impairments across the two domains was designed to improve the sensitivity and specificity of the criteria for diagnostic purposes. It is important to note that the DSM 5 (2013) acknowledges that individuals with an established DSM-IV (2000) diagnosis of AD or AS are not required to be re-diagnosed under this revised criteria. Consistent with more recent literature, the current thesis uses the terminology high-functioning individuals with ASD to refer to individuals with ASD without an accompanying intellectual disability (Felder, McPartland, Klin, & Volkmar, 2014; Wilson et al., 2014).

By specifically focussing on high-functioning adults with ASD in the current investigation, it was understood that some individuals may have received a diagnosis under the previous versions of the DSM or ICD. It was not feasible in the present research to obtain formal verification of participants’ ASD diagnosis from an independent clinical assessment. Instead, characteristics of ASD were measured using a validated assessment tool that is commonly used to support a diagnosis of ASD in adults (note: further information regarding inclusion criteria will be covered in the Methodology sections of relevant chapters).

Historical Background on ASD

Hans Asperger, an Austrian paediatrician, is generally recognised as the first person to document the behaviour of children with social interaction deficits that appeared distinct from classical autism (Asperger, 1938, 1944; Frith, 1991). These children preferred social isolation, engaged in self-stimulatory behaviour and were generally inflexible to changes in their environment. However, these individuals uncharacteristically exhibited IQ in the normal range and typical language development, leading Asperger to infer that he had identified a distinct diagnostic group (Myles &
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Simpson, 1998). Shortly after Asperger’s published work, Leo Kanner (1943) classified and diagnosed 11 children, with remarkably similar characteristics, as having infantile autism. It was not for another 35 years that serious attention was given to the work of Asperger by the scientific community (Fitzgerald, 2008). Much of this interest was facilitated by the research of Lorna Wing (1981), who was responsible for introducing the terms spectrum and Asperger’s Syndrome (Gillberg & Ehlers, 1998). Through her extensive clinical descriptions and case examples, Wing sought to clarify and characterise the disorder, proposing several modifications to Asperger’s original descriptions (Wing, 1981; Woodbury-Smith & Volkmar, 2009). For example, Asperger originally highlighted that problematic behaviours could only be noticed after 3 years of age; however, Wing argued that difficulties were present and observable in the first two years of life. Some of these problems included the absence of imaginative play and speech abnormalities. In addition, Wing stimulated an important discussion on the similarities and differences between AS and high-functioning AD that led to a widespread and controversial debate about the distinction between these two conditions (Fitzgerald, 2008; Myles & Simpson, 1998; Volkmar & Klin, 2000).

Prevalence of ASD

Historically considered to be rare, the apparent increase in prevalence rates of ASD continues to be widely debated in the literature (Duchan & Patel, 2011; Fombonne, 2009; Matson & Kozlowksi, 2011; Piven & Rabins, 2011; K. Williams, MacDermott, Ridley, Glasson, & Wray, 2008). A review of large scale estimates of global prevalence rates of ASD identified 7.6 per 1,000 individuals or one in 132 persons (Baxter et al., 2015). In Australia, ASD prevalence was estimated at 2.9 per 1,000 individuals in 2007, which was more than double the prevalence identified in 2003 (Australian Bureau of Statistics, 2007). A more recent longitudinal study in Australia of children aged 7 years estimated the prevalence of ASD in two separate
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cohorts as between 1.5 and 2.5% (Randall et al., 2016). Further, the Centers for Disease Control Prevention (2014) estimates that 1 in 68 children have been identified with ASD in the United States, and that nearly 70% of these individuals do not have an intellectual disability (i.e., IQ > 70). In his systematic review, Fombonne (2009) proposed that the increase in prevalence of ASD can be largely explained by the broadening of the concept, the expansion of diagnostic criteria and an overall improvement in societal awareness of the condition. For example, prior to the publication of the DSM-IV (American Psychiatric Association, 1994), AS was not recognised by the American Psychiatric Association as a separate PDD. Therefore, individuals may have been either undiagnosed or misdiagnosed up until this time, which is speculated to have contributed to the earlier statistics that appear to underestimate the true prevalence of ASD (Barnhill, 2007).

Aetiology of ASD

From an aetiological perspective, direct causes of ASD remain largely unknown (Duchan & Patel, 2011). Males are diagnosed more often than females with an average male-to-female ratio of 4.3:1 (Duchan & Patel, 2011; Ozonoff et al., 2011). Given the higher rate of ASD in individuals with a family history, it is likely that a genetic link exists (Duchan & Patel, 2011; Johnson & Rausch, 2008). When a child is diagnosed with ASD, the probability that other siblings will have a similar diagnosis is 22 times greater than the general population (Lauritsen, Pederson, & Mortensen, 2005). Twin studies further support the notion of a genetic link with a 60-91% concordance rate for monozygotic twins as compared to 0-6% for dizygotic twins (Folstein & Rosen-Sheidley, 2001; Muhle, Trentacoste, & Rapin, 2004). Moreover, family studies as well as case-controlled family history studies have demonstrated that ASD is an inheritable phenotype (Ghaziuddin, 2005; Gillberg, 1991; Volkmar et al., 1996).
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Environmental risk factors have also been implicated in the aetiology of ASD, particularly via complex gene-environment interactions (Chen, Peñagarikano, Belgard, Swarup, & Geschwind, 2015; Johnson, Sanders, & Rausch, 2008; Koufaris & Sismani, 2015). At present, there is emerging evidence supporting associations between prenatal and perinatal environmental exposures, such as air pollutants, and the development of ASD (Bakare, Munir, & Kinney, 2011; Cannell, 2008; Kočovská, Fernell, Billstedt, Minnis, & Gillberg, 2012; Roberts et al., 2013). In addition, there is preliminary evidence that points to a possible link between Vitamin D deficiency during a woman’s pregnancy and ASD symptomatology for the child (Kočovská et al., 2012). Vitamin D is considered crucial for several key physiological processes (e.g., brain development, DNA repair and the regulation of many genes) and is primarily absorbed from sunlight exposure (Bakare et al., 2011). However, further research is required to improve our understanding of the role of environmental risk factors in ASD aetiology (Chen et al., 2015; Koufaris & Sismani, 2015).

Neuroanatomical Findings

Neuroanatomical studies for individuals with ASD have revealed various structural differences when compared to matched controls, such as megalencephaly (i.e., whole brain enlargement) and increased head circumference (Bauman & Kemper, 2005; Libero et al., 2016). Based on comprehensive post-mortem brain tissue studies, Bauman and Kemper (1996; 1985, 2005) identified five neuropathologies present in the brains of individuals with ASD as follows: (a) increased brain weight and white matter volume during childhood; (b) reduced neuronal size and increased cell packing density in the forebrain limbic system; (c) reduced number of Purkinje cells in the cerebellum; (d) age-related changes in cell size and number in the nucleus of the diagonal band of Broca’s area, deep cerebellar nuclei, and inferior olive; and (e) malformations of the cerebral cortex and brainstem. Despite abnormal brain weight and white matter volume
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observed during childhood, studies have shown that overall brain volume for adults with ASD is normal (Courchesne, Carper, & Akshoomoff, 2003; McAlonan et al., 2005; McAlonan et al., 2002). Interestingly, although brain volume stabilises in adulthood, anatomical and functional abnormalities in the frontal lobe, basal ganglia and the limbic system are evident (Ashwin, Baron-Cohen, Wheelwright, O'Riordan, & Bullmore, 2007; Murphy, Beecham, Craig, & Ecker, 2011; (Patriquin, DeRamus, Libero, Laird, & Kana, 2016). It has broadly been proposed that there are differences in the timing of both initiation and cessation of overall brain growth for individuals with ASD (Chen et al., 2015; Murphy et al., 2011).

Given the social cognitive deficits experienced by individuals with ASD, researchers have conducted numerous face emotion processing studies using functional magnetic resonance imaging to investigate the neural underpinnings of the disorder (Ashwin et al., 2007; Critchley et al., 2000; Dalton et al., 2005). These studies advance that the social deficits observed in ASD may be explained by abnormalities in the limbic system, particularly in the amygdala. Located in the medial temporal lobe, the primary role of the amygdala is processing the emotional salience of stimuli, most specifically fear processing (Friedman, Kleinhans, Munson, & Webb, 2008). To demonstrate the differential activation of the amygdala and its circuitry from other social brain areas (i.e., orbito-frontal cortex, anterior cingulate cortex and occipital and temporal cortices) during a face processing task, Ashwin and colleagues (2007) recruited 13 adults with ASD and matched controls. They found that during fearful emotion processing, different patterns of activation of social brain areas were observed between the groups. For example, the control group showed activations in the left and right amygdala to varying intensities of fearful expression. However, there was evidence of hypo-activation for those in the ASD group, suggesting that reduced activity in the limbic system and its supporting structures contributes to some core
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characteristics of ASD. Evidence from animal studies further suggests that the amygdala and its connective circuitry are centrally involved in ASD (Bachevalier, 1994, 2005; Bachevalier & Merjanian, 1994). For example, research found that rhesus monkeys with neonatal lesions to the medial temporal lobe demonstrated a number of social-emotional abnormalities as they matured, similar to those found in ASD. These behaviours included passivity and social withdrawal, stereotypies and impaired communication (Bachevalier, 2005).

Taken together, these findings suggest that abnormalities of the limbic system provide a neurological explanation for core characteristics of ASD. However, the pattern of phenotypic expression in people with ASD is likely to depend upon the specific location and degree of abnormality within this circuitry involving the amygdala (Bauman & Kemper, 2005).

Functional Deficits of ASD

Numerous studies report an array of functional deficits for individuals with ASD, such as abnormalities in executive functions (e.g., cognitive flexibility; Baez et al., 2012; Hill & Bird, 2006); repetitive, obsessional and restricted behaviours (D'Cruz et al., 2013; Russell, Mataix-Cols, Anson, & Murphy, 2005; Szatmari et al., 2006); pragmatic language (Koning & Magill-Evans, 2001; Loukusa et al., 2007); movement and coordination (Gowin & Miall, 2005; Rinehart, Bradshaw, Brereton, & Tonge, 2001); sensory sensitivity (Dunn, Myles, & Orr, 2002; J. Harrison & Hare, 2004); emotional regulation (Laurent & Rubin, 2004; Rieffe et al., 2011); social cognition (Ambery, Russell, Perry, Morris, & Murphy, 2006; Hill & Bird, 2006; Kleinhans, Akshoomoff, & Delis, 2005) and social interaction (Baron-Cohen, Wheelwright, Hill, et al., 2001; Bauminger & Shulman, 2003).

However, there is emerging evidence that some individuals diagnosed with ASD as children experience functional improvement or a reduction in ASD characteristics
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over time (Fein et al., 2013; Helles, Gillberg, Gillberg, & Billstedt, 2015). For example, in a recent study of 34 adolescents who had a confirmed diagnosis of ASD during early childhood, researchers identified that some individuals no longer met diagnostic criteria, demonstrating fewer symptoms, and were functioning within the non-clinical range in terms of social interaction and communication (Fein et al., 2013). Although there were residual deficits in aspects of social interaction or cognition, the findings highlighted the need for further research to elucidate factors contributing to overall improved outcomes.

Due to the heterogeneous nature and complex characteristics of ASD, no single theory can comprehensively explain the characteristics of the disorder (Happé, Ronald, & Plomin, 2006). However, three cognitive accounts that have dominated the ASD literature include: the theory of mind (ToM) hypothesis, executive dysfunction and weak central coherence (Rajendran & Mitchell, 2007). Each of these accounts provides a unique explanation for many of the primary and secondary aspects of ASD.

**Theory of Mind (ToM) Hypothesis**

The main premise of the ToM hypothesis is that individuals with ASD fail to assign and understand the mental states (i.e., thoughts, beliefs and intentions) of others and themselves (Premack & Woodruff, 1978). Various tests of ToM have been developed over the past two decades, including the False Belief Task (Perner & Wimmer, 1985; Wimmer & Perner, 1983), the Strange Stories Test (Happé, 1994) and The Eyes Task (Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997). Using the False Belief Task, Perner and Wimmer (1985) demonstrated that nearly all neurotypical children by age four develop the ability to evaluate the mental states of others. In contrast, studies have consistently shown that the majority of individuals with ASD fail ToM tests, therefore showing a pattern of impaired comprehension of other people’s thoughts, beliefs and intentions (i.e., mentalising; Baron-Cohen, Leslie, & Frith, 1985; Perner, Frith, Leslie, & Leekam, 1989). Further, deficits in ToM have been associated
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with abnormalities in social communication, such as reduced facial expressivity, poor joint attention and diminished emotional expression (Baron-Cohen, 1995; Baron-Cohen, Wheelwright, Hill, et al., 2001). Finally, ToM neuroimaging studies have identified a specific neural activity pattern for individuals with ASD that is different to typically developing peers when performing a mentalising task (Castelli, Frith, Happé, & Frith, 2002; Frith & Frith, 2003). Specifically, these studies observed reduced activation for those with ASD in the network of structures involving the medial prefrontal cortex, temporal poles and amygdala. Thus, there is preliminary neurophysiological evidence supporting the ToM hypothesis which helps to account for some of the characteristics commonly observed in people with ASD.

Building upon the ToM hypothesis, Baron-Cohen and colleagues (2009) advanced the theory of empathising-systemising to explain deficits in empathy (i.e., both the cognitive and response elements associated with mentalising) as well as the drive to analyse and construct systems (i.e., systematise) associated with ASD. Moreover, Baron-Cohen (2002) attempted to explain the observed sex differences in empathising (i.e., females achieve higher scores on empathy tests) and systematising (i.e., males perform better on systematising tests) in a theory referred to as extreme male brain. He proposed that individuals with ASD can be conceptualised as having a profile of the extreme male brain: individuals whose systemising is above average, but who are challenged when it comes to experiencing and demonstrating empathy (Rajendran & Mitchell, 2007). To date, there is growing support for ToM, empathising-systemising and extreme male brain theories for individuals with ASD (Auyeung et al., 2009; Baron-Cohen, Richler, Bisarya, Gurunathan, & Wheelwright, 2003; Goldenfeld, Baron-Cohen, & Wheelwright, 2005). However, these domain-specific theories cannot adequately account for the broader domain-general abnormalities observed in ASD,
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including those associated with executive dysfunction and sensory-perceptual difficulties (Rajendran & Mitchell, 2007).

**Executive Dysfunction**

It has been proposed that certain ASD characteristics could be explained by frontal lobe dysfunction and associated impairments in executive functions (Ozonoff, Pennington, & Rogers, 1991; Szatmari, Tuff, Finlayson, & Bartolucci, 1990). Unaccounted for by the ToM hypothesis, these symptoms include a need for sameness, problems with switching attention, a tendency to perseverate and difficulties with impulse control (Rajendran & Mitchell, 2007). Executive functions are the higher-order cognitive functions mediated by the pre-frontal cortex (PFC) that are involved in the supervisory control and direction of lower-order brain functions (Stuss & Levine, 2002). Consequently, executive function impairments affect everyday activities such as the ability to work, develop and maintain social relationships and function independently in the home (Attwood, 2007; Ozonoff, 1998; Woodbury-Smith, Robinson, Wheelwright, & Baron-Cohen, 2005).

Although debate continues as to what constitutes the complete set of components representing executive functions (Miller & Ahmed, 2008), a common approach used to conceptualise this complex construct is the distinction between hot and cold executive functions (Chan, Shum, Toulopoulou, & Chen, 2008). Cold executive functions are associated with the dorsolateral pre-frontal cortical regions and include planning, cognitive flexibility, working memory and inhibition. These functions are referred to as cold due to their relatively mechanistic and logical operations, which do not engage emotional processes for effective performance (Grafman & Litvan, 1999). In contrast, hot executive functions are mediated by the ventromedial and orbito-prefrontal cortices which are responsible for behaviours that require emotional awareness, regulation, empathy and ToM (Chan et al., 2008; McDonald, 2013). For
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example, such responses are crucial for adhering to socially appropriate norms, communicating with others, reacting to punishment and reward and managing anger or distress (Bechara, Damasio, & Damasio, 2000; Bechara, Damasio, Damasio, & Lee, 1999). It has been proposed that hot executive function processes work in concert with cold executive functions and other cognitive domains to support social interaction (McDonald, 2013). A review of the literature identified largely mixed empirical support concerning the profile of executive function deficits for high-functioning individuals with ASD (Baez et al., 2012; Hill & Bird, 2006; Pennington & Ozonoff, 1996; Rajendran, Mitchell, & Rickards, 2005; Turner, 1999). Furthermore, research is yet to determine the independence and/or inter-relatedness of deficits in hot and cold executive function domains for this population.

Overall, executive dysfunction can explain some characteristics that are not accounted for by the ToM hypothesis. However, executive dysfunction does not offer a comprehensive account of ASD characteristics, such as difficulties associated with contextual sensitivity and a cognitive style that focuses on specific details rather than the overall context (Attwood, 2007; Happé, 1999).

Weak Central Coherence

Conceptualising ASD from a domain-general perspective, the Weak Central Coherence (Frith, 1989; Frith & Happé, 1994) account explains difficulties associated with perceiving the overall meaning or gist in a given situation. Within this framework it is argued that individuals with ASD have a tendency to process information in a fragmented and fine-grained way rather than perceiving the global perspective; thus, indicating weak central coherence (Frith, 1989). It has been argued that a lack of contextual sensitivity, or contextual blindness, is a key mechanism underpinning deficits in social cognition for individuals with ASD (Baez & Ibanez, 2014; Vermeulen, 2014). Conceptually related to weak central coherence, contextual sensitivity guides
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social perception by helping people to focus on relevant social cues, ignore irrelevant
details and tolerate ambiguous information (Baez & Ibanez, 2014). Vermeulen (2014)
argued that contextual insensitivity leads to stimuli being processed in a maladaptive
way, whereby attention is given to objects or information that should be ignored (i.e.,
they are contextually unimportant), while ignoring important contextual stimuli.

Further evidence supporting weak central coherence comes from studies of
children with ASD who scored above average on the Children's Embedded Figures Test
(Witkin, Oltman, Raskin, & Karp, 1971) when compared to typically developing peers.
This measure requires individuals to locate a small target shape amongst larger and
more distracting objects and thus assesses visual discrimination skills (Shah & Frith,
1983). Moreover, there was evidence that children with ASD were faster and more
accurate at reproducing block designs from the Wechsler Intelligence Scale for
Children-III (WISC-III; Wechsler, 1991) when compared to typically developing peers
(Happé, 1999). Thus, weak central coherence describes both the functional difficulties
associated with ASD (i.e., contextual blindness) as well as a perceptual-cognitive style
that can be advantageous and viewed as a relative strength (Attwood, 2007; Happé,
1999).

Comorbidity of ASD

ASD is frequently associated with intellectual impairment (American
Psychiatric Association, 2013; Tallantyre & Robertson, 2013). Furthermore, numerous
studies have documented the comorbidity of ASD with both physical (Aaronson,
Hagberg, & Gillberg, 1997; Cederlund & Gillberg, 2004; Gillberg, 1989; Gillberg &
Cederlund, 2005) and psychological disorders (Cederlund & Gillberg, 2004; Cederlund,
Hagberg, Billstedt, Gillberg, & Gillberg, 2008; Ghaziuddin, Weidmer-Mikhail, &
Ghaziuddin, 1998; Gutkovich et al., 2007; Kerbeshian & Burd, 1986; Lee & Ousley,
2006; Murphy, 2006; Råstam et al., 2001; Reiersen, Constantino, Volk, & Todd, 2007).
For example, research has shown that epilepsy affects approximately five out of 100 males aged between 16 and 36 years with ASD (Cederlund & Gillberg, 2004), with the prevalence of epilepsy in autism exceeding that of the general population (i.e., approximately 0.5%–1%; Amiet et al., 2008; Hauser, Annegers, & Kurland, 1991). Moreover, there is considerable evidence that psychological disorders, such as attention deficit hyperactivity disorder (ADHD), Tourette’s syndrome, obsessive compulsive disorder, anxiety and depression commonly co-occur with ASD (Autism Spectrum Australia, 2013; Ghaziuddin, Ghaziuddin, & Greden, 2002; Hammond & Hoffman, 2014; Kalyva, Kyriazi, Vargiami, & Zafeiriou, 2016; Kanai et al., 2011; Lee & Ousley, 2006; Maddox & White, 2015; Reiersen et al., 2007; Trembath et al., 2012).

It has been suggested that the neuropsychological deficits inherent in ASD may predispose individuals to a range of psychological disorders, such as depression and anxiety (P. Tani et al., 2003). As previously outlined in Chapter 1, the dynamic model of autism (Bartak et al., 2006) asserts that stress interacts with the core features of ASD (e.g., deficits in processing social cues) to influence secondary characteristics of ASD (e.g., ritualistic behaviours and unusual social behaviour). As such, it is argued that these autism-environment interactions influence behaviour and can contribute to poor mental health functioning (Bartak et al., 2006). Furthermore, it has been proposed that ASD traits may indirectly contribute to more stressful and chaotic environments for individuals (Hallett, Ronald, Rijsdijk, & Happé, 2012). The relationship between ASD and mood disorders is complex with a variety of explanations advanced by Ghaziuddin et al. (1998), such as: (a) an underlying vulnerability to affective disorders (e.g., high trait anxiety); (b) family tension or breakdown (e.g., single parent families); (c) higher than usual rates of adverse life events (e.g., victimisation or being placed in a foster care environment); (d) negative self-appraisals (e.g., helplessness, oversensitivity and rumination). However, the phenotypic and aetiological overlap between affective
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disorders and ASD remains unclear and further prospective longitudinal research is required to investigate these complex relationships (Hallett et al., 2012; Scherff et al., 2014; Weisbrot, Gadow, DeVincent, & Pomeroy, 2005).

Overlap between ASD and Alexithymia

There is evidence to suggest that an overlap in behavioural and cognitive symptomatology exists between the clinical presentations of alexithymia and ASD (Fitzgerald & Bellgrove, 2006; Fitzgerald & Molyneux, 2004; Hill, Berthoz, & Frith, 2004; P. Tani et al., 2004). Alexithymia is a psychological condition that is characterised by a reduced capacity to cognitively process emotions and deficits in the capacity to experience, describe and identify emotions (Fitzgerald & Bellgrove, 2006). There is shared symptomatology between ASD and alexithymia, such as core disturbances in speech, pragmatic language and social relationships (Hill & Berthoz, 2006). Empirical studies have shown that adults with ASD report significantly higher levels of alexithymia (i.e., Toronto Alexithymia Scale [TAS-20]; Bagby, Taylor, & James, 1994) than matched controls (Hill et al., 2004). Moreover, there is evidence to suggest that despite the inherent problems associated with describing their emotional state, individuals with ASD and alexithymia can reliably report their own emotions using self-report measures (Berthoz & Hill, 2005). For example, researchers confirmed that scores on the Bermond and Vorst Alexithymia Questionnaire-Form-B (Vorst & Bermond, 2001) demonstrated convergent validity with the TAS-20 ($r = .48-.77, p<.001$) and achieved adequate test–retest reliability for the ASD and control groups respectively ($r = .45-.77, p < .05-.001$).

Neuroimaging studies reinforce the overlap in symptoms between alexithymia and ASD (Moriguchi et al., 2006). Using a mentalising task, Moriguchi et al. (2006) found reduced activation across a network of neural structures involving the medial prefrontal cortex, temporal poles and amygdala for individuals high in alexithymia.
scores. Interestingly, their neuronal activity patterns were similar to those observed for individuals with ASD. Therefore, there is evidence of common symptomatology and neural activation patterns between people with alexithymia and those with ASD. As such, it has been proposed from a clinical perspective that a diagnosis of ASD should also be considered for individuals who display alexithymia (Attwood, 2007; Hill et al., 2004). However, it is worth noting that alexithymia should not be viewed as synonymous with ASD, because the latter reflects a broader disorder characterised by deficits in social interaction and communication as well as sensory impairments and atypical behaviours (Attwood, 2007; Filipek et al., 1999).

**Psychosocial Outcomes for Adults with ASD**

In the present thesis, psychosocial outcomes broadly incorporate aspects of mental health (e.g., symptoms of depression, anxiety, stress, self-esteem), quality of life (QoL) and social and adaptive functioning (e.g., levels of independence, vocational, academic and interpersonal functioning). Several reviews of the empirical literature have investigated the psychosocial outcomes of individuals on the autistic spectrum with and without intellectual disability (e.g., Magiati et al., 2014; Tobin et al., 2014). Many of these studies report on outcomes (e.g., levels of independence and employment rates) with broad inclusion of studies investigating both children and adults with ASD. Therefore, it is important to provide an overview of psychosocial outcomes of high-functioning adults with ASD.

In a small retrospective study ($n = 16$) with a follow-up interval varying between 11 and 27 years, Szatmari and colleagues (1989) drew attention to the persisting social impairments and poor occupational achievement experienced by high-functioning individuals with ASD into adulthood. In one of the longest known follow-up studies, Larson and Mouridsen (1997) tracked a small number of individuals with autistic disorder (AD; $n = 9$) and Asperger’s Syndrome (AS; $n = 9$) over a 30 year period and
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identified that four individuals from the AS group had a *fair* outcome, two were classified as having a *poor* outcome, while the remaining three participants had a *good* outcome. The four-point outcome rating scale employed was based on Lotter’s (1978) social adjustment scale whereby a *good* outcome is defined as having a normal or near normal social life and satisfactory functioning at school or work. Conversely, a *poor* outcome is described as having a severe handicap and/or no independent social progress.

In a cross-sectional outcome study of 42 adults with ASD (*M* age = 30.8 years; male = 24; IQ > 70), Engstrom and colleagues (2003) reported that the majority of individuals were not in relationships, had limited employment opportunities, were living alone and required a high level of public and/or private support. Using Lotter’s (1978) outcome criteria, 75% were rated as having a *fair* overall adjustment, such that individuals were evaluated as having some social and educational progress despite significant or even marked abnormalities in behaviour and/or interpersonal relationships. In a retrospective follow-up study conducted over an interval of 21-48 years, Howlin and colleagues (2004) found that adults with the highest social outcome ratings had higher scores on cognitive (e.g., IQ score ≥ 70), language, reading and comprehension tests. They showed a greater use of socially appropriate language while abnormal language features and ritualistic behaviours were less frequent. Despite the study including those with intellectual disability (i.e., IQ > 50 and < 70), the authors noted that the majority of individuals were rated as having a *poor* outcome, whereby friendships were limited and a high level of support was required.

In a study assessing QoL outcomes for high-functioning adults with ASD, Jennes-Coussens et al. (2006) found that individuals with ASD reported significantly lower social QoL (*d* = 1.40) and physical QoL (*d* = 1.29) than matched controls. Despite having similar living arrangements, number of friends and education levels to controls,
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those with ASD reported less positive employment experiences and preferred solitary
activities. Further, in a prospective follow-up study comparing individuals with AS ($n = 70$) and those with AD ($n = 70$), Cederlund and colleagues (2008) concluded that
overall outcome was significantly worse for those with AD when compared to those
with AS. Adopting Lotter’s (1978) criteria, 27% of individuals in the AS group were
classified as having a good outcome, 47% were judged as having a fair outcome (i.e.,
some social and educational progress despite significant abnormalities in behaviour or
interpersonal relationships) while 26% of individuals with AS were rated as having
restricted or poor outcomes.

In a study that compared adult outcomes for those diagnosed with ASD during
childhood ($n = 33$) with those diagnosed with ASD after 18 years of age ($n = 34$),
Marriage, Wolverton, and Marriage (2009) found that outcomes varied from poor to
very good in both groups. Anecdotally, it was suggested that dedicated and tolerant
family and workplace support systems contributed to better adjustment in adulthood.
For both groups, only 15-25% lived independently and participated full time in either
tertiary education or employment, and 23-27% had a co-occurring anxiety disorder.
Depression was more frequent for those diagnosed with ASD as adults (44%) compared
to those diagnosed as children (24%). Approximately 80% of individuals in both groups
had a comorbid mental health condition.

Finally, a large-scale Australian study ($n = 313$) described the life experiences,
aspirations, and support needs of high-functioning adults with ASD (Autism Spectrum
Australia, 2013; Baldwin, Costley, & Warren, 2014). Overall, the findings indicated that
many of these individuals have comorbid clinical mental health conditions (71%),
pervasive feelings of worry and stress (78%) and poor access to psychological support
services (50%). Interestingly, a higher proportion of females (83%) than males (67%)
reported having a mental health condition. The group experienced low rates of tertiary
education completion (13%) relative to ABS data for all Australians in 2011 (25%) and was attributed to many factors (e.g., poor support services, mental health difficulties, victimisation from students and teachers, difficulties in verbal comprehension, concentration, organisation and planning). The report also documented high unemployment rates and a high proportion of individuals that are: overeducated and working in jobs that are comparatively low-skilled, poorly paid and with limited prospects for career development (Baldwin et al., 2014). Furthermore, individuals expressed a strong desire for friendships and social connectedness but were isolated and lonely. Many individuals experienced restricted independence and poor daily life skills.

Taken together, these findings suggest that adults with high-functioning ASD face significant psychosocial difficulties, such as poor mental health and limited social and adaptive functioning. Furthermore, a review of the literature highlighted the variability in outcomes for this population and the need to understand both vulnerability and protective factors. In light of these findings, it was a priority to conduct a comprehensive systematic review of empirical studies to determine the factors related to psychosocial outcomes for high-functioning adults with ASD. A review and critical appraisal of such literature would guide future research, including the studies comprising the present thesis.
Chapter 3: Statement of Contribution and Co-Authored Published Paper


This chapter includes a co-authored paper which has been prepared for submission to an international peer reviewed journal (see Appendix B for a copy of the published paper in its original format). The bibliographic details of the co-authored paper, including all authors, are: **David Zimmerman**, Associate Professor Tamara Ownsworth, Professor Analise O’Donovan, Professor Jacqueline Roberts and Dr Matthew J Gullo. The candidate’s contribution to the paper involved conception of the study design, literature review, data collection and analyses, and writing of the manuscript. The co-authors provided review of drafts and supervisory advice.

Name of student: David Zimmerman

Names of corresponding authors of paper:
Associate Professor Tamara Ownsworth (Primary Supervisor)

Professor Analise O’Donovan (Associate supervisor)

Professor Jacqueline Roberts (Associate Supervisor)

Dr Matthew J. Gullo (External Supervisor)
Chapter 3: High-Functioning Autism Spectrum Disorder in Adulthood: A Systematic Review of Factors Related to Psychosocial Outcomes

Introduction

Autism spectrum disorder (ASD) is a grouping of neurodevelopmental disorders characterised by deficits in social communication and language as well as a restricted range of behaviours or interests (American Psychiatric Association, 2013). A wealth of studies have investigated the aetiology and characteristics of ASD in children and adolescents (Chiang & Wineman, 2014; Levy & Perry, 2011). Reviews of the empirical literature to date have focused broadly on social and adaptive outcomes of individuals with high and low functioning ASD (e.g., Magiati et al., 2014; Tobin et al., 2014) and across different developmental phases (e.g., Chiang & Wineman, 2014). Less is known about the psychological, social and adaptive outcomes of adults with ASD who are high-functioning in the sense that their intellectual functioning is in the normal range (i.e., \( \geq 70 \)), commonly referred to as high-functioning ASD (HFASD; see Baron-Cohen, 2000).

Due to the multidimensional nature and complex symptomatology of ASD, no single theory can comprehensively account for the characteristics and outcomes of the disorder (Silva et al., 2013). It has been proposed that diverse factors potentially account for differences in psychological, social and adaptive outcomes. These include demographic characteristics, neurocognitive functioning, severity of ASD symptoms, self-appraisals, emotion regulation and coping skills, and social support (Attwood, 2007). From this perspective, psychosocial outcomes could incorporate both mental health (e.g., depression, anxiety, stress, self-esteem, psychotic symptoms, attention deficit hyperactivity disorder, quality of life) and social and adaptive functioning (e.g., levels of independence, vocational, academic and interpersonal functioning) domains.
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A leading neurocognitive developmental account of ASD implicates deficits in social cognition such as theory of mind (ToM), or the ability to evaluate the mental states of others (Baron-Cohen, Wheelwright, Hill, et al., 2001; Frith & Frith, 2003). A second major neurocognitive developmental account, weak central coherence theory, proposes that individuals with ASD have pervasive difficulties with perceiving the overall meaning or gist in a given situation, which leads to processing information in a fragmented and fine-grained way (Frith & Happé, 1994; Rajendran & Mitchell, 2007). Aspects of ASD symptomatology unaccounted for by ToM and weak central coherence theories have been proposed to arise from deficits in executive functioning such as problems with attentional switching, perseveration and impulse control (Hill, 2004; Kleinhans et al., 2005). Despite generally mixed empirical support concerning the profile of executive function impairments in ASD (Hill & Bird, 2006; Pennington & Ozonoff, 1996; Rajendran et al., 2005; Turner, 1999), there is consistent evidence of difficulties with cognitive shifting (i.e., the ability to engage and disengage actions in the service of predominant goals; Ambery et al., 2006; Hill & Bird, 2006; Pellicano, 2007). However, the influence of neurocognitive functioning on psychosocial outcomes in adults with HFASD is unclear.

The ways in which individuals perceive themselves and their environment has long been recognised to impact on psychological and social functioning in the context of chronic health conditions (Lauwerier et al., 2010; McCracken, 2005). Research has shown that adolescents with HFASD perceive themselves as different and report lower self-esteem than typically developing peers (Vickerstaff, Heriot, Wong, Lopes, & Dossetor, 2007; Williamson, Craig, & Slinger, 2008). Qualitative studies indicate that some individuals perceive positive effects of being diagnosed with ASD and are motivated to seek out likeminded individuals and community support groups (Haertl et al., 2013). In contrast, others express feeling helpless, estranged, and rejected by society.
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(Haertl et al., 2013; Smith & Sharp, 2013; Townson et al., 2007). Individuals may also value certain skills associated with ASD, such as identifying errors quickly and understanding complex mathematics and computers (Smith & Sharp, 2013). Such findings highlight the importance of examining the impact of self-appraisals on psychosocial outcomes for adults with HFASD.

Individuals with ASD are prone to heightened stress and comorbid psychological diagnoses (M. G. Baron, Groden, & Groden, 2006; Samson, Huber, & Gross, 2012). Yet, investigations of stress and coping have mainly focused on family members (M. G. Baron et al., 2006; Dabrowska & Pisula, 2010; Pottie & Ingram, 2008). Stress is thought to detrimentally influence health outcomes on a number of interrelated levels whereby stressful situations trigger negative appraisals of harm, activate physiological systems and elicit unhelpful coping responses (e.g., avoidance, alcohol and illicit drug use; S. Cohen, Kessler, & Gordon, 1995; Lazarus & Folkman, 1984). Long-term activation of stress response systems is associated with a heightened risk of developing a range of physical and psychological disorders (DeLongis, Folkman, & Lazarus, 1988; Rosengren, Orth-Gomer, Wedel, & Wilhelmsen, 1993).

Related to self-appraisals and coping resources, emotion regulation refers to the capacity to simultaneously attend to internal and external cues in order to respond appropriately in a given situation (Ekman, 1992). Samson and colleagues (2012) found that adults with HFASD were less likely to use reappraisal strategies when regulating emotions in a stressful situation than matched controls. Therefore, self-appraisals, coping and emotion regulation skills are important to examine as personal resources potentially related to psychosocial outcomes of HFASD in adulthood.

In addition to emotion regulation skills, social resources can buffer the detrimental effects of stressful events on well-being (S. Cohen, 1988). In particular, social support has been found to moderate the impact of high levels of stress on...
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psychological well-being (S. Cohen, 2004). A fundamental aspect of this buffering effect is the extent to which social support is perceived as available or effective by an individual (S. Cohen, 1988). There is considerable evidence that the perceived availability and quality of social support moderates the influence of high levels of stress on health outcomes in a range of clinical populations (Payne et al., 2012; Steptoe, 2000). However, the influence of perceived social support on psychosocial outcomes of adults with HFASD has received little attention to date.

Broader social environmental factors likely to influence psychological, social adaptive outcomes include the quality of interactions with friends, family and employers (Chiang & Wineman, 2014; Howlin, 2000; Levy & Perry, 2011; Tobin et al., 2014). In particular, the experience of bullying and victimisation during childhood and adolescence, most commonly in the school environment, has been proposed to contribute to poor psychosocial outcomes in adulthood (Cappadocia, Weiss, & Pepler, 2012; Roekel, Didden, & Scholte, 2010). In an unpublished dissertation, Merkler (2007) reported that adults with HFASD were more isolated than matched controls and that isolation from social networks and relationships was associated with psychological distress. Despite their social challenges, individuals with HFASD have been found to report a desire for intimacy and social connectedness and derive satisfaction from contributing to others’ welfare (Muller, Schuler, & Yates, 2008). A better understanding of social environmental influences on outcomes of adults with HFASD may guide support interventions.

Rationale and Aims of the Systematic Review

Previous reviews of factors related to psychosocial outcomes of ASD have typically synthesised the findings for children and adults with high and low functioning ASD (Chiang & Wineman, 2014; Howlin & Moss, 2012; Levy & Perry, 2011; Magiati et al., 2014; Nordin & Gillberg, 1998; Tobin et al., 2014; van Heijst & Geurts, 2014).
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For example, Levy and Perry (2011) found that autism severity, cognitive and language skills, co-morbid psychopathology and access to interventions were consistently related to outcomes for adolescents and adults with ASD. More recently, Magiati et al. (2014) reviewed 25 longitudinal studies of cognitive, language and behavioural outcomes of adults with ASD. The key findings were that IQ typically remained stable between childhood and adulthood and that early IQ and language skills predicted functional outcomes in adulthood. Improvements were evident between childhood and adulthood for ASD symptoms, language and adaptive functioning; however, social outcomes were generally poor and the majority still met partial criteria for ASD in adulthood.

Overall, given the heterogeneity of study samples encompassing participants with high and low functioning ASD (e.g., Magiati et al., 2014; Tobin et al., 2014) and children and adults (e.g., Chiang & Wineman, 2014), it is unclear to what extent these findings generalise to adults with HFASD. Further, greater emphasis has been placed on neurocognitive predictors than self-appraisals, coping resources and aspects of the social environment which are potentially responsive to intervention (Tobin et al., 2014). To guide future research and support interventions specific to adults with HFASD, it is important to understand both risk factors and protective factors impacting long-term psychosocial outcomes.

Accordingly, the broad aims of this systematic review were to identify studies investigating factors associated with psychosocial outcomes of adults with HFASD and synthesise the key findings. A further aim was to appraise the research methodology, identify gaps in the literature and provide future research recommendations. As mentioned previously, psychosocial outcomes broadly include mental health and social and adaptive functioning.
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**Method**

The current paper adopted systematic review methodology in accordance with relevant guidelines outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Moher, Liberati, Tetzlaff, & Altman, 2009). This review process entailed four stages: 1) searching electronic databases using key terms; 2) reviewing abstracts with potentially relevant titles and key terms; 3) reviewing the full-text of articles to determine eligibility (conducted by two authors); and 4) appraising the methodology of eligible studies and summarising the findings.

**Search Strategy**

Eligible articles were identified through systematic electronic searches of the following databases: Ovid (PsycINFO), ProQuest, PubMed, Science Direct, Scopus and Web of Science from inception to the end of October 2015. Keyword searching (i.e., searching of title, abstract, keyword and/or subject) was used for the following terms: 1) autism spectrum disorder or Asperger* or high-functioning autism or HFASD; AND 2) outcome* or psychosocial or mental health or depression or anxiety or self-esteem.

Search terms were chosen based on Diagnostic and Statistical Manual for Mental Disorders-Fourth Edition (DSM-IV; 1994), DSM-IV-TR (2000), DSM-5 (2013) and International Classification of Diseases-Tenth Revision (World Health Organization, 1993) terminology for people with high-functioning autism spectrum disorder (or Asperger’s Syndrome/Disorder) as relevant to the specific focus of our review.

Searches were limited to adults either via limits or through the additional search terms: AND adult*. In addition, specific autism journals (i.e., Autism Research, Journal of Autism and Developmental Disorders, Journal of Intellectual and Developmental Disability and Autism) were screened for articles published online that may not have
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been identified through the original database search. Finally, the reference lists of eligible studies were also manually searched.

Selection Criteria

To identify relevant studies, the following inclusion criteria were applied: peer-reviewed articles published in English; quantitative studies (i.e., use of statistical analysis) that investigated factors related to psychosocial outcomes in adults with HFASD; mean age for the HFASD sample was at least 18 years and the minimum age of a participant was 16 years; participants had a formal diagnosis of ASD and/or ASD severity was measured; and participants’ IQ was in the normal range (i.e., ≥ 70), or intellectual disability was specified in exclusion criteria.

All abstracts of articles that met these inclusion criteria were reviewed by the primary author. Articles were excluded if they were reviews, commentaries or case studies or if they only employed qualitative methodology. Despite having an empirical basis, the findings of case studies and qualitative studies require a different approach to synthesis that was outside the scope of this review.

Following the initial screening stage, the full-text of each article was independently reviewed by two authors. Level of agreement concerning eligibility for inclusion was quantified using a point-by-point method (i.e., number of agreements/[agreements + disagreements] x 100 = % agreement).

Quality of Methodology

The final stage of the review process involved evaluating the methodological quality of the eligible studies according to a checklist adapted from Ownsworth and McKenna (2004). Articles were scored 0 (does not meet) or 1 (meets) on the following five criteria: 1) prospective and/or retrospective design employed with at least two assessment time points (i.e., collection of data on childhood variables and follow-up of outcomes in adulthood); 2) characteristics of the sample (i.e., age, gender, IQ and ASD
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status) and the inclusion criteria for the study were clearly stated; 3) analysis of sample representativeness was conducted. For prospective (and retrospective) studies, participants lost at follow-up were described and the reasons for attrition were explained. For cross-sectional studies, a comparison was conducted between individuals who were eligible and participated and those who were eligible but did not participate; 4) an adequate sample size, i.e. comprised of at least 10 participants per predictor/independent variable (J. Cohen, 2013); and 5) a multivariate statistical approach was used to examine the relationship between the predictor/independent variables and outcomes with examination of, or control for other predictors or covariates. Higher scores (0-5) represented stronger methodological quality. The first author reviewed each study and rated the quality of methodology while the second author checked and confirmed the suitability of these ratings.

Data Synthesis

Due to significant variability in design, sample characteristics, analytic approach and outcome measures, meta-analysis was not used to synthesise the data. Instead, results were synthesized qualitatively.

Results

As shown in Figure 3.1, the initial search yielded a total of 843 articles, which reduced to 807 once duplicates and studies not published in English were removed. A further 726 articles were excluded on the basis of title or abstract, leaving a total of 67 articles to be screened for eligibility as full-texts by both reviewers. Additionally, a further six articles were identified through reviewing the content pages of specific autism journals and searching the reference lists of eligible articles. This process identified 27 articles eligible for review (see Figure 3.1). There was 82% agreement between two independent raters concerning the inclusion or exclusion of the 67 studies based on review of the full text. Initial disagreement regarding eligibility of 12 studies
Step 1: Identification
Electronic databases searched using key terms
\((n = 837)\)

Step 2: Screening
Abstracts reviewed and articles retained if the content suggested potential eligibility.
\((n = 807)\)

Step 3: Eligibility
Full-text articles reviewed independently by two authors to assess for eligibility
\((n = 67)\)

Step 4: Inclusion
Final studies included in qualitative synthesis and appraisal of methodology
\((n = 27)\)

Additional articles identified through other sources \((n = 6)\)

Excluded based on title \((n = 36)\)
- Duplicate \((n = 16)\)
- Not published in English \((n = 20)\)

Excluded based on abstract \((n = 726)\)
- Case studies
- Review or commentary
- Qualitative methodology
- Adults with HFASD were not studied

Excluded based on full-text \((n = 42)\)
- Methodology not relevant (e.g., mixed HFASD and autism sample)

Figure 3.1. Flow diagram of literature search and study selection.
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was resolved through discussion. Specifically, nine studies were included (Gillberg, Helles, Billstedt, & Gillberg, 2015; Gotham, Bishop, Brunwasser, & Lord, 2014; Gotham, Unruh, & Lord, 2014; Hagberg, Billstedt, Nyden, & Gillberg, 2015; Hagberg, Nyden, Cederlund, & Gillberg, 2013; Hare, Wood, Wastell, & Skirrow, 2014; Maddox & White, 2015; Rinaldi, Jacquet, & Lefebvre, 2015; Shtayermman, 2007), while three were not deemed eligible (Bejerot, Eriksson, & Mortberg, 2014; Gray et al., 2014; Hare, Gracey, & Wood, 2015). Two articles (Gotham, Bishop, et al., 2014; Gotham, Unruh, et al., 2014) employed the same sample, but analysed a different set of variables. A further two articles (Hagberg et al., 2015; Hagberg et al., 2013) also employed identical samples that involved analyses of different variables. The results of these four articles were summarised as two broader studies for the purpose of this review. Table 3.1 outlines the design, sample characteristics, correlates/predictors, psychosocial outcomes, quality of methodology ratings and significant findings of the 27 eligible studies.

**Participant and Sample Characteristics**

A total of 1398 individuals (M age = 28.54 years) with HFASD were involved across the 27 studies (published between 1989 and December 2015), with sample sizes of 10-291 (M sample size = 51.8). The cross-sectional study by Khanna, Jariwala-Parikh, West-Strum, and Mahabaleshwarkar (2014) had the largest sample size ($n = 291$), representing 20.8% of the total participants in this review. Across the 26 studies that specified participants’ gender there were 930 males (71.6%) and 369 females (28.4%).

**Quality of Methodology**

As shown in Table 3.2, the methodological quality was variable across the 27 studies (score range: 1-4). Based on the five criteria specified for this review, the two studies with the strongest methodological quality were a cross-sectional study ($n = 141$)
### Table 3.1

**Summary of Studies Investigating Factors Related to Psychosocial Outcomes in Adults with HFASD**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Design and Sample (Mean Age)</th>
<th>Correlates/Predictors</th>
<th>Psychosocial Outcomes</th>
<th>Quality of Methodology</th>
<th>Significant Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abell and Hare (2005)</td>
<td>Cross-sectional ( n = 46 ) (32.5 years)</td>
<td>Age, self-consciousness, executive functioning, delusional beliefs, non-verbal &amp; verbal IQ, FSIQ, theory of mind (ToM), autobiographical memory</td>
<td>Anxiety and depression (HADS)</td>
<td>1</td>
<td>Older age, greater delusional beliefs and self-consciousness correlated with anxiety. Older age was also related to increased depression</td>
</tr>
<tr>
<td>Berger, Aerts, van Spuendorck, Cools, and Teunisse (2003)</td>
<td>Prospective ( n = 30 ) (19.3 years), 3 year follow-up interval</td>
<td>Time 1: central coherence, cognitive shifting; Time 1 &amp; 2: Social functioning (symptom severity, social understanding &amp; competence)</td>
<td>Improvement in social competence (VABS)</td>
<td>2</td>
<td>Cognitive shifting was identified as an early prognostic marker of social competence</td>
</tr>
<tr>
<td>Bishop-Fitzpatrick, Mazefsky, Minshew and Eack (2015)</td>
<td>Cross-sectional ( n = 38 ) (23.1 years)</td>
<td>Age and education</td>
<td>Stress (Brief Psychiatric Rating Scale); Social Functioning (Global Assessment Scale; Social Adjustment Scale-II)</td>
<td>3</td>
<td>Older age, but not education, was related to poorer social functioning (note: associations with stress were not examined)</td>
</tr>
<tr>
<td>Byers, Nichols, Voyer, and Reilly (2013)</td>
<td>Cross-sectional ( n = 141 ) (39.6 years)</td>
<td>Gender, age, relationship status, ASD symptoms, self-esteem,</td>
<td>Sexual well-being (e.g., anxiety, self-esteem)</td>
<td>4</td>
<td>Greater ASD symptoms were related to increased sexual anxiety and lower self-esteem. Males had better sexual well-being</td>
</tr>
<tr>
<td>Farley et al. (2009)</td>
<td>Prospective ( n = 41 ) (32.5 years), mean time interval to follow-up 24.42 years</td>
<td>Social support (vocational rehabilitation, government disabilities support), FSIQ</td>
<td>Social functioning rating (very good-very poor) and adaptive behaviour (VABS)</td>
<td>3</td>
<td>Childhood FSIQ predicted VABS scores in adulthood. Greater gains in intellectual functioning(IQ) were associated with better social and adaptive outcomes</td>
</tr>
</tbody>
</table>
## FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

<table>
<thead>
<tr>
<th>Study Authors and Year</th>
<th>Study Design</th>
<th>Sample Size</th>
<th>Outcome Measures</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gillberg, Helles, Billstedt, and Gillberg (2015)</td>
<td>Prospective, n = 50 (30 years), mean time interval to follow-up 9.4 years</td>
<td>FSIQ, VIQ, PIQ</td>
<td>Depression (BDI), psychiatric disorders (Mini Neuropsychiatric Interview), GAF, ADHD (Adult ADHD Self-Report Scale; SNAP-IV)</td>
<td>Lower current FSIQ and non-verbal IQ was associated with ADHD symptoms.</td>
</tr>
<tr>
<td>Gotham, Unruh, and Lord (2014); Gotham, Bishop, Brunwasser, and Lord (2014)</td>
<td>Cross-sectional, n = 50 (20.7 years)</td>
<td>Age, gender, FSIQ, ASD related impairments, rumination, perceived social support, social interests and habits</td>
<td>Depression (BDI-II; Self-Report Depression Questionnaire), Anxiety (Spence Children’s Anxiety Scale-Parent), adaptive behaviour (VABS)</td>
<td>Greater ASD impairments and rumination and lower levels of perceived social-support, motivation and participation were related to increased depression. Rumination moderated the relationship between ASD symptoms and depression.</td>
</tr>
<tr>
<td>Hagberg, Nyden, Cederlund, and Gillberg (2013); Hagberg, Billstedt, Nyden, and Gillberg (2015)</td>
<td>Prospective, n = 69 (22.2 years), mean time interval to follow-up 9.8 years</td>
<td>Childhood ASD diagnosis and interview, cognitive assessment (verbal and non-verbal IQ, executive function, central coherence, memory)</td>
<td>Social adaptive behaviour (VABS); GAF; ADHD (SNAP-IV)</td>
<td>Adults with lifelong non-verbal disability had worse GAF than those with childhood only non-verbal disability. Those with lifelong non-verbal disability had worse social adaptive outcomes than those with no history of non-verbal disability; Poorer childhood non-verbal IQ was associated with ADHD symptoms in adulthood. Self-focus, worries and longer periods of rumination were positively associated with anxiety.</td>
</tr>
<tr>
<td>Hare, Wood, Wastell, and Skirrow (2014)</td>
<td>Cross-sectional, n = 20 (32.1 years)</td>
<td>Thinking characteristics (e.g., self-focus, confusion, worries about everyday events and rumination)</td>
<td>Anxiety and Depression (HADS)</td>
<td>Emotion processing was not significantly related to depression.</td>
</tr>
<tr>
<td>Hill, Berthoz, and Frith (2004)</td>
<td>Cross-sectional, n = 27 (35.1 years)</td>
<td>Emotion processing on the Toronto Alexithymia Scale</td>
<td>Depression (BDI)</td>
<td>Greater ASD symptoms were associated with higher perceived stress.</td>
</tr>
<tr>
<td>Hirvikoski and Blomqvist (2015)</td>
<td>Cross-sectional, n = 25 (34.1 years)</td>
<td>ASD symptoms</td>
<td>The Perceived Stress Scale (PSS)</td>
<td>Greater ASD symptoms were associated with higher perceived stress.</td>
</tr>
</tbody>
</table>
### FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

<table>
<thead>
<tr>
<th>Study Authors and Year</th>
<th>Design and Sample Size</th>
<th>Variables Measured</th>
<th>Outcomes and Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Howlin (2003)</td>
<td>Cross-sectional, n = 76 (26.1 years)</td>
<td>Autism and Asperger diagnoses, non-verbal IQ, comprehension, vocabulary, parent interview</td>
<td>Social outcomes (Autism Diagnostic Interview) and social functioning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Asperger subgroup achieved higher education attainment than the autism subgroup.</td>
<td></td>
</tr>
<tr>
<td>Jansch and Hare (2014)</td>
<td>Cross-sectional, n = 30 (32.23 years)</td>
<td>ASD symptoms, mentalisation (Reading the Mind in the Eyes Test), data gathering bias (Beads Task)</td>
<td>Depression (PHQ), generalised anxiety (Generalised Anxiety Disorder-7), self-consciousness (Self Consciousness Scale), paranoid thoughts (Paranoid Thought Scales)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Greater ASD symptoms were associated with depression and anxiety</td>
<td></td>
</tr>
<tr>
<td>Jantz (2011)</td>
<td>Cross-sectional, n = 35 (45 years)</td>
<td>Age, gender, ASD symptoms</td>
<td>Loneliness (UCLA Loneliness Scale)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Greater ASD symptoms were related to increased loneliness</td>
<td></td>
</tr>
<tr>
<td>Khanna, Jariwala-Parikh, West-Strum, and Mahabaleshwarkar (2014)</td>
<td>Cross-sectional, n = 291 (30.7 years)</td>
<td>Age, gender, ASD severity, perceived social support, coping</td>
<td>Health-related QoL (HRQoL): Physical and mental (The Medical Outcomes Study Short-Form Health Survey version 2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Poorer perceptions of social support from friends, ASD severity and maladaptive coping strategies were related to poorer physical and mental HRQoL.</td>
<td></td>
</tr>
<tr>
<td>Maddox and White (2015)</td>
<td>Cross-sectional, n = 28 (32.23 years)</td>
<td>ASD symptoms (Social Responsiveness Scale-II)</td>
<td>Social Anxiety Disorder Symptoms (Anxiety Disorders Interview Schedule-DSM-IV [ADIS-IV])</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Greater ASD related social impairments were associated with social anxiety disorder symptoms.</td>
<td></td>
</tr>
<tr>
<td>Montgomery, Stoesz, and McCrimmon (2013)</td>
<td>Cross-sectional, n = 25 (18.2 years)</td>
<td>HFASD symptoms, Verbal IQ, ToM, executive functions, emotional intelligence</td>
<td>Interpersonal relations and social stress (Behaviour Assessment System for Children-2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Greater emotional intelligence was related to better interpersonal relations. Those with greater emotional intelligence and ToM had lower social stress</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Sample Characteristics</td>
<td>Outcome Measures</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>---------------</td>
<td>----------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Renty and Roeyers (2006)</td>
<td>Cross-sectional</td>
<td>Age, gender, ASD symptoms, FSIQ (ASD symptoms + FSIQ = disability characteristics), support characteristics (perceived, received)</td>
<td>Quality of Life Questionnaire</td>
</tr>
<tr>
<td>Renty and Roeyers (2007)</td>
<td>Cross-sectional</td>
<td>Males with ASD, ASD symptoms, informal social support – spouse and family, received support – spouse and family, formal support, coping strategies</td>
<td>Psychological distress – individual satisfaction (The Symptom Checklist-90), marital satisfaction (Dyadic Adjustment Scale)</td>
</tr>
<tr>
<td>Schmidt et al. (2015)</td>
<td>Cross-sectional</td>
<td>Psychological resources and general functioning (WHODAS)</td>
<td>Life satisfaction (German Quality of Life Questionnaire)</td>
</tr>
<tr>
<td>Shlayermman (2007)</td>
<td>Cross-sectional</td>
<td>HFASD symptoms, peer victimisation, level of stigma</td>
<td>Anxiety, depression (PHQ), suicidal ideation (Suicidal Ideation Questionnaire)</td>
</tr>
<tr>
<td>South et al. (2015)</td>
<td>Cross-sectional</td>
<td>Pattern separation memory task</td>
<td>State-Trait anxiety scale; Behavioural inhibition and approach strategies (Behavioural Inhibition and Activation Scales)</td>
</tr>
</tbody>
</table>
### FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

<table>
<thead>
<tr>
<th>Study Authors</th>
<th>Study Design</th>
<th>Sample Size</th>
<th>Follow-up Details</th>
<th>Measures of Outcomes</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Szatmari, Bartolucci, Bremner, Bond, and Rich (1989)</td>
<td>Retrospective</td>
<td>$n = 16$ (26.0 years)</td>
<td>Mean time interval to follow-up $11-27$ years</td>
<td>Early ASD symptoms, current FSIQ, visuo-motor skills, facial recognition, receptive language, non-verbal problem solving (cognitive shifting) skills, visual motor integration</td>
<td>Social adaptive functioning (VABS)</td>
</tr>
<tr>
<td>Tani et al. (2012)</td>
<td>Cross-sectional</td>
<td>$n = 99$ (30.7 years)</td>
<td></td>
<td>ASD symptoms, developmental and social history (structured interview with informant), FSIQ</td>
<td>Psychological and behavioural history (mental health and behavioural symptoms)</td>
</tr>
<tr>
<td>Taylor, Henninger, and Mailick (2015)</td>
<td>Prospective</td>
<td>$n = 73$ (23.83 years) over a $12$ year follow-up</td>
<td></td>
<td>Gender, age, ASD symptoms, maladaptive behaviours, daily activities, parental education, maternal social support, depression, anxiety and pessimism</td>
<td>Employment and study outcome (Vocational Index)</td>
</tr>
<tr>
<td>Wallace et al. (2015)</td>
<td>Cross-sectional</td>
<td>$n = 35$ (21.55 years)</td>
<td></td>
<td>Age, FSIQ, Executive functioning (behaviour regulation and metacognition)</td>
<td>Adaptive functioning (Adaptive Behaviour Assessment System-II); anxiety, depression and ADHD (Adult Behavior Checklist)</td>
</tr>
</tbody>
</table>

*BDI-II = Beck Depression Inventory; GAF = Global Assessment of Functioning; HADS = Hospital Anxiety and Depression Scale; PHQ= Patient Health Questionnaire; SNAP-IV = Swanson, Nolan and Pelham Questionnaire; VABS = Vineland Adaptive Behavior Scale.*
FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

by Byers et al. (2013) and a prospective study by Gillberg et al. (2015). The most common research design was cross-sectional (21/27 studies), whereas five studies employed a prospective design (Berger, Aerts, van Spaendonck, Cools, & Teunisse, 2003; Farley et al., 2009; Gillberg et al., 2015; Hagberg et al., 2013; Taylor, Henninger, & Mailick, 2015) and one study analysed data retrospectively across a time interval of 11-27 years (Szatmari et al., 1989). The prospective study by Berger et al. (2003) is noteworthy as the only study to employ a uniform follow-up period of three years, whereas the length of follow-up period was variable for Hagberg et al. (2013), Farley et al. (2009), Gillberg et al. (2015) and Taylor et al. (2015), ranging from 9.4-24.4 years.

Most studies (22/27) provided a clear description of the sample characteristics, including age, gender, IQ and ASD status (see Table 3.2). In terms of sample representativeness, four studies described and compared the characteristics of individuals who were eligible and participated in the study versus those who were eligible but did not participate (Byers, Nichols, Voyer, & Reilly, 2013; Farley et al., 2009; Gillberg et al., 2015; Szatmari et al., 1989). Two prospective and one retrospective study described participants lost at follow-up and reasons for attrition (Farley et al., 2009; Gillberg et al., 2015; Szatmari et al., 1989). Fourteen studies met the criteria for adequate sample size, with at least 10 participants per variable in the analyses (Bishop-Fitzpatrick, Mazefsky, Minshew, & Eack, 2015; Byers et al., 2013; Gillberg et al., 2015; Gotham, Bishop, et al., 2014; Gotham, Unruh, et al., 2014; Hagberg et al., 2013; Hill et al., 2004; Hirvikoski & Blomqvist, 2015; Howlin, 2003; Jansch & Hare, 2014; Jantz, 2011; Khanna et al., 2014; Schmidt et al., 2015; M. Tani et al., 2012).
### Table 3.2

**Ratings of Quality of Methodology of Included Studies**

<table>
<thead>
<tr>
<th>Study</th>
<th>Prospective/Retrospective Design</th>
<th>Sample Characteristics</th>
<th>Sample representativeness</th>
<th>Adequate sample size</th>
<th>Multivariate Analysis</th>
<th>Total (0-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abell and Hare (2005)</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
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<tr>
<td>Bishop-Fitzpatrick, Mazefsky, Minshew and Eack (2015)</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
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<tr>
<td>Byers, Nichols, Voyer, and Reilly (2013)</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Farley et al. (2009)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
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<tr>
<td>Gillberg, Helles, Billstedt, and Gillberg (2015)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
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<tr>
<td>Gotham, Unruh, and Lord (2014); Gotham, Bishop, Brunwasser, and Lord (2014)</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✓</td>
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<tr>
<td>Hagberg, Nyden, Cederlund, and Gillberg (2013); Hagberg et al. (2015)</td>
<td>✓</td>
<td>✓</td>
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<td>✓</td>
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<tr>
<td>Hare, Wood, Wastell, and Skirrow (2014);</td>
<td>✗</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
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### FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

<table>
<thead>
<tr>
<th>Reference</th>
<th>Environmental</th>
<th>Social</th>
<th>Emotional</th>
<th>Cognition</th>
<th>Overall</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hill, Berthoz, and Frith (2004)</td>
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<td>✗</td>
<td>✔</td>
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<td>Hirvikoski and Blomqvist (2015)</td>
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<tr>
<td>Howlin (2003)</td>
<td>✗</td>
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<td>✗</td>
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<tr>
<td>Jansch and Hare (2014)</td>
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<td>✗</td>
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<tr>
<td>Jantz (2011)</td>
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<td>✗</td>
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<tr>
<td>Khanna, Jariwala-Parikh, West-Strum, and Mahabaleshwarkar (2014)</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>✔</td>
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<td>Maddox and White (2015)</td>
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<tr>
<td>Montgomery, Stoesz, and McCrimmon (2013)</td>
<td>✗</td>
<td>✔</td>
<td>✗</td>
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<td>✔</td>
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<tr>
<td>Renty and Roeyers (2006)</td>
<td>✗</td>
<td>✔</td>
<td>✗</td>
<td>✗</td>
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<td>Renty and Roeyers (2007)</td>
<td>✗</td>
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<td>✗</td>
<td>✗</td>
<td>✔</td>
<td>1</td>
</tr>
<tr>
<td>Rinaldi, Jacquet, and Lefebvre (2015)</td>
<td>✗</td>
<td>✔</td>
<td>✗</td>
<td>✗</td>
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<tr>
<td>Schmidt et al. (2015)</td>
<td>✗</td>
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<td>✗</td>
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<tr>
<td>Shhtayermman (2007)</td>
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<td>✔</td>
<td>✗</td>
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<tr>
<td>South et al. (2015)</td>
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### FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

<table>
<thead>
<tr>
<th>Study</th>
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<th>✓</th>
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<th>✗</th>
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</thead>
<tbody>
<tr>
<td>Szatmari, Bartolucci, Bremner, Bond, and Rich (1989)</td>
<td>✓</td>
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<td>✓</td>
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<td>Tani et al. (2012)</td>
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<tr>
<td>Taylor, Henninger, and Mailick (2015)</td>
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<tr>
<td>Wallace et al. (2015)</td>
<td>✗</td>
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<td>✗</td>
<td>✗</td>
<td>✓</td>
<td>2</td>
</tr>
</tbody>
</table>
Finally, eleven studies utilised multivariate statistical approaches to examine the relationship between independent variables and psychosocial outcomes whilst controlling for other variables (Bishop-Fitzpatrick et al., 2015; Byers et al., 2013; Hill et al., 2004; Khanna et al., 2014; Maddox & White, 2015; Montgomery, Stoesz, & McCrimmon, 2013; Renty & Roeyers, 2006, 2007; Schmidt et al., 2015; Taylor et al., 2015; Wallace et al., 2015).

As shown in Table 3.1, psychosocial outcomes were measured using a combination of clinician or researcher-rated instruments (e.g., the Vineland Adaptive Behavior Scales [VABS; Sparrow et al., 1984], Autism Diagnostic Interview-Revised [ADI-R; Lord, 1994] and Structured Clinical Interviews/Global Assessment of Functioning [DSM IV-TR; APA, 2000]) and various self-report questionnaires. The most common self-report measure used was the Beck Depression Inventory (BDI; Beck, Steer, & Brown, 1996).

Factors Associated with Psychosocial Outcomes

Demographics: Age and Gender. Eight studies (Abell & Hare, 2005; Bishop-Fitzpatrick et al., 2015; Byers et al., 2013; Gotham, Unruh, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006; Taylor et al., 2015; Wallace et al., 2015) investigated the relationship between age and/or gender and psychosocial outcomes in adulthood. A cross-sectional study (n = 46) by Abell and Hare (2005) found that age was significantly and positively correlated with social anxiety and depression. Further, the cross-sectional study (n = 38) by Bishop-Fitzpatrick et al. (2015) noted that older age, and not years of education, was correlated with poorer social and adaptive functioning. However, cross-sectional studies with larger samples sizes (n = 58 and n = 291) by Renty and Roeyers (2006) and Khanna et al. (2014) found no significant associations between age and gender and quality of life (QoL). Further, cross-sectional research by Gotham, Unruh, et al. (2014) (n = 50) and Wallace et al. (2015) (n = 35) identified that age was not
significantly related to mental health or social and adaptive outcomes. In a large internet based study on romantic relationships ($n = 141$), Byers et al. (2013) found that males reported significantly better dyadic and solitary sexual well-being than females. Age was not found to be related to sexual well-being. In a prospective study ($n = 73$) over 12 years, Taylor et al. (2015) reported that after controlling for age, males were more likely to be employed or in post-secondary education than females. Further, females were less likely than males to maintain employment or post-secondary education over time. Overall, the findings for the influence of age and gender on psychosocial outcomes of adults with HFASD were mixed.

**Severity of ASD Symptoms.** Thirteen studies examined the relationship between severity of ASD symptoms and psychosocial outcomes (Byers et al., 2013; Gotham, Bishop, et al., 2014; Hirvikoski & Blomqvist, 2015; Howlin, 2003; Jansch & Hare, 2014; Jantz, 2011; Khanna et al., 2014; Maddox & White, 2015; Renty & Roeyers, 2007; Shtayermman, 2007; Szatmari et al., 1989; M. Tani et al., 2012; Taylor et al., 2015). In a small retrospective study ($n = 16$), Szatmari et al. (1989) found that early ASD symptoms ($M$ age = 6 years) were not significantly associated with social and adaptive functioning in adulthood. Conversely, in the study with the largest sample size ($n = 291$), Khanna et al. (2014) reported that greater ASD symptom severity was associated with poorer mental health-related QoL. Similarly, cross-sectional research by Gotham, Bishop, et al. (2014) ($n = 48$) and Jansch and Hare (2014) ($n = 30$) found that higher levels of ASD impairments were significantly related to greater depressive and anxiety symptoms. Consistent with these findings, Hirvikoski and Blomqvist (2015) reported in their cross-sectional study ($n = 25$) that greater ASD symptoms were associated with higher perceived stress. Further, Maddox and White (2015) reported in their cross-sectional study that greater ASD related social impairments were significantly associated with a co-morbid diagnosis of social anxiety disorder ($n = 28$).
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In a comparison of adults with Asperger’s syndrome (i.e., no early language delays) and those with high-functioning autism with early language delays, Howlin (2003) generally found no significant differences in psychosocial outcomes. However, adults with Asperger’s syndrome \( n = 42 \) achieved a higher level of education than those with high-functioning autism with early language delays \( n = 34 \). On the contrary, Taylor et al. (2015) found in their prospective study \( n = 73 \) that ASD characteristics did not significantly predict participation in post-secondary vocational and/or educational activities.

In a study assessing self-reported psychosocial outcomes, Jantz (2011) identified that despite access to social interaction, information and advice, adults with HFASD \( n = 35 \) attending community social support groups with greater ASD symptoms reported increased loneliness. Similarly, in their large cross-sectional study \( n = 141 \), Byers et al. (2013) found that greater ASD symptoms were related to increased sexual anxiety and lower self-esteem. Additionally, cross-sectional research \( n = 99 \) by M. Tani et al. (2012) found that a higher level of circumscribed interests was associated with increased anxiety. As with many correlational findings, the direction of this association is unclear because higher levels of anxiety could also contribute to people developing more specific or restricted interests in activities.

Focusing on males with HFASD \( n = 21 \) in a marital relationship, Renty and Roeyers (2007) reported that severity of ASD symptoms was negatively associated with spousal marital satisfaction, but not with the participants’ own relationship satisfaction. Finally, Shtayermman (2007) reported a significant negative correlation between severity of ASD symptoms and level of suicidal ideation. Unexpectedly, this finding suggested that people with more severe ASD symptoms experienced lower levels of suicidal ideation. However, caution is needed when interpreting this finding given the small sample size \( n = 10 \).
Measures of Neurocognitive Functioning. Eleven studies examined the relationship between measures of neurocognitive functioning and psychosocial outcomes (Berger et al., 2003; Farley et al., 2009; Gillberg et al., 2015; Gotham, Unruh, et al., 2014; Hagberg et al., 2015; Hagberg et al., 2013; Jansch & Hare, 2014; Montgomery et al., 2013; Rinaldi et al., 2015; South et al., 2015; Szatmari et al., 1989; Wallace et al., 2015). In a prospective study \((n = 41)\) with a mean follow-up of 24 years, Farley et al. (2009) found that after controlling for age at assessment, childhood full scale IQ (FSIQ) significantly predicted social and adaptive functioning in adulthood, explaining 23% of the variance. Current verbal IQ and non-verbal IQ accounted for significant additional variance (14-27%) in social and adaptive outcomes. Therefore, adults demonstrating greater gains in IQ between childhood and adulthood experienced significantly better social and adaptive outcomes in adulthood.

Consistent with these findings, in a prospective study \((n = 69)\) with a mean follow-up of approximately 10 years, Hagberg et al. (2013) reported that adults with persisting non-verbal learning problems from childhood had poorer global outcomes in adulthood than those with improved non-verbal functioning. Additionally, they found that adults with lifelong non-verbal disability had poorer social adaptive behaviour than those with no history of non-verbal disability. In the same sample, Hagberg et al. (2015) found that poorer childhood non-verbal IQ was associated with greater ADHD symptoms in adulthood. Similarly, Gillberg et al. (2015) \((n = 50)\) reported that males with lower current FSIQ and non-verbal IQ demonstrated greater ADHD symptoms.

Further, Szatmari et al. (1989) found that current FSIQ and cognitive shifting skills (i.e., Wisconsin Card Sort Test; Grant & Berry, 1981) were significantly and positively correlated with adaptive behaviour in adulthood. There were no significant associations between adaptive behaviour and tests of motor coordination, facial recognition and receptive language. Consistent with these findings, the prospective
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study (n = 30) by Berger et al. (2003) found that poor cognitive shifting skills in childhood was predictive of lower social competence in adulthood.

However, cross-sectional research (n = 50) by Gotham, Unruh, et al. (2014) reported no significant association between verbal IQ and depressive symptoms. Similarly, in their cross-sectional study (n = 35), Wallace et al. (2015) found that FSIQ was not significantly related to adaptive functioning, anxiety or depression. Instead, they found that poorer executive functioning (i.e., metacognition and behaviour regulation) was related to worse psychosocial outcomes. Specifically, after controlling for age and FSIQ, poorer planning (metacognition subscale) was significantly related to worse adaptive functioning ($sr^2 = .29$) and depression ($sr^2 = .17$), while deficits in shifting (i.e., behaviour regulation subscale) was related to greater anxiety ($sr^2 = .38$). In line with these results, a cross-sectional study (n = 24) by South et al. (2015) reported that poorer memory (i.e., pattern separation memory) was associated with more negative emotionality.

In a small cross-sectional study (n = 17), Rinaldi et al. (2015) found that interference control or inhibition, an executive function domain, distinguished between adults with ASD with a co-morbid diagnosis of schizophrenia and those with ASD with no co-morbid diagnosis. Although there was no significant difference between the groups on verbal and non-verbal fluency, individuals without co-occurring psychotic symptoms performed significantly better on a measure of interference control (i.e., Stroop colour naming task). However, in another cross-sectional study (n = 30), Jansch and Hare (2014) reported no significant associations among data gathering bias (i.e., the tendency to jump to conclusions), mentalisation and paranoid thoughts.

In the only study (n = 25) to examine the relationship between social cognition and psychosocial outcomes, Montgomery et al. (2013) reported a significant positive association between self-reported trait emotional intelligence and interpersonal
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relations. Further, individuals with greater emotional intelligence and ToM had lower social stress. There were no significant associations between FSIQ, executive functioning and interpersonal relations and social stress.

Overall, despite the diversity of neuro-cognitive factors investigated, the findings most consistently indicated significant associations between lower IQ (especially non-verbal functioning) and executive functions (i.e., cognitive shifting skills, planning and inhibition) and poorer psychosocial outcomes.

**Appraisals and Coping Skills.** Six studies examined the relationship between self-appraisals and coping skills and psychosocial outcomes (Abell & Hare, 2005; Gotham, Bishop, et al., 2014; Hare et al., 2014; Hill et al., 2004; Khanna et al., 2014; Renty & Roeyers, 2006). In a large cross-sectional study ($n = 291$), Khanna et al. (2014) reported that maladaptive coping strategies (i.e., behavioural disengagement, denial, self-blame, self-distraction, substance abuse and venting) were significantly related to poorer physical and mental health-related QoL in adulthood. In a small cross-sectional study ($n = 21$), Renty and Roeyers (2007) explored different coping styles employed by males with HFASD using the Ways of Coping Questionnaire (WCQ; Lazarus & Folkman, 1984). They found no significant associations between approach coping strategies (e.g., confronting or seeking social support) and avoidance coping strategies (e.g., distancing or escape avoidance) and marital satisfaction.

Cross-sectional research by Hill et al. (2004) found that adults with HFASD ($n = 27$) reported greater difficulty identifying and describing their feelings (i.e., emotion processing) and were more depressed than matched controls; however, emotion processing was not significantly related to depression. In contrast, Gotham, Bishop, et al. (2014) found that rumination was significantly and positively associated with depressive symptoms, and moderated the relationship between ASD symptoms and depression. In further cross-sectional research ($n = 46$), Abell and Hare (2005) reported
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that greater delusional beliefs and self-consciousness were significantly related to higher levels of anxiety. Similarly, in a small cross-sectional study \((n = 20)\), Hare et al. (2014) found that negative thinking styles (i.e., greater self-focus and worrying) and longer periods of rumination were positively associated with anxiety symptoms.

**Social and Environmental Factors.** Six studies investigated social and environmental factors associated with psychosocial outcomes (Gotham, Bishop, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006; Schmidt et al., 2015; M. Tani et al., 2012; Taylor et al., 2015). In the only prospective study to examine the impact of the familial context on psychosocial outcomes, Taylor et al. (2015) found that adults with HFASD \((n = 73)\) who had fathers with higher educational attainment were more likely to obtain and maintain education or employment activities.

Cross-sectional research \((n = 58)\) by Renty and Roeyers (2006) identified that perceived informal support was more closely related to QoL than actual received support. Further, levels of perceived and received social support were stronger predictors of QoL than disability characteristics (i.e., severity of ASD symptoms and FSIQ). In a separate study, Renty and Roeyers (2007) identified that perceived informal support was related to better psychological functioning and marital adaptation for men with HFASD \((n = 21)\). Similarly, in a large cross-sectional study \((n = 291)\), Khanna et al. (2014) reported that greater perceptions of availability and adequacy of social support from friends were related to better physical and mental health-related QoL.

Further, cross-sectional research \((n = 50)\) by Gotham, Bishop, et al. (2014) reported that lower levels of perceived social support, social motivation and social participation were related to increased depression. In terms of social inclusion, Schmidt et al. (2015) found that participation in society (i.e., taking part in family, social and community activities) was significantly related to overall life satisfaction for adults with HFASD \((n = 43)\).
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Finally, the long-term psychosocial impact of bullying was investigated in a large cross-sectional study \( n = 99 \) by M. Tani et al. (2012), which identified that bullying during the school years was associated with greater mood swings in adulthood. Overall, low levels of perceived social support were consistently found to be related to poorer psychosocial outcomes.

Discussion

This systematic review sought to identify factors related to psychosocial outcomes for adults with HFASD. A review of the 27 selected studies indicated that demographic characteristics (i.e., age and gender), ASD symptom severity and indices of neurocognitive functioning were the most frequently investigated factors. Relatively few studies examined self-appraisals, coping strategies and social and environmental factors. Overall, the methodological quality of the studies reviewed was low (i.e., 19/27 received a rating of <3/5) with common limitations including the use of cross-sectional designs, small and non-representative samples, and reliance on univariate analyses that did not control for other relevant predictors or covariates. There was also considerable variability in the design, sampling characteristics, outcome measures and analytic approach of studies included.

Despite these methodological issues, a consistent finding was that severity of ASD symptoms was significantly related to diverse psychosocial outcomes, including: depression, QoL, loneliness, anxiety, stress, sexual well-being, self-esteem, martial satisfaction and suicidal ideation (Byers et al., 2013; Gotham, Bishop, et al., 2014; Hirvikoski & Blomqvist, 2015; Howlin, 2003; Jansch & Hare, 2014; Jantz, 2011; Khanna et al., 2014; Renty & Roeyers, 2007; Shtayermman, 2007; M. Tani et al., 2012). An exception to this finding was that ASD symptoms during childhood were not related to social and adaptive functioning in adulthood (Szatmari et al., 1989). However, the
small sample size ($n = 13$) and retrospective design limits the ability to draw conclusions from this study. Further, a prospective study by Taylor et al. (2015) identified that ASD characteristics were not related to post-secondary vocational or educational outcomes. Nevertheless, the present findings regarding ASD symptom severity largely concur with those of previous reviews on children and adults with high and low functioning ASD (Chiang & Wineman, 2014; Levy & Perry, 2011), thus highlighting that more severe ASD symptomatology represents a risk factor for poor psychosocial outcomes of adults with HFASD.

The findings regarding the influence of age and gender on psychosocial outcomes were largely mixed. In particular, Abell and Hare (2005) reported a robust positive association between age and levels of anxiety and depression. Additionally, Bishop-Fitzpatrick et al. (2015) found that older age was significantly associated with poorer social and adaptive functioning. Conversely, this association was not significant in studies by Gotham, Unruh, et al. (2014) and Wallace et al. (2015) which adopted similar methodology. Controlling for the effects of age, the prospective study by Taylor et al. (2015) reported that males were more likely to be employed or in post-secondary education than females, and that females were less likely than males to maintain employment or post-secondary education over time. Further, Renty and Roeyers (2006) and Khanna et al. (2014) found that age and gender were not related to QoL for adults with HFASD. These results contrast with the review by Chiang and Wineman (2014), who found that increasing age was related to poorer QoL in a combined group of children with high and low functioning ASD. A potential explanation for these inconsistent findings relates to different approaches to measuring QoL and adaptive functioning in the studies selected for review. For example, in the adult HFASD literature, QoL was typically assessed using self-report measures, whereas parental or
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caregiver ratings were more commonly used for children with ASD. It is likely that perceptions and expectations related to QoL differ for adults with HFASD as compared to parents or caregivers asked to rate a child with high or low functioning ASD.

A further main finding of this review is that neurocognitive functioning was related to various psychosocial outcomes (Berger et al., 2003; Farley et al., 2009; Gillberg et al., 2015; Hagberg et al., 2015; Hagberg et al., 2013; Montgomery et al., 2013; Rinaldi et al., 2015; South et al., 2015; Szatmari et al., 1989; Wallace et al., 2015). It is noteworthy that five of the 11 studies that supported this relationship employed a prospective and/or retrospective design, thus identifying that stronger early cognitive skills (i.e., FSIQ, non-verbal learning and cognitive shifting) were associated with better social and adaptive functioning in adulthood (Berger et al., 2003; Farley et al., 2009; Gillberg et al., 2015; Hagberg et al., 2015; Hagberg et al., 2013; Szatmari et al., 1989). This mirrors the results of previous reviews of adults with high or low functioning ASD (Howlin, 2000; Levy & Perry, 2011; Magiati et al., 2014), which is perhaps not surprising given the overlap in studies selected. However, the present review additionally highlights the early prognostic significance of deficits in executive functions, notably cognitive shifting for individuals with an IQ of > 70 (Berger et al., 2003; Szatmari et al., 1989). In line with these findings, a cross sectional study by Wallace et al. (2015) found that deficits in cognitive shifting was related to greater anxiety. Cognitive shifting, also referred to as set-shifting or task switching, supports the ability to manage goals and self-regulate behaviour and has consistently been shown to be impaired for individuals with HFASD (Ambery et al., 2006; Hill & Bird, 2006; Lopez, Lincoln, Ozonoff, & Lai, 2005; Pellicano, 2007).

This review also identified other executive function domains associated with psychosocial outcomes. Specifically, difficulties with interference control (i.e., inhibition), were associated with a co-morbid diagnosis of schizophrenia (Rinaldi et al.,
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2015). Evidence in the literature suggests an overlap in features between ASD and schizophrenia at the biological (see Burbach & van der Zwaag, 2009 for a review), psychological and psychosocial level (Sven Bölte, Rudolf, & Poustka, 2002; Eack, Bahorik, et al., 2013). In particular, difficulties in some executive processes, such as inhibition and interference control, may act as vulnerability markers for the development of psychotic symptoms (Barneveld, de Sonneville, van Rijn, van Engeland, & Swaab, 2013).

A further noteworthy finding of the present review was the relationship between poorer neuro-cognitive functioning and greater risk of ADHD symptoms in adulthood (Gillberg et al., 2015; Hagberg et al., 2015). The DSM-5 (American Psychiatric Association, 2013) recognises that comorbidity of ASD and ADHD is common, and it is estimated that 30-50% of individuals with ASD manifest ADHD symptoms (Reiersen & Todd, 2008). There is evidence that the profile of executive function deficits for those with ASD and ADHD differs in children and adolescents (Happé, Booth, Charlton, & Hughes, 2006). Overall, the nature of executive function deficits experienced by adults with HFASD and relationship to psychosocial outcomes remains an important area for future research.

Social cognition is often conceptualised as a component of executive function (i.e., hot executive functions; Chan et al., 2008; McDonald, 2013). A novel finding that emerged in a small cross-sectional study ($n = 25$) by Montgomery et al. (2013) is that poorer ToM and lower trait emotional intelligence were associated with higher levels of social stress. Interestingly, trait emotional intelligence was more closely related to quality of interpersonal relations than FSIQ, ToM and executive functioning. Unlike these neuro-cognitive indices, emotional intelligence, social stress and interpersonal relations were assessed using self-report measures. Hence, method variance may have contributed to the significant associations between these constructs. Although discussed
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in the context of social cognition in this review, emotional intelligence may also reflect coping resource (i.e., the ability to perceive, be guided by and manage one’s emotions and those of others; Mayer, Salovey, Caruso, & Sitarenios, 2001). Difficulties with social functioning have long been attributed to socio-cognitive and emotional deficits such as poor joint attention and diminished emotional expressiveness (Baron-Cohen, 1995; Baron-Cohen, Wheelwright, Hill, et al., 2001; Castelli et al., 2002; Frith & Frith, 2003). The early influence of social cognition deficits related to emotional intelligence and ToM on the development of social competency in adults remains an important area for future research.

In relation to self-appraisal and coping variables, there was evidence from several studies that delusional beliefs, perseverative thinking, and maladaptive coping are related to psychosocial outcomes of adults with HFASD (Abell & Hare, 2005; Gotham, Bishop, et al., 2014; Hare et al., 2015; Khanna et al., 2014). Abell and Hare (2005) identified that delusional beliefs were positively related to anxiety. Consequently, they proposed a cognitive model of the development and maintenance of paranoid and grandiose thinking styles. Similarly, perseverative thinking style was related to increased depression and also moderated the relationship between severity of ASD symptoms and depression (Gotham et al., 2014). Hare et al. (2014) found that thinking styles characterised by worrying and rumination were associated with anxiety. Further, in their large cross-sectional study, Khanna et al. (2014) reported that maladaptive coping strategies were related to poorer physical and mental health domains of QoL. Due to the correlational nature of these findings, it is not possible to infer the direction of relationships. Specifically, although negative thinking styles and unhelpful coping strategies may contribute to poor psychosocial outcomes, it is also plausible that emotional distress and adverse social experiences contribute to, and maintain maladaptive appraisals and coping responses. Prospective studies investigating
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these potentially bi-directional or reciprocal effects over time could greatly aid intervention efforts for this population. Further, research investigating the existence of cross-domain interactions among risk factors (e.g., the effects of stress and depression on executive functioning) would advance the field.

A further consistent finding of this review was the association between higher levels of perceived social support and better psychosocial outcomes (Gotham, Bishop, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006). These studies indicated that subjective appraisal of support (i.e., perceived quality or availability) was more closely related to psychosocial outcomes than actual received support. This finding differs from the results of the review by Levy and Perry (2011) which indicated that access to intervention programs was associated with more positive outcomes for adolescents and adults with ASD. Aside from sampling differences, a key difference is that Levy and Perry (2011) focused on functional outcomes (e.g., cognitive function, language, academic performance and social outcomes), rather than indices of subjective well-being (e.g., QoL and depression) as measured by the studies included in the present review (Gotham, Bishop, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006). As noted previously, it is possible that perceptions of social support and levels of subjective well-being have reciprocal or mutually enhancing effects. There is considerable evidence in the general clinical literature that perceived social support moderates the impact of high levels of stress on health outcomes in a range of clinical populations (Payne et al., 2012; Steptoe, 2000). However, the stress buffering effects of perceived social support on psychosocial outcomes of adults with HFASD has received little attention to date and represents an important direction for future research.

Finally, only one study by M. Tani et al. (2012) examined the relationship between bullying and psychosocial outcomes. Based on retrospective reports, bullying during the school years was found to be associated with mood swings in adulthood. This
finding is consistent with other ASD literature which cites that the experience of being bullied, victimised or socially isolated, especially during the school years, may contribute to poor psychosocial functioning in adulthood (Cappadocia et al., 2012; Roekel et al., 2010). Interestingly, Hofvander et al. (2009) found that females with HFASD were more likely to be bullied during schooling than males. The factors that contribute to the experience of bullying (e.g., gender, ASD symptom severity, emotional intelligence, aspects of the education system) and potential mediators and/or moderators (e.g., appraisals, coping and social support) in the relationship between bullying and psychosocial outcomes in adulthood represents an important area for future research.

Methodological Considerations

The aim of the present review was to identify factors related to psychosocial outcomes of adults with HFASD. For this reason, only group studies that reported statistical analyses were included. It is important to recognise the valuable and often more in-depth accounts provided by case studies and qualitative studies, even though the aim of such studies is not to broadly generalise findings to the ASD population (Giarelli & Fisher, 2013; Haertl et al., 2013; Muller et al., 2008; Smith & Sharp, 2013; Townson et al., 2007). Rather, these studies may provide insight into the lived experience of a health condition within a particular social and cultural context.

In terms of the review methodology, the initial article search and screening (stages 1 and 2) and the assessment of methodological quality was not replicated by an independent researcher. However, the first and second authors independently screened full-text articles for inclusion during stage three and worked collaboratively to assess the quality of methodology of selected studies. The use of independent raters to examine methodological quality and obtain mutual agreement would increase the rigour of future reviews.
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In order to achieve extensive coverage of the literature, comprehensive databases (i.e., Ovid (PsycINFO), ProQuest, PubMed, Science Direct, Scopus and Web of Science) were used to identify relevant studies. Further, specific autism journals (i.e., Autism Research, Journal of Autism and Developmental Disorders, Journal of Intellectual and Developmental Disability and Autism) and reference lists of eligible studies were manually screened for articles published online that may not have been identified through the original database search. The search terms that were selected for the present review were based on DSM-IV (1994), DSM-IV-TR (2000), DSM-5 (2013) and ICD-10 (1993) terminology to identify people with high-functioning autism spectrum disorder (Asperger’s Syndrome/Disorder) as relevant to the specific focus of our review. However, it is acknowledged that a different set of search terms, including broader terms such as autism and functioning, or indeed a search of other databases, may have yielded additional papers.

Finally, it is important to recognise that the findings of this review are based on a heterogeneous set of studies with varying methodological quality. In particular, there was wide variation with respect to study design and sample characteristics, variables examined and measurement of psychosocial outcomes. This made the process of appraising methodological quality challenging. Thus, an alternative set of criteria may have yielded different ratings of methodological quality.

Conclusions and Future Directions

The findings of this systematic review on the early prognostic significance of ASD symptom severity and neurocognitive functioning (i.e., IQ and non-verbal abilities) were largely consistent with previous reviews of the broader ASD empirical literature. The present review additionally identified that cognitive shifting deficits are an early risk factor for poor psychosocial outcomes of adults with HFASD. However, further prospective research examining the relationship between deficits in executive
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function and social cognition and psychosocial outcomes for adults with HFASD is warranted. Such research may guide the focus of remedial and/or compensatory strategy training programmes (see Eack, Greenwald, et al., 2013; Hare et al., 2015; Magiati, Tay, & Howlin, 2012; Schmidt et al., 2015).

Although there were fewer studies focusing on self-appraisals and coping, there was evidence that individuals with negative thinking styles and maladaptive coping strategies experience poorer psychosocial outcomes, albeit mainly from cross-sectional research with correlational data. Due to the potentially bi-directional relationships among these factors, prospective studies are needed to better understand the development and maintenance of psychological and social difficulties over time. In terms of social and environmental factors, there was consistent support for the association between higher levels of perceived social support and better psychosocial outcomes. However, it is presently unknown whether perceived social support functions as a stress buffer between risk factors and psychosocial outcomes. More generally, examining the moderating and/or mediating role of psychological resources (e.g., appraisals, coping and social support) on the relationship between key risk factors (e.g., severity of ASD symptoms, neuro-cognitive deficits) and psychosocial outcomes would advance the field. As highlighted by qualitative research, the experience of being diagnosed with ASD, meeting likeminded people and recognising personal talents can have a positive effect on self-concept (Haertl et al., 2013; Smith & Sharp, 2013). Therefore, it is also important to examine positive self-concept domains that may buffer the stressors associated with ASD.

In future research it is recommended that prospective designs with large and representative samples be employed to improve the generalisability of findings to the broader adult HFASD population. Greater use of multivariate analyses that control for potential covariates would increase confidence in the findings. Greater consistency in
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research methodology across studies (including measurement of psychosocial outcomes) would also support quantitative synthesis of findings through meta-analysis.
Chapter 4: Statement of Contribution and Co-Authored Published Paper


This chapter includes a co-authored paper which has been prepared for submission to an international peer reviewed journal. (see Appendix C for a copy of the published paper in its original format). The bibliographic details of the co-authored paper, including all authors, are: **David Zimmerman**, Associate Professor Tamara Ownsworth, Professor Analise O’Donovan, Professor Jacqueline Roberts and Dr Matthew J Gullo. The candidate’s contribution to the paper involved conception of the study design, data collection and analyses, and writing of the manuscript. The co-authors provided review of drafts and supervisory advice.

Name of student: David Zimmerman

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Chapter 4: Foreword

As highlighted by the systematic review (study 1), there is evidence that difficulties in cognitive shifting (i.e., cold executive functions) present as an early risk factor for poor psychosocial outcomes for high-functioning adults with ASD. Furthermore, the review identified the need for further research to determine the impact of higher-order cognitive abilities (i.e., cold and hot executive functions) on psychosocial outcomes for this population. (Chapter 5). However, prior to conducting this investigation, there was an initial need to clarify the profile of executive function deficits experienced by high-functioning individuals with ASD relative to matched controls (see Table 1.1, Chapter 1). In addition, this study examined the relative independence of deficits in hot and cold executive functions. Relevant theoretical and clinical implications are highlighted with recommendations for future research.
Chapter 4: Independence of Hot and Cold Executive Function Deficits in High-Functioning Adults with Autism Spectrum Disorder

Introduction

Neurophysiological differences between adults with autism spectrum disorder (ASD) and neurotypical individuals have been well documented (Bauman, 1996; Bauman & Kemper, 2005). Anatomical and functional abnormalities have been identified in the prefrontal cortex, temporal poles, basal ganglia and the limbic system, a network of structures underlying executive functions and social cognition (Ashwin et al., 2007; Bauman, 1996; Lieberman, 2007; McAlonan et al., 2005). Yet, there are mixed empirical findings on the profile of executive function deficits experienced by high-functioning adults with ASD, or those with an IQ in the normal range (Baez et al., 2012; Boucher et al., 2005; Hill & Bird, 2006; Rajendran et al., 2005). In particular, it is unclear to what extent social cognition deficits overlap with, or are independent of other executive function deficits. An improved understanding of the higher-order impairments that underlie functional difficulties for individuals with ASD may assist with diagnosis and inform targeted intervention programs.

Described as an umbrella term, executive functions encompass higher-order cognitive processes and behavioral competencies such as planning, cognitive flexibility, social cognition (e.g., empathy and theory of mind [ToM]) and emotion regulation (Chan et al., 2008). These higher-order cognitive functions are mediated by the pre-frontal cortex and provide control and direction to lower-order brain functions (Stuss & Levine, 2002). In the literature, a distinction is commonly made between cold and hot executive functions (Chan et al., 2008; McDonald, 2013), as outlined in Figure 4.1.

Cold executive functions are associated with the dorsolateral pre-frontal cortical regions and include planning, cognitive flexibility, working memory, behavioral monitoring and inhibition (Chan et al., 2008). While there is an extensive body of evidence indicating
that individuals with ASD are typically impaired on tests of cold executive functions (Boucher et al., 2005; Hill, 2004; Ozonoff et al., 2004; Rajendran et al., 2005), the findings are mixed in terms of the specific profile of executive dysfunction. For example, deficits in working memory were reported in a number of studies (e.g., Bennetto, Pennington, & Rogers, 1996; Steele, Minshew, Luna, & Sweeney, 2007; D. L. Williams, Goldstein, Carpenter, & Minshew, 2005), whereas other studies found little evidence of working memory impairments (Koshino et al., 2005; Ozonoff & Strayer, 2001). Further, there is conflicting evidence regarding impairments in set-shifting or mental flexibility (Diamond & Kirkham, 2005), with deficits reported in one study (Baez et al., 2012), but not in other studies (Hill & Bird, 2006; Kleinhans et al., 2005). There have also been mixed findings for response initiation and suppression, with impairments evident in some studies (Boucher et al., 2005; Hill & Bird, 2006; K. Johnston, Madden, Bramham, & Russell, 2011) but not others (Abell & Hare, 2005; Baez et al., 2012).
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Hot executive functions are mediated by the ventromedial and orbito-frontal cortices, which support behaviors that require emotional awareness and regulation, empathy and ToM (Chan et al., 2008; McDonald, 2013). Conceptualised as a component of hot executive functions, social cognition is a broad term that encompasses several domains, including: emotion recognition, ToM, central coherence, and empathy (Baez & Ibanez, 2014; Baez et al., 2012). McDonald (2013) distinguished between hot and cold aspects of social cognition involved in evaluating and interpreting a social situation (see Figure 4.1). Hot social cognition refers to the processes responsible for emotion perception and identification, such as empathizing with the affective state of another person (e.g., emotional empathy). Cold social cognition involves a more objective perspective, such as thinking about things from another person’s point of view (e.g., ToM and cognitive empathy). Essentially, social cognition is a complex set of processes subserving adaptive social interactions, allowing an individual to share cognitive and affective experiences of other people, predict their behaviour and communicate effectively (McDonald, 2013). As such, social cognition is recognized as a core domain of impairment for individuals with ASD (Happé, Ronald, et al., 2006; Rajendran & Mitchell, 2007). However, the extent to which social cognition deficits overlap with, or are independent of cold executive function deficits remains unclear.

More generally, there is debate on whether social cognition represents a set of general cognitive abilities applied to social stimuli, or is supported by a dedicated modular cognitive system (Adolphs, 2010). Support for the functional modularity of social cognition is evident from some research on developmental disorders. For example, many high-functioning individuals with ASD demonstrate impairments in social cognition while general intellectual ability is preserved (Boucher et al., 2005). Conversely, individuals with Williams syndrome present with hyper-social behaviours despite impairments in non-social cognitive domains (Adolphs, 1999; Meyer-Lindenberg et al., 2005). Further, neuroimaging research by Castelli
et al. (2002) identified that adults with ASD show reduced activation in a network of structures implicated in the attribution of mental states. Although general cognitive abilities (e.g., attention, memory and language) and cold executive functions most likely play an important role during social interaction, the evaluation and interpretation of emotional and mental states appear to engage unique processes with specific neural substrates (Lieberman, 2007). To investigate whether social cognition operates independently of cold executive functions, reliable and valid measures of hot executive functions are needed.

Most studies of social cognition in adults with ASD have not distinguished between cold and hot ToM (Baron-Cohen et al., 2003; Uljarevic & Hamilton, 2013). Furthermore, first and second order false belief tasks (Perner et al., 1989; Perner & Wimmer, 1985), such as the Faux Pas Test (Stone, Baron-Cohen, & Knight, 1998) and the Strange Stories Test (Happé, 1994) are text-based and do not closely resemble the demands of everyday social interactions (Mathersul, McDonald, & Rushby, 2013). There is mixed evidence of impairments on the Reading the Mind in the Eyes Test (RMET; Baez et al., 2012; Baron-Cohen, Jolliffe, Mortimor, & Robertson, 1997; Baron-Cohen, Wheelwright, Hill, et al., 2001; Couture et al., 2010). The RMET is a static measure of ToM that can be solved using basic and general matching strategies to correctly pair depicted eyes and emotions. Although the RMET has been used extensively to assess ToM in people with ASD, the tests ecological validity has been questioned (Jarrold, Butler, Cottington, & Jimenez, 2000; L. Johnston, Miles, & McKinlay, 2008).

McDonald and colleagues (2003; 2006) developed The Awareness of Social Inference Test (TASIT), a dynamic audio-visual assessment, to more closely approximate the social cognition skills required during social interaction. TASIT assesses basic emotion recognition (TASIT Part 1) and cognitive and affective ToM (Part 2 & 3; TASIT; McDonald, Flanagan, Rollins, & Kinch, 2003). Mathersul et al. (2013) used TASIT Parts 2 and 3 to compare the
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Social cognition performance of adults with ASD to matched controls. Individuals with ASD were found to demonstrate impairments in understanding the beliefs, intentions and meaning of nonliteral expressions (i.e., lies and/or sarcasm) relative to controls. However, their ability to accurately interpret social interactions that involved a sincere exchange was consistent with controls.

Performance on social cognition measures such as TASIT is likely to be influenced by both hot and cold executive functions (McDonald et al., 2006). Yet, Baez et al. (2012) found that after controlling for cognitive flexibility (i.e., Switching Design Fluency), adults with ASD performed more poorly than controls on the emotion recognition test of TASIT (Part 1; McDonald et al., 2003), and emotional and cognitive inference aspects of ToM (FPT). Therefore, deficits in cognitive flexibility could not account for the impaired performance of the ASD group on tests of hot executive function relative to controls. To interpret dynamic social interactions, multiple sources of information need to be held online (i.e., working memory) whilst integrating relevant cues (e.g., facial expression, body language, linguistic content and context) in order to understand the meaning of the interaction and provide an appropriate and timely response. Accordingly, deficits in working memory and response initiation and suppression potentially contribute to social cognition impairments for individuals with ASD, although this has yet to be investigated. Such research would advance understanding of the higher-order cognitive deficits underlying difficulties with social interaction for this population.

The broad objective of the present study was to determine the independence of deficits in hot executive function and cold executive function for high-functioning adults with ASD. Due to their relevance to dynamic social cognition tasks, the cold executive function domains of focus were working memory and response initiation and suppression. The first study aim was to investigate impairments in hot and cold executive functions in high-functioning adults
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with ASD relative to matched controls. It was hypothesized that individuals with ASD would perform more poorly than controls on tests of cold and hot executive functions. Further, we sought to determine whether differences in hot executive function (TASIT) between participants with ASD and controls were significant after controlling for cold executive functions (i.e., working memory and response initiation and suppression).

Methodology

Design

Control participants were matched to high-functioning individuals with ASD on the basis of gender, age and years of education. Based on studies of executive functions in the adult ASD population (Baez et al., 2012; Hill & Bird, 2006; Mathersul et al., 2013), which demonstrated medium to large effect sizes (control group comparisons), the sample size requirement was determined using G*Power 3.1.9.2 (Faul, Erdfelder, Buchner, & Lang, 2009). With power of .80 and alpha set at .05 (one-tailed), power analyses indicated that a sample of approximately 40 participants per group was required to detect significant between group differences.

Participants

The broader sample consisted of 42 high-functioning adults with ASD and 40 matched controls. Participants with ASD were recruited via convenience sampling from ASD support services and clinics within a major metropolitan area. The directors and staff were initially contacted regarding the study and they circulated advertisements for the study in person and through online forums. The principal investigator (DZ) additionally presented an overview of the study at several ASD support group meetings.

All participants were screened to determine eligibility for participation, meeting the following criteria: 1) formal diagnosis of ASD and/or self-reported history of longstanding
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difficulties in social interaction and communication and a restricted range of behaviors and/or interests as reflected by scores equal to or greater than 77 on the Ritvo Autism Asperger’s Diagnostic Scale – Revised (RAADS; Ritvo et al., 2011); 2) aged 18-70 years; 3) adequate understanding of spoken and written English; 4) not currently experiencing a comorbid psychotic disorder; 5) no history of a serious neurological or medical condition (e.g., traumatic brain injury); and 6) absence of suspected literacy difficulties on a validated reading test. Further, all participants were administered a test of non-verbal IQ (Matrix Reasoning) to determine whether their estimated IQ was in the normal range (i.e., ≥ 70). This is in line with previous ASD research that has used IQ scores ≥ 70 to indicate high-functioning status (Baron-Cohen, 2000; Howlin, 2003). The mean estimated non-verbal IQ for the ASD sample was 102.65 (12.65), with scores ranging from 75-131; thus, all participants were considered to be high-functioning in terms of their estimated non-verbal IQ.

The control group participants were matched as closely as possible to the ASD group on gender, age and years of education. Control participants were recruited from a university and the general community. As shown in Table 4.1, participants in both groups were predominantly male (ASD group = 64.3%; Control group = 57.5%), with an average age of 34.02 years for the ASD sample and 33.23 years for the control sample. Although the mean years of education were higher in the control group, there were no significant differences between the groups on any of the matching variables. Most participants in both groups identified as European/Caucasian. Approximately 67% of individuals in the ASD group were employed or in higher education, as compared to 95% of control participants. In terms of friendship status, 100% of the control group identified having one or more close friends compared to 45.2% of individuals in the ASD group.
### Table 4.1
**Demographic Information and ASD Symptom Severity for the HFASD and Matched Control Groups**

<table>
<thead>
<tr>
<th>Demographic Data</th>
<th>HFASD Group (n = 42)</th>
<th>Control Group (n = 40)</th>
<th>(t/\chi^2)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>34.02 (12.42), 18-66</td>
<td>33.23 (12.41), 18-62</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>27 (64.3%)</td>
<td>23 (57.5%)</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td>Female</td>
<td>15 (35.7%)</td>
<td>17 (42.5%)</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Years of Education</strong></td>
<td>14.05 (2.24)</td>
<td>15.18 (2.92)</td>
<td>-</td>
<td>NS</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>European/Caucasian</td>
<td>40 (95.2%)</td>
<td>30 (75%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>-</td>
<td>10 (25%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A/TSI</td>
<td>2 (4.8%)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Employment Status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed/Self-Employed</td>
<td>21 (50%)</td>
<td>27 (67.5%)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>7 (16.6%)</td>
<td>11 (27.5%)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Volunteer</td>
<td>2 (4.8%)</td>
<td>1 (2.5%)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>12 (28.6%)</td>
<td>1 (2.5%)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Friendship Status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 &gt; close friends</td>
<td>19 (45.2%)</td>
<td>40 (100%)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1 &gt; friends, not close</td>
<td>9 (21.4%)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group friends only</td>
<td>6 (14.3%)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No close friends</td>
<td>8 (19.1%)</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Relationship Status</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/De facto</td>
<td>18 (42.9%)</td>
<td>29 (72.5%)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>24 (57.1%)</td>
<td>11 (27.5%)</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>RAADS-R Score</strong></td>
<td>139.05 (36.15), 79-208</td>
<td>37.05 (12.10), 10-58</td>
<td>17.07</td>
<td>p &lt; .001</td>
</tr>
<tr>
<td><strong>ASD Formal Diagnosis</strong></td>
<td>31 (73.8%)</td>
<td>N/A</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Matrix Reasoning</strong></td>
<td>102.38 (12.65), 75-131</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WIAT Reading Subtest</strong></td>
<td>107.64 (9.81), 78-119</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note.* NS = Not significant; ^a^ A/TSI = Aboriginal/Torres Strait Islander; ^b^ n = 41; RAADS-R = Ritvo Autism Asperger Diagnostic Scale-Revised; WIAT = Wechsler Individual Achievement Test.
A higher proportion of individuals in the control group (72.5%) were in a relationship compared to those with ASD (42.9%). All 42 participants identified a history of longstanding ASD symptomatology according to Diagnostic and Statistical Manual of Mental Disorders-Text Revision (DSM-IV-TR) criteria, with scores on the RAADS-R equal to or greater than the established clinical cut-off (i.e., ≥77; range: 79-205) (American Psychiatric Association, 2000; Ritvo et al., 2011). Seventy-four percent also reported a prior formal diagnosis of either ASD or Asperger's syndrome. There was no evidence of clinically significant literacy difficulties for the ASD sample, with a mean scaled score of 107.64 (12.65), and scores ranging from 78-119 on a standardized reading test (see materials).

Data on adaptive functioning and psychological status (see Materials) were collected as part of a broader research project focusing on psychosocial outcomes of adults with ASD. In terms of adaptive functioning (Table 4.2), most participants with ASD were classified as having Good (40.5%) or Fair/Poor (38.1%) functioning, whereas 21.4% were classified as having Very Good functioning. There were no individuals classified as having Very Poor adaptive functioning. A measure of self-reported psychological status (see Materials) indicated that approximately half of the sample (i.e., 43-48%) were in the normal range for depression, anxiety and stress. However, severe or extremely severe mood symptoms were reported by 41% of the sample for depression and 29% for both anxiety and stress.
Table 4.2

*Descriptive Statistics for Current Mental Health and Adaptive Functioning for the ASD Group (n = 42)*

<table>
<thead>
<tr>
<th>Test</th>
<th>Mean (SD)/Range/Frequency (%)</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>Mental Health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DASS – Depression</td>
<td>8.86 (9.05), 0-28</td>
<td>19 (45%)</td>
</tr>
<tr>
<td>DASS – Anxiety</td>
<td>5.10 (5.83), 0-24</td>
<td>18 (43%)</td>
</tr>
<tr>
<td>DASS – Stress</td>
<td>8.57 (7.41), 0-30</td>
<td>20 (47.5%)</td>
</tr>
<tr>
<td>Adaptive Functioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Good</td>
<td>9 (21.4%)</td>
<td>-</td>
</tr>
<tr>
<td>Good</td>
<td>17 (40.5%)</td>
<td>-</td>
</tr>
<tr>
<td>Fair/Poor</td>
<td>16 (38.1%)</td>
<td>-</td>
</tr>
<tr>
<td>Very Poor</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

*Note. DASS = Depression, Anxiety and Stress Scales.*
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Materials

Screening Assessments

Ritvo Autism Asperger’s Diagnostic Scale – Revised (RAADS; Ritvo et al., 2011). The RAADS-R is a self-report measure based on the DSM-IV-TR and International classification of diseases: Tenth revision (ICD-10 criteria) which is used to assist in the diagnosis of adults with ASD. The scale consists of 80-items (i.e., 64 symptom and 16 non-symptom based responses). Each question is rated on a 4-point Likert scale in order of severity ranging from “True now and when I was young” = 3 to “Never true” = 0. To minimize response bias, the 16 non-symptom based responses are reverse scored and are indicated by an asterisk beside each item. A total score of ≥77 out of a maximum score of 240 is indicative of an ASD diagnosis (Ritvo et al., 2011). The RAADS-R has demonstrated excellent test re-test reliability ($r = .99$) and sensitivity (97-100%) and specificity (100%; Ritvo et al., 2011; Ritvo et al., 2008).

Matrix Reasoning: Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). The WASI measures estimated verbal and non-verbal intelligence (i.e., Matrix Reasoning), and can yield a Full Scale intelligence quotient (IQ). Due to possible language difficulties impacting estimated IQ, only the Matrix Reasoning subtest was administered as a measure of estimated non-verbal IQ to help determine eligibility for those in the ASD group (i.e., IQ ≥ 70 based on T-score equivalent of >30).

Wechsler Individual Achievement Test-Third Edition (WIAT III; Wechsler, 2009). The Word Reading subtest of the WIAT was administered as a screening assessment of literacy difficulties for high-functioning individuals with ASD. Individuals read from a list of 35 words, with each correctly pronounced word scored as one point and converted to a scaled score. In the present study, no participant with ASD performed in the range indicating suspected literacy difficulties (i.e., scores < 70(Wechsler, 2009).
Depression, Anxiety and Stress Scales-21 (DASS-21; Lovibond & Lovibond, 1995). The DASS-21 comprises three 7-item subscales that assess the negative emotional states of depression, anxiety and stress and is based on the original 42-item version. Respondents are asked to rate the extent to which each item applied to them over the past week on a 4-point Likert scale, whereby higher scores indicate greater emotional distress. Scores on each 7-item scale are doubled to enable the following clinical cut-offs to be applied: Depression 0-8 (normal), 9-13 (mild), 14-22 (moderate), 24-36 (severe) and >36 (very severe); Anxiety 0-5 (normal), 6-8 (mild), 9-15 (moderate), 16-26 (severe) and >26 (very severe); Stress 0-14 (normal), 15-18 (mild), 19-26 (moderate), 27-37 (severe) and >37 (very severe; Lovibond & Lovibond, 1995). The DASS was used in the present study to provide descriptive information on the current mental health status for the ASD group.

Adaptive Functioning. For descriptive purposes for the ASD sample, a composite measure of overall adaptive functioning was derived from key demographic information (i.e., employment, relationship status, independence and friendships), with low scores indicating better outcomes. Outcome ratings were determined using a scale adapted from Howlin (2004) and Lotter (1978): Very Good = employed/studying, one or more close friends, high level of independence, in a relationship (total scores 0-2); Good = working or studying in some capacity; requiring some degree of support in daily living; some friends/acquaintances (total scores 3-5); Fair/Poor = has some degree of independence; requiring special residential provision/high level of support; no friends outside of residence; voluntary work (total scores 6-11); Very Poor = needing high-level hospital based or institutional care; no friends; no autonomy or independence (total score = >11).

Measures of cold executive functions

Hayling Sentence Completion Test (Hayling; Burgess & Shallice, 1997). The Hayling Test is designed to assess problems with response initiation and suppression. In the first part,
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the test administrator reads aloud 15 incomplete sentences that the respondent is required to complete with a word that would make the sentence meaningful. The second part is comprised of an additional 15 incomplete sentences that the individual needs to complete with a word that does not fit the context. Four scores are obtained: time taken for part one and two (response initiation [Box A and Box B]), errors for part two (response suppression and concept formation [Box C]) and an overall score (total of Box A, B and C scores). All response latency and error scores are converted to scaled scores that range from 1 (impaired) to 10 (very superior), with a score of 6 indicating average ability. Burgess and Shallice (1997) report test-retest reliability coefficients ranging from $r = .52$ (total errors) to $r = .78$ (Part 2, time) over an interval of two days to four weeks. The Hayling Test has good convergent validity with other measures of response inhibition (e.g., Stroop Inference Test and Color Trails Test; D'Elia, Satz, Uchiyama, & White, 1996; Stroop, 1935) and is sensitive to executive impairment in ASD (Boucher et al., 2005; Hill & Bird, 2006).

**Letter Number Sequencing** (LNS; Wechsler, 2008). LNS is a subtest of the Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV) designed to assess working memory. During this test, the examiner reads a string of numbers and letters (e.g., C-5-A-1) of increasing length across trials. Test-takers are required to say numbers first in ascending order and letters second in alphabetical order (e.g., 1-5-A-C). Correct responses for each item are totalled across trials and range from 0-30 with lower scores indicating poorer working memory. Scaled scores are derived using aged-based normative data (Wechsler, 2008). Studies have reported adequate test-retest reliability ($r = .75$) for the LNS and good ecological validity in the context of predicting functional status in a clinical population (Nuechterlein et al., 2008).
Measures of Hot Executive Functions

The Awareness of Social-Inference Test-Revised (TASIT; McDonald et al., 2006). TASIT is a dynamic audio-visual based assessment of social cognition. Comprised of a series of 15-60 second video vignettes, TASIT requires participants to implicitly encode and integrate contextual information to understand the social situation in three conditions: 1) Emotion Evaluation; 2) Social Inference–Minimal (SI-M); and 3) Social Inference–Enriched (SI-E). TASIT 2 and 3 assess simple and complex ToM judgments (Mathersul et al., 2013).

For emotion evaluation (part 1), there are 28 scenes for which the respondent is required to identify an actor’s emotional state by choosing from one of six basic emotions: happy, sad, angry, anxious, surprised and revolted. When the actor is not exhibiting any particular emotion, the participant is advised to select a neutral response. Each correct response is allocated one point and then summed for a total score, ranging from 0 to 28. In addition, the seven response options can be classified into either positive (i.e., happy, surprised and neutral) or negative (i.e., sad, angry, anxious and revolted) emotions (Flanagan, McDonald, & Rollins, 2002).

In Part 2, the SI-M subtest assesses the ability to determine the meaning and intention of a speaker’s dialogue, emotional expression and other paralinguistic cues with minimal context. Comprised of 15 short video scenes of social interactions, the participant responds to four separate questions related to what they think the key actor was doing, saying, thinking and feeling towards another person. The respondent answers in three possible ways: yes, no or don’t know. There are five scenes in which the actors are sincere (i.e., the actors thoughts and feelings are congruent with the words they use), five scenes in which the actors are sarcastic using paralinguistic cues (e.g., tone of voice) and fives scenes in which paradoxical sarcasm is utilized. Each correct response is allocated one point and then summed for the question type (i.e., do, say, think and feel) to yield a total score ranging from 0-60.
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Part 3 (SI-E) incorporates the same response format as SI-M, but examines an individual’s ability to understand social inferences within an enriched context. For the 16 scenes, half the videos depict an actor telling a lie while the remaining scenes involve sarcasm. In addition, eight scenes use either a visual or verbal cue to reveal the true state of affairs or the true beliefs of the speaker. Each correct response is allocated one point and scores are summed for the question type (i.e., do, say, think and feel) and the number of items to calculate a total score ranging from 0-64. TASIT 3 is proposed to assess second-order or advanced ToM, whereby the respondent must infer the thoughts of one actor towards another actor (Baron-Cohen, 1995).

TASIT has been widely validated as a measure of social cognition in different clinical populations, including traumatic brain injury (McDonald & Flanagan, 2004; McDonald et al., 2003; McDonald & Saunders, 2005), schizophrenia (Chung, Mathews, & Barch, 2011; Kern et al., 2009; Sparks, McDonald, Lino, O'Donnell, & Green, 2010) and dementia (Kipps, Nestor, Acosta-Cabronero, Arnold, & Hodges, 2009). It has also demonstrated validity as a measure of social cognition for high-functioning adults with ASD (Mathersul et al., 2013). TASIT has sound psychometric properties with good test-retest reliability over a period of 5-26 weeks ($r = .74-.88$) and evidence of convergent and discriminant validity (McDonald, 2012; McDonald et al., 2006).

Procedure

Ethical clearance was granted by the Griffith University Human Research Ethics Committee (protocol number PSY/28/13/HREC) and the study was conducted in accordance with the National Statement on Ethical Conduct in Human Research. The assessment process was conducted over two phases: 1) demographic survey and the RAADS-R were completed online via a web-link based survey emailed to individuals; and 2) face-to-face administration of a cognitive test battery. Participants in the ASD group received a $20 gift voucher for their
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participation. The control group participants were recruited via the researchers’ social networks and the Griffith University psychology subject pool whereby individuals received course credit for their participation.

In the first assessment phase, participants provided their informed consent followed by questions relating to their demographic and social functioning status using LimeSurvey, a free open source software tool (Schmitz, 2015). For the face-to-face assessment, the Hayling Sentence Completion Test, LNS and TASIT were administered in a quiet room. To ensure that results from the cognitive test battery were not confounded by order effects (Shum, O'Gorman, & Myors, 2006), each test was assigned a number and the sequence was randomized to determine the order of administration for each participant.

**Data Analysis**

The Statistical Package for Social Sciences (SPSS) Version 22 for Windows was utilized for all analyses and data screening procedures were conducted according to guidelines by Tabachnick and Fidell (2007). Data were examined for entry errors and missing values. The descriptive data revealed plausible ranges, means and standard deviations for all variables. Neuropsychological performance was classified into the categories of Normal performance and Mild/Moderate (i.e., ≥ -1 SD) and Severe (i.e., ≥ -2 SD) impairment based on the normative data for each test.

Frequency analysis revealed no missing data for the ASD and control group. As it was intended to conduct analyses on group data, univariate outliers and assumptions of normality were examined separately for the control and ASD groups. Examination of total scores revealed a violation of normality for TASIT 2. This was successfully transformed to correct the negatively skewed data. There were no univariate outliers in the total scores of executive function measures. Inspection of subscales within TASIT 1-3 and Hayling revealed numerous violations of normality and univariate outliers (i.e., z > +/- 3.29) for which transformations
were unable to correct (note: this was the case for subscales but not total scores). Thus, non-parametric tests (Mann Whitney U tests) were conducted to test the hypothesis regarding differences between the ASD and control groups on measures of executive function. Holm’s (1979) step-down procedure was employed to control the Familywise error rate. This method involves ordering $p$ values from lowest to highest and cumulatively adding each value until .05 is reached. The null hypothesis is rejected for all values less than the cumulative .05 total (Aickin & Gensler, 1996; Holland & Copenhaver, 1988).

Three sets of hierarchical multiple regression analyses were conducted with TASIT 1-3 total scores as the outcome variables to determine whether between-group differences in social cognition were significant after controlling for potential covariates and cold executive functions. There were no significant associations between TASIT performance and age, gender and education. However, independent $t$-tests revealed significant between group differences on TASIT 1 and 2 total scores according to employment status (dummy coded). Employment status (for TASIT 1 and 2 only) and scores on Hayling and LNS and were entered in the first step of the regression and ASD status (dummy coded) was entered in the second step. There were no violations of multivariate assumptions for these variables.

**Results**

**Comparison of ASD and Control Groups on Measures of Executive Functioning**

Descriptive statistics were generated for TASIT parts 1-3, LNS and Hayling (see Table 4.3). Based on TASIT norms, the majority of participants (i.e., >50%) in the control and ASD groups were in the normal range for emotion evaluation (Part 1), social inference-minimal (Part 2) and social inference-enriched (Part 3). However, a greater proportion of participants in the ASD group (38-45%) was classified as having either mild/moderate or severe impairment than the control group (0-7.5%) on all parts of TASIT (see Table 4.3).
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As shown in Table 4.3, significant between group differences were evident on most TASIT subscales and LNS and Hayling scores. The medians indicated that the control group consistently outperformed the ASD group on these measures. Effect sizes ($r$) were manually calculated using $z$ scores as recommended by Pallant (2013). According to Cohen’s (1988) criteria, effect sizes ranged from small to large ($r = .26$-.60).

For TASIT Part 1, the seven response options are classified into either positive (i.e., happy, surprised and neutral) or negative (i.e., sad, angry, anxious and revolted) emotions. Mann-Whitney U tests revealed a significant overall difference in the ability to identify positive emotions between the ASD group ($Md = 10$) and the control group ($Md = 11$), $U = 382.5, z = -4.38, p < .001, r = .48$). In addition, there was a significant overall difference in detecting negative emotions between the ASD group ($Md = 13$) and the control group ($Md = 15$), $U = 299, z = -5.15, p < .001, r = .60$). The medians suggested that the control group were significantly better at identifying both positive and negative emotions than the ASD group.

For TASIT Part 2, vignettes are categorized according to whether the social interaction was sincere or involved simple sarcasm or paradoxical sarcasm. Mann-Whitney U tests revealed a significant difference in the ability to interpret sincere interactions between the ASD group ($Md = 16$) and control group ($Md = 19$), $U = 541.5, z = -2.80, p = .005, r = .31$). There was also a significant difference in the ability to detect simple sarcasm between the ASD group ($Md = 16.5$) and control group ($Md = 20$), $U = 365, z = -4.55, p < .001, r = .50$).
Table 4.3

Executive Function Performance and Classification of Impairment for the ASD and Control Groups

<table>
<thead>
<tr>
<th>Test</th>
<th>Scoring</th>
<th>Median/n (%)</th>
<th>ASD (n = 42)</th>
<th>Controls (n = 40)</th>
<th>U/z (Effect size)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TASIT</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EE (part 1)</td>
<td>Raw scores</td>
<td>23</td>
<td>26</td>
<td>257.5/-5.46 (.60)*b</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>Normative</td>
<td>25 (59.5%)</td>
<td>40 (100%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild/Moderate</td>
<td>descriptions</td>
<td>10 (23.8%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td></td>
<td>7 (16.7%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Happy</td>
<td>Raw scores</td>
<td>3</td>
<td>4</td>
<td>547/-3.09 (.34)*</td>
<td></td>
</tr>
<tr>
<td>Surprised</td>
<td></td>
<td>4</td>
<td>4</td>
<td>612.5/-2.77 (.31)*</td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td></td>
<td>3</td>
<td>3</td>
<td>581.5/-2.65 (.29)*</td>
<td></td>
</tr>
<tr>
<td>Sad</td>
<td></td>
<td>3</td>
<td>4</td>
<td>637/-2.15 (.24)*</td>
<td></td>
</tr>
<tr>
<td>Angry</td>
<td></td>
<td>3</td>
<td>4</td>
<td>402.5/-4.62 (.51)*</td>
<td></td>
</tr>
<tr>
<td>Anxious</td>
<td></td>
<td>4</td>
<td>4</td>
<td>654/-2.04</td>
<td></td>
</tr>
<tr>
<td>Revolted</td>
<td></td>
<td>4</td>
<td>4</td>
<td>693/1.79</td>
<td></td>
</tr>
<tr>
<td>SI-M (part 2)</td>
<td>Raw scores</td>
<td>50 (319)</td>
<td>56</td>
<td>-4.84 (.53)*</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>Normative</td>
<td>23 (54.8%)</td>
<td>37 (92.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild/Moderate</td>
<td>descriptions</td>
<td>7 (16.7%)</td>
<td>3 (7.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td></td>
<td>12 (28.6%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do</td>
<td>Raw scores</td>
<td>13</td>
<td>14</td>
<td>441.5/-3.38 (.42)*</td>
<td></td>
</tr>
<tr>
<td>Say</td>
<td></td>
<td>12.5</td>
<td>14</td>
<td>365/-4.53 (.50)*</td>
<td></td>
</tr>
<tr>
<td>Think</td>
<td></td>
<td>12</td>
<td>14</td>
<td>385/-4.28 (.47)*</td>
<td></td>
</tr>
<tr>
<td>Feel</td>
<td></td>
<td>13</td>
<td>14</td>
<td>336.5/-4.80 (.53)*</td>
<td></td>
</tr>
<tr>
<td>SI-E (part 3)</td>
<td>Raw scores</td>
<td>52</td>
<td>58</td>
<td>337.5/-4.67 (.52)*</td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>Normative</td>
<td>26 (61.9%)</td>
<td>37 (92.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild/Moderate</td>
<td>description</td>
<td>6 (14.3%)</td>
<td>3 (7.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td></td>
<td>10 (23.8%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do</td>
<td>Raw scores</td>
<td>14</td>
<td>14</td>
<td>636.5/-1.93</td>
<td></td>
</tr>
<tr>
<td>Say</td>
<td></td>
<td>13</td>
<td>14</td>
<td>573.5/-2.51 (.28)*</td>
<td></td>
</tr>
<tr>
<td>Think</td>
<td></td>
<td>13</td>
<td>14</td>
<td>728/-1.07</td>
<td></td>
</tr>
<tr>
<td>Feel</td>
<td></td>
<td>13</td>
<td>13.5</td>
<td>577.5/-2.49 (.27)*</td>
<td></td>
</tr>
<tr>
<td><strong>LNS</strong></td>
<td>Scaled scores</td>
<td>10</td>
<td>11</td>
<td>526/-2.95 (.33)*</td>
<td></td>
</tr>
<tr>
<td><strong>Hayling</strong></td>
<td>Scaled scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Box A</td>
<td></td>
<td>5</td>
<td>6</td>
<td>460/-3.83 (.42)*</td>
<td></td>
</tr>
<tr>
<td>Box B</td>
<td></td>
<td>6</td>
<td>6</td>
<td>446/-4.38 (.48)*</td>
<td></td>
</tr>
<tr>
<td>Box C</td>
<td></td>
<td>7</td>
<td>7</td>
<td>601.5/-2.33 (.26)*</td>
<td></td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
<td></td>
<td>17</td>
<td>19</td>
<td>365.5/-4.48 (.49)*</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* *p* < .05; EE = Emotion Evaluation; LNS = Letter Number Sequencing; SI-M = Social Inference-Minimal; SI-E = Social Inference-Enriched; TASIT = The Awareness of Social Inference Test; a Classification relative to TASIT norms: Mild/Moderate = ≥ -1 SD to < -2 SD; Severe = ≥ -2 SD; b Significance values adjusted using Holm’s procedure; c Total Scaled Scores from Box A, B and C
Finally, there was a significant difference in the ability to identify paradoxical sarcasm between the ASD group ($Md = 18.5$) and control group ($Md = 20$), $U = 556.5$, $z = -2.77$, $p = .006$, $r = .31$). The median scores indicated that the controls were significantly more accurate than participants with ASD group in making social inferences with minimal context.

For TASIT Part 3, vignettes related to situations involving either lies or sarcasm. Mann-Whitney U tests revealed a significant difference in the ability to understand social inferences involving lies between the ASD group ($Md = 26$) and control group ($Md = 29$), $U = 459.5$, $z = -3.55$, $p < .001$, $r = .39$). Further, there was a significant difference in the ability to detect sarcasm between the ASD group ($Md = 26$) and control group ($Md = 29$), $U = 404.5$, $z = -4.06$, $p < .001$, $r = .45$). The median scores indicated that the control group demonstrated a greater ability to make social inferences in situations with enriched information than participants with ASD.

Given the generalized pattern of impairment across hot and cold executive functions demonstrated by the ASD group relative to controls, it was relevant to examine whether the between-group differences in hot executive function were significant after controlling for performance on tests of cold executive function.

**Independence of Impairments in Hot and Cold Executive Functions**

Table 4.4 displays the descriptive statistics and correlations for TASIT, LNS and Hayling for the combined control and ASD sample. The measures of executive functioning were significantly inter-related, with medium to large association ($r = .42-.48$) between TASIT and Hayling, and small to medium associations between TASIT and LNS ($r = .25-.34$).
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Table 4.4
Means, Standard Deviations and Correlations between TASIT Part 1-3, Hayling and LNS (n = 82)\(^1\)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>TASIT Part 2</th>
<th>TASIT Part 3</th>
<th>Hayling</th>
<th>LNS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TASIT Part 1</td>
<td>24.49</td>
<td>2.21</td>
<td>.51**</td>
<td>.49**</td>
<td>.48**</td>
<td>.34*</td>
</tr>
<tr>
<td>TASIT Part 2</td>
<td>52.20</td>
<td>6.29</td>
<td>.69**</td>
<td>.47**</td>
<td>.25*</td>
<td></td>
</tr>
<tr>
<td>TASIT Part 3</td>
<td>54.22</td>
<td>6.73</td>
<td>.42**</td>
<td>.29*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hayling(^b)</td>
<td>17.37</td>
<td>3.22</td>
<td></td>
<td>.23*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LNS(^c)</td>
<td>10.63</td>
<td>2.82</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. * \(p < .05\) ** \(p < .01\); \(^1\) Group: 1 = ASD, 2 = Control; \(^b\) = Total scaled scores from Box A, B and C; \(^c\) = Letter Number Sequencing scaled score; TASIT = The Awareness of Social Inference Test.

As shown in Table 4.5, Hayling, LNS and employment status initially explained 36.8% of the variance in TASIT Part 1 \((F[3, 78] = 15.11, p < .001)\). When ASD status was entered in Step 2, the total variance explained significantly increased to 46.3%, \(F(4, 77) = 16.34, p < .001\) (adjusted \(R^2 = .43\)). ASD status explained an additional 9.2% of the variance in TASIT Part 1 scores, \(F\) change \((1, 77) = 13.03, p < .01\). In the final model, ASD status \((sr^2 = .09)\), Hayling \((sr^2 = .04)\) and LNS \((sr^2 = .03)\) were all significant predictors. Therefore, the ASD group demonstrated deficits in emotional evaluation relative to controls that were independent of impairments in cold executive function and employment status.

For TASIT 2 (see Table 4.6), Hayling, LNS and employment status initially explained 25.7% of the variance in performance \((F[3, 78] = 9.00, p < .001)\). When ASD status was entered in Step 2, the total variance explained increased significantly to 34.6%, \(F(4, 77) = 8.89, p < .001\) (adjusted \(R^2 = .31\)). ASD status explained an additional 8.9% of the variance in TASIT Part 2 scores, \(F\) change \((1, 77) = 10.43, p = .002\). In the final model, only Hayling \((sr^2 = .04)\) and ASD status \((sr^2 = .09)\) were significant predictors. Thus, individuals with ASD

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\(^1\) For the ASD group \((n = 42)\), the measures of executive functioning were significantly inter-related \((p < .05)\) with medium associations between TASIT, Hayling and LNS \((r = .25-.34)\).
demonstrated deficits in making social inferences with minimal context relative to controls that were independent of impairments in cold executive function and employment status.

Table 4.5

Hierarchical Multiple Regression Analysis of the Relationship between ASD Status and TASIT Part 1 (Emotion Evaluation) Controlling for Hayling, LNS and Employment Status (n = 82)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>B</th>
<th>sr²</th>
<th>p</th>
<th>95 % CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>17.55</td>
<td></td>
<td></td>
<td></td>
<td>[14.93, 20.17]</td>
</tr>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hayling</td>
<td>.28</td>
<td>.39</td>
<td>.13</td>
<td>&lt; .001***</td>
<td>[.14, .42]</td>
</tr>
<tr>
<td>LNS</td>
<td>.20</td>
<td>.24</td>
<td>.05</td>
<td>.012*</td>
<td>[.05, .36]</td>
</tr>
<tr>
<td>Employmenta</td>
<td>-1.3</td>
<td>-.21</td>
<td>.04</td>
<td>.024*</td>
<td>[-2.47, -.18]</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hayling</td>
<td>.18</td>
<td>.25</td>
<td>.04</td>
<td>.013**</td>
<td>[.04, .32]</td>
</tr>
<tr>
<td>LNS</td>
<td>.15</td>
<td>.19</td>
<td>.03</td>
<td>.04*</td>
<td>[.01, .30]</td>
</tr>
<tr>
<td>Employmenta</td>
<td>-.76</td>
<td>-.12</td>
<td>.02</td>
<td>.17</td>
<td>[-1.87, .34]</td>
</tr>
<tr>
<td>ASD statusb</td>
<td>1.80</td>
<td>.37</td>
<td>.09</td>
<td>.001***</td>
<td>[.81, 2.80]</td>
</tr>
</tbody>
</table>

Note. * p < .05, ** p < .01 *** p < .001; a Employment: 1 = Employed/Student, 2 = Unemployed; b ASD status: 1 = ASD, 2 = Control.

Table 4.6

Hierarchical Multiple Regression Analysis of the Relationships between ASD Status and TASIT Part 2 (Social Inference-Minimal) Controlling for Hayling, LNS and Employment Status (n = 82)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>β</th>
<th>sr²</th>
<th>p</th>
<th>95 % CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-5.66</td>
<td></td>
<td></td>
<td></td>
<td>[-6.95, -4.36]</td>
</tr>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hayling</td>
<td>.125</td>
<td>.38</td>
<td>.13</td>
<td>&lt; .001***</td>
<td>[.06, .19]</td>
</tr>
<tr>
<td>LNS</td>
<td>.07</td>
<td>.18</td>
<td>.02</td>
<td>.09</td>
<td>[-.01, .15]</td>
</tr>
<tr>
<td>Employmenta</td>
<td>-.36</td>
<td>-.13</td>
<td>.01</td>
<td>.21</td>
<td>[-.92, .21]</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hayling</td>
<td>.08</td>
<td>.24</td>
<td>.04</td>
<td>.029*</td>
<td>[.01, .15]</td>
</tr>
<tr>
<td>LNS</td>
<td>.05</td>
<td>.12</td>
<td>.01</td>
<td>.23</td>
<td>[-.03, .12]</td>
</tr>
<tr>
<td>Employmenta</td>
<td>-.10</td>
<td>-.04</td>
<td>.001</td>
<td>.71</td>
<td>[.66, .45]</td>
</tr>
<tr>
<td>ASD statusb</td>
<td>.81</td>
<td>.36</td>
<td>.09</td>
<td>.002**</td>
<td>[.31, 1.31]</td>
</tr>
</tbody>
</table>

Note. * p < .05, ** p < .01 *** p < .001; a Employment: 1 = Employed/Student, 2 = Unemployed; b ASD status: 1 = ASD, 2 = Control.
As presented in Table 4.7, Hayling and LNS initially explained 24.7% of the variance in TASIT Part 3 performance ($F[2, 79] = 12.93$, $p<.001$). When ASD status was entered in Step 2, the total variance explained significantly increased to 33.6%, $F(3, 78) = 13.15$, $p<.001$ (adjusted $R^2 = .31$). ASD status explained an additional 8.9% of the variance in TASIT Part 3 scores ($F(1, 78) = 10.47$, $p = .002$). In the final model, only LNS ($sr^2 = .04$) and ASD ($sr^2 = .09$) were significant predictors. Therefore, consistent with TASIT Parts 1 and 2, the ASD group demonstrated deficits in making social inferences with enriched context relative to controls that were independent of impairments in cold executive function.

### Table 4.7

Hierarchical Multiple Regression Analysis of the Relationship between ASD Status and TASIT Part 3 (Social Inference-Enriched) Controlling for the Hayling and LNS ($n = 82$)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>β</th>
<th>sr²</th>
<th>$p$</th>
<th>95 % CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-4.22</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hayling</td>
<td>1.50</td>
<td>.33</td>
<td>.09</td>
<td>.002**</td>
<td>[.56, 2.43]</td>
</tr>
<tr>
<td>LNS</td>
<td>.65</td>
<td>.28</td>
<td>.07</td>
<td>.010**</td>
<td>[.16, 1.13]</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hayling</td>
<td>.77</td>
<td>.17</td>
<td>.02</td>
<td>.13</td>
<td>[-.22, 1.76]</td>
</tr>
<tr>
<td>LNS</td>
<td>.51</td>
<td>.22</td>
<td>.04</td>
<td>.03*</td>
<td>[.042, .98]</td>
</tr>
<tr>
<td>ASD status</td>
<td>.73</td>
<td>.35</td>
<td>.09</td>
<td>.002**</td>
<td>[.28, 1.17]</td>
</tr>
</tbody>
</table>

$p < .05$, ** $p < .01$ *** $p < .001$; * ASD status: 1 = ASD, 2 = Control.

**Discussion**

The broad aim of this study was to investigate the profile of hot and cold executive function impairments in high-functioning adults with ASD relative to matched controls. Overall, the ASD group demonstrated general impairments in hot and cold executive functions (i.e., emotion recognition, ToM, working memory and response initiation and suppression) when compared to matched controls. Further, the impairments in emotion
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recognition and ToM demonstrated by ASD participants were independent of deficits in working memory and response initiation and suppression. The pattern of findings and the theoretical and clinical implications will now be discussed.

Consistent with previous research, high-functioning individuals with ASD demonstrated deficits in working memory (Bennetto et al., 1996; Steele et al., 2007; D. L. Williams et al., 2005), response initiation and suppression (Boucher et al., 2005; Hill & Bird, 2006; K. Johnston et al., 2011) and multiple components of social cognition (Auyeung et al., 2009; Baez et al., 2012; Baron-Cohen et al., 2003; Goldenfeld et al., 2005; Mathersul et al., 2013). However, in contrast to the findings of Baez et al. (2012), participants with ASD in the present study were significantly poorer at recognising emotions on TASIT Part 1 than matched controls. A likely explanation for these contrasting findings for emotion recognition relates to statistical power; namely, the sample size (n = 42) was larger in the present study than the study by Baez et al. (n = 15).

Further analyses on TASIT Part 1 revealed that participants with ASD were significantly poorer at identifying both positive and negative emotions than controls. Interestingly, there were no significant between group differences in accuracy for the emotions of anxiety and revolted. Although there are few previous studies examining recognition of different emotions in high-functioning adults with ASD, a meta-analysis by Uljarevic and Hamilton (2013) investigated emotion recognition in 48 studies with ASD samples spanning a broad age range (note: there were no significant effects of age or IQ on emotion recognition performance). Overall, the meta-analysis yielded a large effect size which indicated a general impairment in emotion recognition. However, they found that the ability to recognise happiness was only marginally impaired, whereas impairments in fear recognition were more marked than happiness. One potential explanation for the inconsistency between these findings and that of the present study is that most studies
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included in the meta-analysis employed tasks involving static faces rather than dynamic stimuli. Further, in most studies reviewed in the meta-analysis, happiness was treated as a baseline emotion for comparison of impairment between different emotions (Uljarevic & Hamilton, 2013). Overall, the present findings support the view that high-functioning adults with ASD experience a more generalised impairment in the recognition of positive and negative emotions. However, they may find some emotions more difficult to recognise (e.g., neutral expressions) than others (e.g., revolted) in dynamic displays.

The overall finding that high-functioning individuals with ASD were significantly poorer at making social inferences than controls is in line with previous research (Auyeung et al., 2009; Baron-Cohen et al., 1997; Baron-Cohen et al., 2003; Goldenfeld et al., 2005; Happé, 1994; Mathersul et al., 2013; Perner et al., 1989; Perner & Wimmer, 1985; Stone et al., 1998). These results add further support to the idea that contextual insensitivity (i.e., appraising critical information as unimportant while ignoring essential contextual stimuli) is a key mechanism underpinning deficits in social cognition for high-functioning individuals with ASD (Baez & Ibanez, 2014; Vermeulen, 2014). However, in contrast to Mathersul et al. (2013), who did not find a between group difference for sincere exchanges (i.e., SI-M or simple ToM judgements), the present study identified that participants with ASD were significantly poorer at perceiving sincere interactions. One potential explanation relates to the lower mean RAADS-R score (i.e., 126.4) for the sample in the study of Mathersul et al. (2013) when compared to the present sample (i.e., 137.88). Thus, more severe ASD symptoms may have contributed to the poorer performance of ASD participants in making simple ToM judgements about sincere interactions relative to controls.

The finding that ASD participants were impaired at detecting sarcasm and lies when contextual information is enriched (i.e., SI-E or advanced ToM) is consistent with previous research (Mathersul et al., 2013). However, unlike Mathersul et al. (2013), significant
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differences were not observed for the *doing* and *thinking* probes. A possible explanation for these results relates to the differential demands placed on executive control processes between SI-M and SI-E tasks (Castelli et al., 2002; McDonald, 2013). More specifically, to interpret dynamic social interactions, multiple sources of information need to be held online whilst integrating relevant cues (e.g., facial expression, body language, linguistic content and context) to understand the meaning of the interaction, and formulate an appropriate and timely response. When less contextual information was provided (i.e., SI-M), and there were less demands on working memory, ASD participants in the current study were significantly poorer at answering all response probes (i.e., doing, saying, thinking and feeling) relative to controls. When contextual information was enriched and there were greater demands on working memory to support social inference skills, the performance of ASD participants on the doing and thinking probes was more consistent with controls. Therefore, despite overall poorer performance on measures of social inference, the pattern of impairment across the response probes may have been influenced by the varying demands on cold executive function processes between the minimal and enriched conditions of SI-M and SI-E.

The independence of hot and cold executive functions and differential contributions of working memory and response initiation and suppression processes to TASIT performance was further investigated using regression analyses. Individuals with ASD demonstrated poorer performance on measures of emotion recognition and social inference than controls after controlling for cold executive functions. The findings also demonstrated that the ability to recognise emotions and make correct social inferences during dynamic displays was supported by working memory and response initiation and suppression processes, irrespective of participants’ ASD status and employment status. When contextual information was minimal, better response initiation and suppression skills supported correct social inferences.
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Conversely, when contextual information was enriched, stronger working memory skills enhanced the ability to make correct social inferences.

Overall, the present results extend upon those of Baez et al. (2012) and support the distinction between impairments in cold and hot executive functions for adults with ASD. Further, consistent with neurophysiological evidence (Ashwin et al., 2007; Bauman, 1996; Lieberman, 2007; McAlonan et al., 2005), these findings suggest that hot and cold executive functions are supported by an integrated neural network. Hence, response initiation and suppression and working memory processes support emotion recognition and social inference skills during dynamic social interaction.

There are several study limitations that are important to acknowledge. For the ASD group, the convenience sampling method yielded a male-to-female ratio of approximately 2.8:1 and considerable variability in the age range (18-66 years). It is broadly accepted that males are more commonly diagnosed with ASD (i.e., ratio of approximately 4.3:1; Fombonne, 2003). There was also a high proportion of individuals in the present study with elevated levels of self-reported depression, anxiety and stress symptoms and adaptive functioning was variable for the sample. More generally, given the convenience sampling approach and demographic characteristics, the participants in the present study may not be representative of the broader ASD population. Further research is needed to examine the relationship between hot and cold executive functions, severity of ASD symptoms and psychosocial outcomes (note: a study with this objective has recently been completed by the authors and a manuscript is in preparation).

An additional study limitation was the lack of formal verification of a current ASD diagnosis from an independent clinical assessment. The reliance on a past diagnosis and self-reported symptoms may have misidentified some participants as having an ASD. Nonetheless, all participants in the ASD group reported a history of longstanding difficulties
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in social interaction and communication, and a restricted range of behaviours and/or interests on the RAADS-R, which is a validated assessment tool to support diagnosis of ASD (Ritvo et al., 2011; Ritvo et al., 2008). As a further limitation, the estimate of IQ was based only on Matrix Reasoning which is a non-verbal test. Although no individuals with ASD performed in the range indicating literacy difficulties on a reading test, a measure of verbal reasoning skills may have provided a more accurate reflection of verbal IQ. Related to this point, both cold executive function tests required verbal responses. Thus, it is possible that the poorer performance of the ASD sample on the cold executive function tests relative to controls may have been related to lower verbal reasoning skills.

Finally, only two tests of cold executive functions were selected for this study based on the perceived relevance of working memory and response initiation and suppression to dynamic social cognition tasks. A broader battery of tests of cold executive function (including switching, planning, reasoning and problem-solving) is needed to further determine the independence of impairments in hot and cold executive functioning for individuals with ASD in future research. The influence of other cognitive domains (e.g., language, visuo-spatial skills and processing speed), adaptive functioning and mental health status on social cognition deficits also needs to be investigated for this population.

The present findings improve understanding of the profile of higher-order cognitive deficits underlying difficulties with social interaction for high-functioning adults with ASD. Specifically, the independence of deficits in social cognition and working memory and response initiation and suppression highlights the need for comprehensive assessment of hot and cold executive functions to aid diagnosis and inform interventions. The finding that working memory and response initiation and suppression skills contribute to the ability to recognise emotions and make social inferences suggests the likely value of targeting both hot and cold executive function impairments in interventions.
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There is some empirical support for the efficacy of social cognition skills training for the ASD population through computer-based programs or group-based cognitive behavioral interventions (see review by Bishop-Fitzpatrick, Minshew, & Eack, 2013). Further, Eack, Greenwald, et al. (2013) demonstrated the feasibility, acceptability and initial efficacy of Cognitive Enhancement Therapy (Hogarty & Flesher, 1999), a comprehensive cognitive rehabilitation program, for treating impairments in social and non-social information processing in adults with ASD. They reported significant effects for both cognitive deficits (i.e., working memory, behavioural monitoring and perseverative errors) and social behaviour. Further research is needed to determine the efficacy of integrated cognitive rehabilitation and social cognition interventions that concurrently target cold and hot executive function deficits. It would be particularly valuable to determine whether improvements in cold executive function might positively influence improvements in hot executive functions or vice versa.

In summary, the present study identified that high-functioning adults with ASD performed more poorly on measures of both hot and cold executive functions relative to controls. Furthermore, their impairments in emotion recognition and social inference were independent of deficits in working memory and response initiation and suppression. The findings highlight the need to assess hot and cold executive functions in clinical practice and to concurrently target impairments in both domains in interventions for the ASD population.
Chapter 5: Foreword

As highlighted by the systematic review (study 1), there is evidence that difficulties in cognitive shifting, interference control and inhibition (i.e., cold executive functions) are associated with poor psychosocial outcomes for high-functioning adults with ASD. Key gaps identified by the review relate to the need for further research to determine how both cold and hot executive functions relate to ASD characteristics and psychosocial outcomes for adults with high-functioning ASD. However, there was an initial need to clarify the profile of executive function deficits experienced by high-functioning individuals with ASD. In study 2 participants with ASD demonstrated generalised impairments in executive functions relative to matched controls, and the findings supported the partial independence of hot and cold executive functions. Specifically, although performance on tests of hot and cold executive functions was significantly correlated for the ASD group, the regression analysis identified that the ASD group demonstrated impaired social cognition relative to controls after controlling for working memory and response initiation and suppression. The aims of study 3 in the next chapter are to investigate associations among ASD characteristics, hot and cold executive functions and psychosocial outcomes.
Chapter 5: Associations among ASD Characteristics, Executive Functions and Psychosocial Outcomes

Introduction

As previously outlined in Chapter 2, individuals with ASD display numerous functional deficits, such as impairments in social cognition (Ambery et al., 2006; Hill & Bird, 2006); repetitive, obsessional and restricted behaviours and rigid thinking (D'Cruz et al., 2013; Russell et al., 2005; Szatmari et al., 2006); pragmatic language (Koning & Magill-Evans, 2001; Loukusa et al., 2007); movement and coordination (Gowin & Miall, 2005; Rinehart et al., 2001); sensory sensitivity (Dunn et al., 2002; J. Harrison & Hare, 2004); emotional regulation (Laurent & Rubin, 2004; Rieffe et al., 2011); and social interaction (Baron-Cohen, Wheelwright, Hill, et al., 2001; Bauminger & Shulman, 2003). As supported by the systematic review (study 1), impairments in executive functioning are proposed to underlie many functional deficits associated with ASD and contribute to poor psychosocial outcomes, including interpersonal difficulties, low occupational achievement, high dependence on others and poor mental health (Henninger & Taylor, 2012; Howlin, 2000; Kamio, Naoko, & Koyama, 2012; Szatmari, Bryson, Boyle, Streiner, & Duku, 2003). However, to date, there has been a lack of research investigating associations among ASD characteristics, executive functions and psychosocial outcomes.

There are different neurocognitive explanations for the varied characteristics associated with ASD, such as the ToM hypothesis, executive dysfunction and weak central coherence (see Chapter 2). Many studies have investigated the relationship between cold executive functions and ASD characteristics in children and adults (Bishop & Norbury, 2005; Joseph & Tager-Flusberg, 2004; Kenworthy, Black, Harrison, Della Rosa, & Wallace, 2009; Kleinhans et al., 2005; South, Ozonoff, & Mcmahon, 2007). For example, some studies found significant associations between inhibition and cognitive flexibility and restrictive and
repetitive behaviours in children with ASD (Kenworthy et al., 2009; South et al., 2007). However, associations between these indices were not significant in other studies (Bishop & Norbury, 2005; Joseph & Tager-Flusberg, 2004). Potential explanations for these mixed findings include insufficient sample size (e.g., n = 14; Bishop & Norbury, 2005) and the confounding influence of intellectual and language impairments (Kenworthy et al., 2009).

In a small sample of adults with high-functioning ASD (n = 17), Lopez et al. (2005) found that greater restricted and repetitive behaviours on the Autism Diagnostic Interview and the ADOS (Le Couteur et al., 1989; Lord, Rutter, DiLavore, & Risi, 1999) were associated with poorer cognitive flexibility ($r = .63$; Trail Making Test and Wisconsin Card Sorting Test; Delis, Kaplan, & Kramer, 2001; Grant & Berry, 1981) and response inhibition ($r = .54$; Interference condition of The California Stroop Test; Delis et al., 2001; Grant & Berry, 1981). This finding suggests that the tendency to perseverate and failure to inhibit automatic responses is related to greater stereotypic behaviours. Moreover, Lopez et al. (2005) found that cognitive flexibility was the only aspect of executive functions that was independently associated with restricted, repetitive behaviours. In a separate study, Hill and Bird (2006) found that higher overall ASD symptoms on the Autism Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) were associated with poorer response initiation and suppression on the Hayling Sentence Completion Test (Burgess & Shallice, 1997). However, there is a lack of research investigating the associations among core domains of ASD characteristics such as poor social relatedness and sensory difficulties, and measures of both hot (i.e., social cognition) and cold executive functions. Such research could help to identify the nature of executive function deficits associated with ASD characteristics and guide more tailored assessment and intervention practices.

The most consistent finding from the systematic review (study 1) was that individuals with greater ASD characteristics experience poorer psychosocial outcomes, including:
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depression, reduced quality of life (QoL), loneliness, anxiety and low self-esteem (Gotham, Bishop, et al., 2014; Howlin, 2003; Jansch & Hare, 2014; Jantz, 2011; Khanna et al., 2014; Renty & Roeyers, 2007; M. Tani et al., 2012). In addition, the review revealed that lower neurocognitive functioning was related to poorer social and adaptive functioning (Berger et al., 2003; Farley et al., 2009; Hagberg et al., 2013; Montgomery et al., 2013; Sparrow et al., 1984; Szatmari et al., 1989). Specifically, lower IQ, non-verbal learning and cognitive shifting skills in childhood were associated with poorer social and adaptive functioning in adulthood (Berger et al., 2003; Farley et al., 2009; Hagberg et al., 2013; Szatmari et al., 1989). Also referred to as set-shifting or task switching, cognitive shifting has consistently been shown to be impaired for individuals with ASD (Ambery et al., 2006; Hill & Bird, 2006; Lopez et al., 2005; Pellicano, 2007). The systematic review additionally highlighted the early prognostic significance of deficits in cognitive shifting for psychosocial outcomes of individuals with an IQ of > 70 (Berger et al., 2003; Szatmari et al., 1989).

Several studies have investigated the psychosocial outcomes of individuals with ASD using a four-point outcome rating scale based on Lotter’s (1978) social adjustment scale (Cederlund et al., 2008; Engstrom et al., 2003; Howlin et al., 2004; Larson & Mouridsen, 1997). Using descriptive information regarding an individual’s employment, independence, friendship and relationship status, this measure defines a very good outcome as being employed, having close reciprocated friendships, living independently and being in a close relationship. Conversely, a very poor outcome is described as not being employed, no close friends, living in supported accommodation and not being in a relationship. Larson and Mouridsen (1997) tracked a small number of high-functioning individuals with ASD (n = 18) over a 30 year period and identified that greater IQ was associated with more favourable outcomes. In a retrospective follow-up study (interval of 21-48 years), Howlin and colleagues (2004) found that adults with the highest social outcome ratings had higher scores on
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cognitive (e.g., IQ score > 70), language, reading and comprehension tests. Such adults showed greater use of socially appropriate language whereas abnormal language features and ritualistic behaviours were less frequent. Although their study included adults with ASD with an intellectual disability (i.e., IQ > 50 to < 70), the authors noted that the majority of individuals were rated as having a poor outcome, whereby friendships were limited and a high level of support was required. Finally, in a prospective follow-up study of high-functioning individuals with ASD (n = 70), Cederlund and colleagues (2008) noted that higher FSIQ, particularly verbal IQ (WAIS-III), during early childhood was positively associated with improved outcomes in adulthood on Lotter’s (1978) social and adaptive scale. Overall, the majority of research to date has focused on the association between social and adaptive outcomes and IQ. Further research is needed to determine whether performance on measures of hot and cold executive functions can differentiate between groups with varying levels of social and adaptive functioning.

Contrary to the findings for social and adaptive outcomes, there is some evidence that children and adolescents with ASD who have greater cognitive ability (i.e., IQ) are more likely to report lower self-esteem and greater anxiety and depressive symptomatology (Barnhill, 2001; Barnhill & Myles, 2001; Capps, Sigman, & Yirmiya, 1995; Gotham, Bishop, et al., 2014; Hedley & Young, 2006; Solomon, Goodlin-Jones, & Anders, 2004; Vickerstaff et al., 2007). Consistent with the childhood literature, Sterling, Dawson, Estes, and Greenson (2008) found that higher IQ was associated with increased symptoms of depression and anxiety in high-functioning adults with ASD. Collectively, these studies suggest that higher general cognitive functioning may act as a vulnerability factor for the development of a negative self-view and associated emotional distress. However, research is yet to examine the relationships between executive functions and mental health indices, such as depression, anxiety, stress, self-esteem and self-concept.
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Self-concept refers to the self-appraised cognitive component of the self, while self-esteem refers to the evaluative component or affect associated with the cognitive judgement (Breytspraak & George, 1982). Developmental accounts propose that self-concept develops in a hierarchical manner with lower-level self-perceptions (e.g., situation-specific self-appraisals) having a bottom-up influence on domain-specific areas (e.g., physical, cognitive, social and behavioural). These self-concept domains are subjectively evaluated in terms of importance and contribute to higher-level self-representations or global self-concept (Marsh, Byrne, & Shavelson, 1992). Developmental theorists contend that self-concept is both unitary and multi-dimensional with global and domain-specific components (Harter, 1999; Marsh et al., 1992; Shavelson, Hubner, & Stanton, 1976). Thus, better cognitive functioning may heighten individuals’ awareness of their own impaired competencies, particularly in social situations, which in turn may contribute to lower global self-concept and self-esteem (Barnhill & Myles, 2001). Yet, qualitative research suggests that individuals with ASD can derive a sense of competency and positive identity via special interests and talents, and often describe themselves in terms of these interests and talents (Giarelli & Fisher, 2013; Haertl et al., 2013; Muller et al., 2008; Smith & Sharp, 2013; Townson et al., 2007). The preliminary findings by Sterling et al. (2008) and qualitative literature on self-perceptions highlights the need for further research to examine associations between executive functions and mental health outcomes for high-functioning adults with ASD.

Overall, many studies support the relationship between stronger executive functions and better social and adaptive outcomes of ASD (Berger et al., 2003; Farley et al., 2009; Hagberg et al., 2013; Szatmari et al., 1989). However, to shed light on potential intervention targets there is a need for further research to examine the profile of executive function deficits associated with ASD characteristics in high-functioning adults with ASD. Further, research is yet to examine the associations between hot and cold executive functions and
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mental health outcomes, including self-esteem and self-concept for high-functioning adults with ASD. Such research is needed to clarify whether stronger executive functions may have a positive or negative influence on mental health status.

Aims and Hypotheses

Based on the preceding rationale, the aims of the present study were as follows:

1. To examine the associations between hot and cold executive functions (i.e., social cognition, working memory, response inhibition, cognitive flexibility and non-verbal reasoning) and core domains of ASD characteristics.

2. To investigate associations between hot and cold executive functions and psychosocial outcomes (i.e., social and adaptive functioning and mental health).

In relation to these aims, the following hypotheses were formulated:

1. Greater ASD characteristics would be associated with poorer social cognition, working memory, response inhibition, cognitive flexibility and non-verbal reasoning.

2. There would be significant differences in executive functioning between the social and adaptive outcome groups; specifically, individuals classified as having better social and adaptive outcomes would demonstrate greater performance on tests of hot and cold executive functions.

Due to the lack of prior research to guide a directional hypothesis, the associations between performance on tests of executive functions and levels of depression, anxiety, stress, self-esteem and self-concept were examined as an exploratory component.

Methodology

Design

A correlational and between-groups design was employed in this study. For aim 1, performance on tests of executive functions were conceptualised as the independent variables.
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(IVs) and ASD characteristics (total and core domains) as the dependent variables (DVs). For aim 2 social and adaptive functioning was treated as an IV (categorical data) and scores on tests of executive functions were the DVs. Based on previous research examining the relationship between neuropsychological variables, ASD characteristics and social outcomes (Hill & Bird, 2006; Montgomery et al., 2013; Szatmari et al., 1989), medium to large effect sizes were expected ($r = .35-.50$). With power of .80 and alpha set at .05, a minimum sample size of 37 was required to detect significant correlations (G*Power 3.1.9.2; Faul et al., 2009).

**Participants**

Participants in the present study involved the sample of 42 high-functioning adults with ASD described in Chapter 4. A detailed summary of demographic information can be found in Chapter 4, Table 4.1. All participants were screened to determine eligibility for participation, meeting the following criteria: 1) formal diagnosis of ASD and/or self-reported history of longstanding difficulties in social interaction and communication and a restricted range of behaviours and/or interests as reflected by scores equal to or greater than 77 on the Ritvo Autism Asperger’s Diagnostic Scale – Revised (RAADS; Ritvo et al., 2011); 2) aged 18-70 years; 3) adequate understanding of spoken and written English; 4) absence of a current comorbid psychotic disorder; 5) no history of a serious neurological or medical condition (e.g., traumatic brain injury); and 6) absence of suspected literacy difficulties (i.e., standardised scores of $\leq 70$ or 1.5 standard deviations below age norms on a validated reading test). Further, to screen for co-occurring intellectual impairment all participants were administered a test of estimated non-verbal IQ (Matrix Reasoning from the WAIS-IV – see materials Chapter 4). An estimated non-verbal IQ of $> 70$ was used to indicate that participants were high-functioning. This is in line with previous ASD research that has used IQ scores $> 70$ as a proxy for high-functioning status (Baron-Cohen, 2000; Howlin, 2003). Based on the $T$-score for Matrix Reasoning, the mean estimated non-verbal IQ for the ASD
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participants was 102.65 (12.65), with scores ranging from 75-131; thus, all participants were considered to be high-functioning in terms of their IQ.

As shown in Chapter 4 (Table 4.1), participants were predominantly male (64.3%), with an average age of 34.02 years. Most participants identified as European/Caucasian (95%). In terms of occupation, 67% of individuals were employed or in higher education. In terms of friendship status, 45% of individuals identified having one or more close friends and 43% were in a relationship. All 42 participants identified a history of longstanding ASD characteristics according to Diagnostic and Statistical Manual of Mental Disorders-Text Revision (DSM-IV-TR) criteria, with scores on the RAADS equal to or greater than the established clinical cut-off (i.e., ≥ 77; scores ranging from 79-205) (American Psychiatric Association, 2000; Ritvo et al., 2011). Seventy-four percent also reported a prior formal diagnosis of either ASD or Asperger’s syndrome. There was no evidence of clinically significant literacy difficulties for the ASD sample, with a mean scaled score of 107.64 (12.65), and scores ranging from 78-119 on a standardized reading test (see the Materials section in Chapter 4).

Materials

ASD Characteristics

Ritvo Autism Asperger’s Diagnostic Scale – Revised (RAADS; Ritvo et al., 2011). ASD status and ASD characteristics were assessed using the Ritvo Autism Asperger’s Diagnostic Scale – Revised (RAADS; Ritvo et al., 2011). The RAADS is a self-report measure that is based on the DSM-IV-TR and ICD-10 criteria and used to assist in the diagnosis of ASD in high-functioning adults. The scale consists of 80-items (i.e., 64 symptom and 16 non-symptom based responses) and is divided into four factor analytically derived subscales: Social Relatedness – 23 items (e.g., “I can put myself into other people’s shoes”); Circumscribed Interests – 28 items (e.g., “I focus on details rather than the overall idea”);
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Sensory Motor (e.g., “I always notice how food feels in my mouth and this is more important to me than how it tastes”) – 18 items; and Social Anxiety – 12 items (e.g., “It can be very intimidating for me to talk to more than one person at the same time”). Each question is rated on a 4-point Likert scale ranging from “True now and when I was young” = 3 to “Never true” = 0. To minimise response bias, the 16 non-symptom based responses are reverse scored and are indicated by an asterisk beside each item. The authors advance that a total score of $\geq 77$ out of a maximum score of 240 is indicative of a diagnosis of Asperger’s Syndrome (Ritvo et al., 2011).

The original validation study included 200 high-functioning individuals with ASD across nine research sites and three English speaking continents. The RAADS demonstrates adequate internal consistency on all subscales ($\alpha = .87-.95$) and excellent test-retest reliability over an average period of one year ($r = .98$). It was validated against the Constantino’s Social Responsiveness Scale-Adult Research Version (SRS-A; S Bölte, Postka, & Constantino, 2008), a measure of ASD traits, achieving a concordance rate of 95%. In another validation study, Andersen and colleagues (2011) reported sensitivity of 91% and specificity of 93% using a cut-off score $\geq 72$, demonstrating that the instrument has good diagnostic validity in distinguishing between those with ASD and neurotypical individuals. In addition, there was evidence of concurrent validity such that the RAADS was significantly and positively associated with the Autism Quotient (AQ; Baron-Cohen, Wheelwright, Skinner, et al., 2001), an established self-report scale measuring the degree of ASD traits.

The total RAADS score and its subscales were used in the present study as a severity index of ASD characteristics. The RAADS was selected because, unlike the AQ, it contains four factor analytically derived subscales related to ASD characteristics (i.e., Social Relatedness, Circumscribed Interests, Sensory Motor and Social Anxiety). At present, there are no validated diagnostic assessment scales based on the Diagnostic and Statistical Manual
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– 5th Edition (DSM-5; American Psychiatric Association, 2013). Although the authors intended for the RAADS to be administered face-to-face in a clinical setting, it has since been administered in a large online study and demonstrated adequate internal consistency (α = .89; Ratner & Berman, 2014). For the present sample, the internal consistency of the RAADS total score was excellent α = .92. However, reliability of the Social Relatedness scale was lower than desirable (α = .58). The removal of two negative values (i.e., item 6 and 16) identified from Corrected-Item Total Correlation analysis in SPSS improved the reliability of the subscale (α = .64) for use in the present study (albeit with caution). Good internal consistency was demonstrated for the Social Anxiety (α = .85), Circumscribed Interests (α = .82) and Sensory Motor (α = .85) subscales.

Executive Functioning

Delis-Kaplan Executive Function System (DKEFS) Sorting Test (Delis et al., 2001). The DKEFS Sorting Test is one of nine tests of a larger executive function battery that provides a comprehensive assessment of higher-level cognitive functions. The DKEFS tests have demonstrated sensitivity for identifying executive function deficits in a number of clinical populations, including high-functioning adults with ASD (Kleinhans et al., 2005). The DKEFS Sorting Test is a measure of conceptual reasoning that aims to distinguish between concept formation and conceptual flexibility skills. In Condition 1 (Free Sort; concept formation), respondents are presented with six cards that display both stimulus words (e.g., tiger, plane and bus) and perceptual features (e.g., sharp and round edges; small and large cards; and yellow and blue backgrounds), allowing them to categorize the cards in a variety of ways. They are instructed to sort the cards in as many ways as possible such that two groups are formed with three cards in each group, and then provide a verbal description to the examiner as to how they sorted the cards. Individuals obtain a score for the number of
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confirmed correct sorts (referred to as DKEFS 1 in the present study) as well as a description score for how well they verbally describe the sorted cards.

In Condition 2 (Sort Recognition Description; conceptual flexibility), the examiner sorts the same cards from Condition 1 into two groups with three cards in each group, instructing the respondent to explain the categorisation rule used by the examiner. Individuals obtain a score based on how well they describe the various sorting combinations made by the examiner (referred to in this study as DKEFS 2). There is also a combined sort description score for Conditions 1 and 2 (i.e., Combined Description), whereby higher scores are indicative of greater concept formation and conceptual flexibility skills (i.e., DKEFS 3). Finally, a scaled contrast score (i.e., DKEFS 4) is obtained by contrasting the sort recognition description (i.e., Condition 2) with the free sort description (i.e., Condition 1), such that higher scores reflect greater difficulties transferring knowledge into action. Moderate internal consistency has been reported for the DKEFS Sorting Test ($\alpha = .62-.81$), as well as evidence of convergent and discriminant validity with other established tests (i.e., Wisconsin Card Sort Test and the California Verbal Learning Test-II; Delis et al., 2001; Grant & Berry, 1981). Although there are many indices derived from the Sorting Test, the key indices examined in this study included: Free Sort (DKEFS 1), Sort Recognition Description (DKEFS 2), Combined Description (DKEFS 3) and Contrast (DKEFS 4).

Matrix Reasoning: Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). The WASI two-subtest form provides an estimate of verbal IQ (i.e., vocabulary and long-term recall) and performance or non-verbal IQ (i.e., Matrix Reasoning) and can yield an estimated Full Scale IQ. Due to possible language difficulties impacting estimated verbal IQ, only the Matrix Reasoning (MR) was administered as a measure of estimated non-verbal IQ to determine eligibility (i.e., $T$ scores $> 30$ which equate to IQ $> 70$) for this study. MR additionally provided a measure of non-verbal concept formation and problem solving as an
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index of cold executive functions. In this test, the respondent is presented with a partially completed grid and asked to select an item that best completes the matrix. There are a total of 30 items with a discontinuation rule employed after three consecutive incorrect attempts or pass responses. Each correct answer is scored one point and the sum of correct responses is converted to a T-score based on age norms. Subtests of the WASI have been widely used in research involving both clinical and non-clinical samples, and were found to correlate strongly (verbal IQ score, $r = .88$, performance IQ, $r = .84$, Full Scale IQ, $r = 0.92$) with the Wechsler Adult Intelligence Scale Third Edition (WAIS-III; Wechsler, 2000). As previously outlined in Chapter 4, the following tests of response initiation/suppression, working memory and social cognition were also administered in the present study: Hayling Sentence Completion Test (Hayling; Burgess & Shallice, 1997); Letter Number Sequencing (LNS; Wechsler, 2008); The Awareness of Social-Inference Test-Revised (TASIT; McDonald et al., 2006). Please refer to the Materials section of Chapter 4 for a detailed description of these measures.

Psychosocial Functioning

Social and Adaptive Functioning Rating Scale. A composite measure of overall social and adaptive functioning was derived from key demographic information (i.e., employment, independence, friendship and relationship status), with low scores indicating better outcomes. Outcome classification was determined using a scale adapted from Howlin (2004) and Lotter (1978): Very Good = employed/studying; one or more close friends; high level of independence; and in a relationship (total scores 0-2); Good = working or studying in some capacity; some friends/acquaintances; living with parents/others with moderate level of independence; single but recent history of significant relationship (total scores 3-5); Fair = engaging in voluntary work; limited friendships; some independence but relies on others for daily living needs; relationship status is single but has a history of being in a significant
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relationship (total scores 6-8); Poor = voluntary work or unemployed; limited/no friendships; supported accommodation and reliance on others for daily living needs; single and no history of a significant relationship (total scores 9-11); Very Poor = Not employed; no close friends; supported accommodation and requiring high-level daily living support; single and no history of significant relationship (total score = >11). See Appendix D for a summary of the scoring criteria and items for employment, friendship, independence and relationship domains.

**Depression, Anxiety and Stress Scales-21** (DASS-21; Lovibond & Lovibond, 1995). The DASS-21 comprises three 7-item subscales that assess the negative emotional states of depression, anxiety and stress and is based on the original 42-item version. Respondents are asked to rate the extent to which each item applied to them over the past week on a 4-point Likert scale, whereby higher scores indicate greater emotional distress. Scores on each 7-item scale are doubled to enable the following clinical cut-offs to be applied: Depression 0-8 (normal), 9-13 (mild), 14-22 (moderate), 24-36 (severe) and >36 (very severe); Anxiety 0-5 (normal), 6-8 (mild), 9-15 (moderate), 16-26 (severe) and >26 (very severe); Stress 0-14 (normal), 15-18 (mild), 19-26 (moderate), 27-37 (severe) and >37 (very severe; Lovibond & Lovibond, 1995). The DASS-21 demonstrates good internal consistency in both clinical and general community populations for all three subscales: Depression $\alpha = .92-.94$; Anxiety $\alpha = .82-.87$; and Stress $\alpha = .91-.96$ (Antony, Bieling, Cox, Enns, & Swinson, 1998; A. Harrison, Tchanturia, & Treasure, 2010). In addition, the subscales of the DASS-21 exhibit adequate concurrent validity with other established measures of similar constructs (i.e., Beck Depression Inventory, Beck Anxiety Inventory and State-Trait Anxiety Inventory; Lovibond & Lovibond, 1995). The internal consistency of the DASS for the present sample ranged from good to excellent, as follows: Depression .90; Anxiety .76; and Stress .82.

**Rosenberg Self-Esteem Scale** (RSES; Rosenberg, 1965). The RSES is a brief measure of global self-esteem comprised of 10 items (five negatively and five positively
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worded statements). Using a 4-point Likert scale (3 = strongly agree to 0 = strongly disagree), respondents are asked to indicate their level of agreement with each of the statements. An example of a positively worded statement includes “On the whole, I am satisfied with myself”. An example of a negatively phrased item is “At times I think I’m no good at all”. The minimum score obtainable is 0 while the maximum score is 30, with higher scores indicative of greater levels of self-esteem. Scores between 15 and 25 are within normal range while scores below 15 suggest low self-esteem (Rosenberg, 1965). The RSES demonstrates good internal consistency (α = .72–.88; Byrne, 1996), adequate test-retest reliability (r = .85; Silber & Tippett, 1965) and substantial evidence of construct and predictive validity (i.e., low self-esteem was related to anxiety, depression and loneliness; Rosenberg, 1965). In the present study, the RSES demonstrated excellent internal consistency (α = .94).

The Six-Factor Self-Concept Scale for Adults (SFSCS; Stake, 1994). The SFSCS is a 36-item multidimensional measure of adult self-concept. The SFSCS consists of six factor-analytically derived subscales: likability (6 items), morality (6 items), task accomplishment (6 items), giftedness (5 items), power (7 items) and vulnerability (6 items). The measure was chosen for the present study because it was designed for adults and the items were considered particularly relevant for high-functioning individuals with ASD due to the subscales reflecting self-perceived competency across a range of life settings and attributes, including special talents. Each item is rated on a Likert-scale from 1 (never or almost never true) to 7 (always or almost always true), with scores ranging from 36-252 for the total composite score and higher subscale and total scores representing more positive self-concept. An example of an item reflecting the subscale likability is “Easy to talk to”, while a giftedness item is “Bright and ingenious”. The SFSCS has been shown to be reliable with test-retest coefficients ranging from r = .74–.88 and internal consistency values for all subscales ranging from α = .76–.86 (Stake, 1994). Significant correlations (r = .62, p < .001) were observed between the
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SFSCS and the Rosenberg Self-Esteem Scale, thus supporting the validity of the SFSCS, but also indicating that it measures a construct related to but distinct from global self-esteem (Stake, 1994). In the current study, the total SFSCS was used as a measure of global self-concept, representing individuals’ overarching thoughts about their abilities and attributes. The SFSCS showed good internal consistency (α = .80) for the overall scale and all six subscales: Likeability α = .84; Task Accomplishment α = .84; Power α = .74; Vulnerability: α = .79; Giftedness α = .85; and Morality α = .89.

Procedure

Ethical clearance for the present study was granted by the Griffith University Human Research Ethics Committee (protocol number PSY/28/13/HREC). To minimise burden on participants, the assessment process was conducted over two phases: 1) an online survey via a web-link based survey emailed to individuals; and 2) face-to-face administration of a cognitive test battery (see Chapter 4) conducted in the university psychology clinic rooms. All individuals received a $20 gift voucher for their participation. For the online survey, participants initially provided their informed consent and then completed questions relating to their demographic and social functioning status using LimeSurvey, a free open source software tool (Schmitz, 2015). Following these, the RAADS, DASS, RSES and SFSCS were completed (note: see Appendix E for full versions of self-report questionnaires and the Materials section of Chapter 6 for details of other questionnaires administered). Participants were administered the cognitive test battery within approximately 4 weeks after completing the online survey. The DKEFS was administered in addition to the cognitive test battery outlined in Chapter 4. The order of the cognitive measures administered to each participant was randomised to avoid the potential confound of test order and fatigue.
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Data Analyses

The Statistical Package for Social Sciences (SPSS) Version 22 for Windows was utilised for all analyses and data screening procedures were conducted according to guidelines by Tabachnick and Fidell (2007). Data were examined for entry errors, missing values, univariate outliers and normality. The descriptives function in SPSS revealed plausible ranges, means and standard deviations for all variables. There were no missing values. Inspection of histograms and standardised scores revealed no univariate outliers (i.e., \( z > +/- 3.29 \)). Assumptions of normality were upheld after successful logarithmic transformations to DASS Anxiety and TASIT 2 variables. Descriptive data on the neuropsychological tests and psychosocial outcomes were compared to the norms for different measures where available.

Pearson’s product moment correlations were conducted for \( H1 \), with a one-tailed test utilised due to the directional hypothesis. A one-way analysis of variance (ANOVA) was employed to test \( H2 \) due to the categorical data for social and adaptive functioning. Pearson’s \( r \) was used to investigate the associations between executive functions and mental health indices (two-tailed). Holm’s (1979) step-down procedure was employed to control for Familywise error rate for all multiple comparisons. This method involves ordering \( p \) values from lowest to highest and cumulatively adding each value until .05 is reached. The null hypothesis is rejected for all values less than the cumulative .05 total (Aickin & Gensler, 1996; Holland & Copenhaver, 1988).

Results

Descriptive Data

Descriptive statistics are presented in Tables 5.1 and 5.2 for ASD characteristics, tests of executive functions and psychosocial outcomes. In terms of social and adaptive functioning, there were no individuals classified in the Very Poor group.
### Table 5.1

*Descriptive Statistics on Tests of Executive Functioning (n = 42)*

<table>
<thead>
<tr>
<th>Test</th>
<th>Scoring Method</th>
<th>Cut-Off Indicating Impairment&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Mean (SD)</th>
<th>Range</th>
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<tbody>
<tr>
<td><strong>Executive Functioning</strong></td>
<td></td>
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<tr>
<td>Hayling Total</td>
<td>Total Scaled Scores&lt;sup&gt;a&lt;/sup&gt;</td>
<td>&lt; 9.74</td>
<td>15.71 (3.98)</td>
<td>6-20</td>
</tr>
<tr>
<td>LNS</td>
<td>Scaled Score</td>
<td>&lt; 8</td>
<td>9.71 (2.42)</td>
<td>5-16</td>
</tr>
<tr>
<td>Matrix Reasoning</td>
<td>T-Score</td>
<td>&lt;30</td>
<td>51.40 (8.54)</td>
<td>34-71</td>
</tr>
<tr>
<td>TASIT 1</td>
<td>Raw Scores</td>
<td>&lt;19.27</td>
<td>22.90 (2.42)</td>
<td>16-27</td>
</tr>
<tr>
<td>TASIT 2</td>
<td>Raw Scores</td>
<td>&lt;36.1</td>
<td>48.10 (8.00)</td>
<td>26-60</td>
</tr>
<tr>
<td>TASIT 3</td>
<td>Raw Scores</td>
<td>&lt;38.62</td>
<td>50.38 (7.87)</td>
<td>28-64</td>
</tr>
<tr>
<td><strong>DKEFS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free Sort (1)</td>
<td>Scaled Scores</td>
<td>&lt;8</td>
<td>11.45 (2.72)</td>
<td>4-17</td>
</tr>
<tr>
<td>Sort Recognition Description (2)</td>
<td>Scaled Scores</td>
<td>&lt;8</td>
<td>9.93 (3.40)</td>
<td>2-15</td>
</tr>
<tr>
<td>Combined Description (3)</td>
<td>Scaled Scores</td>
<td>&lt;8</td>
<td>10.67 (3.46)</td>
<td>3-16</td>
</tr>
<tr>
<td>Contrast (4)</td>
<td>Scaled Scores</td>
<td>&lt;8</td>
<td>8.74 (2.83)</td>
<td>3-15</td>
</tr>
</tbody>
</table>

*Note.* <sup>a</sup> Total Scaled Scores from Box A, B and C; <sup>b</sup> = < 25th percentile or < 1.5 SD; DKEFS = Delis Kaplan Executive Functioning System Sorting Test; LNS = Letter Number Sequencing; TASIT = The Awareness of Social Inference Test.
Table 5.2

*Descriptive Statistics for Psychosocial Outcomes and ASD Characteristics (n = 42)*

<table>
<thead>
<tr>
<th>Test</th>
<th>Mean (SD)/Range/Frequency (%)</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>Psychosocial Outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DASS – Depression</td>
<td>8.86 (9.05), 0-28</td>
<td>19 (45%)</td>
</tr>
<tr>
<td>DASS – Anxiety</td>
<td>5.10 (5.83), 0-24</td>
<td>18 (43%)</td>
</tr>
<tr>
<td>DASS – Stress</td>
<td>8.57 (7.41), 0-30</td>
<td>20 (47.5%)</td>
</tr>
<tr>
<td>RSES (Self-Esteem)</td>
<td>16.02 (7.87), 2-30</td>
<td>22 (52.5%)</td>
</tr>
<tr>
<td>SFSCS (Self-Concept)</td>
<td>164.64 (23.77), 124-223</td>
<td>-</td>
</tr>
<tr>
<td>Social and Adaptive Functioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Good</td>
<td>9 (21.4%)</td>
<td>-</td>
</tr>
<tr>
<td>Good</td>
<td>17 (40.5%)</td>
<td>-</td>
</tr>
<tr>
<td>Fair/Poor</td>
<td>16 (38.1%)</td>
<td>-</td>
</tr>
<tr>
<td>Very Poor</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ASD Characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAADS Total</td>
<td>139.05 (36.15), 79-208</td>
<td>-</td>
</tr>
<tr>
<td>Social Relatedness</td>
<td>22.79 (8.70), 7-40</td>
<td>-</td>
</tr>
<tr>
<td>Social Anxiety</td>
<td>23.93 (9.02), 6-36</td>
<td>-</td>
</tr>
<tr>
<td>Circumscribed Interests</td>
<td>59.05 (13.08), 31-82</td>
<td>-</td>
</tr>
<tr>
<td>Sensory Motor</td>
<td>30.48 (12.73), 9-51</td>
<td>-</td>
</tr>
</tbody>
</table>

Note. DASS = Depression, Anxiety and Stress Scales; RAADS-R = Ritvo Autism Asperger Diagnostic Scale-Revised; RSES = Rosenberg Self-Esteem Scale; SFSCS = Six Factor Self-Concept Scale.
The largest proportion of participants was classified in the Good group (40.5%). Only two participants were classified in the Poor group. Therefore, participants in the Fair group (33%) and Poor group were combined to comprise a Fair/Poor group (38.1%). Performance was variable across tests of executive functions, spanning the extremely low to very superior ranges. Overall, mean scores were within the normal range for Hayling, LNS, MR and DKEFS 1-4. There was a large proportion of individuals with self-reported symptoms of depression (41%), anxiety (28.5%), stress (28.5%) and low self-esteem (33.5%) in the severe to extremely severe clinical range (see Table 5.2). Based on existing normative data for the SFSCS, the mean total score for the current sample was higher (i.e., 164.64) when compared to the mean score ($M = 128.5$) of adults taken from the original validation study, although no standard deviation was reported in Stake’s (2010) study.

**Associations between ASD Characteristics and Tests of Executive Functions**

As presented in Table 5.3, correlational analyses (one-tailed test) were conducted to investigate H1, that greater ASD characteristics would be associated with poorer performance on tests of executive functions. Overall, there was only select support for this hypothesis. Specifically, RAADS-SA (social anxiety) was significantly and positively associated with DKEFS 4 ($r = .31, p = .023$). The direction of this association indicated that individuals with ASD who reported higher levels of social anxiety on the RAADS demonstrated greater impairment in transferring knowledge into action (Delis et al., 2001). RAADS-CI (circumscribed interests) was significantly and negatively associated with TASIT 3 (social inference-enriched; $r = -.34, p = .014$), suggesting that greater circumscribed interests are

---

2 Higher scores on the DKEFS 4 reflect greater difficulties transferring knowledge into action.
Table 5.3

<table>
<thead>
<tr>
<th>Test</th>
<th>Hayling</th>
<th>LNS</th>
<th>MR</th>
<th>DKEFS-1</th>
<th>DKEFS-2</th>
<th>DKEFS-3</th>
<th>DKEFS-4</th>
<th>TASIT-1</th>
<th>TASIT-2</th>
<th>TASIT-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAADS-SR</td>
<td>.23</td>
<td>.14</td>
<td>.19</td>
<td>.06</td>
<td>.12</td>
<td>.07</td>
<td>.07</td>
<td>-.09</td>
<td>-.22</td>
<td>-.14</td>
</tr>
<tr>
<td>RAADS-SA</td>
<td>-.06</td>
<td>.07</td>
<td>.19</td>
<td>-.04</td>
<td>.12</td>
<td>.04</td>
<td>.31*</td>
<td>-.01</td>
<td>-.19</td>
<td>-.06</td>
</tr>
<tr>
<td>RAADS-CI</td>
<td>-.17</td>
<td>.10</td>
<td>-.06</td>
<td>-.18</td>
<td>.05</td>
<td>-.05</td>
<td>.21</td>
<td>-.12</td>
<td>-.26</td>
<td>-.34*</td>
</tr>
<tr>
<td>RAADS-SM</td>
<td>-.08</td>
<td>-.13</td>
<td>.02</td>
<td>-.10</td>
<td>.08</td>
<td>-.03</td>
<td>.21</td>
<td>-.09</td>
<td>-.28</td>
<td>-.19</td>
</tr>
<tr>
<td>RAADS Total</td>
<td>-.05</td>
<td>.03</td>
<td>.07</td>
<td>-.09</td>
<td>.11</td>
<td>.01</td>
<td>.24</td>
<td>-.09</td>
<td>-.28</td>
<td>-.23</td>
</tr>
</tbody>
</table>

Note. *p < .05; "a" Holm’s procedure was used to control for Familywise or Type 1 errors; DKEFS-1-4 = 1) Free Sort; 2) Sort Recognition Description; 3) Combined Description; 4) Contrast; LNS = Letter Number Sequencing; MR = Matrix Reasoning; RAADS-SR = Social Relatedness; RAADS-SA = Social Anxiety; RAADS-CI = Circumscribed Interests; RAADS-SM = Sensory Motor; RAADS-SP = Social Performance; TASIT-1 = Emotion Recognition; TASIT-2 = Social Inference-Minimal; TASIT-3 = Social Inference-Enriched
related to a poorer ability to interpret social situations when contextual information is enriched. There were no other significant correlations between ASD characteristics and tests of executive functions.

**Differences in Executive Functioning between the Social and Adaptive Functioning Outcome Groups**

In relation to *H2*, a one-way analysis of variance (ANOVA) was conducted to examine whether performance on tests of executive functions significantly differed according to the social outcome groups: Very Good, Good and Fair/Poor. Due to violation of normality for TASIT 2, analyses were run with and without transformation, revealing no difference in results. Two of the executive function measures (LNS and DKEFS 3) violated the homogeneity of variances assumption; however, the interpretation of results for LNS did not change after using the adjusted Welch test (Pallant, 2013). There were no significant differences in RAADS Total scores between the three social and adaptive outcome groups. Thus, ASD characteristics were not controlled for in any of the ANOVAs. As relevant, post-hoc comparisons were conducted using the Tukey HSD or Games-Howell test.

As presented in Table 5.4, there were statistically significant differences in performance on the TASIT 1 (*p* = .023, $\eta^2 = .18$), MR (*p* = .019, $\eta^2 = .18$) and DKEFS 3 (*p* = .010, $\eta^2 = .21$) between the outcome groups. According to J. Cohen (2013), effect sizes for these overall differences were all large (i.e., $\geq .14$). Post-hoc comparisons using the Tukey HSD test indicated that the mean score for TASIT 1 for the Very Good social outcome group ($M = 24.00$, $SD = 2.56$) was significantly higher than the mean score for the Good social outcome group ($M = 21.70$, $SD = 2.54$).
### Table 5.4

*Analysis of Variance between Social and Adaptive Functioning and Executive Function Performance (n = 42)*

<table>
<thead>
<tr>
<th>Test</th>
<th>Very Good (n = 9)</th>
<th>Good (n = 17)</th>
<th>Fair/Poor (n = 16)</th>
<th>F</th>
<th>p</th>
<th>η²</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>CI</td>
<td>M</td>
<td>SD</td>
<td>CI</td>
</tr>
<tr>
<td>TASIT 2</td>
<td>51.11</td>
<td>7.22</td>
<td>[45.56-56.66]</td>
<td>46.12</td>
<td>8.50</td>
<td>[41.75-50.49]</td>
</tr>
<tr>
<td>TASIT 3</td>
<td>53.44</td>
<td>6.58</td>
<td>[48.39-58.50]</td>
<td>49.53</td>
<td>6.68</td>
<td>[46.09-52.96]</td>
</tr>
<tr>
<td>MR</td>
<td>57.44</td>
<td>4.48</td>
<td>[54.00-60.88]</td>
<td>48.06</td>
<td>9.65</td>
<td>[43.10-53.02]</td>
</tr>
<tr>
<td>DKEFS 4</td>
<td>8.56</td>
<td>2.79</td>
<td>[6.41-10.70]</td>
<td>8.88</td>
<td>3.26</td>
<td>[7.21-10.56]</td>
</tr>
</tbody>
</table>

*Note.* *p* < .05; DKEFS-1-4 = 1) Free Sort; 2) Sort Recognition Description; 3) Combined Description; 4) Contrast; LNS = Letter Number Sequencing; MR = Matrix Reasoning; TASIT-1 = Emotion Recognition; TASIT-2 = Social Inference-Minimal; TASIT-3 = Social Inference-Enriched.
For MR, the mean T-score for the Very Good social outcome group \((M = 57.44, SD = 4.48)\) was significantly higher than the measure for the Good social outcome group \((M = 48.06, SD = 9.65)\). For DKEFS 3, post-hoc comparisons using the Games-Howell test revealed that the Very Good social outcome group \((M = 13.00, SD = 1.87)\) demonstrated significantly better concept formation and flexibility skills than the Good social outcome group \((M = 9.71, SD = 4.09)\). No significant differences were observed between the Very Good and Fair/Poor groups or between the Good and Fair/Poor groups on any other tests of executive function.

Therefore, unexpectedly, individuals classified as having Fair/Poor social and adaptive functioning performed at a comparable level to individuals in the Very Good and Good social and adaptive outcome groups on tests of executive functions. However, individuals classified as having Very Good social and adaptive outcomes performed significantly better than those with Good social and adaptive functioning on measures of emotion recognition, non-verbal reasoning and concept formation and conceptual flexibility.

**Associations between Tests of Executive Functioning and Mental Health Outcomes**

As shown in Table 5.5, levels of depression and stress were not significantly related to tests of executive functions \((p > .05)\). However, there was a significant negative association between DASS anxiety and DKEFS 1 \((r = -.45, p < .01)\), TASIT 2 \((r = -.37, p = .015)\) and TASIT 3 \((r = -.43, p < .01)\). Such findings suggested that individuals with poorer concept formation and social inference skills were more likely to experience greater anxiety symptoms. Consistent with these findings, there was a negative correlation between DASS anxiety and DKEFS 3 \((r = -.33, p = .032)\); however, this result failed to reach the adjusted significance level using Holm’s step-down approach.
Table 5.5

*Correlations between Tests of Executive Functions and Mental Health Outcomes (n = 42)*

<table>
<thead>
<tr>
<th>Test</th>
<th>Hayling</th>
<th>LNS</th>
<th>MR</th>
<th>DKEFS-1</th>
<th>DKEFS-2</th>
<th>DKEFS-3</th>
<th>DKEFS-4</th>
<th>TASIT-1</th>
<th>TASIT-2*</th>
<th>TASIT-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>DASS Depression</td>
<td>-.05</td>
<td>.11</td>
<td>.09</td>
<td>-.03</td>
<td>.07</td>
<td>.02</td>
<td>.07</td>
<td>.20</td>
<td>-.11</td>
<td>-.05</td>
</tr>
<tr>
<td>DASS Anxiety*</td>
<td>-.14</td>
<td>-.06</td>
<td>-.24</td>
<td>-.45**</td>
<td>-.20</td>
<td>-.33</td>
<td>.23</td>
<td>-.21</td>
<td>-.37*</td>
<td>-.43**</td>
</tr>
<tr>
<td>DASS Stress</td>
<td>-.14</td>
<td>.13</td>
<td>.013</td>
<td>-.22</td>
<td>.02</td>
<td>-.09</td>
<td>.19</td>
<td>.10</td>
<td>-.27</td>
<td>-.34</td>
</tr>
<tr>
<td>RSES</td>
<td>-.33</td>
<td>-.19</td>
<td>-.45**</td>
<td>-.26</td>
<td>-.36</td>
<td>-.33</td>
<td>-.13</td>
<td>-.22</td>
<td>-.13</td>
<td>-.13</td>
</tr>
<tr>
<td>SFSCS (Total)</td>
<td>-.20</td>
<td>-.30</td>
<td>-.56**</td>
<td>-.46**</td>
<td>-.50**</td>
<td>-.52**</td>
<td>-.12</td>
<td>-.40**</td>
<td>-.40**</td>
<td>-.43**</td>
</tr>
</tbody>
</table>

*Note.* *p < .05, **p < .01;* *a* = Logarithmic Transformation; DASS = Depression, Anxiety and Stress Scales; DKEFS-1-4 = 1) Free Sort; 2) Sort Recognition Description; 3) Combined Description; 4) Contrast; LNS = Letter Number Sequencing; MR = Matrix Reasoning; RSES = Rosenberg Self-Esteem Scale; SFSCS = Six Factor Self-Concept Scale; TASIT-1 = Emotion Recognition; TASIT-2 = Social Inference-Minimal; TASIT-3 = Social Inference-Enriched.
Furthermore, there was a significant negative correlation between self-esteem and MR ($r = -.45, p < .01$), which suggested that higher levels of non-verbal reasoning were associated with poorer self-esteem. Although results were not significant with the adjusted alpha level, there were also negative correlations between self-esteem and Hayling ($r = -.33, p = .032$), DKEFS 2 ($r = -.36, p = .019$) and DKEFS 3 ($r = -.33, p = .036$).

Broadly consistent with the results for self-esteem, there were significant negative correlations between self-concept and MR ($r = -.56, p < .001$), DKEFS 1 ($r = -.46, p < .01$), DKEFS 2 ($r = -.50, p < .001$), DKEFS 3 ($r = -.52, p < .001$), TASIT 1 ($r = -.40, p < .01$), TASIT 2 ($r = -.40, p < .01$) and TASIT 3 ($r = -.43, p < .01$). Such results indicate that higher levels of non-verbal reasoning, concept formation and flexibility, emotion recognition and social inference skills are associated with poorer self-concept. Consistent with these results, there was a negative correlation between self-concept and LNS that approached significance ($r = -.30, p = .051$).

Given the mixed pattern of associations between anxiety and executive functions and self-esteem/self-concept and executive functions, some supplementary correlational analyses between DASS subscales, self-esteem and self-concept were conducted. These revealed significant negative associations in the expected direction between self-esteem and depression ($r = -.55, p < .001$). Interestingly, self-esteem was not significantly associated with anxiety ($r = -.18, p > .05$) or stress ($r = -.24, p > .05$). Further, self-concept was not significantly correlated with depression ($r = -.22, p > .05$), anxiety ($r = -.25, p > .05$) or stress ($r = -.07, p > .05$). There was a significant positive correlation between self-esteem and self-concept ($r = .67, p < .001$).
FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

Discussion

Overview of Key Findings

The broad aims of the present study were to understand how impairments in executive functions relate to core domains of ASD characteristics and investigate the associations between executive functions and psychosocial outcomes. There was some limited support for $H_1$, whereby the contrast score on DKEFS 4 was significantly associated with the RAADS social anxiety subscale. Further, level of circumscribed interests on the RAADS was negatively associated with social cognition (TASIT 3), suggesting that greater circumscribed interests are related to a poorer ability to interpret social situations when contextual information is enriched. There was also some support for $H_2$, with individuals classified as having Very Good social and adaptive outcomes demonstrating significantly better performance on tests of emotion recognition, non-verbal reasoning and concept formation/flexibility (i.e., TASIT 1, MR and DKEFS 3) than those with Good outcomes.

However, there were no significant differences in executive function performance between individuals classified as having Very Good and Fair/Poor outcomes. Thus, these findings suggest that variations in individuals’ social and adaptive functioning are not adequately accounted for impairments in executive function. Finally, significant negative associations were found between DASS anxiety and DKEFS 1, TASIT 2 and TASIT 3, indicating that greater symptoms of anxiety are associated with poorer conceptual flexibility and social reasoning skills. Conversely, the significant negative associations between self-esteem/self-concept and MR, DKEFS 1-3 and TASIT 1-3 indicate that individuals with stronger non-verbal reasoning, concept formation and flexibility, emotion recognition, and social inference skills experience lower self-worth and poorer global self-concept. Some potential explanations for these findings and their theoretical and clinical implications will now be discussed.
Associations between ASD Characteristics and Executive Functioning

The finding that the contrast score on DKEFS 4 was significantly and positively associated with RAADS-SA (social anxiety) is broadly consistent with research supporting the relationship between cold executive function domains and ASD characteristics (Hill & Bird, 2006; Kenworthy et al., 2009; Kleinhans et al., 2005; Lopez et al., 2005; South et al., 2007). Higher contrast scores for DKEFS 4 are reflective of greater difficulties in transferring knowledge into action (Delis et al., 2001). There is some evidence that high-functioning adults with ASD have difficulty translating knowledge into action due to an impaired ability to inhibit a prepotent response (i.e., a response generated from repetition; Hill & Bird, 2006; Kleinhans et al., 2005). Thus, although they may know the correct action or answer, they can have difficulty inhibiting habitual responses (Kleinhans et al., 2005). In the context of social interaction, this suggests a dissonance between intellectually understanding social convention (e.g., manners and etiquette) and responding appropriately in a given social context, which in turn may contribute to social anxiety symptoms (e.g., worrying about how to act in social situations).

There was a significant negative association between TASIT 3 (social inference-enriched) and RAADS-CI (circumscribed interests), suggesting that greater circumscribed interests are related to poorer mentalising or impaired ability to understand intentions in social situations when contextual information is enriched. Lack of contextual sensitivity has been proposed as a key mechanism underpinning deficits in social cognition (Baez & Ibanez, 2014; Vermeulen, 2014). Thus, the repetitive behaviours and fixated interests associated with ASD may contribute to individuals focusing their attention on unimportant contextual information and missing social cues that are salient to understanding the meaning of social interaction. The present study is the first to demonstrate an association between ASD characteristics and impaired performance on the TASIT, an ecologically valid measure of social cognition.
Associations between Executive Functioning and Social and Adaptive Functioning

A further key finding of this study was that performance on TASIT 1, MR (Matrix Reasoning) and DKEFS distinguished between individuals with Very Good social and adaptive functioning and those with Good functioning. However, unexpectedly, the performance of individuals classified as having Fair/Poor social and adaptive functioning did not significantly differ from that of individuals in the Very Good and Good social and adaptive outcome groups on tests of executive functions. These findings differ from the systematic review (see Chapter 3), which indicated that stronger cognitive skills (e.g., intellectual functioning [IQ], non-verbal learning and cognitive shifting) are associated with better social and adaptive functioning in adulthood (Berger et al., 2003; Farley et al., 2009; Hagberg et al., 2013; Howlin et al., 2004; Larson & Mouridsen, 1997; Montgomery et al., 2013; Szatmari et al., 1989). Notably, several studies reporting these associations used the same outcome rating scale as the one employed in the present study (Cederlund et al., 2008; Howlin et al., 2004). For example, Cederlund et al. (2008) found that higher FSIQ and verbal IQ were associated with better outcomes using similar categorical groups \(p < .05\) for 66 high-functioning adults with ASD. Other studies used the Vineland Adaptive Behavior Scale (VABS; Sparrow et al., 1984) to examine associations between cognitive measures and psychosocial outcomes (Szatmari et al., 1989; Venter, Lord, & Schopler, 1992). The VABS is a semi-structured interview that provides a comprehensive assessment of adaptive behaviour across three domains: communication, socialisation and daily living skills.

In a retrospective follow-up study (11 to 27 years), Szatmari et al. (1989) found strong positive associations between the VABS and IQ \(r = .60\) and the Wisconsin Card Sorting Test \(r = .68\). Thus, it is possible that a more comprehensive measure such as the VABS may have better discriminated between levels of social and adaptive functioning than the ordinal approach used in the present study to classify people into three outcome groups. However,
due to its lengthy administration time (i.e., approximately 60 minutes) the VABS was not feasible to administer in the current study.

As a further potential explanation for the discrepant findings, the group of individuals classified as having Fair/Poor outcomes may have performed relatively well on the tests of executive function due to the structured testing conditions, which may not reflect their cognitive abilities in daily living. Overall, the present findings suggest that differences in individuals’ social and adaptive functioning cannot be adequately accounted for on the basis of tests of executive function. Thus, there is a need to examine the influence of personal and social resources, such as self-appraisals, perceived social support, emotion regulation and coping strategies, which are the focus of Chapter 6 (study 4).

**Associations between Executive Functioning and Mental Health**

The negative associations between DASS anxiety and DKEFS 1, TASIT 2 and TASIT 3 were broadly consistent with previous research (South et al., 2015; Wallace et al., 2015). Specifically, these studies found that poorer executive functions (i.e., shifting and memory) were related to greater anxiety and negative emotionality (South et al., 2015; Wallace et al., 2015). The results in the present study indicate that high-functioning individuals with ASD with poorer concept formation and social inference are more likely to experience greater symptoms of anxiety. However, it is important to note that this association could be bi-directional, such that individuals with greater anxiety may perform worse on executive function tests (i.e., anxiety due to performance and/or interaction with the researcher); alternatively, poorer cognitive flexibility and mentalising may contribute to the development of anxiety.

The lack of significant associations between tests of executive function and the depression and stress subscales of the DASS conflicts with prior research (Barnhill, 2001; Solomon et al., 2004). As shown in Tables 4.1 and 4.2, there was considerable variability in
performance on tests of executive function and levels of depression (0-28) and stress (0-30) reported by participants. Therefore, a restricted range of scores on measures is unlikely to account for the non-significant associations between executive function and depression and stress. Aside from possible issues with statistical power (see Limitations), it appears that factors other than executive functioning influence these mental health outcomes for high-functioning adults with ASD, as covered in Chapter 6.

In contrast to the findings for anxiety, there was a pattern of significant negative associations between self-esteem and non-verbal reasoning (MR) and self-concept and non-verbal reasoning (MR), cognitive flexibility (DKEFS 1-3) and social cognition (TASIT 1-3). These findings are in line with a previous ASD study which identified that individuals with higher IQ reported greater mental health symptoms (Sterling et al., 2008). Interestingly, Barnhill (2001) found that adolescents with higher IQ were more likely to attribute social failure to their own abilities and effort rather than external factors. Barnhill (2001) proposed that higher IQ may be related to increased cognitive awareness and internal attributions concerning social failure. The present findings extend the literature by demonstrating that high-functioning adults with stronger hot and cold executive functions experience more negative global self-concept. Given that social interaction difficulties are particularly common for individuals with ASD (Happé, Ronald, et al., 2006; Rajendran & Mitchell, 2007), stronger executive functions may contribute to heightened self-awareness of one’s own functional difficulties, which in turn lowers global self-concept. Although this was not investigated in the present study, research in the field of brain injury identified that lower self-esteem was associated with greater awareness of deficits (Carroll & Coetzer, 2011) and better cognitive (IQ) and executive functioning (Cooper-Evans, Alderman, Knight, & Oddy, 2008). Overall, further research is needed to examine factors such as self-awareness which potentially mediate the relationship between greater executive function and poorer self-concept.
Limitations

Several limitations of the present study need to be acknowledged, particularly in relation to sampling. As previously discussed in Chapter 3, the convenience sampling approach yielded a smaller male-to-female ratio (2.8:1) than the ratio typically reported in the literature and there was considerable variability in the age range (18-66 years). It is broadly accepted that males are more commonly diagnosed with ASD (i.e., ratio of approximately 4.3:1; (Fombonne, 2003). Thus, the participants in the present study may not be representative of the broader ASD population, which in turn may limit the generalisability of the findings. Further, as previously acknowledged in Chapter 3, there was a lack of verification of participants’ ASD diagnosis from an independent clinical assessment. Nonetheless, all participants reported a history of longstanding difficulties in social interaction and communication, and a restricted range of behaviours and/or interests. Further, the RAADS has established validity as an assessment tool supporting a diagnosis of ASD for adults (Ritvo et al., 2011; Ritvo et al., 2008).

It is also acknowledged that the two significant medium correlations (i.e., .31 & .34) presented in Table 5.3 may be spurious. However, the use of Holm’s procedure to control for Familywise error rate provides some reassurance that this was not the case. Additionally, the non-significant associations of the present study may be due to a lack of statistical power. Based on the small effect sizes observed for many analyses, post-hoc power analyses indicated that a much larger sample size was required to detect significant associations or between group differences (i.e., $n > 150$). However, it is important to note that previous studies obtained significant findings with sample sizes similar to or smaller ($n = 11$ to 25) than the present study (Hill & Bird, 2006; Montgomery et al., 2013; Szatmari et al., 1989). Therefore, although lack of statistical power is considered likely to have contributed to some of the non-significant findings, insufficient sample size cannot solely account for these. As
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previously discussed, the categorical approach used to classify participants’ social and adaptive functioning may have potentially influenced non-significant results.

A further key study limitation relates to the cross-sectional design, which does not allow for conclusions to be drawn concerning the direction of relationships between variables. It is considered likely that the relationships among some variables are bi-directional or mutually enhancing. For example, it is possible that poorer concept formation and social inference skills contribute to increased anxiety symptoms; however, greater anxiety may negatively influence performance on executive function tests (i.e., anxiety regarding test performance and social interaction with the researcher). Furthermore, there is particularly a need for caution when interpreting the direction of relationships between ASD characteristics and executive functions in an adult ASD sample. Specifically, although deficits in both hot and cold executive functions may underlie certain ASD characteristics (e.g., need for sameness and social interaction difficulties), it is also plausible that early ASD symptoms such as sensory processing difficulties influence the maturation of higher-order cognitive processes throughout development (Lopez et al., 2005). Furthermore, these relationships are most likely moderated by autism-environment interactions related to, for example, access to interventions and the presence of supportive relationships (Bartak et al., 2006). As such, there is a need for prospective longitudinal studies spanning early childhood through to adulthood in order to examine the complex and dynamic relationships between ASD characteristics, executive functions and psychosocial functioning and potential environmental moderators.

Conclusions and Implications

The present findings extend the literature by identifying that social anxiety and circumscribed interest characteristics of ASD are related to impairments in cognitive flexibility and social inference. Specifically, the social anxiety features common to ASD are related to difficulties in translating knowledge into action, whereas greater stereotyped
behaviours and fixated interests are associated with poorer mentalising or understanding or others’ intentions in social situations. A further novel finding of the present study was that individuals with stronger hot and cold executive functions experienced less anxiety but reported more negative self-concept. As such, stronger executive functions may serve as a vulnerability factor for developing negative self-concept. Although it is unclear from the present findings why this is the case, individuals with stronger higher-order cognitive functioning may have greater self-awareness of their functional difficulties and engage in more critical self-evaluation of their performance (Barnhill, 2001). Such findings highlight the need to examine factors such as self-awareness of functional abilities and attribution style which potentially mediate the relationship between stronger executive function and poorer self-concept. A main clinical implication of these findings relates to the importance of screening for and monitoring mental health concerns for those with ASD, irrespective of their executive function. To further advance understanding of risk and protective factors related to psychosocial outcomes in high-functioning adults with ASD, Chapter 6 investigates the influence of personal and social resources on the relationship between ASD characteristics and mental health and social and adaptive functioning.
Chapter 6: The Relationship between ASD Characteristics and Psychosocial Outcomes:

Investigation of the Vulnerability and Stress-Buffer Hypotheses

Introduction

The International Classification of Functioning, Disability and Health (ICF) provides a useful framework for conceptualising how personal and social resources influence the health and wellbeing of individuals (World Health Organization [WHO], 2005). In the context of a health condition, personal and social resources refer to the individual characteristics and social capital drawn upon to make sense of and adapt to symptoms and associated functional limitations (Hobfoll, 2002). Developed as an alternative to the medical model, ICF recognises disability as a multidimensional construct with bi-directional relationships among biological, psychological and social domains that influence health and well-being. Further, personal and contextual factors (e.g., coping styles, appraisals, and social support) are viewed as key determinants of well-being. Throughout the literature, personal and social resources are commonly referred to as third variables or intervening variables (i.e., mediators and/or moderators) in the relationship between stress and health outcomes. Differences in personal and social resources may account for why individuals with the same or similar health condition can experience varying levels of quality of life and social integration (MacKinnon & Luecken, 2008).

A theoretical framework that has guided investigations into the role of personal and social resources is the transactional model of stress and coping (Folkman, 1997; Lazarus & Folkman, 1984). This model is comprised of two main processes, namely appraisal and coping, which determine the impact of a stressor on well-being. Appraisals refer to the person’s subjective evaluation of the significance of the stressor and the adequacy of personal resources for coping with the demands of the situation. Coping refers to the thoughts and behaviours a person uses to regulate distress, manage the problem causing the distress and
maintain positive well-being (Folkman, 1997). The pattern of stress appraisals and coping efforts employed give rise to different outcomes in terms of well-being (e.g., levels of depression and self-esteem).

For individuals with ASD, greater ASD characteristics (i.e., social, communicative and sensory impairments and repetitive behaviours) can be conceptualised as a major stressor or source of stress. Accordingly, the transactional model of stress and coping may guide hypotheses regarding the role of personal and social resources in the relationship between ASD characteristics and psychosocial outcomes. From this perspective, both mediation and moderation models are plausible. Specifically, a mediation model (i.e., vulnerability model) would predict that greater ASD characteristics are associated with the depletion of personal and social resources (i.e., negative appraisals, maladaptive coping and poor perceptions of social support) which in turn contribute to poorer psychosocial outcomes.

Conversely, the stress-buffer hypothesis (Cohen & Wills, 1985) proposes that in the context of elevated stress, an individual’s well-being is buffered or protected by personal and social resources (S. Cohen & Edwards, 1989; S. Cohen & Wills, 1985; Wheaton, 1985). In statistical terms, support for the stress-buffering model is demonstrated by a moderating effect or interaction between levels of stress and personal and social resources, whereby greater resources can improve well-being under conditions of high stress (S. Cohen, 2004). Accordingly, for individuals with ASD, positive self-appraisals, adaptive coping and high levels of perceived social support may enhance psychosocial outcomes for those with greater ASD characteristics. Although these relationships are yet to be investigated, as highlighted in Chapter 3, preliminary research supports the associations between personal and social resources and psychosocial outcomes. As such, this body of research and the rationale for examining personal and social resources in this study will now be outlined.
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Self-Appraisals

It is well established in the psychological literature that the ways in which individuals perceive themselves and the environment affect their emotional wellbeing (Evers et al., 2001; Folkman, 1997; Lauwerier et al., 2010; McCracken, 2005). Much of this research has focused on self-perceptions in the context of chronic disease, which is defined as an aversive, long-term condition with a high degree of uncontrollability and unpredictability (Evers et al., 2001). Evers and colleagues (2001) proposed three overarching cognitions: (a) helplessness as a way of accentuating the negative meaning of the situation; (b) acceptance as a way to reduce the aversive meaning; and (c) perceived benefits as a way of adding positive meaning to one’s situation. These authors developed a self-report measure of illness-related cognitions (i.e., Illness Cognition Questionnaire [ICQ]; Evers et al., 2001) and found that greater helplessness predicted a deterioration of physical health while acceptance and perceived benefits were associated with an improvement in both physical and psychological wellbeing.

ASD is broadly defined as a chronic neurodevelopmental disorder (Wing & Potter, 2002) and shares some characteristics with chronic health conditions, such that a diagnosis of ASD is typically lifelong and characteristics are broadly stable (Attwood, 2007; Woodbury-Smith et al., 2005). Qualitative studies indicate that some individuals value certain characteristics associated with a diagnosis of ASD, such as attention to detail, identifying errors quickly and having extensive knowledge in a particular area or topic (e.g., mathematics and/or computers) (Haertl et al., 2013; Smith & Sharp, 2013). Conversely, others express feeling helpless, estranged, and rejected by society (Haertl et al., 2013; Smith & Sharp, 2013; Townson et al., 2007). However, research is yet to examine the impact of self-appraisals related to ASD, such as helplessness, acceptance and perceived benefits, on the association between ASD characteristics and psychosocial outcomes.
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Although self-concept and self-esteem are conceptually related as components of self-perception, self-concept refers to the self-appraised cognitive component of the self, while self-esteem refers to the evaluative component or affect associated with the cognitive judgement (Breytspraak & George, 1982). Qualitative research suggests that individuals with ASD can acquire a sense of competency and positive identity via special interests and talents (Giarelli & Fisher, 2013; Haertl et al., 2013; Muller et al., 2008; Smith & Sharp, 2013; Townson et al., 2007), which in turn, may positively impact on psychosocial outcomes. In this way, positive self-concept could be conceptualised as a personal resource that individuals draw on to understand, accept and adapt to characteristics associated with ASD in order to maximise well-being. Hence, positive self-concept might buffer the effects of greater ASD characteristics on psychosocial outcomes. Alternatively, individuals with greater ASD characteristics may be more likely to hold negative self-views (i.e., poor self-concept) and self-appraisals related to ASD (i.e., higher levels of helplessness and lower perceived benefits and acceptance), which in turn contribute to poorer psychosocial outcomes.

As noted in Chapter 3, there is evidence that negative thinking styles are related to poorer psychosocial outcomes, including depression and anxiety (Abell & Hare, 2005; Gotham, Bishop, et al., 2014; Hare et al., 2015). For example, in a small sample of high-functioning adults with ASD (n = 21), Gotham, Bishop, et al. (2014) found that a perseverative thinking style moderated the relationship between greater ASD characteristics and depression, whereby lower levels of rumination buffered individuals in terms of depressive symptoms. However, overall, there is a lack of research investigating the mediating or moderating role of self-appraisals in the relationship between ASD characteristics and psychosocial outcomes.
Stress and Coping

According to the systematic review in Chapter 3, relatively few studies have examined the relationship between ASD characteristics, coping and psychosocial outcomes for high-functioning adults with ASD (Khanna et al., 2014; Renty & Roeyers, 2007). However, in a large cross-sectional study (n = 291), Khanna et al. (2014) reported that maladaptive coping strategies (i.e., behavioural disengagement, denial, self-blame, self-distraction, substance abuse and venting) were significantly related to poorer physical and mental health-related QoL in adulthood.

In line with the transactional model of stress and coping (Folkman, 1997; Lazarus & Folkman, 1984), the cybernetic theory of stress, coping and wellbeing advanced by Edwards and Baglioni (1999) highlights the central role of appraisals and coping. Their model conceptualises stress as the discrepancy between the individual's perceived state and desired state. Greater discrepancies between the environment and internal standards produce higher level of stress, which stimulates coping efforts to resolve these discrepancies and attenuate the negative effects of stress on well-being. Edwards and Baglioni outlined five forms of coping that include: (a) changing the situation: attempts to bring the situation in line with desires; (b) accommodation: efforts to regulate desires or one’s goals to meet the situation; (c) devaluation: a focus on reducing the importance associated with the discrepancy; (d) avoidance: efforts to transfer attention away from the situation; and (e) symptom reduction: efforts to improve well-being directly.

The cybernetic theory of stress and associated forms of coping has particular relevance for individuals with ASD who often experience a discrepancy between their desired and actual state and heightened sensitivity to their environment (e.g., desire for order and sameness; Attwood, 2007). Further, as demonstrated in Chapter 4, due to impairments in hot and cold executive functions and sensory integration and verbal communication, individuals
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with ASD may find it problematic to engage in behaviours that reduce symptoms of stress (i.e., symptom reduction or changing the situation), avoid thinking about the stressor (i.e., avoidance) or to change the way they view a certain stressor (i.e., accommodation or devaluation; Attwood, 2004). Accordingly, the aforementioned mediation model would predict that individuals with greater ASD characteristics are more likely to employ maladaptive coping strategies, which in turn contribute to poorer psychosocial outcomes.

Alternatively, in line with the stress-buffering model, it is also plausible that employing adaptive coping strategies to manage stress could attenuate the negative effect of greater ASD characteristics on psychosocial outcomes.

**Emotion Regulation**

Closely related to coping, emotion regulation refers to the capacity to simultaneously attend to internal and external cues in order to respond appropriately in a given situation (Ekman, 1992). As such, strategies employed to regulate emotions influence the experience and expression of emotions as well as mental health outcomes (Hu et al., 2014; Koole, 2009; Kring & Sloan, 2009). For example, maladaptive attempts to regulate unpleasant feelings (e.g., emotional suppression) are associated with poor mental health outcomes, such as depression and anxiety (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Campbell-Sills & Barlow, 2007; Trosper, Buzzella, Bennett, & Ehrenreich, 2009). Conversely, adaptive emotion regulation strategies such as cognitive reappraisal are associated with positive mental health outcomes (Hu et al., 2014).

Numerous models have been proposed to explain the development and maintenance of emotion regulation strategies (Connor-Smith, Compas, Wadsworth, Thomsen, & Saltzman, 2000; Gross, 1998; Koole, 2009; Larsen, 2000; Parkinson & Totterdell, 1999; Thayer, Newman, & McClain, 1994). Gross’s (1998) well established process model describes strategies that are employed before (i.e., cognitive reappraisal) and after (i.e., expressive
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suppression) an emotional response, and may be generated either consciously or automatically (Gross & John, 2003). Specifically, cognitive reappraisal refers to the process of altering the emotional meaning of the situation via re-interpretation of what happened, whereas expressive suppression modulates an individual’s response to the situation (e.g., controlling or neutralising emotional behaviour). The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) assesses the use of cognitive reappraisal and expressive suppression strategies. In their original validation study of the ERQ, the authors found that cognitive reappraisal was associated with greater positive emotions, better interpersonal relationships and enhanced overall well-being. In contrast, expressive suppression was related to more negative emotional experiences, poorer interpersonal relationships and worse overall well-being. Rieffe and colleagues (2011) found that high-functioning children with ASD employ less adaptive emotion regulation strategies, such as lower use of cognitive reappraisal, when compared to typically developing peers. Using the ERQ, Samson and colleagues (2012) identified that high-functioning adults with ASD employ fewer emotion regulation strategies (e.g., lower use of reappraisal of cognitions) and report lower self-efficacy regarding their ability to use reappraisal strategies when compared to matched controls.

To date, there has been limited research investigating the relationship between emotion regulation and psychosocial outcomes in the high-functioning ASD population. Hill et al. (2004) found that high-functioning adults with ASD reported greater difficulties with emotion regulation and were more depressed than matched controls; however, difficulties with emotion regulation were not significantly related to symptoms of depression. In a recent study, Swain, Scarpa, White, and Laugeson (2015) found that self-reported emotion dysregulation, such as difficulties controlling emotions when upset, was associated with higher levels of social anxiety.
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Given that maladaptive attempts to regulate emotions are associated with poor mental health outcomes in the general clinical population (Aldao et al., 2010; Campbell-Sills & Barlow, 2007; Trosper et al., 2009), less use of cognitive reappraisal and greater use of expressive suppression is expected to be related to poorer psychosocial outcomes. Consistent with other coping resources previously discussed, it is possible that those with greater ASD characteristics are less able to employ effective emotion regulation strategies which, in turn, contributes to poor psychosocial outcomes (i.e., vulnerability model). Conversely, the use of these emotion regulation strategies could moderate the relationship between greater ASD characteristics and psychosocial outcomes (i.e., stress-buffering model). Accordingly, the mediating and/or moderating influence of emotion regulation on the relationship between greater ASD characteristics and psychosocial outcomes for adults with ASD was investigated in the present study.

Perception of Social Support

In addition to coping resources, there is considerable evidence that the perceived availability and quality of social support buffers the impact of high levels of stress on psychosocial outcomes in a range of clinical populations (S. Cohen, 1988; Payne et al., 2012; Steptoe, 2000). A fundamental aspect of this buffering effect is the extent to which social support is perceived as available or effective by an individual (S. Cohen, 1988). In this way, appraisals of social support could be regarded as the social capital individuals with ASD perceive they can draw upon to support their emotional, social and adaptive functioning. There is consistent evidence that individuals with ASD often have poor social functioning, with many reporting persisting social impairments and a lack of close personal relationships (Attwood, 2007; Engstrom et al., 2003; Howlin, 2003, 2007; Jennes-Coussens et al., 2006). In an unpublished dissertation, Merkler (2007) reported that high-functioning adults with ASD were more isolated than matched controls and that isolation from social networks and
relationships was associated with psychological distress. A main finding of the systematic review in Chapter 3 was that there was a significant association between higher levels of perceived social support and positive psychosocial outcomes (Gotham, Bishop, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006). These studies indicated that subjective appraisal of support (i.e., perceived quality or availability) was more closely related to quality of life than actual received support.

Consistent with personal resources, it is conceivable that appraisals of social support may have a mediating or moderating effect on the relationship between greater ASD characteristics and psychosocial outcomes. In terms of the vulnerability model, elevated ASD characteristics may be associated with lower appraisals of social support (i.e., due to the impact of ASD characteristics on social networks), which in turn contribute to poorer mental health and social and adaptive functioning. Alternatively, in line with the stress-buffering model, individuals with greater ASD characteristics who perceive high levels of social support may experience more positive psychosocial outcomes.

Aims and Hypotheses

Individuals appraise and cope with characteristics associated with ASD in diverse ways (Haertl et al., 2013; Smith & Sharp, 2013; Townson et al., 2007). Guided by leading theories of stress and coping (Folkman, 1997; Lazarus & Folkman, 1984), the broad aim of the present study was to investigate the role of personal and social resources as vulnerability or protective factors in the relationship between ASD characteristics and mental health and social and adaptive functioning. More specifically, this study aimed to determine whether personal and social resources serve as stress-buffers or vulnerability factors in the relationship between ASD characteristics and psychosocial outcomes (i.e., mental health outcomes and social and adaptive functioning) for high-functioning individuals with ASD. Due to the relatively small number of studies investigating personal and social resources of adults with
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ASD and the lack of instruments developed specifically for the ASD population, the initial focus of this study was to investigate reliability and validity of self-report measures of these constructs.

**Phase 1: Psychometric Analysis of Measures of Personal and Social Resources**

The first phase of this study aimed to investigate the reliability and validity of measures of personal and social resources for high-functioning adults with ASD. It was hypothesised (H1) that the measures assessing personal and social resources (i.e., ASD self-appraisals, self-concept, emotion regulation, coping and social support) would demonstrate acceptable internal consistency, whereby all relevant subscales would achieve acceptable Cronbach’s alpha levels (α ≥ .70; DeVellis, 2012). To clarify the underlying constructs assessed by the measures of ASD self-appraisals, coping and emotion regulation a principal component analysis was conducted.

**Phase 2: Investigation of Vulnerability and Stress-Buffering Hypotheses**

In relation to social and adaptive functioning, there was mixed evidence in the systematic review that greater ASD characteristics were associated with poorer social and adaptive functioning; thus supporting moderation analyses. However, theoretically, both mediation and moderation are possible and will be tested in the present study. As such, the association between ASD characteristics and social and adaptive functioning, and potential interactions between ASD characteristics and personal and social resources were examined as an exploratory component, for which no hypotheses were formed.

In line with the findings of the systematic review in Chapter 3, it was hypothesised (H2.1) that greater ASD characteristics would be significantly associated with poorer mental health outcomes (i.e., increased depression, anxiety and stress and lower self-esteem). Guided by theories of adjustment to chronic health conditions, the mediating and moderating influence of personal and social resources on the relationship between ASD characteristics
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and mental health outcomes was investigated. As such, two alternative hypotheses were formulated:

H2.2.1 According to the stress-buffering model, it is hypothesised that the association between greater ASD characteristics and poorer mental health outcomes would be moderated by personal and social resources. Specifically, individuals with greater ASD characteristics who have better personal and social resources would experience more positive mental health outcomes than those who have fewer personal and social resources.

H2.2.2 According to the vulnerability model, it was hypothesised that the relationship between ASD characteristics and mental health outcomes would be mediated by personal and social resources. Specifically, greater ASD characteristics would be related to more negative self-appraisals and social support appraisals and maladaptive coping and emotion regulation skills, which in turn would be related to poorer mental health outcomes.

Methodology

Design and Sample Considerations

Based on recommendations by Fritz and MacKinnon (2007) when using the bias-corrected bootstrap method (Preacher & Hayes, 2008), and estimating the size of regression coefficients for the $a$ (0.26) and $b$ (0.39) paths, a minimum sample size of 115 participants was required. In order to achieve the required sample size for the relevant analyses, an online survey was chosen as the mode of administration as it was considered more likely that people would consent to participate using this format than face-to-face or postal surveys. Further, the online mode of delivery enabled people from around Australia and other countries to participate.

Internal consistency analyses and a principal component analysis were conducted in Phase 1. For Phase 2, moderation analyses were conducted to test whether personal and social resources (i.e., factors identified in phase 1) moderated the relationship between the IV (i.e.,
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ASD characteristics) and the DVs (i.e., psychosocial outcomes [depression, anxiety, stress, self-esteem and social and adaptive functioning]; see Figure 6.1a). Mediation analyses were conducted to test whether personal and social resources mediate the relationship between the IV (i.e., ASD characteristics) and the DVs (i.e., psychosocial outcomes [depression, anxiety, stress, self-esteem and social and adaptive functioning]; see Figure 6.1b).

Figure 6.1a. General model for moderation analysis

Figure 6.1b. General model for mediation analysis

Participants

Consistent with recruitment for studies outlined in Chapters 4 and 5, participants were recruited via convenience sampling from relevant national ASD websites (e.g., Tony Attwood [http://www.tonyattwood.com.au]), support services (e.g., Asperger Services Australia [http://www.asperger.asn.au], Amaze [http://www.amaze.org.au]) and clinics (Minds and Hearts [http://www.mindsandhearts.net]). All participants were screened to determine eligibility for participation, meeting the following criteria: 1) formal diagnosis of ASD and/or self-reported history of longstanding difficulties in social interaction and communication and a restricted range of behaviours and/or interests as reflected by scores equal to or greater than
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77 on the Ritvo Autism Asperger’s Diagnostic Scale – Revised (RAADS; Ritvo et al., 2011); 2) aged 18-70 years; 3) adequate understanding of spoken and written English; 4) not currently experiencing a comorbid psychotic disorder; and 5) no history of a serious neurological or medical condition (e.g., traumatic brain injury).

A total of 188 individuals initiated the survey. Of these, 44 people did not meet the inclusion criteria (e.g., RAADS-R Score < 77). The sample of 42 participants in Chapters 4 and 5 formed part of the total sample in the present study. A sample of 144 individuals met the required cut-off score on the RAADS. Demographic information for these participants is displayed in Table 6.1. There was a slightly higher proportion of female participants (56.9%) than males. The age of participants ranged from 18-70 years (M = 38.27, SD = 13.07) and years of education ranged from 8-17 (M = 14.15, SD = 2.42). The majority of participants identified as European/Caucasian (97.9%), with the highest proportion of individuals residing in Australia (74.3%). Given the diverse representation of countries, analyses were conducted between individuals residing in Australia and those living outside Australia to examine potential differences on key measures (see Analyses section). Although most individuals endorsed their employment status as employed/self-employed (47.9%), almost one third (31.9%) identified as being unemployed. There was a higher proportion of individuals that reported being single (59%) than in a relationship (41%). In terms of social and adaptive functioning, 66.7% of individuals were classified as having Very Good or Good functioning, 27.1% were rated as Fair and 6.2% were categorised as having either Poor or Very Poor functioning. Ninety-six individuals (66.7%) reported an official diagnosis of either ASD or Asperger’s syndrome; however, all 144 participants identified a history of longstanding ASD characteristics.
### Table 6.1

*Demographic Information for High-Functioning Individuals with ASD (n = 144)*

<table>
<thead>
<tr>
<th>Demographic Data</th>
<th>Mean/SD/Frequency (%)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>38.27 (13.07)</td>
<td>18-70</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>62 (43.1%)</td>
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</tr>
<tr>
<td>Female</td>
<td>82 (56.9%)</td>
<td></td>
</tr>
<tr>
<td><strong>Years of Education</strong></td>
<td>14.15 (2.42)</td>
<td>8-17</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
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<td></td>
</tr>
<tr>
<td>European/Caucasian</td>
<td>141 (97.9%)</td>
<td></td>
</tr>
<tr>
<td>A/TSI</td>
<td>1 (.7%)</td>
<td></td>
</tr>
<tr>
<td>Pacific Islander</td>
<td>1 (.7%)</td>
<td></td>
</tr>
<tr>
<td>Latino</td>
<td>1 (.7%)</td>
<td></td>
</tr>
<tr>
<td><strong>Residing Country</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>107 (74.3%)</td>
<td></td>
</tr>
<tr>
<td>New Zealand</td>
<td>3 (2.1%)</td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>6 (4.2%)</td>
<td></td>
</tr>
<tr>
<td>North America</td>
<td>17 (11.8%)</td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>10 (6.9%)</td>
<td></td>
</tr>
<tr>
<td>South America</td>
<td>1 (.7%)</td>
<td></td>
</tr>
<tr>
<td><strong>Employment Status</strong></td>
<td></td>
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</tr>
<tr>
<td>Employed/Self-Employed</td>
<td>69 (47.9%)</td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>21 (14.6%)</td>
<td></td>
</tr>
<tr>
<td>Volunteer</td>
<td>8 (5.6%)</td>
<td></td>
</tr>
<tr>
<td>Unemployed</td>
<td>46 (31.9%)</td>
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</tr>
<tr>
<td><strong>Relationship Status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married/Defacto</td>
<td>59 (41%)</td>
<td></td>
</tr>
<tr>
<td>Single, relationship &lt; 2 years</td>
<td>20 (13.8%)</td>
<td></td>
</tr>
<tr>
<td>Single, relationship &gt; 2 years</td>
<td>27 (18.8%)</td>
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</tr>
<tr>
<td>No relationship history</td>
<td>38 (26.4%)</td>
<td></td>
</tr>
<tr>
<td><strong>Friendship Status</strong></td>
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</tr>
<tr>
<td>More than one close friend</td>
<td>91 (63.2%)</td>
<td></td>
</tr>
<tr>
<td>More than one friend, but not considered close</td>
<td>2 (1.4%)</td>
<td></td>
</tr>
<tr>
<td>Friends only associated from group membership</td>
<td>16 (11.1%)</td>
<td></td>
</tr>
<tr>
<td>No close friends</td>
<td>35 (24.3%)</td>
<td></td>
</tr>
<tr>
<td><strong>Social and Adaptive Functioning</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Good</td>
<td>44 (30.6%)</td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>52 (36.1%)</td>
<td></td>
</tr>
<tr>
<td>Fair</td>
<td>39 (27.1%)</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>8 (5.5%)</td>
<td></td>
</tr>
<tr>
<td>Very Poor</td>
<td>1 (.7%)</td>
<td></td>
</tr>
<tr>
<td><strong>ASD Diagnosis</strong></td>
<td>96 (66.7%)</td>
<td></td>
</tr>
</tbody>
</table>

*Note. A/TSI = Aboriginal/Torres Strait Islander*
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Materials

ASD Characteristics

The Ritvo Autism Asperger’s Diagnostic Scale – Revised (RAADS; Ritvo et al., 2011) is a self-report measure based on the DCM-IV-TR and ICD-10 criteria which is used to assist in the diagnosis of adults with ASD. As outlined previously in Chapters 4 and 5, the scale consists of 80-items (i.e., 64 symptom and 16 non-symptom based responses) and is divided into four factor analytically derived subscales: Social Relatedness (SR) – 23 items (e.g., “I can put myself into other people’s shoes”); Circumscribed Interests (CI) – 28 items (e.g., “I focus on details rather than the overall idea”); Sensory Motor (SM) (e.g., “I always notice how food feels in my mouth and this is more important to me than how it tastes”) – 18 items; and Social Anxiety (SA) – 12 items (e.g., “It can be very intimidating for me to talk to more than one person at the same time”). Each question is rated on a 4-point Likert scale in order of severity ranging from “True now and when I was young” = 3 to “Never true” = 0. To minimise response bias, the 16 non-symptom based responses are reverse scored and are indicated by an asterisk beside each item. A total score of ≥ 77 out of a maximum score of 240 is indicative of a HFASD diagnosis (Ritvo et al., 2011). The total RAADS score was used in this study to indicate overall severity of ASD characteristics.

Personal and Social Resources

ASD Appraisals

ASD Appraisals were assessed using a modified version of the Illness Cognition Questionnaire (ICQ; Evers et al., 2001). The ICQ is an 18-item self-report measure designed to identify both favourable and unfavourable ways of perceiving a long-term illness. In the present study, the ICQ was modified such that the term illness was not mentioned and questions were slightly re-worded to focus on cognitions relevant to characteristics associated with ASD (see Appendix E for the adjusted ICQ items). The ICQ has been shown to reliably
assess three overarching cognitions: (a) helplessness as a way of accentuating the aversive meaning of the situation; (b) acceptance as a way to reduce the aversive meaning; and (c) perceived benefits as a way of adding a positive meaning (Lauwerier et al., 2010). With each scale comprising of six items, participants are asked to indicate the extent to which they agree with each statement on a 4-point Likert scale ranging from “Not at all” = 1 to “Completely” = 4. Each scale has a scoring range of 6-24, with higher scores reflecting greater helplessness, acceptance and perceived benefits.

The ICQ has previously shown good internal consistency for all three subscales (α = .84-.91) and high test-retest reliability (r = .68-.79) in chronic illness samples. The three factor structure of the ICQ has been validated in two separate samples of individuals with chronic pain and chronic fatigue (Lauwerier et al., 2010). Evers and colleagues (2001) found that the ICQ has adequate predictive validity whereby helplessness predicted a deterioration of physical health while acceptance was associated with an improvement in both physical and psychological well-being.

**Self-Concept**

The Six-Factor Self-Concept Scale for Adults (SFSCS; Stake, 1994) is a 36-item multidimensional measure of adult self-concept that consists of six factor-analytically derived subscales: likability (6 items), morality (6 items), task accomplishment (6 items), giftedness (5 items), power (7 items) and vulnerability (6 items). Each item is rated on a Likert-scale from 1 (never or almost never true) to 7 (always or almost always true), with scores ranging from 36-252 for the total composite score. Higher subscale and total scores represent more positive self-concept. The SFSCS was used in Chapter 5 as a measure of adult self-concept and was selected due to its relevance for individuals with ASD across a wide range of life settings, roles and activities. Please refer to the Materials section of Chapter 5 for an
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Overview of the scale and psychometric properties. In the current study, the total SFSCS score was used to reflect global self-appraisal of competency.

**Emotion Regulation**

The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) measures the extent to which two distinct emotion regulation strategies, namely, cognitive re-appraisal and expressive suppression, are used. Cognitive reappraisal is defined as an attempt to alter the meaning of a situation such that the emotional significance of the event has changed (e.g., “I control my emotions by changing the way I think about the situation I’m in”). In contrast, expressive suppression describes the attempts made to constrain emotion-expressive behaviour (e.g., "I control my emotions by not expressing them") (Swart, Kortekaas, & Aleman, 2009). The ERQ consists of 10 items (six re-appraisal items, four suppression items), with higher suppression and lower re-appraisal scores indicative of less adaptive emotion regulation (Gross & John, 2003). Respondents are asked to indicate the extent to which they agree with each statement on a seven-point scale from “strongly disagree” (1-7) to “strongly agree” (1-7). The maximum score on the reappraisal subscale is 42 while the highest score for the suppression subscale is 28. The ERQ has demonstrated acceptable psychometric properties in both clinical and normative samples, with good internal consistency for both subscales (reappraisal: $\alpha = .72-.84$ and suppression: $\alpha = .73-.82$) and evidence of both convergent and discriminant validity (Davies, Swan, Schmidt, & Tchanturia, 2011; Dennis, 2007; Fresco et al., 2007; Gross & John, 2003; McLean, Miller, & Hope, 2007).

**Coping**

The Cybernetic Coping Scale (CCS; Edwards & Baglioni, 1993) is a theoretically derived scale based on the cybernetic theory of stress, coping and well-being (Edwards, 1988). A 20-item version of the original 40-item scale has demonstrated good internal
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consistency ($\alpha = .73-.88$) for each subscale in an organisational context (Brough, O'Driscoll, & Kalliath, 2005). Respondents are asked to indicate how often they use each item to cope with stress according to a seven point Likert scale, ranging from 1 = Do not use, to 7 = Use very much. Each subscale contains 4 items that represent different forms of coping: changing the situation; accommodation; devaluation; avoidance; and symptom reduction. For each subscale, scores range from 4-28, with higher scores reflective of greater use of specific coping behaviours.

While the CCS is yet to be administered in a clinical context, the 20-item version represents an efficient way of measuring different coping styles; thus reducing assessment burden for participants. Further, as outlined previously, the coping strategies assessed by the CCS are considered particularly relevant for adults with ASD.

Perceived Social Support

The Interpersonal Support Evaluation List-Short Form (ISEL-SF; S. Cohen & Hoberman, 1983) is a 16-item measure that provides an index of perceived social support. The original version of the ISEL (40-items) contains four theoretically derived subscales thought to buffer the effects of stressful events: (a) appraisal support (AP): the perceived availability of someone to discuss issues of personal importance; (b) tangible assets support (TA): the perceived availability of material aid; (c) belonging support (BE): the perceived availability of others to interact with socially; and (d) self-esteem support (SE): the perceived availability of others with whom one compares favourably (S. Cohen & Hoberman, 1983). The items that possessed the highest factor loadings within each of the four subscales from the original analysis of the full ISEL instrument were selected for the 16-item ISEL-SF (Brookings & Bolton, 1988). The response format for the ISEL-SF consists of a 4-point rating scale (definitely true, probably true, probably false, and definitely false; scored from 0-3), which summed provides an aggregate index of perceived social support ranging from 0 to
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48, with higher scores indicating greater perceived social support. Studies have shown that scores on the ISEL-SF significantly correlate with the longer 40-item version ($r = 0.92$). The ISEL-SF has demonstrated adequate internal reliability for the total scale ($\alpha = .73-.79$; Emery et al., 2004; Shelby, Lamdan, Siegel, Hrywna, & Taylor, 2006), as used in the analysis for the present study.

**Outcome Variables**

**Emotional Status**

The Depression, Anxiety and Stress Scales-21 (DASS-21; Lovibond & Lovibond, 1995) were used in the present study to measure the negative emotional states of depression, anxiety and stress (see Chapter 5, Materials section). To summarise, each scale is comprised of seven items that are rated on a 4-point scale (0-3) and summed to derive a score ranging from 0 to 21 (note: this scored is doubled for analysis), with higher scores indicating greater symptoms of depression, anxiety and stress. Please refer to the Materials section of Chapter 5 for psychometric properties of the DASS.

**Self-Esteem**

The Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1965) is a brief measure of global self-esteem which is comprised of 10 items (five negatively and five positively worded statements) that are rated on a 4-point scale (0-3). Items are summed to derive a total score (note: negatively worded items are reverse scored), with higher scores reflecting greater self-esteem. Please refer to the Materials section of Chapter 5 for psychometric properties of the RSES.

**Social and Adaptive Functioning**

Social and adaptive functioning was assessed using a five-point outcome rating measure based on Lotter’s (1978) social adjustment scale. Participants completed a brief interview that obtained relevant details regarding their employment, independence,
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friendships and relationship status which were used to classify outcomes according five categories: very good, good, fair, poor and very poor (see Appendix D for the social and adaptive functioning scoring key). Descriptive data for social and adaptive functioning are presented in Table 6.1. Given the small number of people classified as Poor \( (n = 8) \) and Very Poor \( (n = 1) \) in the present study, the categories of Fair, Poor and Very Poor were collapsed into the one category, referred to as Fair-Very Poor \( (n = 48) \). Very Good was coded as 0, Good was coded as 1 and Fair-Very Poor was coded as 2 for analysis.

**Procedure**

In order to conduct the online study, ethical clearance was granted by the Griffith University Human Research Ethics Committee (protocol number PSY/28/13/HREC). There is preliminary evidence that individuals with ASD feel more comfortable communicating using online technology due to visual anonymity and its flexible pace in responding to questions (Benford & Standen, 2009; Gillespie-Lynch, Kapp, Shane-Simpson, Smith, & Hutman, 2014; van der Aa, Pollmann, Plaat, & van der Gaag, 2014). A battery of questionnaires was completed online via a web-link based survey emailed to individuals that took approximately one hour to complete. LimeSurvey, a free open source software tool (Schmitz, 2015) was used to administer the questionnaires, with data securely stored on Griffith University servers. The questionnaires in their respective order included: demographic and social information, RAADS, DASS 21, ICQ, SFSCS, ERQ, CCS and ISEL (see Appendix E for full versions of self-report questionnaires).

**Results**

**Phase 1: Psychometric Analysis of Measures of Personal and Social Resources**

The Statistical Package for Social Sciences (SPSS) Version 22 for Windows was utilised for all analyses and data screening procedures were conducted according to guidelines by Tabachnick and Fidell (2007). Data were examined for entry errors, missing
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values, univariate outliers and normality. Missing values analyses identified the following missing data: 13 cases on ICQ (9%) and SFSCS (9%); nine cases on ERQ (6.3%); 11 cases on CCS (7.6%); and 12 cases on ISEL (8.5%). Missing data were not missing completely at random for ICQ, SFSCS and ERQ and were left unchanged. However, missing data occurred at random for CCS (Little’s Missing Completely At Random test, $\chi^2[5] = 4.59, p = .47$) and ISEL (Little’s Missing Completely At Random test, $\chi^2[12] = 12.36, p = .42$). Missing data were imputed using the Multiple Imputation method as recommended by Rubin (1996) and Sinharay, Stern, and Russell (2001), with results reported using pooled data when supported by the software. Therefore, the total sample size for all analyses was $n = 131$. Descriptive analyses and Cronbach’s alpha were calculated for all measures prior to imputation, with reliability coefficients interpreted using guidelines by Robinson, Shaver, and Wrightsman (1991).

In line with the approach of Rutterford and Wood (2006), a principal component analysis (PCA) was conducted as a data reduction technique and to examine the underlying factor structure (or constructs assessed) by the personal resource measures. A sample size of at least 100 participants and a ratio of 5 participants per item is generally regarded as the minimum for a reliable factor solution (Guadagnoli & Velicer, 1988). For the present study there were approximately 13 participants per item in the PCA. Relevant assumptions for assessing the suitability of PCA were verified in line with Pallant (2013) and Hair, Black, Babin, Anderson, and Tatham (2006). After reversing relevant items, standardised Z-scores were created for each subscale to avoid scaling artefacts and used within the PCA.

**Internal Consistency**

Table 6.2 presents the descriptive statistics and reliability coefficients for the DASS, RSES and personal and social resource variables. The CCS subscale symptom reduction
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Table 6.2

*Descriptive Statistics for ASD Characteristics, Mental Health and Personal and Social Resources*

<table>
<thead>
<tr>
<th>Variable/Test/Sub-scale</th>
<th>Mean (SD), Range</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASD Characteristics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAADS-R Total</td>
<td>149.43 (33.11), 79-220</td>
<td>.91</td>
</tr>
<tr>
<td><strong>Mental Health Outcomes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DASS&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>18.43 (11.73), 0-42</td>
<td>.92</td>
</tr>
<tr>
<td>Anxiety</td>
<td>14.54 (10.09), 0-42</td>
<td>.86</td>
</tr>
<tr>
<td>Stress</td>
<td>21.50 (10), 0-42</td>
<td>.87</td>
</tr>
<tr>
<td>Rosenberg Self-Esteem Scale&lt;sup&gt;b&lt;/sup&gt;</td>
<td>15.73 (7.10), 0-30</td>
<td>.92</td>
</tr>
<tr>
<td><strong>Personal Resources</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illness Cognition Questionnaire&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Helplessness</td>
<td>13.66 (4.38), 6-33</td>
<td>.88</td>
</tr>
<tr>
<td>Acceptance</td>
<td>15.23 (3.64), 7-24</td>
<td>.84</td>
</tr>
<tr>
<td>Perceived Benefits</td>
<td>15.15 (4.77), 7-24</td>
<td>.88</td>
</tr>
<tr>
<td>Six Factor Self Concept Scale Total&lt;sup&gt;c&lt;/sup&gt;</td>
<td>113.34 (24.42), 36-175</td>
<td>.83</td>
</tr>
<tr>
<td>Emotion Regulation Questionnaire&lt;sup&gt;d&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cognitive Reappraisal</td>
<td>27.25 (8.23), 6-42</td>
<td>.90</td>
</tr>
<tr>
<td>Expressive Suppression</td>
<td>17.93 (5.52), 4-28</td>
<td>.78</td>
</tr>
<tr>
<td><strong>Cybernetic Coping Scale</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Changing the Situation</td>
<td>17.15 (5.61), 5-28</td>
<td>.84</td>
</tr>
<tr>
<td>Accommodation</td>
<td>14.95 (5.62), 4-28</td>
<td>.83</td>
</tr>
<tr>
<td>Devaluation</td>
<td>14.82 (6.58), 4-28</td>
<td>.93</td>
</tr>
<tr>
<td>Avoidance</td>
<td>14.62 (6.23), 4-28</td>
<td>.88</td>
</tr>
<tr>
<td>Symptom Reduction</td>
<td>15.62 (5.03), 4-28</td>
<td>.69</td>
</tr>
<tr>
<td><strong>Social Resources</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpersonal Support Evaluation List</td>
<td>22.70 (8.52), 1-48</td>
<td>.83</td>
</tr>
</tbody>
</table>

Note. <sup>a</sup>n = 141; <sup>b</sup>n = 140; <sup>c</sup>n = 131; <sup>d</sup>n = 135.
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Subscale had the lowest alpha coefficient (α = .69). As noted by Pallant (2013), scales with a small number of items (i.e., 4 items) commonly have low reliability coefficients. As such, Briggs and Cheek (1986) suggest that mean inter-item correlations are more appropriate to report. They advise an optimal range for the inter-item correlations of .2-.4. The mean inter-item correlation for symptom reduction was .36, suggesting this subscale has acceptable internal consistency. All other scales and subscales demonstrated acceptable to excellent internal consistency, with coefficients ranging from α = .70-.92 (DeVellis, 2012).

Common Factors Underlying Personal Resource Variables

Ten personal resource variables/items were entered into the PCA, as follows: three ICQ subscales: 1) helplessness, 2) acceptance and 3) perceived benefits; two ERQ subscales: 4) cognitive reappraisal and 5) expressive suppression; and five CCS subscales: 6) changing the situation; 7) accommodation; 8) devaluation; 9) avoidance; and 10) symptom reduction. Initial inspection of the correlation matrix revealed the presence of numerous coefficients > .3. The Kaiser-Meyer-Olkin value was .64, exceeding the recommended value of .6 (Kaiser, 1974) and Bartlett’s Test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix. A PCA with oblique rotation was conducted because it allows factors to be correlated (Pallant, 2013).

As outlined in Table 6.3, a PCA revealed the presence of three components with eigenvalues exceeding 1, explaining 29.16%, 19.23% and 14.52% of the variance respectively. A three component solution was supported by Cattell’s (1966) scree test as well as Parallel Analysis (Watkins, 2005). The three component solution explained a total of 62.91% of the variance. Table 6.3 presents the items, obliquely rotated salient factor loadings (≥ .40), and communalities (h^2) for the solution. Component one was labelled Cognitive Reappraisal and Control Coping (CRC), accounting for 29.16% of the variance, with higher scores indicating greater use of cognitive reappraisal and efforts to control or alter one’s
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thought processes (i.e., CCS devaluation, accommodation and avoidance). Component two was labelled ASD Appraisals (ASD-A), accounting for 19.23% of the variance, with higher scores reflecting more negative appraisals of ASD characteristics (i.e., greater helplessness, and lower acceptance and perceived benefits).

Finally, component three was labelled Emotional Suppression and Situational Avoidance Coping, accounting for 14.52% of the variance, with higher scores indicating greater use of emotional suppression and situational avoidance coping strategies (i.e., greater expressive suppression on the ERQ and less effort to change the situation or improve well-being through symptom reduction).

Table 6.3

Principal Component Analysis for Personal Resource Variables: Obliquely Rotated Salient Factor Loadings (≥0.40) and Communalities ($h^2$) for the Three Factor Solution (n = 131)

<table>
<thead>
<tr>
<th>Variable/Item</th>
<th>Measure</th>
<th>CRC</th>
<th>ASD-A</th>
<th>ESSA</th>
<th>$h^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devaluation</td>
<td>CCS</td>
<td>.85</td>
<td>--</td>
<td>--</td>
<td>.74</td>
</tr>
<tr>
<td>Accommodation</td>
<td>CCS</td>
<td>.83</td>
<td>--</td>
<td>--</td>
<td>.69</td>
</tr>
<tr>
<td>Avoidance</td>
<td>CCS</td>
<td>.77</td>
<td>--</td>
<td>--</td>
<td>.64</td>
</tr>
<tr>
<td>Reappraisal</td>
<td>ERQ</td>
<td>.54</td>
<td>--</td>
<td>--</td>
<td>.42</td>
</tr>
<tr>
<td>Acceptance</td>
<td>ICQ</td>
<td>--</td>
<td>-.86</td>
<td>--</td>
<td>.77</td>
</tr>
<tr>
<td>Helplessness</td>
<td>ICQ</td>
<td>--</td>
<td>.81</td>
<td>--</td>
<td>.65</td>
</tr>
<tr>
<td>Perceived Benefits</td>
<td>ICQ</td>
<td>--</td>
<td>-.53</td>
<td>--</td>
<td>.61</td>
</tr>
<tr>
<td>Change the Situation</td>
<td>CCS</td>
<td>--</td>
<td>--</td>
<td>-.78</td>
<td>.60</td>
</tr>
<tr>
<td>Suppression</td>
<td>ERQ</td>
<td>--</td>
<td>--</td>
<td>.75</td>
<td>.62</td>
</tr>
<tr>
<td>Symptom Reduction</td>
<td>CCS</td>
<td>.49</td>
<td>--</td>
<td>-.52</td>
<td>.56</td>
</tr>
</tbody>
</table>

| Eigenvalues            | 2.92      | 1.93  | 1.45  |
| % Variance Explained   | 29.16     | 19.23 | 14.52 |

Note: ASD-A = ASD Appraisals; CCS = Cybernetic Coping Scale; CRC = Cognitive Re-appraisal and Control Coping; ERQ = Emotion Regulation Questionnaire; ESSA = Emotional Suppression and Situational Avoidance Coping; ICQ = Illness Cognition Questionnaire.
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Phase 2: Investigation of Vulnerability and Stress-Buffering Hypotheses

Prior to the analyses, data were examined for entry errors, missing values, univariate and multivariate outliers and normality. Examination of variables revealed a univariate outlier for self-concept (i.e., SFSCS). Analyses were run with and without this participant and revealed no changes in the final results; thus, the outlier remained in the data set (Tabachnick & Fidell, 2007). There were no other violations of relevant assumptions.

Preliminary Pearson product-moment correlations were conducted to examine associations between the IVs (i.e., greater ASD characteristics [RAADS] and personal and social resource variables) and the continuous DVs: mental-health outcomes (i.e., depression, anxiety, stress and self-esteem). Age, gender, years of education and country of residence (coded as Australia = 0, outside Australia = 1) were examined as potential covariates.

A one-way analysis of variance (ANOVA) was employed to determine whether the social and adaptive functioning groups (Very Good, Good, Fair-Very Poor) differed in terms of ASD characteristics and personal and social resources.

Moderation Analyses

A stress-buffer or moderated relationship is represented by a significant interaction between the IV (i.e., ASD characteristics) and the moderator (i.e., personal and social resource variable), regardless of the significance of the main effects of these variables in relation to the DVs (i.e., mental health outcomes and social and adaptive functioning variables). Specific to mental health outcomes, the macro developed by Preacher and Hayes (2008; Model 1) provided unstandardised coefficients that were used to assess the significance of main effects and interaction terms, after controlling for relevant covariates. Multinominal logistic regression was planned to test whether personal and social resources moderated the relationship between ASD characteristic and personal and social resources.
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Mediation Analyses

Only those personal and social resource variables that were significantly correlated with both ASD characteristics (i.e., path $a$) and outcome variables (i.e., path $b$) were tested in mediation models in the present study. This approach is described as the test of joint significance for mediation analyses as recommended by MacKinnon, Lockwood, Hoffman, West, and Sheets (2002). Historically, it was considered that a significant association between the IV and DV (i.e., path $c$) was a prerequisite for mediation analyses (R. M. Baron & Kenny, 1986). However, it is now accepted that this requirement is too conservative when testing the significance of mediation models (Hayes, 2013; MacKinnon, Krull, & Lockwood, 2000; Shrout & Bolger, 2002).

In order to estimate the size of the mediation or indirect effect, the present study utilised the macro developed by Hayes (2013). Hayes argues that assessing the significance of the indirect effects utilising the bootstrapping technique has greater statistical rigour when compared to the more common causal method proposed by R. M. Baron and Kenny (1986). Further, Preacher and Hayes contend that testing the indirect effects provides a more optimal balance between the potential for Type I and Type II errors. The authors explain that the indirect effect is the product of the path between the independent variable and mediator (i.e., path $a$), and the mediator and dependent variable (i.e., path $b$). Due to the multi-category nature of social and adaptive functioning (i.e., Very Good, Good, Fair-Very Poor), it was not possible to test the significance of the indirect effects in the present study. Despite this, the test of joint significance would provide preliminary support as to whether personal and social resources mediate the relationship between ASD characteristics and social and adaptive functioning.

In multiple mediation, specific indirect effects refer to the effects of path $a$ multiplied by path $b$ via each specific mediator. The combination of all specific indirect effects is
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referred to as the total indirect effects. The macro developed by Preacher and Hayes (2008) with bias-corrected bootstrap 95% confidence intervals ($n = 5000$) was used to assess the significance of the overall total indirect effect and the specific individual indirect pathways.

**Associations between ASD Characteristics, Personal and Social Resources and Mental Health Outcomes**

Table 6.4 presents the bivariate correlations ($n = 131$) between ASD characteristics (i.e., RAADS Total), personal and social resource variables (i.e., CRC, ASD-A, ESSA, ISEL and SFSCS), mental health outcomes (i.e., depression, anxiety, stress and self-esteem) and potential covariates (i.e., age, gender and years of education). There were significant correlations between RAADS and anxiety ($r = .31, p < .01$), stress ($r = .30, p < .01$) and self-esteem ($r = -.23, p < .01$), indicating that greater ASD characteristics are related to increased anxiety and stress and poorer self-esteem. There was a significant correlation between RAADS and ASD-A ($r = .19, p < .05$), suggesting that greater ASD characteristics are related to more negative ASD appraisals. Further, the significant correlation between RAADS and ISEL ($r = -24, p < .01$), indicated that greater ASD characteristics are associated with lower appraisals of social support. The RAADS was positively correlated with age ($r = .17, p < .05$), indicating that older participants reported greater ASD characteristics. There were no significant correlations between RAADS and the following variables: depression, CRC, ESSA, and SFSCS, gender and years of education. In terms of correlations between the potential mediators and DVs, CRC was significantly correlated with self-esteem ($r = .21, p < .05$), indicating that greater cognitive re-appraisal and control coping was associated with increased self-esteem. Significant correlations were observed between ASD-A and depression ($r = .57, p < .01$), anxiety ($r = .44, p < .01$), stress ($r = .42, p < .01$) and self-esteem ($r = -.65, p < .01$), suggesting that more negative ASD appraisals were associated with increased depression, anxiety and stress and poorer self-esteem. ESSA was significantly correlated with
### FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

**Table 6.4**

*Associations between ASD Characteristics, Personal and Social Resources, Mental Health Outcomes and Covariates (n = 131)*

<table>
<thead>
<tr>
<th></th>
<th>RAADS</th>
<th>Depression</th>
<th>Anxiety</th>
<th>Stress</th>
<th>Self-Est.</th>
<th>CRC</th>
<th>ASD-A</th>
<th>ESSA</th>
<th>ISEL</th>
<th>SFSCS</th>
<th>Age</th>
<th>Gender</th>
<th>Ed.</th>
<th>Count.</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAADS</td>
<td>-</td>
<td>.16</td>
<td>.31**</td>
<td>.30**</td>
<td>-.23**</td>
<td>-.11</td>
<td>.19*</td>
<td>-.03</td>
<td>-.24**</td>
<td>-.09</td>
<td>.17*</td>
<td>.12</td>
<td>-.006</td>
<td>.27**</td>
</tr>
<tr>
<td>Depression</td>
<td>-</td>
<td>.56**</td>
<td>.60**</td>
<td>-.61**</td>
<td>-.01</td>
<td>.57**</td>
<td>.19*</td>
<td>-.48**</td>
<td>-.35**</td>
<td>-.07</td>
<td>.07</td>
<td>.08</td>
<td>-.10</td>
<td>.02</td>
</tr>
<tr>
<td>Anxiety</td>
<td>-</td>
<td>.74**</td>
<td>-.37**</td>
<td>.06</td>
<td>.44**</td>
<td>-.001</td>
<td>-.26**</td>
<td>-.09</td>
<td>-.16</td>
<td>.18*</td>
<td>-.08</td>
<td>.23**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>-</td>
<td>-.39**</td>
<td>-.10</td>
<td>.42**</td>
<td>-.06</td>
<td>-.29**</td>
<td>-.18*</td>
<td>-.11</td>
<td>.15</td>
<td>-.08</td>
<td>.10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-Est.</td>
<td>-</td>
<td>.21*</td>
<td>-.65**</td>
<td>-.35**</td>
<td>.50**</td>
<td>.62**</td>
<td>.05</td>
<td>-.19*</td>
<td>.05</td>
<td>-.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRC</td>
<td>-</td>
<td>-.06</td>
<td>-.12</td>
<td>.14</td>
<td>.21*</td>
<td>-.12</td>
<td>-.06</td>
<td>-.01</td>
<td>-.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASD-A</td>
<td>-</td>
<td>.14</td>
<td>-.46**</td>
<td>-.39**</td>
<td>-.07</td>
<td>.16</td>
<td>.07</td>
<td>.14</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>ESSA</td>
<td>-</td>
<td>-.31**</td>
<td>-.44**</td>
<td>.11</td>
<td>-.04</td>
<td>-.09</td>
<td>.10</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>ISEL</td>
<td>-</td>
<td>.31**</td>
<td>-.24**</td>
<td>-.13</td>
<td>.08</td>
<td>.02</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>SFSCS</td>
<td>-</td>
<td>.05</td>
<td>.08</td>
<td>.001</td>
<td>-.19*</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td>.04</td>
<td>.24**</td>
<td>-.06</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>.01</td>
<td>.22**</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Education</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Count.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.11</td>
<td></td>
</tr>
</tbody>
</table>

Note. *p < .05 **p < .01; *0 = Male, 1 = Female; #0 = Australia, 1 = International; ASD-A = ASD Appraisals; Count. = CRC = Cognitive Re-appraisal and Control Coping; Ed = Years of education; ESSA = Emotional Suppression and Situational Avoidance Coping; ISEL = Interpersonal Support Evaluation List; SFSCS = Six Factor Self Concept Scale.
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depression ($r = .19, p < .05$) and self-esteem ($r = -.35, p < .01$), suggesting that greater
emotional suppression and situational avoidance coping was associated with increased
depression and poorer self-esteem. In addition, there were significant correlations between
ISEL and depression ($r = -.48, p < .01$), anxiety ($r = -.26, p < .01$), stress ($r = -.29, p < .01$)
self-esteem ($r = .50, p < .01$) and age ($r = -.24, p < .01$). These findings suggest that greater
perceived social support is related to better self-esteem and lower depression, anxiety, stress
and younger age. Regarding self-concept, there were significant correlations between SFSCS
and depression ($r = -.35, p < .01$), stress ($r = -.18, p < .01$) and self-esteem ($r = .62, p < .01$),
indicating that more positive self-concept is associated with lower depression and stress and
greater self-esteem. Regarding the covariates, there were significant correlations between
country of residence (i.e., dummy coded: 0 = participants residing in Australia, 1 =
participants residing outside of Australia) and anxiety ($r = .23, p < .01$) and SFSCS ($r = .19, p
< .05$). Gender (i.e., dummy coded: 0 = males, 1 = females) was significantly related to
anxiety ($r = .18, p < .05$) and self-esteem ($r = -.19, p < .05$), indicating that females reported
greater anxiety and lower self-esteem. Thus, subsequent analyses involving anxiety
controlled for the effects of gender and country of residence, while analyses concerning self-
estime controlled for the effects of gender.

Associations between ASD Characteristics, Personal and Social Resources and Social
and Adaptive Functioning

A series of one-way analysis of variance (ANOVA) was conducted primarily to
examine the relationship between personal and social resources and social and adaptive
functioning (i.e., b path). This analysis examined the relationship between ASD
characteristics and social and adaptive functioning. As presented in Table 6.5, there were no
significant differences in ASD characteristics and personal and social resources between the
### FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

#### Table 6.5

*Analysis of Variance between Social and Adaptive Functioning, ASD Characteristics and Personal and Social Resource Variables (n = 131)*

<table>
<thead>
<tr>
<th>Social and Adaptive Functioning</th>
<th>Test</th>
<th>Very Good (n = 44)</th>
<th>Good (n = 52)</th>
<th>Fair-Very Poor (n = 48)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>CI</td>
<td>M</td>
</tr>
<tr>
<td>RAADS</td>
<td>148.97</td>
<td>30.93</td>
<td>[139.57-158.38]</td>
<td>152.86</td>
</tr>
<tr>
<td>ASD-A</td>
<td>-.10</td>
<td>1.01</td>
<td>[-.42-.22]</td>
<td>-.15</td>
</tr>
<tr>
<td>CRC</td>
<td>.09</td>
<td>.91</td>
<td>[-.19-.37]</td>
<td>-.16</td>
</tr>
<tr>
<td>ESSA</td>
<td>.01</td>
<td>.93</td>
<td>[-.28-.30]</td>
<td>.02</td>
</tr>
<tr>
<td>ISEL</td>
<td>24.42</td>
<td>8.56</td>
<td>[21.82-27.03]</td>
<td>22.96</td>
</tr>
<tr>
<td>SFSCS</td>
<td>115.90</td>
<td>23.21</td>
<td>[108.67-123.14]</td>
<td>113.71</td>
</tr>
</tbody>
</table>

Note: * p < .05; ASD-A = ASD Appraisals; CRC = Cognitive Re-appraisal and Control Coping; ESSA = Emotional Suppression and Situational Avoidance Coping; ISEL = Interpersonal Support Evaluation List; SFSCS = Six Factor Self-Concept Scale; RAADS = Ritvo Autism Asperger’s Diagnostic Scale – Revised
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outcomes groups \((p > .05)\). Therefore, individuals classified as having Fair–Very Poor social and adaptive functioning reported comparable levels of functioning on personal and social resource variables and ASD characteristics when compared to those classified as having Very Good and Good social and adaptive functioning. Given the non-significant between group differences on personal and social resources (i.e., \(b\) path), mediation analyses were not conducted.

**Moderation Analyses for ASD Characteristics, Personal and Social Resources and Social and Adaptive Functioning**

As an exploratory component, a multinominal logistic regression examined whether ASD characteristics and personal and social resources had an interactive effect on social and adaptive functioning. Presented in Table 6.6, this analysis revealed no significant interactions between ASD characteristics and personal and social resources for the three category outcome of social and adaptive functioning. Further, the full model was non-significant \((\chi^2(10) = 12.26, p = .268)\), suggesting that it failed to accurately predict social and adaptive functioning better than the null model. Therefore, personal and social resources did not moderate or buffer the relationship between ASD characteristics and social and adaptive functioning.

**Moderation Analyses for ASD Characteristics, Personal and Social Resources and Mental Health Outcomes**

A series of moderation regression analyses were performed to test whether personal and social resources (i.e., CRC, ASD-A, ESSA, ISEL and SFSCS) moderated the relationship between ASD characteristics and mental health outcomes (i.e., depression, anxiety, stress and self-esteem). As shown in Table 6.7, for each of these analyses, there were no significant interaction terms for the relevant variables. This suggests that there are no stress-buffering
FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

effects of personal and social resources on the relationship between ASD characteristics and mental health outcomes.

Table 6.6

Multinomial Logistic Regression for ASD Characteristics, Personal and Social Resources and Social and Adaptive Functioning (n =131)

<table>
<thead>
<tr>
<th>Model/Group</th>
<th>Chi-Square</th>
<th>df</th>
<th>R²</th>
<th>p</th>
<th>β (SE)</th>
<th>Wald</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final</td>
<td>12.26</td>
<td>10</td>
<td>.09</td>
<td>.27</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model/Group</th>
<th>β (SE)</th>
<th>Wald</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-.27 (.93)</td>
<td>.08</td>
<td>.77</td>
<td></td>
</tr>
<tr>
<td>RAADS * CRC</td>
<td>-.001 (.001)</td>
<td>1.03</td>
<td>.31</td>
<td>[.996-1.001]</td>
</tr>
<tr>
<td>RAADS*ESSA</td>
<td>.00 (.001)</td>
<td>.03</td>
<td>.86</td>
<td>[.997-1.003]</td>
</tr>
<tr>
<td>RAADS*ASD-A</td>
<td>-.001 (.002)</td>
<td>.38</td>
<td>.54</td>
<td>[.996-1.002]</td>
</tr>
<tr>
<td>RAADS*ISEL</td>
<td>.00 (.00)</td>
<td>.18</td>
<td>.67</td>
<td>[1.00-1.00]</td>
</tr>
<tr>
<td>RAADS*SFSCS</td>
<td>.00 (.00)</td>
<td>.46</td>
<td>.49</td>
<td>[1.00-1.00]</td>
</tr>
<tr>
<td>Fair-Very Poor</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.79 (.93)</td>
<td>3.72</td>
<td>.05</td>
<td></td>
</tr>
<tr>
<td>RAADS * CRC</td>
<td>.00 (.001)</td>
<td>.026</td>
<td>.87</td>
<td>[.997-1.003]</td>
</tr>
<tr>
<td>RAADS*ESSA</td>
<td>-.002 (.002)</td>
<td>.97</td>
<td>.32</td>
<td>[.995-1.002]</td>
</tr>
<tr>
<td>RAADS*ASD-A</td>
<td>.001 (.002)</td>
<td>.47</td>
<td>.49</td>
<td>[.998-1.004]</td>
</tr>
<tr>
<td>RAADS*ISEL</td>
<td>.00 (.00)</td>
<td>2.71</td>
<td>.10</td>
<td>[.999-1.00]</td>
</tr>
<tr>
<td>RAADS*SFSCS</td>
<td>.00 (.00)</td>
<td>.79</td>
<td>.38</td>
<td>[1.00-1.00]</td>
</tr>
</tbody>
</table>

Note. * = The reference category is: Very Good; R² = Pseudo R-Square, Cox and Snell;
### Table 6.7

**Standardised Beta Coefficients for Personal and Social Resources as Potential Moderators between ASD Characteristics and Mental Health Outcomes (n = 131)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Depression</th>
<th>Anxiety$^a$</th>
<th>Stress</th>
<th>Self-Esteem$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BE (SE)</td>
<td>BE (SE)</td>
<td>BE (SE)</td>
<td>BE (SE)</td>
</tr>
<tr>
<td><strong>Main Effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASD-A</td>
<td>4.83 (.09)</td>
<td>2.71 (3.71)</td>
<td>2.86 (3.72)</td>
<td>-1.38 (2.29)</td>
</tr>
<tr>
<td>SFSCS</td>
<td>.01 (.19)</td>
<td>.06 (.17)</td>
<td>.08 (.16)</td>
<td>.14 (.09)</td>
</tr>
<tr>
<td>CRC</td>
<td>3.90 (4.69)</td>
<td>-.56 (3.84)</td>
<td>2.77 (3.83)</td>
<td>-.19 (2.76)</td>
</tr>
<tr>
<td>ESSA</td>
<td>-5.61 (4.50)</td>
<td>-4.10 (3.79)</td>
<td>-.57 (3.76)</td>
<td>-.67 (2.57)</td>
</tr>
<tr>
<td>ISEL</td>
<td>-.002 (.003)</td>
<td>.04 (.42)</td>
<td>.52 (.42)</td>
<td>.48 (.28)</td>
</tr>
<tr>
<td><strong>Interactions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAADS x ASD-A</td>
<td>.01 (.03)</td>
<td>.007 (.02)</td>
<td>.005 (.02)</td>
<td>-.02 (.01)</td>
</tr>
<tr>
<td>RAADS x SFSCS</td>
<td>-.001 (.001)</td>
<td>-.001 (.001)</td>
<td>-.001 (.001)</td>
<td>.001 (.001)</td>
</tr>
<tr>
<td>RAADS x CRC</td>
<td>-.02 (.03)</td>
<td>.01 (.02)</td>
<td>-.02 (.02)</td>
<td>.009 (.02)</td>
</tr>
<tr>
<td>RAADS x ESSA</td>
<td>.05 (.03)</td>
<td>.03 (.02)</td>
<td>.03 (.02)</td>
<td>-.01 (.02)</td>
</tr>
<tr>
<td>RAADS x ISEL</td>
<td>-.002 (.003)</td>
<td>-.002 (.003)</td>
<td>-.005 (.003)</td>
<td>-.0007 (.002)</td>
</tr>
</tbody>
</table>

*Note: * $p < .05$ **$p < .01$; $^a$ = Controlling for gender and country of residence; $^b$ = Controlling for gender; BE = Bootstrap Estimate; Unstandardised Coefficients reported*

### Mediation Analyses for Greater ASD Characteristics, Personal and Social Resources and Psychosocial Outcomes

In relation to mental health outcomes, ASD-A and ISEL were the only personal and social resources to meet the assumptions of joint significance. Specifically, these personal and social resources were significantly related to both ASD characteristics (path $a$) and mental health outcome variables (path $b$; see Table 6.4). Regarding assumptions for mediation analysis, there were no violations of influential scores for ASD characteristics (i.e., RAADS) or mediating variables. Although RAADS was not significantly related to depression ($r = .16, p = .06$), a significant relationship between the IV and DV is not a
prerequisite for testing mediation models (MacKinnon et al., 2000; Shrout & Bolger, 2002); thus mediation models were tested regardless of non-significant total effect relationships between the IVs and DVs.

Four multiple-mediation analyses were performed with ASD appraisals (i.e., ASD-A) and perceptions of social support (i.e., ISEL) tested as mediators in the relationship between ASD characteristics and depression (see Figure 6.2), anxiety (see Figure 6.3), stress (see Figure 6.4) and self-esteem (see Figure 6.5). As presented in Table 6.8, there was a significant overall indirect effect of ASD characteristics on depression ($\beta = .061, p < .05$). Both social support ($\beta = .032, p < .05$) and ASD appraisals ($\beta = .029, p < .05$) had significant specific indirect effects (i.e., $a \times b$ pathways) and a significant total indirect effect (i.e., $a1 \times b1 + a2 \times b2$) on depression. The mediation model accounted for 41% of the variance in depression, $F(3,126) = 23.17, p < .001$.

**Figure 6.2.** ASD appraisals and perceived social support mediating the relationship between ASD characteristics and depression
Note: Unstandardised coefficients are shown; $M =$ Mediators; * $p < .05$ ** $p < .01$
Table 6.8

Specific Indirect Effects and Total Indirect Effects of ASD Characteristics on Mental Health Outcomes through Personal and Social Resources (n = 131)

<table>
<thead>
<tr>
<th>Mediators</th>
<th>Depression</th>
<th></th>
<th>Anxiety</th>
<th></th>
<th>Stress</th>
<th></th>
<th>Self-Esteem</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BE (SE)</td>
<td>BC 95% CI</td>
<td>BE (SE)</td>
<td>BC 95% CI</td>
<td>BE (SE)</td>
<td>BC 95% CI</td>
<td>BE (SE)</td>
<td>BC 95% CI</td>
</tr>
<tr>
<td>Perceived Social Support</td>
<td>.032 (.013)*</td>
<td>.012, .063</td>
<td>.005 (.008)</td>
<td>-.008, .026</td>
<td>.009 (.008)</td>
<td>-.004, .030</td>
<td>-.016 (.006)*</td>
<td>-.032, -.006</td>
</tr>
<tr>
<td>(ISEL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASD Appraisals (ASD-A)</td>
<td>.029 (.015)*</td>
<td>.004, .062</td>
<td>.021 (.011)*</td>
<td>.0039, .048</td>
<td>.019 (.010)*</td>
<td>.003, .045</td>
<td>-.020 (.010)*</td>
<td>-.044, -.002</td>
</tr>
<tr>
<td>Total Indirect Effect</td>
<td>.061 (.021)*</td>
<td>.022, .104</td>
<td>.026 (.013)*</td>
<td>.004, .055</td>
<td>.028 (.013)*</td>
<td>.007, .057</td>
<td>-.037 (.013)*</td>
<td>-.064, -.011</td>
</tr>
</tbody>
</table>

*Indicates a significant indirect effect.

Note. BC = Biased corrected; BE = Bootstrap Estimate; CI = Confidence Interval; Unstandardised Coefficients reported; SE = Standard Error.
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There was a significant total indirect effect of ASD characteristics on anxiety ($\beta = .026, p < .05$). ASD appraisals ($\beta = .021, p < .05$), but not perceived social support ($\beta = .005, p > .05$), significantly mediated the relationship between ASD characteristics and anxiety, after controlling for gender and country of residence. The mediation model accounted for 29% of the variance in anxiety, $F(5,125) = 11.51, p < .001$, after controlling for gender and country of residence.

There was a significant total indirect effect of ASD characteristics on stress ($\beta = .028, p < .05$). Again, ASD appraisals ($\beta = .019, p < .05$), but not perceived social support ($\beta = .009, p < .05$), significantly mediated the relationship between ASD characteristics and stress. The mediation model accounted for 25% of the variance in stress, $F(3,126) = 11.88, p < .001$.

Finally, there was a significant indirect relationship between ASD characteristics and self-esteem ($\beta = .037, p < .05$). The association was significantly mediated by perceived social support ($\beta = -.016, p < .05$) and ASD appraisals ($\beta = -.020, p < .05$) when controlling for...
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gender. The mediation model accounted for 49% of the variance in self-esteem, $F(4,125) = 24.65, p < .001$, after controlling for gender.

Figure 6.4. ASD appraisals and perceived social support mediating the relationship between ASD characteristics and stress

Note: Unstandardised coefficients are shown; $M =$ Mediators; * $p < .05$ ** $p < .01$

Figure 6.5. ASD appraisals and perceived social support mediating the relationship between ASD characteristics and self-esteem (controlling for gender)

Note: Unstandardised coefficients are shown; $M =$ Mediators; * $p < .05$ ** $p < .01$
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Pairwise comparisons for each multiple mediation model found no significant difference in the strength of the indirect effects suggesting that both ASD appraisals and perceived social support mediated the relationship between ASD characteristics and mental health outcomes equally well. Taken together, these findings suggest that for individuals with greater ASD characteristics, a greater sense of helplessness and lower acceptance and perceived benefits associated with their ASD symptoms (i.e., ASD appraisals) uniquely contributes to higher levels of depression, anxiety, stress and lower self-esteem. Further, for individuals with greater ASD characteristics, poorer perceived social support contributes to higher levels of depression and lower self-esteem.

Discussion

Overview of Key Findings

The initial aim of the present study was to examine the reliability of personal and social resource measures and to identify common factors underlying personal resources (i.e., health related cognitions, emotion regulation and coping) for high-functioning adults with ASD. Secondly, this study aimed to investigate the role of personal and social resources as vulnerability or protective factors in the relationship between ASD characteristics, personal and social resources and psychosocial outcomes. More specifically, the study investigated whether personal and social resources have a moderating and/or mediating role in the relationship between ASD characteristics and psychosocial outcomes. The first hypothesis ($H_1$) was supported, with all measures demonstrating acceptable to excellent internal consistency. Three main factors emerged from the PCA of the personal resource variables, namely cognitive re-appraisal and control coping (CRC), ASD appraisals (ASD-A) and emotional suppression and situational avoidance coping (ESSA).

There was partial support for $H_{2.1}$, with greater ASD characteristics found to be significantly correlated with increased anxiety and stress and lower self-esteem but not with
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depression. In relation to the exploratory component of the study, there was no significant association between ASD characteristics and social and adaptive functioning. There was no support for the stress buffering hypothesis (H2.2.1), as none of the personal and social resource variables significantly moderated the relationships between ASD characteristics and mental health outcomes. Furthermore, no significant moderating effects were found for the relationship between ASD characteristics and social and adaptive functioning. There was mixed support for H2.2.2, with negative ASD appraisals (ASD-A) and poorer perceived social support (ISEL) both found to independently mediate the relationship between greater ASD characteristics and poorer mental health outcomes. The pattern of findings and their theoretical and clinical implications will now be discussed.

Reliability and Factor Structure of Personal and Social Resource Measures

As predicted, the measures of personal and social resources used in the present study (i.e., Illness Cognition Questionnaire [ICQ], self-concept [SFSCS], emotion regulation [ERQ], coping [CCS] and social support [ISEL]) demonstrated adequate internal consistency. The Cronbach’s alpha coefficients in this study were consistent with those reported by the authors in their original validation studies (S. Cohen & Hoberman, 1983; Edwards & Baglioni, 1993; Evers et al., 2001; Gross & John, 2003; Stake, 1994), which supports the reliability of these measures for high-functioning adults with ASD.

Although individuals with ASD have difficulties describing their emotional state (Mazefsky, Kao, & Oswald, 2011; White, Schry, & Maddox, 2012), the present finding reinforce other studies indicating that they can reliably report their subjective experiences using self-report measures (Berthoz & Hill, 2005; Ozsivadjian, Hibberd, & Hollocks, 2014). Therefore, this study provides preliminary evidence for the reliability of these measures and clarifies the factors underlying personal resource constructs assessed (DeVellis, 2012; Pallant, 2013). Further research is needed to investigate other forms of reliability (e.g., test-
retest reliability) and validity (e.g., convergent and divergent validity) for high-functioning adults with ASD.

**Associations between ASD Characteristics, Personal and Social Resources and Psychosocial Outcomes**

The findings that greater ASD characteristics were associated with increased anxiety and stress, poorer appraisals of social support and lower self-esteem are broadly consistent with the literature (Byers et al., 2013; Gotham, Bishop, et al., 2014; Howlin, 2003; Jansch & Hare, 2014; Jantz, 2011; Khanna et al., 2014; Renty & Roeyers, 2007; M. Tani et al., 2012). However, the non-significant association between ASD characteristics and depression is in contrast to previous findings (Gotham, Bishop, et al., 2014; Jansch & Hare, 2014). A possible explanation relates to the different measures of depression employed. In the present study, a brief set of items tapping cognitive and affective symptoms of depression was used. For example, “I found it difficult to experience any positive feeling at all” and “I felt I wasn’t worth much as a person.” Previous research reporting a significant association between ASD impairments and depression (Gotham, Bishop, et al., 2014) used the Beck Depression Inventory (BDI-II; Beck et al., 1996). The BDI-II is a 21 item questionnaire that more broadly assesses physical, somatic, cognitive, affective and behavioural symptoms of depression, such as irritability, guilt, feelings of being punished, fatigue, weight loss and lack of interest in sex. Thus, the approach to measuring depression using the DASS may account for the conflicting findings between the present study and past research.

In terms of social and adaptive functioning, there were no significant differences between the outcome groups on measures of ASD characteristics and personal and social resources. This is in line with evidence outlined in the systematic review in Chapter 3 that ASD characteristics are not related to adaptive behaviour and employment outcomes (Szatmari et al., 1989; Taylor et al., 2015). For example, in a prospective study (n = 73) by
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Taylor et al. (2015), it was reported that ASD characteristics did not significantly predict participation in post-secondary vocational and/or educational activities. Rather, gender (i.e., males) and years of paternal tertiary education were significant predictors of these outcomes. In a small retrospective study ($n = 16$), Szatmari et al. (1989) reported that ASD characteristics in childhood were not associated with social and adaptive functioning in adulthood, as measured by the Vineland Adaptive Behavior Scale (VABS; Sparrow et al., 1984). Taken together, the present findings broadly concur with previous research indicating that greater ASD characteristics are associated with poorer mental health outcomes but not social and adaptive functioning.

Investigation of Vulnerability and Stress-Buffering Hypotheses

Guided by leading theories of stress and coping (Folkman, 1997; Lazarus & Folkman, 1984), this study aimed to elucidate the role of personal and social resources in terms of whether these serve as stress-buffers or vulnerability factors in the relationship between ASD characteristics and psychosocial outcomes for high-functioning individuals with ASD. Overall, the analyses revealed that personal and social resources (i.e., CRC, ASD-A, ESSA, ISEL and SFSCS) did not significantly moderate the relationship between ASD characteristics and psychosocial outcomes (i.e., depression, anxiety, stress and self-esteem and social and adaptive functioning). Therefore, there was no evidence to support that personal and social resources have a stress-buffering effect on psychosocial outcomes for individuals with greater ASD characteristics.

These findings conflict with evidence from the broader literature highlighting that perceived availability and quality of social support buffers the effects of high levels of stress on health outcomes in a range of clinical populations, such as cardiovascular disease, brain tumour and cancer (e.g., Ownsworth, Henderson, & Chambers, 2010; Payne et al., 2012; Steptoe, 2000). In the present study, it is possible that perceptions of social support do not
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buffer mental health outcomes in the presence of greater ASD characteristics due to inherent interpersonal difficulties associated with the disorder (Attwood, 2007), which will be discussed shortly.

There was some support for the vulnerability model. In accordance with the transactional model of stress and coping (Folkman, 1997; Lazarus & Folkman, 1984), negative ASD appraisals (ASD-A) and poorer perceived social support (ISEL) mediated the relationship between greater ASD characteristics and poorer mental health outcomes. Specifically, these findings suggest that individuals with greater ASD characteristics were more likely to perceive increased helplessness, lack of acceptance and fewer benefits associated with their ASD characteristics (i.e., ASD appraisals). In turn, these negative appraisals were related to increased depression, anxiety, stress and lower self-esteem. These findings broadly support existing research on the detrimental effects of negative self-appraisals on psychosocial outcomes for those with chronic disease (Evers et al., 2001; Lauwerier et al., 2010; McCracken, 2005). There are similar characteristics between chronic illness and ASD, such that a diagnosis of ASD is typically lifelong and characteristics are relatively stable (Attwood, 2007; Woodbury-Smith et al., 2005). Moreover, these findings improve understanding of the role of negative ASD appraisals as a vulnerability factor for poor mental health in high-functioning individuals with ASD. Qualitative studies reveal that while some individuals appraise their diagnosis of ASD positively, others report feeling helpless, estranged, and rejected by society (Haertl et al., 2013; Smith & Sharp, 2013; Townson et al., 2007). The present findings extend upon this research by indicating that people with greater ASD characteristics are more likely to experience feelings of helplessness, and find it difficult to accept and derive benefits from having ASD, which in turn, contributes to poorer mental health functioning.
The finding that perceived social support mediated the relationship between ASD characteristics and depression and self-esteem contrasts with findings in other clinical populations in which perceived availability and quality of social support moderated the influence of high levels of stress on health outcomes (Ownsworth et al., 2010; Payne et al., 2012; Steptoe, 2000). A likely reason for these conflicting findings is that greater ASD characteristics affect the perceived availability of social support. Specifically, these individuals may be less able to capitalise on available supports due to the very nature of their social communication difficulties and/or because they have limited social contacts in the first place. For example, difficulties in reading social cues, understanding intentions and relating to others in adaptive ways may reduce the likelihood of developing satisfying and reciprocal relationships, which may result in fewer available social supports. Social networks can help individuals feel as though they belong and matter to others whereby they have opportunities to both give and receive support (S. Cohen, 1988; S. Cohen, Mermelstein, Kamarck, & Hoberman, 1985). Thus, it is possible that individuals with greater ASD characteristics are less able to derive the typical benefits associated with social support. Overall, these findings indicate that low perceptions of social support represent a risk factor for poor mental health outcomes in individuals with greater ASD characteristics.

**Study Limitations**

The main limitations of this study relate to the sample, design and self-report methodology. The convenience sampling approach yielded a male-to-female ratio of approximately 0.76:1. It is broadly accepted that males are more commonly diagnosed with ASD than females with a ratio of approximately 4.3:1; (Fombonne, 2003). It is difficult to explain why a higher proportion of females participated than expected. As noted earlier, participants were recruited in the present study via national ASD and support websites, whereby individuals often seek information and support about ASD. It is noteworthy that a
report conducted by Autism Spectrum Australia (2013), who adopted a similar online methodology, also had a higher proportion of females participate in their study when compared to ASD population data. One possible explanation for higher rates of female participants is that females with ASD have more favourable attitudes about participating in research, and in seeking help more generally, when compared to males with ASD. This is consistent with research in the general population that females have more positive attitudes towards seeking psychological support than their male counterparts (Nam et al., 2010). Additionally, it is also possible that females in the present study were experiencing greater psychological distress, as indicated by significantly greater self-reported anxiety and lower self-esteem than males, and were more likely to access the websites advertising the study when compared to male participants. This is consistent with Australian research that suggests that a higher proportion of females with ASD report having a mental health condition when compared to males (Autism Spectrum Australia, 2013). Although the potential effects of gender were examined and controlled for, the participants in the present study are unlikely to be representative of the broader ASD population. Further research should consider a more representative sampling approach, such as recruitment based on consecutive referrals to specialist ASD clinics. Moreover, there is a need to cross-validate the present findings concerning the mediating effects of personal and social resources on the relationship between ASD characteristics and mental health outcomes.

A further key study limitation relates to the cross-sectional design. It is possible that relationships among variables may be bi-directional (Pallant, 2013). For example, the results indicated that those with greater ASD appraisals are more likely to report increased symptoms of depression. However, it is also possible that increased symptoms of depression contribute to more negative ASD appraisals. As such, longitudinal research is needed to
determine the potentially reciprocal relationships between ASD appraisals and mental health outcomes.

Another study limitation relates to the lack of formal verification of a current ASD diagnosis from an independent clinical assessment, which means that some participants may have been misidentified as having ASD. Nevertheless, all participants identified longstanding difficulties in social communication skills and a restricted range of behaviours and/or interests on the RAADS, which is a validated assessment tool commonly used to support a diagnosis of ASD in adults (Ritvo et al., 2011; Ritvo et al., 2008). As an additional limitation, it was not possible to screen participants in terms of intellectual impairment or literacy difficulties. However, the Flesch-Kincaid readability index was calculated for all questionnaires (Kincaid, Aagard, O'Hara, & Cottrell, 1981). The results indicated that readability levels of the questionnaires ranged from “very easy to read” (i.e., easily understood by an average 11 year old student) to “fairly easy to read” (i.e., easily understood by 12-13 year old students). In addition, there were intrinsic features associated with the methodology of the study that would have been difficult for an individual to complete with a co-occurring intellectual disability. For instance, the questionnaire required the participant to answer over one hundred questions and necessitated considerable concentration to complete.

The relative advantages and disadvantages of employing self-report measures in the present study (i.e., RAADS, DASS, RSES, ICQ, SFSCS, ERQ, CCS, ISEL and social and adaptive functioning) also warrant consideration. In particular, the issue of method variance, or reliance on self-report data, needs to be acknowledged. For the present study, it is possible that multiple approaches to statistical analysis and the use of similar scale formats (i.e., self-report Likert scales), increased the likelihood of false positives and artificially magnified the covariance between measures. Specifically, when the same method is employed to measure two constructs, it is possible that negativity biases common to both constructs may inflate the
relationship between these variables (Spector, 2006). However, it has been acknowledged that common scale formats are problematic when significant correlations among all variables using the common method are observed (Spector, 2006), which did not occur for the present study. Despite having common scale formats, the measures were selected because they were brief and practical and were found to demonstrate sound reliability and evidence of construct validity. This confirms previous findings that adults with ASD can reliably report on their mental health using self-report measures (Adams, Fredstrom, Duncan, Holleb, & Bishop, 2014; Berthoz & Hill, 2005; Ozsivadjian et al., 2014). However, further research examining other psychometric properties (e.g., test-retest reliability and convergent validity) of these measures is recommended for this population.

Conclusions

The present findings extend the literature by providing empirical support for the vulnerability model, as opposed to the stress-buffering model, for understanding the relationships between ASD characteristics, personal and social resources and psychosocial outcomes. The findings suggested that more negative ASD appraisals and lower perceptions of social support help to explain why people with greater ASD characteristics are more vulnerable to poor mental health outcomes. As such, the key clinical implications arising from this study relate to the likely value of targeting ASD appraisals and perceived social support in treatment interventions for mental health problems in adults with ASD. Further implications will be outlined in more detail in the next chapter.
Chapter 7: General Discussion

High-functioning individuals with ASD present with a unique profile of strengths and challenges (Attwood, 2007; Haertl et al., 2013). Outcome studies highlight that the mental health and social and adaptive functioning of these individuals varies considerably (Autism Spectrum Australia, 2013; Cederlund et al., 2008; Ghaziuddin, 2005; Ghaziuddin et al., 2002; Howlin, 2007; Reiersen et al., 2007). However, there is a poor understanding of the factors that can account for variations in individuals’ psychological and social and adaptive functioning. As such, guided by a biopsychosocial framework, the present thesis broadly sought to identify the factors influencing psychosocial outcomes for high-functioning adults with ASD. This final chapter will summarise the key findings of each study, highlight relevant clinical and theoretical implications, outline the methodological limitations and propose recommendations for future research.

Chapter 3: Systematic Review (Study 1)

To guide the present research, systematic review methodology was employed to comprehensively search for peer reviewed articles that investigated factors related to psychosocial outcomes for high-functioning adults with ASD (see Table 7.1). The review aimed to appraise the research methodology and synthesise the findings of selected studies and identify gaps in the literature. A total of 27 studies was identified and reviewed. The quality of the reviewed studies was appraised as low to medium based on the methodological quality indicators adopted for the review (see Table 3.2 for ratings).

The factors most frequently investigated as predictors or correlates of psychosocial outcomes across the 27 studies were demographic characteristics (i.e., age and gender), ASD symptom severity and indices of neurocognitive functioning (e.g., IQ, verbal and non-verbal functioning. Conversely, relatively few studies examined the influence of self-appraisals, coping strategies and social and environmental factors (see Table 3.1 for a summary).
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Table 7.1
Summary of Key Findings and Theoretical and Clinical Implications for each Study

<table>
<thead>
<tr>
<th>Chapter/Study</th>
<th>Key Findings</th>
<th>Theoretical Implications</th>
<th>Clinical Implications</th>
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<tr>
<td><strong>Chapter 3: Study 1</strong></td>
<td>Twenty-seven studies were selected and reviewed. Factors significantly related to poor psychosocial outcomes included: greater ASD symptom severity, lower childhood IQ, impaired non-verbal learning, cognitive shifting deficits, negative thinking styles, maladaptive coping and perceptions of low social support.</td>
<td>No specific theoretical implications. Key gaps in the literature related to understanding: a) the impact of higher-order cognitive abilities (cold and hot executive functions) on psychosocial outcomes; and b) the role of personal and social resources (appraisals, coping and social support) as potential mediators or moderators of the relationship between ASD characteristics and psychosocial outcomes.</td>
<td>Individuals with greater ASD characteristics are most at risk for poor psychosocial outcomes. However, the role of personal and social resources as vulnerability or protective factors in this relationship is unknown.</td>
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<tr>
<td><strong>Chapter 4: Study 2</strong></td>
<td>ASD participants demonstrated generalised impairments in hot and cold executive functions relative to matched controls. ASD participants performed more poorly on emotion recognition and social inference tasks than matched controls after controlling for cold executive functions.</td>
<td>Findings demonstrate both the independence and inter-relatedness of impairments in cold and hot executive functions for the ASD population, and support the functional modularity of social cognition. Cold executive functions contribute to emotion recognition and social inference processes.</td>
<td>Assessments of hot and cold executive functioning are needed in clinical practice to aid diagnosis and inform interventions. Impairments in both hot and cold executive function need to be targeted in remedial and compensatory interventions.</td>
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**Chapter 5: Study 3**

**Aims:** 1) investigate associations among ASD characteristics and hot and cold executive functions; and 2) examine associations between hot and cold executive functions and psychosocial outcomes.

Greater social anxiety and circumscribed interests were related to impairments in cognitive flexibility and social inference (respectively). Individuals with Very Good social and adaptive outcomes showed better emotion recognition, non-verbal reasoning and cognitive flexibility than those with Good outcomes. Stronger hot and cold executive functions were related to lower levels of anxiety and more negative self-concept.

ASD characteristics are largely unrelated to impairments in hot and cold executive function. However, some indices of executive function can distinguish between Very Good and Good social adaptive outcomes. Stronger hot and cold executive functions are linked to negative self-concept, potentially due to higher self-expectations and more critical self-evaluation.

There is a need to screen for and monitor mental health concerns in people with ASD regardless of their executive function levels. Those with poorer executive function may be more prone to anxiety, whereas those with stronger executive function may experience poorer self-concept.

**Chapter 6: Study 4**

**Aims:** 1) investigate reliability and validity of measures of personal and social resources for adults with ASD; and 2) examine the role of personal and social resources as vulnerability or protective factors in the relationship between ASD characteristics and psychosocial outcomes.

All measures of personal and social resources demonstrated adequate internal consistency ($\alpha = .69 - .92$). Three factors were found to underlie personal resource measures: CRC, ASD-A and ESSA. There was some support for the vulnerability hypothesis, whereby negative ASD appraisals (ASD-A) and poorer perceived social support (ISEL) mediated the relationship between greater ASD characteristics and mental health outcomes.

More negative ASD appraisals and lower perceptions of social support help to explain why people with greater ASD characteristics are more vulnerable to poor mental health outcomes.

Assessing people’s ASD appraisals and social support may help to identify those most at risk of poor mental health outcomes and guide the focus of psychosocial interventions.

*Note: ASD-A = ASD Appraisals; CRC = Cognitive Re-appraisal and Control Coping; ESSA = Emotional Suppression and Situational Avoidance Coping; ISEL = Interpersonal Support Evaluation List*
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The review found that the factors most consistently related to poor psychosocial outcomes included greater symptom severity or ASD characteristics, lower childhood IQ, impaired non-verbal learning, cognitive shifting deficits, negative thinking styles, and perceptions of low social support. Of these factors, greater ASD characteristics were significantly related to increased depression, loneliness, anxiety, stress, suicidal ideation, poorer quality of life, sexual well-being, self-esteem and marital satisfaction (Byers et al., 2013; Gotham, Bishop, et al., 2014; Hirvikoski & Blomqvist, 2015; Howlin, 2003; Jansch & Hare, 2014; Jantz, 2011; Khanna et al., 2014; Renty & Roeyers, 2007; Shtayermman, 2007; M. Tani et al., 2012). Therefore, the review indicates that individuals with greater ASD characteristics are most at risk for poor psychosocial outcomes.

A further main finding of the systematic review was that impaired cognitive shifting was an early risk factor for poor psychosocial outcomes in adults with ASD with normal intelligence (Berger et al., 2003). Cognitive shifting refers to the ability to flexibly shift one’s thoughts and behaviour as needed, and is commonly conceptualised as a cold executive functions (Chan et al., 2008). The review identified that other cold executive functions such as interference control and inhibition were also related to poorer psychosocial outcomes (Rinaldi et al., 2015). Surprisingly, hot executive functions such as social cognition (i.e., empathy, theory of mind and emotion recognition) were only investigated as a correlate of psychosocial functions in one small cross-sectional study by Montgomery et al. (2013), who found that lower trait emotional intelligence and poorer theory of mind were associated with higher levels of social stress.

In terms of personal and social resources (i.e., self-appraisals, coping skills and social support), there was evidence from the review that adults with ASD with more negative thinking styles, maladaptive coping and lower perceived social support
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experienced poorer mental health and quality of life outcomes (e.g., Abell & Hare, 2005; Gotham, Bishop, et al., 2014; Hare et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2007). Differences in personal and social resources may account for why individuals with similar ASD characteristics experience varying mental health and social and adaptive outcomes. However, due to the predominant use of univariate analyses in studies included in the review, the role of personal and social resources as potential mediators or moderators of the relationship between ASD characteristics and psychosocial outcomes could not be determined.

In summary, the findings of the systematic review highlighted numerous gaps in the literature with respect to understanding both vulnerability and protective factors impacting psychosocial outcomes of high-functioning adult with ASD. As relevant to the scope of the present thesis, the review identified the need for further research to determine the impact of higher-order cognitive abilities (i.e., cold and hot executive functions) on psychosocial outcomes for this population (Chapter 5). However, to facilitate this investigation there was an initial need to clarify the profile of executive function deficits experienced by high-functioning individuals with ASD, particularly with respect to the independence of cold and hot executive functions (Chapter 4). Additionally, guided by the systematic review findings, the final study (Chapter 6) aimed to investigate the role of personal and social resources as vulnerability or protective factors in the relationship between greater ASD characteristics and psychosocial outcomes.

Chapter 4: Independence of Hot and Cold Executive Function Deficits (Study 2)

As identified by the systematic review, there is some evidence that impairments in executive function contribute to poorer psychosocial outcomes for adults with ASD who have an IQ in the normal range. However, there are mixed findings on the profile of executive deficits experienced by high-functioning adults with ASD (Boucher et al.,
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2005; Hill, 2004; Ozonoff et al., 2004; Rajendran et al., 2005). Social cognition (i.e., hot executive function) is recognised as a core domain of impairment for individuals with ASD (Happé, Ronald, et al., 2006; Rajendran & Mitchell, 2007). However, it is unclear whether the social interaction difficulties commonly experienced by this population are related to specific deficits in the evaluation and interpretation of emotional and mental states, or broader impairments in cognitive abilities such as cool executive functions. To help address this knowledge gap, the key aims of study 2 were to investigate the profile of hot and cold executive function impairments for high-functioning adults with ASD relative to matched controls, and to examine the independence of these deficits.

As summarised in Table 7.1, a main finding of study 2 was that the ASD group demonstrated generalised impairments in hot and cold executive functions (i.e., emotion recognition, social inference, working memory and response initiation and suppression) relative to matched controls. These findings are consistent with previous research indicating that high-functioning individuals with ASD demonstrate deficits in working memory (Bennetto et al., 1996; Steele et al., 2007; D. L. Williams et al., 2005), response initiation and suppression (Boucher et al., 2005; Hill & Bird, 2006; K. Johnston et al., 2011) and multiple components of social cognition (Auyeung et al., 2009; Baez et al., 2012; Baron-Cohen et al., 2003; Goldenfeld et al., 2005; Mathersul et al., 2013).

The key novel finding of study 2 was that the impairments in hot executive functions (i.e., emotion recognition and social inference) demonstrated by ASD participants were independent of deficits in cold executive functions, namely, working memory and response initiation and suppression. More specifically, the ASD participants performed more poorly on emotion recognition and social inference tasks than matched controls after controlling for cold executive functions. However, the ability to recognise emotions and make social inferences was supported by working
memory and response initiation and suppression processes. Hence, hot and cold executive functions are to some extent inter-related. In terms of theoretical implications, these findings support the distinction between impairments in cold and hot executive functions for the ASD population. Moreover, in line with neurophysiological evidence (Ashwin et al., 2007; Bauman, 1996; Lieberman, 2007; McAlonan et al., 2005), the findings provide preliminary support for the functional modularity of social cognition and suggest that hot and cold executive functions are supported by a distinct yet integrated neural network (Adolphs, 2010).

Regarding implications for clinical practice, the partial independence of deficits in hot and cold executive functions highlights the need for comprehensive assessment of higher-order cognitive abilities to aid diagnosis and inform treatment interventions. As noted in Chapter 4, there is some empirical support for the effectiveness of social cognition skills training for the ASD population via computer-based programs or group interventions (Bishop-Fitzpatrick et al. (2013). Further, Eack, Greenwald, et al. (2013) targeted impairments in social and non-social information processing in adults with ASD using Cognitive Enhancement Therapy. Significant effects were reported for both cognitive deficits (i.e., working memory, behavioural monitoring and perseverative errors) and social behaviour. As discussed later, intervention programs for the ASD population need to have a multi-level focus, with remedial interventions, compensatory training (Hare et al., 2015) and social inclusion programs (Schmidt et al., 2015) used to target impairment, activity and participation outcomes respectively.

**Chapter 5: Associations between ASD Characteristics, Executive Functions and Psychosocial Outcomes (Study 3)**

The primary aims of study 3 were to examine the associations between hot and cold executive functions and core ASD characteristics, and to investigate the associations between executive functions and psychosocial outcomes. Overall, there
was limited support for the study 3 hypotheses. Specifically, greater social anxiety characteristics on the RAADS were significantly related to impairments in transferring knowledge into action, a specific component of cognitive flexibility. Further, individuals reporting greater circumscribed interests on the RAADS demonstrated poorer social inference skills under conditions where contextual information is enriched. However, there were no significant associations between ASD characteristics and working memory, response inhibition, and non-verbal reasoning. Also contrary to the hypotheses, the social and adaptive outcome groups typically did not significantly differ on indices of hot and cold executive function. The only exception was the finding that individuals classified as having Very Good outcomes demonstrated better emotion recognition, non-verbal reasoning and cognitive flexibility than those classified as having Good outcomes.

In terms of the exploratory component of study 3, individuals demonstrating poorer cognitive flexibility and social inference skills reported greater anxiety symptoms. Interestingly, however, poorer performance on measures of non-verbal reasoning, cognitive flexibility and social cognition was associated with more positive self-concept. Although previous research had shown that higher IQ was related to more negative self-appraisals in individuals with ASD (Sterling et al., 2008), the findings of study 3 extend the literature by indicating that those with stronger hot and cold executive functions experience less anxiety but poorer self-concept. Theoretically, stronger executive functions may contribute to poorer self-concept through individuals having high self-expectations and more critical self-evaluation of and insight into their functioning (Barnhill, 2001), although this remains to be specifically tested. Furthermore, because they are more likely to interpret social cues accurately, individuals with ASD with stronger social cognition skills may be more likely to process negative social feedback, which in turn affects their global self-perceptions. In
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terms of clinical implications, as outlined in Table 7.1, there is a need to screen for and
monitor mental health concerns in people with ASD regardless of their level of
executive function. In summary, the present findings indicate that individuals with
poorer executive function may be more prone to anxiety, whereas those with stronger
executive function may be more likely to experience negative self-concept.

Chapter 6: The Relationship between ASD Characteristics and Psychosocial
Outcomes: Investigation of the Vulnerability and Stress-Buffer Hypotheses (Study 4)

The broad aim of study 4 was to investigate the role of personal and social
resources as vulnerability or protective factors in the relationship between ASD
characteristics and psychosocial outcomes. More specifically, this chapter aimed to
clarify whether, for people with greater ASD characteristics, personal and social
resources serve as stress-buffers (i.e., have a protective function) or increase their
vulnerability to poor psychosocial outcomes. Prior to testing these relationships, the
reliability and validity of measures of personal and social resources for high-functioning
adults with ASD was examined as an initial study aim.

In relation to the initial aim, all personal and social resources measures
demonstrated adequate internal consistency (α = .69-.92). Three factors were found to
underlie the personal resource variables, namely: cognitive re-appraisal and control
coping (CRC), ASD appraisals (ASD-A) and emotional suppression and situational
avoidance coping (ESSA). Overall, there was a lack of support for the stress-buffer
hypothesis, as the personal and social resource variables did not significantly moderate
the relationship between ASD characteristics and psychosocial outcomes (i.e.,
depression, anxiety, stress and self-esteem and social and adaptive functioning).
However, there was some support for the vulnerability hypothesis, whereby negative
ASD appraisals (ASD-A) and poorer perceived social support (ISEL) mediated the
relationship between ASD characteristics and mental health outcomes. Specifically,
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Individuals with greater ASD characteristics were more likely to perceive increased helplessness, lack of acceptance and fewer benefits (i.e., ASD-A) associated with their experience of ASD. In turn, these negative appraisals were related to increased depression, anxiety, stress and lower self-esteem. These findings are consistent with the transactional model of stress and coping (Folkman, 1997; Lazarus & Folkman, 1984), and reinforce prior research indicating that negative self-appraisals are deleterious to mental health outcomes (Evers et al., 2001; Lauwerier et al., 2010; McCracken, 2005).

As further support for the vulnerability hypothesis, perceived social support (i.e., ISEL) also mediated the relationship between ASD characteristics and depression and self-esteem. This finding contrasts with previous research in cancer and cardiovascular populations (Ownsworth et al., 2010; Payne et al., 2012; Steptoe, 2000), in which perceived availability and quality of social support were found to moderate the influence of high levels of stress on health outcomes. A possible explanation for these contradictory findings is that individuals with greater ASD characteristics are more likely to experience interpersonal difficulties, which in turn reduces their capacity to establish supportive social networks and derive benefits from them. In support of this view, research indicates that adults with ASD experience social communication difficulties that affect their interpersonal relationships (Barnhill, 2007; Montgomery et al., 2013). The present findings extend upon previous research by indicating that, for individuals with greater ASD characteristics, lower perceived social support increases their vulnerability to depression and low self-esteem. Overall, the findings of study 4 significantly advance the literature by demonstrating that more negative ASD appraisals and lower perceptions of social support can explain why people with greater ASD characteristics are more vulnerable to poor mental health outcomes.

Important clinical implications arising from this study relate to the likely value of assessing individuals’ appraisals of their ASD (i.e., the extent to which they feel
helpless, are accepting of, or perceive benefits) and their perceived availability of social support. For individuals with greater ASD characteristics, assessment of these personal and social resources may help to identify those at risk of poor mental health outcomes and guide the focus of interventions. As outlined in Chapter 4, multi-level intervention programs that concurrently target underlying ASD symptoms (e.g., sensory-perceptual and socio-cognitive deficits), skill and strategy development and social participation and inclusion, are likely to be most beneficial (Bishop-Fitzpatrick et al., 2013; Eack, Greenwald, et al., 2013). To address negative self-appraisals that contribute to poor mental health, interventions that integrate psychotherapy and compensatory strategy training (e.g., via mobile phone platforms) may have potential utility. Such interventions may support individuals to identify triggers, become aware of unhelpful thoughts and to employ more adaptive coping strategies during stressful situations (Hare et al., 2015; Spek, van Ham, & Nyklicek, 2013; Weiss & Lunsly, 2010). Furthermore, interventions focusing on social networks may support high-functioning individuals with ASD to better understand the main functions of social support (e.g., emotional, tangible, belonging and self-esteem), and then determine on an individualised basis what forms of social support are most valued and relevant for psychological well-being.

**Methodological Considerations**

A number of key methodological limitations need to be acknowledged regarding the current research, all of which must be considered with respect to understanding and generalisability of the results. Firstly, due to the convenience sampling approach and profile of demographic characteristics, the participants may not be representative of the broader ASD population due to sampling bias. For the ASD sample in studies 2 and 3, the sampling approach yielded a male-to-female ratio of approximately 2.8:1 and considerable variability in age (i.e., 18-66 years). Further, the convenience sample for
the online survey in study 4 yielded a male-to-female ratio of approximately 0.76:1. It is broadly accepted that males are more commonly diagnosed with ASD than females (i.e., ratio of approximately 4.3:1; Fombonne, 2003). As acknowledged in the Study Limitations section of Chapter 6, it is possible that females in the present study were experiencing greater psychological distress, as indicated by significantly higher self-reported anxiety and lower self-esteem, when compared to male participants. This is consistent with Australian research that suggests that a higher proportion of females with ASD report having a mental health condition when compared to males (Autism Spectrum Australia, 2013). Further, research in the general population supports the notion that females have more positive attitudes towards seeking psychological help and support than males (Nam et al., 2010). While it is acknowledged that the male-to-female ratio is not in line with the broader ASD literature, the strong subset of data relevant to females with ASD may be considered a strength of the present thesis. This is particularly valuable given the limited research in this area (Gould & Ashton-Smith, 2011). Although efforts were made to control for the effects of gender, caution is needed in generalising the findings to the broader ASD population. Thus, it is recommended that future research adopt a more representative sampling approach such as recruitment based on consecutive referrals to specialist ASD clinics.

An additional limitation of the present research relates to the lack of formal verification of a current ASD diagnosis from an independent clinical assessment. Therefore, it is possible that some participants may have been misidentified as having ASD. Nonetheless, all participants in the ASD sample reported a history of longstanding ASD characteristics on the RAADS, including difficulties in social interaction and communication, and a restricted range of behaviours and/or interests. The RAADS is a validated assessment tool commonly used to support diagnosis of ASD in adults (Ritvo et al., 2011; Ritvo et al., 2008). As a further limitation relevant to
studies 2 and 3, the estimate of IQ was based only on Matrix Reasoning which is a non-verbal test. Although no individuals with ASD in these studies performed in the range indicating literacy difficulties on a standardised test of reading ability, a measure of verbal reasoning skills would have provided a more accurate reflection of verbal IQ. Further, regarding study 4, due to the use of an online survey it was not possible to screen participants in terms of intellectual impairment or literacy difficulties. However, the Flesch-Kincaid readability index was calculated for all questionnaires with results indicating readability levels consistent with 11-13 years of age. Furthermore, there were intrinsic features associated with the methodology of the study that would have been difficult for an individual to complete with a co-occurring intellectual disability. For instance, the questionnaire required the participant to answer over one hundred questions and necessitated considerable concentration to complete.

As noted in Chapter 6, the relative advantages and disadvantages of self-report measures for use in this research is important to acknowledge. In particular, the issue of common-method variance associated with self-report measures is important to consider. It is possible that similar Likert scale formats may have increased the likelihood of spurious variance in the analyses involving these measures. However, as Spector (2006) points out, common-method variance is considered problematic when significant correlations among all variables using the same measurement method are observed, which was not the case in the present research. Further, self-report measures were selected because, in addition to the practical advantage of brevity, such tools are best suited to assessing psychological constructs such as self-appraisals, coping and perceived social support, for which collateral reports from significant others are not appropriate. There is a growing body of evidence that adults with ASD can reliably report on their psychological functioning using self-report measures (Adams et al., 2014; Berthoz & Hill, 2005; Ozsivadjian et al., 2014). Consistent with this view, the
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self-report measures demonstrated sound reliability and evidence of construct validity in the present ASD sample. Further research examining other psychometric properties (e.g., test-retest reliability and convergent validity) of these measures is recommended for this population.

A further key limitation of the present research relates to the cross-sectional design and linked assumptions regarding uni-directional relationships among variables. In an adult ASD sample in particular, there is a need for caution regarding the direction of relationships between ASD characteristics and executive functions. Although impairments in hot and cold executive function may underlie particular ASD characteristics (e.g., need for sameness and social interaction difficulties), early ASD features such as sensory processing deficits could also affect the emergence and maturation of higher-order cognitive functions throughout development (Lopez et al., 2005). Furthermore, the relationship between ASD characteristics, personal and social resources and psychosocial outcomes are potentially bi-directional or mutually enhancing (Bartak et al., 2006). For example, as outlined in Chapter 6, it is plausible that a deterioration in mental health functioning (i.e., greater depression, anxiety and stress and lower self-esteem) may contribute to poorer personal and social resources and therefore exacerbate ASD characteristics. As highlighted by the dynamic model of autism (Bartak et al., 2006) and outlined in Chapter 1, the complex interactions between ASD characteristics, stressors within the environment and psychosocial functioning are important to recognise. More specifically, variations in psychosocial outcomes could be related to the ways in which the environment responds to individuals’ underlying ASD characteristics. The dynamic model proposes that sources of stress interact with the primary features of ASD (e.g., deficits in processing information), thus producing secondary features of ASD (e.g., ritualistic behaviour to cope with sensory overload),
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which in turn place individuals at greater risk of poorer psychological and social outcomes.

This dynamic and developmental perspective on ASD characteristics and psychosocial outcomes requires prospective longitudinal research which was not feasible for the present thesis. Moreover, given the gaps in the literature on factors related to psychosocial outcomes of high-functioning adults with ASD, the present findings make an important empirical contribution to the unfolding knowledge base for ASD, as outlined in Table 7.1.

**Recommendations for Future Research**

As identified in the preceding sections, there are several key directions for future research in this field. In particular, there is a need for prospective longitudinal studies spanning early childhood through to adulthood in order to examine the complex interactions between ASD characteristics, environmental factors and psychosocial functioning. Given the findings on the independence and inter-relatedness of hot and cold executive functions in study 2, research is needed to compare the efficacy of interventions that target these deficits concurrently or in isolation. Such research may determine whether improvements in cold executive functions positively influence improvements in hot executive functions or vice versa. To improve understanding of the relationship between hot and cold executive functions and mental health as identified in study 3, it would be beneficial to examine the potential mediating role of self-appraisal processes (e.g., self-awareness and attribution style).

Informed by the findings of study 4, interventions targeting appraisals that contribute to poor mental health need to be developed and evaluated. As previously outlined, these may include cognitive and behavioural interventions that support individuals to identify triggers, become aware of unhelpful thoughts and employ adaptive coping strategies during stressful situations. Furthermore, social support
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Interventions that are tailored to individuals’ preferred forms of support (i.e., those serving emotional, tangible, belonging and/or self-esteem support functions) may contribute to enhanced psychological well-being.

Conclusion

Overall, this thesis advances the ASD literature in several important respects. In particular, the systematic review (study 1) demonstrated that adults with greater ASD characteristics are most at risk for poor psychosocial outcomes. This review also highlighted the need to better understand the impact of cold and hot executive functions on psychosocial outcomes. To facilitate this, study 2 examined the profile of hot and cold executive function impairments experienced by high-functioning adults with ASD. The findings of study 2 demonstrated both the independence and inter-relatedness of impairments in cold and hot executive function for the ASD population, providing preliminary support for the functional modularity of social cognition. Study 3 found that ASD characteristics were largely unrelated to impairments in hot and cold executive function. However, specific indices of executive function distinguished between Very Good and Good social adaptive outcomes. A key novel finding of study 3 that extends on the literature is that adults with ASD with stronger executive function may be less prone to anxiety, but experience more negative self-concept. Finally, study 4 demonstrated that negative ASD appraisals and low perceptions of social support help to explain why people with greater ASD characteristics are more vulnerable to poor mental health outcomes. Collectively, these findings have important implications for assessment and intervention practices and future research for the ASD population.
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Appendix A: Diagnostic Criteria for ASD

Diagnostic Criteria for 299.80: Asperger’s Disorder (DSM-IV-TR)

I. Qualitative impairment in social interaction, as manifested by at least two of the following:
   1) Marked impairments in the use of multiple nonverbal behaviours such as eye-to-eye gaze, facial expression, body posture, and gestures to regulate social interaction.
   2) Failure to develop peer relationships appropriate to developmental level.
   3) A lack of spontaneous seeking to share enjoyment, interest or achievements with other people, (e.g., by a lack of showing, bringing, or pointing out objects of interest to other people).
   4) Lack of social or emotional reciprocity.

II. Restricted repetitive & stereotyped patterns of behaviours, interests and activities, as manifested by at least one of the following:
   1) Encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus.
   2) Apparently inflexible adherence to specific, non-functional routines or rituals.
   3) Stereotyped and repetitive motor mannerisms (e.g. hand or finger flapping or twisting, or complex whole-body movements).
   4) Persistent preoccupation with parts of objects.

III. The disturbance causes clinically significant impairments in social, occupational, or other important areas of functioning.

IV. There is no clinically significant general delay in language (e.g., single words used by age 2 years, communicative phrases used by age 3 years).

V. There is no clinically significant delay in cognitive development or in the development of age-appropriate self-help skills, adaptive behaviours (other than in social interaction) and curiosity about the environment in childhood.

VI. Criteria are not met for another specific Pervasive Developmental Disorder or Schizophrenia.

ICD-10 Diagnostic Criteria for Asperger’s Syndrome (F84.5)

I. A lack of any clinically significant general delay in spoken or receptive language or cognitive development. Diagnosis requires that single words should have developed by two years of age or earlier and that communicative phrases be used by three years of age or earlier. Self-help skills, adaptive behaviour and curiosity about the environment during the first three years should be at a level consistent with intellectual development. However, motor milestones may be somewhat delayed and motor clumsiness is usual (although not a necessary diagnostic feature). Isolated
special skills, often related to abnormal preoccupations, are common, but are not required for diagnosis.

II. Qualitative abnormalities in reciprocal social interaction (criteria as for autism).

III. An unusually intense circumscribed interest or restrictive, repetitive, and stereotyped patterns of behaviour, interests and activities (criteria as for autism; however, it would be less usual for these to include either motor mannerisms or preoccupations with part-objects or non-functional elements of play materials).

IV. The disorder is not attributable to other varieties of pervasive developmental disorder; schizotypal disorder (F21); simple schizophrenia (F20.6); reactive and disinhibited attachment disorder of childhood (F94.1 and .2); obsessional personality disorder (F60.5); obsessive-compulsive disorder (F42).

Diagnostic Criteria for 299.00 Autistic Disorder (DSM-IV-TR)

I. Six or more items from (A), (B), and (C), with at least two from (A), and one each from (B) and (C):

A. Qualitative impairment in social interaction, as manifested by at least two of the following:
   1) Marked impairment in the use of multiple nonverbal behaviours such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction.
   2) Failure to develop peer relationships appropriate to developmental level.
   3) A lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest).
   4) Lack of social or emotional reciprocity.

B. Qualitative impairments in communication as manifested by at least one of the following:
   1) Delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime).
   2) In individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others.
   3) Stereotyped and repetitive use of language or idiosyncratic language.
   4) Lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level.

C. Restricted repetitive and stereotyped patterns of behaviours, interests, and activities, as manifested by at least one of the following:
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1) Encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus.

2) Apparently inflexible adherence to specific, non-functional routines or rituals.

3) Stereotyped and repetitive motor manners (e.g., hand or finger flapping or twisting, or complex whole-body movements).

4) Persistent preoccupation with parts of objects.

II. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years:

1) Social interaction;

2) Language as used in social communication; or

3) Symbolic or imaginative play.

III. The disturbance is not better accounted for by Rett’s Disorder or Childhood Disintegrative Disorder.

ICD-10 Criteria for Childhood Autism (F84.0)

I. Abnormal or impaired development is evident before the age of 3 years in at least one of the following areas:

1) Receptive or expressive language as used in social communication;

2) The development of selective social attachments or of reciprocal social interaction;

3) Functional or symbolic play.

II. A total of at least six symptoms from (1), (2) and (3) must be present, with at least two from (1) and at least one from each of (2) and (3):

1) Qualitative impairment in social interaction are manifest in at least two of the following areas:

a) Failure adequately to use eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction;

b) Failure to develop (in a manner appropriate to mental age, and despite ample opportunities) peer relationships that involve a mutual sharing of interests, activities and emotions;

c) Lack of socio-emotional reciprocity as shown by an impaired or deviant response to other people’s emotions; or lack of modulation of behaviour according to social context; or a weak integration of social, emotional, and communicative behaviours;

d) Lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., a lack of showing, bringing, or pointing out to other people objects of interest to the individual).
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2) Qualitative abnormalities in communication as manifest in at least one of the following areas:
   a) Delay in or total lack of, development of spoken language that is not accompanied by an attempt to compensate through the use of gestures or mime as an alternative mode of communication (often preceded by a lack of communicative babbling);
   b) Relative failure to initiate or sustain conversational interchange (at whatever level of language skill is present), in which there is reciprocal responsiveness to the communications of the other person;
   c) Stereotyped and repetitive use of language or idiosyncratic use of words or phrases;
   d) Lack of varied spontaneous make-believe play or (when young) social imitative play.

3) Restricted, repetitive, and stereotyped patterns of behaviour, interests, and activities are manifested in at least one of the following:
   a) An encompassing preoccupation with one or more stereotyped and restricted patterns of interest that are abnormal in content or focus; or one or more interests that are abnormal in their intensity and circumscribed nature though not in their content or focus;
   b) Apparently compulsive adherence to specific, non-functional routines or rituals;
   c) Stereotyped and repetitive motor mannerisms that involve either hand or finger flapping or twisting or complex whole body movements;
   d) Preoccupations with part-objects of non-functional elements of play materials (such as their order, the feel of their surface, or the noise or vibration they generate).

III. The clinical picture is not attributable to the other varieties of pervasive developmental disorders; specific development disorder of receptive language (F80.2) with secondary socio-emotional problems, reactive attachment disorder (F94.1) or disinhibited attachment disorder (F94.2); mental retardation (F70-F72) with some associated emotional or behavioural disorders; schizophrenia (F20.-) of unusually early onset; and Rett’s Syndrome (F84.12).

DSM 5: Autistic Spectrum Disorder

Must meet criteria A, B, C, and D:

A. Persistent deficits in social communication and social interaction across contexts, not accounted for by general developmental delays, and manifest by all 3 of the following:
   1. Deficits in social-emotional reciprocity; ranging from abnormal social approach and failure of normal back and forth conversation through reduced sharing of interests, emotions, and affect and response to total lack of initiation of social interaction;
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2. Deficits in nonverbal communicative behaviors used for social interaction; ranging from poorly integrated verbal and nonverbal communication, through abnormalities in eye contact and body-language, or deficits in understanding and use of nonverbal communication, to total lack of facial expression or gestures;

3. Deficits in developing and maintaining relationships, appropriate to developmental level (beyond those with caregivers); ranging from difficulties adjusting behavior to suit different social contexts through difficulties in sharing imaginative play and making friends to an apparent absence of interest in people.

B. Restricted, repetitive patterns of behavior, interests, or activities as manifested by at least two of the following:
   1. Stereotyped or repetitive speech, motor movements, or use of objects; (such as simple motor stereotypies, echolalia, repetitive use of objects, or idiosyncratic phrases).
   2. Excessive adherence to routines, ritualized patterns of verbal or nonverbal behavior, or excessive resistance to change; (such as motoric rituals, insistence on same route or food, repetitive questioning or extreme distress at small changes).
   3. Highly restricted, fixated interests that are abnormal in intensity or focus; (such as strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).
   4. Hyper- or hypo-reactivity to sensory input or unusual interest in sensory aspects of environment; (such as apparent indifference to pain/heat/cold, adverse response to specific sounds or textures, excessive smelling or touching of objects, fascination with lights or spinning objects).

C. Symptoms must be present in early childhood (but may not become fully manifest until social demands exceed limited capacities)

D. Symptoms together limit and impair everyday functioning.
Appendix B: High-Functioning Autism Spectrum Disorder in Adulthood: A Systematic Review of Factors Related to Psychosocial Outcomes

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Abstract

Background: This systematic review aimed to identify the factors related to psychosocial outcomes for adults with high-functioning autism spectrum disorder (HFASD). A further aim was to appraise the research methodology and provide recommendations for future research.

Method: Systematic review methodology was used to comprehensively search for peer reviewed articles, assess methodological rigor and summarise the results. Twenty-seven studies published between 1989 and December 2015 met inclusion criteria and included 1398 individuals (M age = 28.54 years) with HFASD (IQ ≥ 70).

Results: Factors most consistently found to be related to poor psychological, social and adaptive outcomes included: greater symptom severity, lower childhood IQ, impaired non-verbal learning, cognitive shifting deficits, negative thinking styles, and perceptions of low social support.

Conclusions: Overall, key risk factors for poor psychosocial outcomes of adults with HFASD were identified. However, further prospective longitudinal research with large samples is needed to examine the complex, and potentially bi-directional relationships among these factors.

Key words: adults, high-functioning, autism spectrum disorder, psychosocial outcomes
Introduction

Autism spectrum disorder (ASD) is a grouping of neurodevelopmental disorders characterised by deficits in social communication and language as well as a restricted range of behaviours or interests (American Psychiatric Association, 2013). A wealth of studies have investigated the aetiology and characteristics of ASD in children and adolescents (Chiang & Wineman, 2014; Levy & Perry, 2011). Reviews of the empirical literature to date have focused broadly on social and adaptive outcomes of individuals with high and low functioning ASD (e.g., Magiati, Tay, & Howlin, 2014; Tobin, Drager, & Richardson, 2014) and across different developmental phases (e.g., Chiang & Wineman, 2014). Less is known about the psychological, social and adaptive outcomes of adults with ASD who are “high-functioning” in the sense that their intellectual functioning is in the normal range (i.e., ≥ 70), commonly referred to as high-functioning ASD (HFASD; see Baron-Cohen, 2000).

Due to the multidimensional nature and complex symptomatology of ASD, no single theory can comprehensively account for the characteristics and outcomes of the disorder (Silva et al., 2013). It has been proposed that diverse factors potentially account for differences in psychological, social and adaptive outcomes. These include demographic characteristics, neurocognitive functioning, severity of ASD symptoms, self-appraisals, emotion regulation and coping skills, and social support (Attwood, 2007). From this perspective, psychosocial outcomes could incorporate both mental health (e.g., depression, anxiety, stress, self-esteem, psychotic symptoms, attention deficit hyperactivity disorder, quality of life) and social and adaptive functioning (e.g., levels of independence, vocational, academic and interpersonal functioning) domains.

A leading neurocognitive developmental account of ASD implicates deficits in social cognition such as theory of mind (ToM), or the ability to evaluate the mental states of others (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Frith & Frith, 2003). A second major neurocognitive developmental account, weak central coherence theory, proposes that individuals with ASD have pervasive difficulties with perceiving the overall meaning or gist in a given situation, which leads to processing information in a fragmented and fine-grained way (Frith & Happé, 1994; Rajendran & Mitchell, 2007). Aspects of ASD symptomatology unaccounted for by ToM and weak central coherence theories have been proposed to arise from deficits in executive functioning such as problems with attentional switching, perseveration and impulse control (Hill, 2004; Kleinans, Akshoomoff, & Delis, 2005). Despite generally mixed empirical support concerning the profile of executive function impairments in ASD (Hill & Bird, 2006; Pennington & Ozonoff, 1996; Rajendran, Mitchell, & Rickards, 2005; Turner, 1999), there is consistent evidence of difficulties with cognitive shifting (i.e., the ability to engage and disengage actions in the service of predominant goals; Ambery, Russell, Perry, Morris, & Murphy, 2006; Hill & Bird, 2006; Pellicano, 2007). However, the influence of neurocognitive functioning on psychosocial outcomes in adults with HFASD is unclear.

The ways in which individuals perceive themselves and their environment has long been recognised to impact on psychological and social functioning in the context of chronic health conditions (Lauwerier et al., 2010; McCracken, 2005). Research has shown that adolescents with HFASD perceive themselves as different and report lower self-esteem than typically developing peers (Vickerstaff, Heriot, Wong, Lopes, & Dossetor, 2007; Williamson, Craig, & Slinger, 2008). Qualitative studies indicate that some individuals perceive positive effects of being diagnosed with ASD and are motivated to seek out likeminded individuals and community support groups (Haertl, Callahan, Markovics, & Sheppard, 2013). In contrast, others express feeling helpless,
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estranged, and rejected by society (Haertl et al., 2013; Smith & Sharp, 2013; Townson et al., 2007). Individuals may also value certain skills associated with ASD, such as identifying errors quickly and understanding complex mathematics and computers (Smith & Sharp, 2013). Such findings highlight the importance of examining the impact of self-appraisals on psychosocial outcomes for adults with HFASD.

Individuals with ASD are prone to heightened stress and comorbid psychological diagnoses (Baron, Groden, & Groden, 2006; Samson, Huber, & Gross, 2012). Yet, investigations of stress and coping have mainly focused on family members (Baron et al., 2006; Dabrowska & Pisula, 2010; Pottie & Ingram, 2008). Stress is thought to detrimentally influence health outcomes on a number of inter-related levels whereby stressful situations trigger negative appraisals of harm, activate physiological systems and elicit unhelpful coping responses (e.g., avoidance, alcohol and illicit drug use; Cohen, Kessler, & Gordon, 1995; Lazarus & Folkman, 1984). Long-term activation of stress response systems is associated with a heightened risk of developing a range of physical and psychiatric disorders (DeLongis, Folkman, & Lazarus, 1988; Rosengren, Orth-Gomer, Wedel, & Wilhelmsen, 1993).

Related to self-appraisals and coping resources, emotion regulation refers to the capacity to simultaneously attend to internal and external cues in order to respond appropriately in a given situation (Ekman, 1992). Samson and colleagues (2012) found that adults with HFASD were less likely to use reappraisal strategies when regulating emotions in a stressful situation than matched controls. Therefore, self-appraisals, coping and emotion regulation skills are important to examine as personal resources potentially related to psychosocial outcomes of HFASD in adulthood.

In addition to emotion regulation skills, social resources can buffer the detrimental effects of stressful events on well-being (Cohen, 1988). In particular, social support has been found to moderate the impact of high levels of stress on psychological well-being (Cohen, 2004). A fundamental aspect of this buffering effect is the extent to which social support is perceived as available or effective by an individual (Cohen, 1988). There is considerable evidence that the perceived availability and quality of social support moderates the influence of high levels of stress on health outcomes in a range of clinical populations (Payne et al., 2012; Steptoe, 2000). However, the influence of perceived social support on psychosocial outcomes of adults with HFASD has received little attention to date.

Broader social environmental factors likely to influence psychological, social adaptive outcomes include the quality of interactions with friends, family and employers (Chiang & Wineman, 2014; Howlin, 2000; Levy & Perry, 2011; Tobin et al., 2014). In particular, the experience of bullying and victimisation during childhood and adolescence, most commonly in the school environment, has been proposed to contribute to poor psychosocial outcomes in adulthood (Cappadocia, Weiss, & Pepler, 2012; Roekel, Didden, & Scholte, 2010). In an unpublished dissertation, Merkler (2007) reported that adults with HFASD were more isolated than matched controls and that isolation from social networks and relationships was associated with psychological distress. Despite their social challenges, individuals with HFASD have been found to report a desire for intimacy and social connectedness and derive satisfaction from contributing to others’ welfare (Muller, Schuler, & Yates, 2008). A better understanding of social environmental influences on outcomes of adults with HFASD may guide support interventions.
Rationale and Aims of the Systematic Review

Previous reviews of factors related to psychosocial outcomes of ASD have typically synthesised the findings for children and adults with high and low functioning ASD (Chiang & Wineman, 2014; Howlin & Moss, 2012; Levy & Perry, 2011; Magiati et al., 2014; Nordin & Gillberg, 1998; Tobin et al., 2014; van Heijst & Geurts, 2014). For example, Levy and Perry (2011) found that autism severity, cognitive and language skills, co-morbid psychopathology and access to interventions were consistently related to outcomes for adolescents and adults with ASD. More recently, Magiati et al. (2014) reviewed 25 longitudinal studies of cognitive, language and behavioural outcomes of adults with ASD. The key findings were that IQ typically remained stable between childhood and adulthood and that early IQ and language skills predicted functional outcomes in adulthood. Improvements were evident between childhood and adulthood for ASD symptoms, language and adaptive functioning; however, social outcomes were generally poor and the majority still met partial criteria for ASD in adulthood.

Overall, given the heterogeneity of study samples encompassing participants with high and low functioning ASD (e.g., Magiati et al., 2014; Tobin et al., 2014) and children and adults (e.g., Chiang & Wineman, 2014), it is unclear to what extent these findings generalise to adults with HFASD. Further, greater emphasis has been placed on neurocognitive predictors than self-appraisals, coping resources and aspects of the social environment which are potentially responsive to intervention (Tobin et al., 2014). To guide future research and support interventions specific to adults with HFASD, it is important to understand both risk factors and protective factors impacting long-term psychosocial outcomes.

Accordingly, the broad aims of this systematic review were to identify studies investigating factors associated with psychosocial outcomes of adults with HFASD and synthesise the key findings. A further aim was to appraise the research methodology, identify gaps in the literature and provide future research recommendations. As mentioned previously, psychosocial outcomes broadly include mental health and social and adaptive functioning.

Method

The current paper adopted systematic review methodology in accordance with relevant guidelines outlined by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Moher, Liberati, Tetzlaff, & Altman, 2009). This review process entailed four stages: 1) searching electronic databases using key terms; 2) reviewing abstracts with potentially relevant titles and key terms; 3) reviewing the full-text of articles to determine eligibility (conducted by two authors); and 4) appraising the methodology of eligible studies and summarising the findings.

Search Strategy

Eligible articles were identified through systematic electronic searches of the following databases: Ovid (PsycINFO), ProQuest, PubMed, Science Direct, Scopus and Web of Science from inception to the end of October 2015. Keyword searching (i.e. searching of title, abstract, keyword and/or subject) was used for the following terms: 1) autism spectrum disorder or Asperger* or high-functioning autism or high-functioning autism or HFASD; AND 2) outcome* or psychosocial or mental health or depression or anxiety or self-esteem.

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terminology for people with high-functioning autism spectrum disorder (or Asperger’s Syndrome/Disorder) as relevant to the specific focus of our review.

Searches were limited to adults either via limits or through the additional search terms: AND adult*. In addition, specific autism journals (i.e., Autism Research, Journal of Autism and Developmental Disorders, Journal of Intellectual and Developmental Disability and Autism) were screened for articles published online that may not have been identified through the original database search. Finally, the reference lists of eligible studies were also manually searched.

Selection Criteria

To identify relevant studies, the following inclusion criteria were applied: peer-reviewed articles published in English; quantitative studies (i.e., use of statistical analysis) that investigated factors related to psychosocial outcomes in adults with HFASD; mean age for the HFASD sample was at least 18 years and the minimum age of a participant was 16 years; participants had a formal diagnosis of ASD and/or ASD severity was measured; and participants’ IQ was in the normal range (i.e., ≥ 70), or intellectual disability was specified in exclusion criteria.

All abstracts of articles that met these inclusion criteria were reviewed by the primary author. Articles were excluded if they were reviews, commentaries or case studies or if they only employed qualitative methodology. Despite having an empirical basis, the findings of case studies and qualitative studies require a different approach to synthesis that was outside the scope of this review.

Following the initial screening stage, the full-text of each article was independently reviewed by two authors. Level of agreement concerning eligibility for inclusion was quantified using a point-by-point method (i.e., number of agreements/[agreements + disagreements] x 100 = % agreement).

Quality of Methodology

The final stage of the review process involved evaluating the methodological quality of the eligible studies according to a checklist adapted from Ownsworth and McKenna (2004). Articles were scored 0 (does not meet) or 1 (meets) on the following five criteria: 1) prospective and/or retrospective design employed with at least two assessment time points (i.e., collection of data on childhood variables and follow-up of outcomes in adulthood); 2) characteristics of the sample (i.e., age, gender, IQ and ASD status) and the inclusion criteria for the study were clearly stated; 3) analysis of sample representativeness was conducted. For prospective (and retrospective) studies, participants lost at follow-up were described and the reasons for attrition were explained. For cross-sectional studies, a comparison was conducted between individuals who were eligible and participated and those who were eligible but did not participate; 4) an adequate sample size, i.e. comprised of at least 10 participants per predictor/independent variable (Cohen, 2013); and 5) a multivariate statistical approach was used to examine the relationship between the predictor/independent variables and outcomes with examination of, or control for other predictors or covariates. Higher scores (0-5) represented stronger methodological quality. The first author reviewed each study and rated the quality of methodology while the second author checked and confirmed the suitability of these ratings.

Data Synthesis

Due to significant variability in design, sample characteristics, analytic approach and outcome measures, meta-analysis was not used to synthesise the data. Instead, results were synthesized qualitatively.
Results

As shown in Figure 1, the initial search yielded a total of 843 articles, which reduced to 807 once duplicates and studies not published in English were removed. A further 726 articles were excluded on the basis of title or abstract, leaving a total of 67 articles to be screened for eligibility as full-texts by both reviewers. Additionally, a further six articles were identified through reviewing the content pages of specific autism journals and searching the reference lists of eligible articles. This process identified 27 articles eligible for review (see Figure 1). There was 82% agreement between two independent raters concerning the inclusion or exclusion of the 67 studies based on review of the full text. Initial disagreement regarding eligibility of 12 studies was resolved through discussion. Specifically, nine studies were included (Gillberg, Helles, Billstedt, & Gillberg, 2015; Gotham, Bishop, Brunwasser, & Lord, 2014; Gotham, Unruh, & Lord, 2014; Hagberg, Billstedt, Nyden, & Gillberg, 2015; Hagberg, Nyden, Cederlund, & Gillberg, 2013; Hare, Wood, Wastell, & Skirrow, 2014; Maddox & White, 2015; Rinaldi, Jacquet, & Lefebvre, 2015; Shtayermman, 2007), while three were not deemed eligible (Bejerot, Eriksson, & Mortberg, 2014; Gray et al., 2014; Hare, Gracey, & Wood, 2015). Two articles (Gotham, Bishop, et al., 2014; Gotham, Unruh, et al., 2014) employed the same sample, but analysed a different set of variables. A further two articles (Hagberg et al., 2015; Hagberg et al., 2013) also employed identical samples that involved analyses of different variables. The results of these four articles were summarised as two broader studies for the purpose of this review. Table 1 outlines the design, sample characteristics, correlates/predictors, psychosocial outcomes, quality of methodology ratings and significant findings of the 27 eligible studies.

Participant and Sample Characteristics

A total of 1398 individuals (M age = 28.54 years) with HFASD were involved across the 27 studies (published between 1989 and December 2015), with sample sizes of 10-291 (M sample size = 51.8). The cross-sectional study by Khanna, Jariwala-Parikh, West-Strum, and Mahabaleshwarkar (2014) had the largest sample size (n = 291), representing 20.8% of the total participants in this review. Across the 26 studies that specified participants’ gender there were 930 males (71.6%) and 369 females (28.4%).

Quality of Methodology

As shown in Table 2, the methodological quality was variable across the 27 studies (score range: 1-4). Based on the five criteria specified for this review, the two studies with the strongest methodological quality were a cross-sectional study (n = 141) by Byers et al. (2013) and a prospective study by Gillberg et al. (2015). The most common research design was cross-sectional (21/27 studies), whereas five studies employed a prospective design (Berger, Aerts, van Spaendonck, Cools, & Teunisse, 2003; Farley et al., 2009; Gillberg et al., 2015; Hagberg et al., 2013; Taylor, Henninger, & Maillieck, 2015) and one study analysed data retrospectively across a time interval of 11-27 years (Sztamari, Bartolucci, Bremner, Bond, & Rich, 1989). The prospective study by Berger et al. (2003) is noteworthy as the only study to employ a uniform follow-up period of three years, whereas the length of follow-up period was variable for Hagberg et al. (2013), Farley et al. (2009), Gillberg et al. (2015) and Taylor et al. (2015), ranging from 9.4-24.4 years.

Most studies (22/27) provided a clear description of the sample characteristics, including age, gender, IQ and ASD status (see Table 2). In terms of sample representativeness, four studies described and compared the characteristics of
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individuals who were eligible and participated in the study versus those who were eligible but did not participate (Byers, Nichols, Voyer, & Reilly, 2013; Farley et al., 2009; Gillberg et al., 2015; Szatmari et al., 1989). Two prospective and one retrospective study described participants lost at follow-up and reasons for attrition (Farley et al., 2009; Gillberg et al., 2015; Szatmari et al., 1989). Fourteen studies met the criteria for adequate sample size, with at least 10 participants per variable in the analyses (Bishop-Fitzpatrick, Mazefsky, Minshew, & Eack, 2015; Byers et al., 2013; Gillberg et al., 2015; Gotham, Bishop, et al., 2014; Gotham, Unruh, et al., 2014; Hagberg et al., 2013; Hill, Berthoz, & Frith, 2004; Hirvikoski & Blomqvist, 2015; Howlin, 2003; Jansch & Hare, 2014; Jantz, 2011; Khanna et al., 2014; Schmidt et al., 2015; Tani et al., 2012). Finally, eleven studies utilised multivariate statistical approaches to examine the relationship between independent variables and psychosocial outcomes whilst controlling for other variables (Bishop-Fitzpatrick et al., 2015; Byers et al., 2013; Hill et al., 2004; Khanna et al., 2014; Maddox & White, 2015; Montgomery, Stoesz, & McCrímmion, 2013; Renty & Roeyers, 2006, 2007; Schmidt et al., 2015; Taylor et al., 2015; Wallace et al., 2015).

***Insert TABLE 2 about Here***

As shown in Table 1, psychosocial outcomes were measured using a combination of clinician or researcher-rated instruments (e.g., the Vineland Adaptive Behavior Scales [VABS; Sparrow et al., 1984], Autism Diagnostic Interview-Revised [ADI-R; Lord, 1994] and Structured Clinical Interviews/Global Assessment of Functioning [DSM IV-TR; APA, 2000]) and various self-report questionnaires. The most common self-report measure used was the Beck Depression Inventory (BDI; Beck, Steer, & Brown, 1996).

**Factors Associated with Psychosocial Outcomes**

**Demographics: Age and Gender.** Eight studies (Abell & Hare, 2005; Bishop-Fitzpatrick et al., 2015; Byers et al., 2013; Gotham, Unruh, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006; Taylor et al., 2015; Wallace et al., 2015) investigated the relationship between age and/or gender and psychosocial outcomes in adulthood. A cross-sectional study (n = 46) by Abell and Hare (2005) found that age was significantly and positively correlated with social anxiety and depression. Further, the cross-sectional study (n = 38) by Bishop-Fitzpatrick et al. (2015) noted that older age, and not years of education, was correlated with poorer social and adaptive functioning. However, cross-sectional studies with larger samples sizes (n = 58 and n = 291) by Renty and Roeyers (2006) and Khanna et al. (2014) found no significant associations between age and gender and quality of life (QoL). Further, cross-sectional research by Gotham, Unruh, et al. (2014) (n = 50) and Wallace et al. (2015) (n = 35) identified that age was not significantly related to mental health or social and adaptive outcomes. In a large internet based study on romantic relationships (n = 141), Byers et al. (2013) found that males reported significantly better dyadic and solitary sexual well-being than females. Age was not found to be related to sexual well-being. In a prospective study (n = 73) over 12 years, Taylor et al. (2015) reported that after controlling for age, males were more likely to be employed or in post-secondary education than females. Further, females were less likely than males to maintain employment or post-secondary education over time. Overall, the findings for the influence of age and gender on psychosocial outcomes of adults with HFASD were mixed.

**Severity of ASD Symptoms.** Thirteen studies examined the relationship between severity of ASD symptoms and psychosocial outcomes (Byers et al., 2013; Gotham, Bishop, et al., 2014; Hirvikoski & Blomqvist, 2015; Howlin, 2003; Jansch & Hare, 2014; Jantz, 2011; Khanna et al., 2014; Maddox & White, 2015; Renty & Roeyers, 2007; Shtayerman, 2007; Szatmari et al., 1989; Tani et al., 2012; Taylor et al., 2015).
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In a small retrospective study (n = 16), Szatmari et al. (1989) found that early ASD symptoms (M age = 6 years) were not significantly associated with social and adaptive functioning in adulthood. Conversely, in the study with the largest sample size (n = 291), Khanna et al. (2014) reported that greater ASD symptom severity was associated with poorer mental health-related QoL. Similarly, cross-sectional research by Gotham, Bishop, et al. (2014) (n = 48) and Jansch and Hare (2014) (n = 30) found that higher levels of ASD impairments were significantly related to greater depressive and anxiety symptoms. Consistent with these findings, Hirvikoski and Blomqvist (2015) reported in their cross-sectional study (n = 25) that greater ASD symptoms were associated with higher perceived stress. Further, Maddox and White (2015) reported in their cross-sectional study that greater ASD related social impairments were significantly associated with a co-morbid diagnosis of social anxiety disorder (n = 28). In a comparison of adults with Asperger’s syndrome (i.e., no early language delays) and those with high-functioning autism with early language delays, Howlin (2003) generally found no significant differences in psychosocial outcomes. However, adults with Asperger’s syndrome (n = 42) achieved a higher level of education than those with high-functioning autism with early language delays (n = 34). On the contrary, Taylor et al. (2015) found in their prospective study (n = 73) that ASD characteristics did not significantly predict participation in post-secondary vocational and/or educational activities.

In a study assessing self-reported psychosocial outcomes, Jantz (2011) identified that despite access to social interaction, information and advice, adults with HFASD (n = 35) attending community social support groups with greater ASD symptoms reported increased loneliness. Similarly, in their large cross-sectional study (n = 141), Byers et al. (2013) found that greater ASD symptoms were related to increased sexual anxiety and lower self-esteem. Additionally, cross-sectional research (n = 99) by Tani et al. (2012) found that a higher level of circumscribed interests was associated with increased anxiety. As with many correlational findings, the direction of this association is unclear because higher levels of anxiety could also contribute to people developing more specific or restricted interests in activities.

Focusing on males with HFASD (n = 21) in a marital relationship, Renty and Roeyers (2007) reported that severity of ASD symptoms was negatively associated with spousal marital satisfaction, but not with the participants’ own relationship satisfaction. Finally, Shtayermman (2007) reported a significant negative correlation between severity of ASD symptoms and level of suicidal ideation. Unexpectedly, this finding suggested that people with more severe ASD symptoms experienced lower levels of suicidal ideation. However, caution is needed when interpreting this finding given the small sample size (n = 10).

Measures of Neurocognitive Functioning: Eleven studies examined the relationship between measures of neurocognitive functioning and psychosocial outcomes (Berger et al., 2003; Farley et al., 2009; Gillberg et al., 2015; Gotham, Unruh, et al., 2014; Hagberg et al., 2015; Hagberg et al., 2013; Jansch & Hare, 2014; Montgomery et al., 2013; Rinaldi et al., 2015; South et al., 2015; Szatmari et al., 1989; Wallace et al., 2015). In a prospective study (n = 41) with a mean follow-up of 24 years, Farley et al. (2009) found that after controlling for age at assessment, childhood full scale IQ (FSIQ) significantly predicted social and adaptive functioning in adulthood, explaining 23% of the variance. Current verbal IQ and non-verbal IQ accounted for significant additional variance (14-27%) in social and adaptive outcomes. Therefore, adults demonstrating greater gains in IQ between childhood and adulthood experienced significantly better social and adaptive outcomes in adulthood.
Consistent with these findings, in a prospective study \((n = 69)\) with a mean follow-up of approximately 10 years, Hagberg et al. (2013) reported that adults with persisting non-verbal learning problems from childhood had poorer global outcomes in adulthood than those with improved non-verbal functioning. Additionally, they found that adults with “lifelong non-verbal disability” had poorer social adaptive behaviour than those with no history of non-verbal disability. In the same sample, Hagberg et al. (2015) found that poorer childhood non-verbal IQ was associated with greater ADHD symptoms in adulthood. Similarly, Gillberg et al. (2015) \((n = 50)\) reported that males with lower current FSIQ and non-verbal IQ demonstrated greater ADHD symptoms.

Further, Szatmari et al. (1989) found that current FSIQ and cognitive shifting skills (i.e., Wisconsin Card Sort Test; Grant & Berry, 1981) were significantly and positively correlated with adaptive behaviour in adulthood. There were no significant associations between adaptive behaviour and tests of motor coordination, facial recognition and receptive language. Consistent with these findings, the prospective study \((n = 30)\) by Berger et al. (2003) found that poor cognitive shifting skills in childhood was predictive of lower social competence in adulthood. However, cross-sectional research \((n = 50)\) by Gotham, Unruh, et al. (2014) reported no significant association between verbal IQ and depressive symptoms. Similarly, in their cross-sectional study \((n = 35)\), Wallace et al. (2015) found that FSIQ was not significantly related to adaptive functioning, anxiety or depression. Instead, they found that poorer executive functioning (i.e., metacognition and behaviour regulation) was related to worse psychosocial outcomes. Specifically, after controlling for age and FSIQ, poorer planning (metacognition subscale) was significantly related to worse adaptive functioning \((sr^2 = .29)\) and depression \((sr^2 = .17)\), while deficits in shifting (i.e., behaviour regulation subscale) was related to greater anxiety \((sr^2 = .38)\). In line with these results, a cross sectional study \((n = 24)\) by South et al. (2015) reported that poorer memory (i.e., pattern separation memory) was associated with more negative emotionality.

In a small cross sectional study \((n = 17)\), Rinaldi et al. (2015) found that interference control or inhibition, an executive function domain, distinguished between adults with ASD with a co-morbid diagnosis of schizophrenia and those with ASD with no co-morbid diagnosis. Although there was no significant difference between the groups on verbal and non-verbal fluency, individuals without co-occurring psychotic symptoms performed significantly better on a measure of interference control (i.e., Stroop colour naming task). However, in another cross sectional study \((n = 30)\), Jansch and Hare (2014) reported no significant associations among data gathering bias (i.e., the tendency to jump to conclusions), mentalisation and paranoid thoughts.

In the only study \((n = 25)\) to examine the relationship between social cognition and psychosocial outcomes, Montgomery et al. (2013) reported a significant positive association between self-reported trait emotional intelligence and interpersonal relations. Further, individuals with greater emotional intelligence and ToM had lower social stress. There were no significant associations between FSIQ, executive functioning and interpersonal relations and social stress.

Overall, despite the diversity of neuro-cognitive factors investigated, the findings most consistently indicated significant associations between lower IQ (especially non-verbal functioning) and executive functions (i.e., cognitive shifting skills, planning and inhibition) and poorer psychosocial outcomes.

**Appraisals and Coping Skills.** Six studies examined the relationship between self-appraisals and coping skills and psychosocial outcomes (Abell & Hare, 2005; Gotham, Bishop, et al., 2014; Hare et al., 2014; Hill et al., 2004; Khanna et al., 2014; Renty & Roeyers, 2006). In a large cross-sectional study \((n = 291)\), Khanna et al. (2014)
reported that maladaptive coping strategies (i.e., behavioural disengagement, denial, self-blame, self-distraction, substance abuse and venting) were significantly related to poorer physical and mental health-related QoL in adulthood. In a small cross-sectional study \((n = 21)\), Renty and Roeyers (2007) explored different coping styles employed by males with HFASD using the Ways of Coping Questionnaire (WCQ; Lazarus & Folkman, 1984). They found no significant associations between approach coping strategies (e.g., confronting or seeking social support) and avoidance coping strategies (e.g., distancing or escape avoidance) and marital satisfaction.

Cross-sectional research by Hill et al. (2004) found that adults with HFASD \((n = 27)\) reported greater difficulty identifying and describing their feelings (i.e., emotion processing) and were more depressed than matched controls; however, emotion processing was not significantly related to depression. In contrast, Gotham, Bishop, et al. (2014) found that rumination was significantly and positively associated with depressive symptoms, and moderated the relationship between ASD symptoms and depression. In further cross-sectional research \((n = 46)\), Abell and Hare (2005) reported that greater delusional beliefs and self-consciousness were significantly related to higher levels of anxiety. Similarly, in a small cross-sectional study \((n = 20)\), Hare et al. (2014) found that negative thinking styles (i.e., greater self-focus and worrying) and longer periods of rumination were positively associated with anxiety symptoms.

### Social and Environmental Factors

Six studies investigated social and environmental factors associated with psychosocial outcomes (Gotham, Bishop, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006; Schmidt et al., 2015; Tani et al., 2012; Taylor et al., 2015). In the only prospective study to examine the impact of the familial context on psychosocial outcomes, Taylor et al. (2015) found that adults with HFASD \((n = 73)\) who had fathers with higher educational attainment were more likely to obtain and maintain education or employment activities.

Cross-sectional research \((n = 58)\) by Renty and Roeyers (2006) identified that perceived informal support was more closely related to QoL than actual received support. Further, levels of perceived and received social support were stronger predictors of QoL than disability characteristics (i.e., severity of ASD symptoms and FSIQ). In a separate study, Renty and Roeyers (2007) identified that perceived informal support was related to better psychological functioning and marital adaptation for men with HFASD \((n = 21)\). Similarly, in a large cross-sectional study \((n = 291)\), Khanna et al. (2014) reported that greater perceptions of availability and adequacy of social support from friends were related to better physical and mental health-related QoL. Further, cross-sectional research \((n = 50)\) by Gotham, Bishop, et al. (2014) reported that lower levels of perceived social support, social motivation and social participation were related to increased depression. In terms of social inclusion, Schmidt et al. (2015) found that participation in society (i.e., taking part in family, social and community activities) was significantly related to overall life satisfaction for adults with HFASD \((n = 43)\).

Finally, the long-term psychosocial impact of bullying was investigated in a large cross-sectional study \((n = 99)\) by Tani et al. (2012), which identified that bullying during the school years was associated with greater mood swings in adulthood. Overall, low levels of perceived social support were consistently found to be related to poorer psychosocial outcomes.

### Discussion

This systematic review sought to identify factors related to psychosocial outcomes for adults with HFASD. A review of the 27 selected studies indicated that demographic characteristics (i.e., age and gender), ASD symptom severity and indices of neurocognitive functioning were the most frequently investigated factors. Relatively
Few studies examined self-appraisals, coping strategies and social and environmental factors. Overall, the methodological quality of the studies reviewed was low (i.e., 19/27 received a rating of <3/5) with common limitations including the use of cross-sectional designs, small and non-representative samples, and reliance on univariate analyses that did not control for other relevant predictors or covariates. There was also considerable variability in the design, sampling characteristics, outcome measures and analytic approach of studies included.

Despite these methodological issues, a consistent finding was that severity of ASD symptoms was significantly related to diverse psychosocial outcomes, including: depression, QoL, loneliness, anxiety, stress, sexual well-being, self-esteem, martial satisfaction and suicidal ideation (Byers et al., 2013; Gotham, Bishop, et al., 2014; Hirvikoski & Blomqvist, 2015; Howlin, 2003; Jansch & Hare, 2014; Jantz, 2011; Khanna et al., 2014; Renty & Roeyers, 2007; Shtayermman, 2007; Tani et al., 2012). An exception to this finding was that ASD symptoms during childhood were not related to social and adaptive functioning in adulthood (Szatmari et al., 1989). However, the small sample size (n = 13) and retrospective design limits the ability to draw conclusions from this study. Further, a prospective study by Taylor et al. (2015) identified that ASD characteristics were not related to post-secondary vocational or educational outcomes. Nevertheless, the present findings regarding ASD symptom severity largely concur with those of previous reviews on children and adults with high and low functioning ASD (Chiang & Wineman, 2014; Levy & Perry, 2011), thus highlighting that more severe ASD symptomatology represents a risk factor for poor psychosocial outcomes of adults with HFASD.

The findings regarding the influence of age and gender on psychosocial outcomes were largely mixed. In particular, Abell and Hare (2005) reported a robust positive association between age and levels of anxiety and depression. Additionally, Bishop-Fitzpatrick et al. (2015) found that older age was significantly associated with poorer social and adaptive functioning. Conversely, this association was not significant in studies by Gotham, Unruh, et al. (2014) and Wallace et al. (2015) which adopted similar methodology. Controlling for the effects of age, the prospective study by Taylor et al. (2015) reported that males were more likely to be employed or in post-secondary education than females, and that females were less likely than males to maintain employment or post-secondary education over time. Further, Renty and Roeyers (2006) and Khanna et al. (2014) found that age and gender were not related to QoL for adults with HFASD. These results contrast with the review by Chiang and Wineman (2014), who found that increasing age was related to poorer QoL in a combined group of children with high and low functioning ASD. A potential explanation for these inconsistent findings relates to different approaches to measuring QoL and adaptive functioning in the studies selected for review. For example, in the adult HFASD literature, QoL was typically assessed using self-report measures, whereas parental or caregiver ratings were more commonly used for children with ASD. It is likely that perceptions and expectations related to QoL differ for adults with HFASD as compared to parents or caregivers asked to rate a child with high or low functioning ASD.

A further main finding of this review is that neurocognitive functioning was related to various psychosocial outcomes (Berger et al., 2003; Farley et al., 2009; Gillberg et al., 2015; Hagberg et al., 2015; Hagberg et al., 2013; Montgomery et al., 2013; Rinaldi et al., 2015; South et al., 2015; Szatmari et al., 1989; Wallace et al., 2015). It is noteworthy that five of the 11 studies that supported this relationship employed a prospective and/or retrospective design, thus identifying that stronger early cognitive skills (i.e., FSIQ, non-verbal learning and cognitive shifting) were associated with better social and adaptive functioning in adulthood (Berger et al., 2003; Farley et
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al., 2009; Gillberg et al., 2015; Hagberg et al., 2015; Hagberg et al., 2013; Szatmari et al., 1989). This mirrors the results of previous reviews of adults with high or low functioning ASD (Howlin, 2000; Levy & Perry, 2011; Magiati et al., 2014), which is perhaps not surprising given the overlap in studies selected. However, the present review additionally highlights the early prognostic significance of deficits in executive functions, notably cognitive shifting for individuals with an IQ of > 70 (Berger et al., 2003; Szatmari et al., 1989). In line with these findings, a cross sectional study by Wallace et al. (2015) found that deficits in cognitive shifting was related to greater anxiety. Cognitive shifting, also referred to as set-shifting or task switching, supports the ability to manage goals and self-regulate behaviour and has consistently been shown to be impaired for individuals with HFASD (Ambery et al., 2006; Hill & Bird, 2006; Lopez, Lincoln, Ozonoff, & Lai, 2005; Pellicano, 2007).

This review also identified other executive function domains associated with psychosocial outcomes. Specifically, difficulties with interference control (i.e., inhibition), were associated with a co-morbid diagnosis of schizophrenia (Rinaldi et al., 2015). Evidence in the literature suggests an overlap in features between ASD and schizophrenia at the biological (see Burbach & van der Zwaag, 2009 for a review), psychological and psychosocial level (Bölte, Rudolf, & Poustka, 2002; Eack, Bahorik, et al., 2013). In particular, difficulties in some executive processes, such as inhibition and interference control, may act as vulnerability markers for the development of psychotic symptoms (Barneveld, de Sonneville, van Rijn, van Engeland, & Swaab, 2013).

A further noteworthy finding of the present review was the relationship between poorer neuro-cognitive functioning and greater risk of ADHD symptoms in adulthood (Gillberg et al., 2015; Hagberg et al., 2015). The DSM-5 (American Psychiatric Association, 2013) recognises that comorbidity of ASD and ADHD is common, and it is estimated that 30-50% of individuals with ASD manifest ADHD symptoms (Reiersen & Todd, 2008). There is evidence that the profile of executive function deficits for those with ASD and ADHD differs in children and adolescents (Happé, Booth, Charlton, & Hughes, 2006). Overall, the nature of executive function deficits experienced by adults with HFASD and relationship to psychosocial outcomes remains an important area for future research.

Social cognition is often conceptualised as a component of executive function (i.e., hot executive functions; Chan, Shum, Toulopoulou, & Chen, 2008; McDonald, 2013). A novel finding that emerged in a small cross-sectional study (n = 25) by Montgomery et al. (2013) is that poorer ToM and lower trait emotional intelligence were associated with higher levels of social stress. Interestingly, trait emotional intelligence was more closely related to quality of interpersonal relations than FSIQ, ToM and executive functioning. Unlike these neuro-cognitive indices, emotional intelligence, social stress and interpersonal relations were assessed using self-report measures. Hence, method variance may have contributed to the significant associations between these constructs. Although discussed in the context of social cognition in this review, emotional intelligence may also reflect coping resource (i.e., the ability to perceive, be guided by and manage one’s emotions and those of others; Mayer, Salovey, Caruso, & Sitarenios, 2001). Difficulties with social functioning have long been attributed to socio-cognitive and emotional deficits such as poor joint attention and diminished emotional expressiveness (Baron-Cohen, 1995; Baron-Cohen et al., 2001; Castelli, Frith, Happé, & Frith, 2002; Frith & Frith, 2003). The early influence of social cognition deficits related to emotional intelligence and ToM on the development of social competency in adults remains an important area for future research.
In relation to self-appraisal and coping variables, there was evidence from several studies that delusional beliefs, perseverative thinking, and maladaptive coping are related to psychosocial outcomes of adults with HFASD (Abell & Hare, 2005; Gotham, Bishop, et al., 2014; Hare et al., 2015; Khanna et al., 2014). Abell and Hare (2005) identified that delusional beliefs were positively related to anxiety. Consequently, they proposed a cognitive model of the development and maintenance of paranoid and grandiose thinking styles. Similarly, perseverative thinking style was related to increased depression and also moderated the relationship between severity of ASD symptoms and depression (Gotham, Bishop, et al. (2014). Hare et al. (2014) found that thinking styles characterised by worrying and rumination were associated with anxiety. Further, in their large cross-sectional study, Khanna et al. (2014) reported that maladaptive coping strategies were related to poorer physical and mental health domains of QoL. Due to the correlational nature of these findings, it is not possible to infer the direction of relationships. Specifically, although negative thinking styles and unhelpful coping strategies may contribute to poor psychosocial outcomes, it is also plausible that emotional distress and adverse social experiences contribute to, and maintain maladaptive appraisals and coping responses. Prospective studies investigating these potentially bi-directional or reciprocal effects over time could greatly aid intervention efforts for this population. Further, research investigating the existence of cross-domain interactions among risk factors (e.g., the effects of stress and depression on executive functioning) would advance the field.

A further consistent finding of this review was the association between higher levels of perceived social support and better psychosocial outcomes (Gotham, Bishop, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006). These studies indicated that subjective appraisal of support (i.e., perceived quality or availability) was more closely related to psychosocial outcomes than actual received support. This finding differs from the results of the review by Levy and Perry (2011) which indicated that access to intervention programs was associated with more positive outcomes for adolescents and adults with ASD. Aside from sampling differences, a key difference is that Levy and Perry (2011) focused on functional outcomes (e.g., cognitive function, language, academic performance and social outcomes), rather than indices of subjective well-being (e.g., QoL and depression) as measured by the studies included in the present review (Gotham, Bishop, et al., 2014; Khanna et al., 2014; Renty & Roeyers, 2006). As noted previously, it is possible that perceptions of social support and levels of subjective well-being have reciprocal or mutually enhancing effects. There is considerable evidence in the general clinical literature that perceived social support moderates the impact of high levels of stress on health outcomes in a range of clinical populations (Payne et al., 2012; Steptoe, 2000). However, the stress buffering effects of perceived social support on psychosocial outcomes of adults with HFASD has received little attention to date and represents an important direction for future research.

Finally, only one study by Tani et al. (2012) examined the relationship between bullying and psychosocial outcomes. Based on retrospective reports, bullying during the school years was found to be associated with mood swings in adulthood. This finding is consistent with other ASD literature which cites that the experience of being bullied, victimised or socially isolated, especially during the school years, may contribute to poor psychosocial functioning in adulthood (Cappadocia et al., 2012; Roekel et al., 2010). Interestingly, Hofvander et al. (2009) found that females with HFASD were more likely to be bullied during schooling than males. The factors that contribute to the experience of bullying (e.g., gender, ASD symptom severity, emotional intelligence, aspects of the education system) and potential mediators and/or moderators (e.g.,
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appraisals, coping and social support) in the relationship between bullying and psychosocial outcomes in adulthood represents an important area for future research.

Methodological Considerations

The aim of the present review was to identify factors related to psychosocial outcomes of adults with HFASD. For this reason, only group studies that reported statistical analyses were included. It is important to recognise the valuable and often more in-depth accounts provided by case studies and qualitative studies, even though the aim of such studies is not to broadly generalise findings to the ASD population (Giarelli & Fisher, 2013; Haertl et al., 2013; Muller et al., 2008; Smith & Sharp, 2013; Townson et al., 2007). Rather, these studies may provide insight into the lived experience of a health condition within a particular social and cultural context.

In terms of the review methodology, the initial article search and screening (stages 1 and 2) and the assessment of methodological quality was not replicated by an independent researcher. However, the first and second authors independently screened full-text articles for inclusion during stage three and worked collaboratively to assess the quality of methodology of selected studies. The use of independent raters to examine methodological quality and obtain mutual agreement would increase the rigour of future reviews.

In order to achieve extensive coverage of the literature, comprehensive databases (i.e., Ovid (PsycINFO), ProQuest, PubMed, Science Direct, Scopus and Web of Science) were used to identify relevant studies. Further, specific autism journals (i.e., Autism Research, Journal of Autism and Developmental Disorders, Journal of Intellectual and Developmental Disability and Autism) and reference lists of eligible studies were manually screened for articles published online that may not have been identified through the original database search. The search terms that were selected for the present review were based on DSM-IV (1994), DSM-IV-TR (2000), DSM-5 (2013) and ICD-10 (1993) terminology to identify people with high-functioning autism spectrum disorder (Asperger’s Syndrome/Disorder) as relevant to the specific focus of our review. However, it is acknowledged that a different set of search terms, including broader terms such as ‘autism’ and ‘functioning’, or indeed a search of other databases, may have yielded additional papers.

Finally, it is important to recognise that the findings of this review are based on a heterogeneous set of studies with varying methodological quality. In particular, there was wide variation with respect to study design and sample characteristics, variables examined and measurement of psychosocial outcomes. This made the process of appraising methodological quality challenging. Thus, an alternative set of criteria may have yielded different ratings of methodological quality.

Conclusions and Future Directions

The findings of this systematic review on the early prognostic significance of ASD symptom severity and neurocognitive functioning (i.e., IQ and non-verbal abilities) were largely consistent with previous reviews of the broader ASD empirical literature. The present review additionally identified that cognitive shifting deficits are an early risk factor for poor psychosocial outcomes of adults with HFASD. However, further prospective research examining the relationship between deficits in executive function and social cognition and psychosocial outcomes for adults with HFASD is warranted. Such research may guide the focus of remedial and/or compensatory strategy training programmes (see Eack, Greenwald, et al., 2013; Hare et al., 2015; Magiati, Tay, & Howlin, 2012; Schmidt et al., 2015).

Although there were fewer studies focusing on self-appraisals and coping, there was evidence that individuals with negative thinking styles and maladaptive coping
strategies experience poorer psychosocial outcomes, albeit mainly from cross-sectional research with correlational data. Due to the potentially bi-directional relationships among these factors, prospective studies are needed to better understand the development and maintenance of psychological and social difficulties over time. In terms of social and environmental factors, there was consistent support for the association between higher levels of perceived social support and better psychosocial outcomes. However, it is presently unknown whether perceived social support functions as a stress buffer between risk factors and psychosocial outcomes. More generally, examining the moderating and/or mediating role of psychological resources (e.g., appraisals, coping and social support) on the relationship between key risk factors (e.g., severity of ASD symptoms, neuro-cognitive deficits) and psychosocial outcomes would advance the field. As highlighted by qualitative research, the experience of being diagnosed with ASD, meeting likeminded people and recognising personal talents can have a positive effect on self-concept (Haertl et al., 2013; Smith & Sharp, 2013). Therefore, it is also important to examine positive self-concept domains that may buffer the stressors associated with ASD. In future research it is recommended that prospective designs with large and representative samples be employed to improve the generalisability of findings to the broader adult HFASD population. Greater use of multivariate analyses that control for potential covariates would increase confidence in the findings. Greater consistency in research methodology across studies (including measurement of psychosocial outcomes) would also support quantitative synthesis of findings through meta-analysis.
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References


Byers, E., Nichols, S., Voyer, S. D., & Reilly, G. (2013). Sexual well-being of a community sample of high-functioning adults on the Autism spectrum who have
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Figure 1. Flow diagram of literature search and study selection

**Step 1: Identification**
Electronic databases searched using key terms ($n = 837$)

- Additional articles identified through other sources ($n = 6$)

**Step 2: Screening**
Abstracts reviewed and articles retained if the content suggested potential eligibility. ($n = 807$)

- Excluded based on title ($n = 36$)
  - Duplicate ($n = 16$)
  - Not published in English ($n = 20$)
- Excluded based on abstract ($n = 726$)
  - Case studies
  - Review or commentary
  - Qualitative methodology
  - Adults with HFASD were not studied

**Step 3: Eligibility**
Full-text articles reviewed independently by two authors to assess for eligibility ($n = 67$)

- Excluded based on full-text ($n = 42$)
  - Methodology not relevant (e.g., mixed HFASD and autism sample)

**Step 4: Inclusion**
Final studies included in qualitative synthesis and appraisal of methodology ($n = 27$)
## Table 1

**Summary of Studies Investigating Factors Related to Psychosocial Outcomes in Adults with HFASD**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Design and Sample (Mean Age)</th>
<th>Correlates/Predictors</th>
<th>Psychosocial Outcomes</th>
<th>Quality of Methodology</th>
<th>Significant Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abell and Hare (2005)</td>
<td>Cross-sectional, n = 46 (32.5 years)</td>
<td>Age, self-consciousness, executive functioning, delusional beliefs, non-verbal &amp; verbal IQ, FSIQ, theory of mind (ToM), autobiographical memory</td>
<td>Anxiety and depression (HADS)</td>
<td>1</td>
<td>Older age, greater delusional beliefs and self-consciousness correlated with anxiety. Older age was also related to increased depression</td>
</tr>
<tr>
<td>Berger, Aerts, van Spaendonck, Cools, and Teunisse (2003)</td>
<td>Prospective, n = 30 (19.3 years), 3 year follow-up interval</td>
<td>Time 1: central coherence, cognitive shifting; Time 1 &amp; 2: Social functioning (symptom severity, social understanding &amp; competence)</td>
<td>Improvement in social competence (VABS)</td>
<td>2</td>
<td>Cognitive shifting was identified as an early prognostic marker of social competence</td>
</tr>
<tr>
<td>Bishop-Fitzpatrick, Mazefsky, Minshew and Eack (2015)</td>
<td>Cross-sectional, n = 38 (23.1 years)</td>
<td>Age and education</td>
<td>Stress (Brief Psychiatric Rating Scale); Social Functioning (Global Assessment Scale; Social Adjustment Scale-II)</td>
<td>3</td>
<td>Older age, but not education, was related to poorer social functioning (note: associations with stress were not examined)</td>
</tr>
<tr>
<td>Byers, Nichols, Voyer, and Reilly (2013)</td>
<td>Cross-sectional, n = 141 (39.6 years)</td>
<td>Gender, age, relationship status, ASD symptoms, self-esteem,</td>
<td>Sexual well-being (e.g., anxiety, self-esteem)</td>
<td>4</td>
<td>Greater ASD symptoms were related to increased sexual anxiety and lower self-esteem. Males had better sexual well-being</td>
</tr>
<tr>
<td>Farley et al. (2009)</td>
<td>Prospective, n = 41 (32.5 years), mean time interval to follow-up 24.42 years</td>
<td>Social support (vocational rehabilitation, government disabilities support), FSIQ</td>
<td>Social functioning rating (very good-very poor) and adaptive behaviour (VABS)</td>
<td>3</td>
<td>Childhood FSIQ predicted VABS scores in adulthood. Greater gains in intellectual functioning(IQ) were associated with better social and adaptive outcomes</td>
</tr>
</tbody>
</table>
### FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

<table>
<thead>
<tr>
<th>Study Authors, Year</th>
<th>Study Design</th>
<th>Sample Size</th>
<th>Variables</th>
<th>Summary</th>
</tr>
</thead>
</table>
| Gillberg, Helles, Billstedt, and Gillberg (2015) | Prospective | $n = 50$ (30 years) | FSIQ, VIQ, PIQ | Depression (BDI, psychiatric disorders (Mini Neuropsychiatric Interview), GAF, ADHD (Adult ADHD Self-Report Scale ; SNAP-IV)  
  Lower current FSIQ and non-verbal IQ was associated with ADHD symptoms. |
| Gotham, Unruh, and Lord (2014); Gotham, Bishop, Brunwasser, and Lord (2014) | Cross-sectional | $n = 50$ (20.7 years) | Age, gender, FSIQ, ASD related impairments, rumination, perceived social support, social interests and habits | Depression (BDI-II; Self-Report Depression Questionnaire), Anxiety (Spence Children’s Anxiety Scale-Parent), adaptive behaviour (VABS)  
  Greater ASD impairments and rumination and lower levels of perceived social-support, motivation and participation were related to increased depression. Rumination moderated the relationship between ASD symptoms and depression. |
| Hagberg, Nyden, Cederlund, and Gillberg (2013); Hagberg, Billstedt, Nyden, and Gillberg (2015) | Prospective | $n = 69$ (22.2 years) | Childhood ASD diagnosis and interview, cognitive assessment (verbal and non-verbal IQ, executive function, central coherence, memory) | Social adaptive behaviour (VABS); GAF; ADHD (SNAP-IV)  
  Adults with lifelong non-verbal disability had worse GAF than those with childhood only non-verbal disability. Those with lifelong non-verbal disability had worse social adaptive outcomes than those with no history of non-verbal disability; Poorer childhood non-verbal IQ was associated with ADHD symptoms in adulthood |
| Hare, Wood, Wastell, and Skirrow (2014); | Cross-sectional | $n = 20$ (32.1 years) | Thinking characteristics (e.g., self-focus, confusion, worries about everyday events and rumination) | Anxiety and Depression (HADS)  
  Self-focus, worries and longer periods of rumination were positively associated with anxiety |
### FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Measures</th>
<th>Outcomes</th>
<th>Association</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hill, Berthoz, and Frith (2004)</td>
<td>Cross-sectional</td>
<td>Emotion processing on the Toronto Alexithymia Scale</td>
<td>Depression (BDI)</td>
<td>2</td>
</tr>
<tr>
<td>Hirvikoski and Blomqvist (2015)</td>
<td>Cross-sectional</td>
<td>ASD symptoms</td>
<td>The Perceived Stress Scale (PSS)</td>
<td>1</td>
</tr>
<tr>
<td>Howlin (2003)</td>
<td>Cross-sectional</td>
<td>Autism and Asperger diagnoses, non-verbal IQ, comprehension, vocabulary, parent interview</td>
<td>Social outcomes (Autism Diagnostic Interview) and social functioning</td>
<td>2</td>
</tr>
<tr>
<td>Jansch and Hare (2014)</td>
<td>Cross-sectional</td>
<td>ASD symptoms, mentalisation (Reading the Mind in the Eyes Test), data gathering bias (Beads Task)</td>
<td>Depression (PHQ), generalised anxiety (Generalised Anxiety Disorder-7), self-consciousness (Self Consciousness Scale), paranoid thoughts (Paranoid Thought Scales)</td>
<td>2</td>
</tr>
<tr>
<td>Jantz (2011)</td>
<td>Cross-sectional</td>
<td>Age, gender, ASD symptoms</td>
<td>Loneliness (UCLA Loneliness Scale)</td>
<td>1</td>
</tr>
<tr>
<td>Khanna, Jariwala-Parikh, West-Strum, and Mahabaleshwarkar (2014)</td>
<td>Cross-sectional</td>
<td>Age, gender, ASD severity, perceived social support, coping</td>
<td>Health-related QoL (HRQoL): Physical and mental (The Medical Outcomes Study Short-Form Health Survey version 2)</td>
<td>2</td>
</tr>
<tr>
<td>Study</td>
<td>Design Type</td>
<td>Sample Characteristics</td>
<td>Variables</td>
<td>Outcomes</td>
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</tr>
<tr>
<td>Maddox and White (2015)</td>
<td>Cross-sectional</td>
<td>$n = 28$ (32.23 years)</td>
<td>ASD symptoms (Social Responsiveness Scale-II)</td>
<td>Social Anxiety Disorder Symptoms (Anxiety Disorders Interview Schedule-DSM-IV [ADIS-IV])</td>
</tr>
<tr>
<td>Montgomery, Stoesz, and McCrimmon (2013)</td>
<td>Cross-sectional</td>
<td>$n = 25$ (18.2 years)</td>
<td>HFASD symptoms, Verbal IQ, ToM, executive functions, emotional intelligence</td>
<td>Interpersonal relations and social stress (Behaviour Assessment System for Children-2)</td>
</tr>
<tr>
<td>Renty and Roeyers (2006)</td>
<td>Cross-sectional</td>
<td>$n = 58$ (28.3 years)</td>
<td>Age, gender, ASD symptoms, FSIQ (ASD symptoms + FSIQ = disability characteristics), support characteristics (perceived, received)</td>
<td>Quality of Life Questionnaire</td>
</tr>
<tr>
<td>Renty and Roeyers (2007)</td>
<td>Cross-sectional</td>
<td>$n = 21$ (43.5 years)</td>
<td>Males with ASD, ASD symptoms, informal social support – spouse and family, received support – spouse and family, formal support, coping strategies</td>
<td>Psychological distress – individual satisfaction (The Symptom Checklist-90), marital satisfaction (Dyadic Adjustment Scale)</td>
</tr>
<tr>
<td>Schmidt et al. (2015)</td>
<td>Cross-sectional</td>
<td>$n = 43$ (31 years)</td>
<td>Psychological resources and general functioning (WHODAS)</td>
<td>Life satisfaction (German Quality of Life Questionnaire)</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>n</td>
<td>Age (Years)</td>
<td>Measures of ASD Symptoms</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>--------------</td>
<td>-------</td>
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<td>---------------------------</td>
</tr>
<tr>
<td>Shattérmman (2007)</td>
<td>Cross-sectional</td>
<td>10</td>
<td>19.7</td>
<td>HFASD symptoms, peer victimisation, level of stigma</td>
</tr>
<tr>
<td>South et al. (2015)</td>
<td>Cross-sectional</td>
<td>24</td>
<td>22.51</td>
<td>Pattern separation memory task</td>
</tr>
<tr>
<td>Szatmari, Bartolucci, Bremner, Bond, and Rich (1989)</td>
<td>Retrospective</td>
<td>16</td>
<td>26.0</td>
<td>Early ASD symptoms, current FSIQ, visuo-motor skills, facial recognition, receptive language, non-verbal problem solving (cognitive shifting) skills, visual motor integration</td>
</tr>
<tr>
<td>Tani et al. (2012)</td>
<td>Cross-sectional</td>
<td>99</td>
<td>30.7</td>
<td>ASD symptoms, developmental and social history (structured interview with informant), FSIQ</td>
</tr>
<tr>
<td>Taylor, Henninger, and Mailick (2015)</td>
<td>Prospective</td>
<td>73</td>
<td>23.83</td>
<td>Gender, age, ASD symptoms, maladaptive behaviours, daily activities, parental education, maternal social support, depression, anxiety and pessimism</td>
</tr>
</tbody>
</table>
### FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>N (Age)</th>
<th>Variables</th>
<th>n</th>
<th>Findings</th>
</tr>
</thead>
</table>
| Wallace et al. (2015) | Cross-sectional  
 n = 35 (21.55 years) | Age, FSIQ, Executive functioning (behaviour regulation and metacognition) | Adaptive functioning (Adaptive Behaviour Assessment System-II); anxiety, depression and ADHD (Adult Behavior Checklist) | 2 | Poorer planning was related to worse adaptive functioning and increased depression, whereas poorer shifting was related to greater anxiety. |

BDI-II = Beck Depression Inventory; GAF = Global Assessment of Functioning; HADS = Hospital Anxiety and Depression Scale; PHQ= Patient Health Questionnaire; SNAP-IV = Swanson, Nolan and Pelham Questionnaire; VABS = Vineland Adaptive Behavior Scale.
Table 2

*Ratings of Quality of Methodology of Included Studies*

<table>
<thead>
<tr>
<th>Study</th>
<th>Prospective/Retrospective Design</th>
<th>Sample Characteristics</th>
<th>Sample Representativeness</th>
<th>Adequate Sample Size</th>
<th>Multivariate Analysis</th>
<th>Total (0-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abell and Hare (2005)</td>
<td>☒</td>
<td>✓</td>
<td>☒</td>
<td>✓</td>
<td>✓</td>
<td>1</td>
</tr>
<tr>
<td>Bishop-Fitzpatrick, Mazefsky, Minshew and Eack (2015)</td>
<td>☒</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>3</td>
</tr>
<tr>
<td>Byers, Nichols, Voyer, and Reilly (2013)</td>
<td>☒</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>4</td>
</tr>
<tr>
<td>Farley et al. (2009)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>Hirvikoski and Blomqvist (2015)</td>
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## FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

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<th>Communication</th>
<th>Emotional *</th>
<th>Social Skills</th>
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</tr>
</tbody>
</table>
Appendix C: Social and Adaptive Functioning Composite Score Key

Employment

0 = Employed/self-employed; 1 = higher education/vocational training; 2 = Voluntary work; 3 = Sheltered employment for people with disability; 4 = Not employed.

Friendship

0 = I have one or more close friends that I’m not related to, and they would also consider me a close friend; 1 = I have one or more friends but we only share some of the same interests; 2 = I really only spend time with people in a work group or club situation; 3 = I don’t have anyone that I would consider a close friend.

Independence

0 = I live my myself/or with significant other and take care of all of my daily living needs; 1 = I live with parents/others, but more or less take care of my daily living needs; 2 = I live with parents/others, and rely on them for most of my daily living needs; 3 = I live in supported accommodation and rely on others for most of my daily living needs.

Relationship

0 = Married/Defacto; 1 = Single, but have been in a serious relationship in the last 2 years; 2 = Single and have not been in a relationship in the last 2 years; 3 = Single and have never had a serious relationship.
### Appendix D: List of Self-Report Measures

#### Ritvo Autism Asperger’s Diagnostic Scale – Revised

<table>
<thead>
<tr>
<th>Some life experiences and personality characteristics that may apply to you</th>
<th>True now and when I was young</th>
<th>True only now</th>
<th>True only when I was younger than 16</th>
<th>Never true</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> I am a sympathetic person.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>2</strong> I often use words and phrases from movies and television in conversations.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>3</strong> I am often surprised when others tell me I have been rude.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>4</strong> Sometimes I talk too loudly or too softly, and I am not aware of it.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>5</strong> I often don’t know how to act in social situations.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>6</strong> I can “put myself in other people’s shoes.”</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>7</strong> I have a hard time figuring out what some phrases mean, like “you are the apple of my eye.”</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>8</strong> I only like to talk to people who share my special interests.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>9</strong> I focus on details rather than the overall idea.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>10</strong> I always notice how food feels in my mouth. This is more important to me than how it tastes.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>11</strong> I miss my best friends or family when we are apart for a long time.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>12</strong> Sometimes I offend others by saying what I am thinking, even if I don’t mean to.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>13</strong> I only like to think and talk about a few things that interest me.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>14</strong> I’d rather go out to eat in a restaurant by myself than with someone I know.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>15</strong> I cannot imagine what it would be like to be someone else.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td><strong>16</strong> I have been told that I am clumsy or uncoordinated.</td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
<td><img src="image" alt=" " /></td>
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</table>

*Please continue on the next page*

© Riva Ariella Ritvo, Ph.D. and Edward Ritvo, M.D., 2007
<table>
<thead>
<tr>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Others consider me odd or different.</td>
</tr>
<tr>
<td>I understand when friends need to be comforted.</td>
</tr>
<tr>
<td>I am very sensitive to the way my clothes feel when I touch them. How they feel is more important to me than how they look.</td>
</tr>
<tr>
<td>I like to copy the way certain people speak and act. It helps me appear more normal.</td>
</tr>
<tr>
<td>It can be very intimidating for me to talk to more than one person at the same time.</td>
</tr>
<tr>
<td>I have to &quot;act normal&quot; to please other people and make them like me.</td>
</tr>
<tr>
<td>Meeting new people is usually easy for me.</td>
</tr>
<tr>
<td>I get highly confused when someone interrupts me when I am talking about something I am very interested in.</td>
</tr>
<tr>
<td>It is difficult for me to understand how other people are feeling when we are talking.</td>
</tr>
<tr>
<td>I like having a conversation with several people, for instance around a dinner table, at school or at work.</td>
</tr>
<tr>
<td>I take things too literally, so I often miss what people are trying to say.</td>
</tr>
<tr>
<td>It is very difficult for me to understand when someone is embarrassed or jealous.</td>
</tr>
<tr>
<td>Some ordinary textures that do not bother others feel very offensive when they touch my skin.</td>
</tr>
<tr>
<td>I get extremely upset when the way I like to do things is suddenly changed.</td>
</tr>
<tr>
<td>I have never wanted or needed to have what other people call an &quot;intimate relationship.&quot;</td>
</tr>
<tr>
<td>It is difficult for me to start and stop a conversation. I need to keep going until I am finished.</td>
</tr>
</tbody>
</table>

Check only one column

True now and when I was young
True only now
True only when I was younger than 16
Never true
FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

<table>
<thead>
<tr>
<th>Some life experiences and personality characteristics that may apply to you</th>
<th>True now and when I was young</th>
<th>True only now</th>
<th>True only when I was younger than 16</th>
<th>Never true</th>
</tr>
</thead>
<tbody>
<tr>
<td>33* I speak with a normal rhythm.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>34. The same sound, color or texture can suddenly change from very sensitive to very dull.</td>
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</tr>
<tr>
<td>35. The phrase &quot;I've got you under my skin&quot; makes me very uncomfortable.</td>
<td></td>
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<tr>
<td>36. Sometimes the sound of a word or a high-pitched noise can be painful to my ears.</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>37* I am an understanding type of person.</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>38. I do not connect with characters in movies and cannot feel what they feel.</td>
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</tr>
<tr>
<td>39. I cannot tell when someone is flirting with me.</td>
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</tr>
<tr>
<td>40. I can see in my mind in exact detail things that I am interested in.</td>
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<tr>
<td>41. I keep lists of things that interest me, even when they have no practical use (for example sports statistics, train schedules, calendar dates, historical facts and dates).</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>42. When I feel overwhelmed by my senses, I have to isolate myself to shut them down.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>43* I like to talk things over with my friends.</td>
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<td></td>
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</tr>
<tr>
<td>44. I cannot tell if someone is interested or bored with what I am saying.</td>
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</tr>
<tr>
<td>45. It can be very hard to read someone's face, hand and body movements when they are talking.</td>
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</tr>
<tr>
<td>46. The same thing (like clothes or temperatures) can feel very different to me at different times.</td>
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</tr>
<tr>
<td>47* I feel very comfortable with dating or being in social situations with others.</td>
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</tr>
<tr>
<td>48* I try to be as helpful as I can when other people tell me their personal problems.</td>
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</tbody>
</table>

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## FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

<table>
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<tr>
<th>Some life experiences and personality characteristics that may apply to you</th>
<th>True now and when I was young</th>
<th>True only now</th>
<th>True only when I was younger than 16</th>
<th>Never true</th>
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</thead>
<tbody>
<tr>
<td>49. I have been told that I have an unusual voice (for example flat, monotone, childish, or high-pitched).</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>50. Sometimes a thought or a subject gets stuck in my mind and I have to talk about it even if no one is interested.</td>
<td></td>
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</tr>
<tr>
<td>51. I do certain things with my hands over and over again (like flapping, twirling sticks or strings, waving things by my eyes).</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>52. I have never been interested in what most of the people I know consider interesting.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53* I am considered a compassionate type of person.</td>
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<td></td>
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</tr>
<tr>
<td>54. I get along with other people by following a set of specific rules that help me look normal.</td>
<td></td>
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</tr>
<tr>
<td>55. It is very difficult for me to work and function in groups.</td>
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</tr>
<tr>
<td>56. When I am talking to someone, it is hard to change the subject. If the other person does so, I can get very upset and confused.</td>
<td></td>
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</tr>
<tr>
<td>57. Sometimes I have to cover my ears to block out painful noises (like vacuum cleaners or people talking too much or too loudly).</td>
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</tr>
<tr>
<td>58* I can chat and make small talk with people.</td>
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</tr>
<tr>
<td>59. Sometimes things that should feel painful are not (for instance when I hurt myself or burn my hand on a stove).</td>
<td></td>
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</tr>
<tr>
<td>60. When talking to someone, I have a hard time telling when it is my turn to talk or to listen.</td>
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</tr>
<tr>
<td>61. I am considered a loner by those who know me best.</td>
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<tr>
<td>62* I usually speak in a normal tone.</td>
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</tr>
<tr>
<td>63. I like things to be exactly the same day after day and even small changes in my routines upset me.</td>
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</tr>
<tr>
<td>64. How to make friends and socialize is a mystery to me.</td>
<td></td>
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</tr>
</tbody>
</table>

*Please continue on the next page*  
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### FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

| Some life experiences and personality characteristics that may apply to you | Check only one column |
|---|---|---|---|---|
| **65.** It calms me to spin around or to rock in a chair when I am feeling stressed. | True now and when I was young | True only now | True only when I was younger than 16 | Never true |
| **66.** The phrase, “He wears his heart on his sleeve,” does not make sense to me. |  |  |  |  |
| **67.** If I am in a place where there are many smells, textures to feel, noises or bright lights, I feel anxious or frightened. |  |  |  |  |
| **68** I can tell when someone says one thing but means something else. |  |  |  |  |
| **69.** I like to be by myself as much as I can. |  |  |  |  |
| **70.** I keep my thoughts stacked in my memory like they are on filing cards, and I pick out the ones I need by looking through the stack and finding the right one (or another unique way). |  |  |  |  |
| **71.** The same sound sometimes seems very loud or very soft, even though I know it has not changed. |  |  |  |  |
| **72** I enjoy spending time eating and talking with my family and friends. |  |  |  |  |
| **73.** I can’t tolerate things I dislike (like smells, textures, sounds or colors). |  |  |  |  |
| **74.** I don’t like to be hugged or held. |  |  |  |  |
| **75.** When I go somewhere, I have to follow a familiar route or I can get very confused and upset. |  |  |  |  |
| **76.** It is difficult to figure out what other people expect of me. |  |  |  |  |
| **77** I like to have close friends. |  |  |  |  |
| **78.** People tell me that I give too much detail. |  |  |  |  |
| **79.** I am often told that I ask embarrassing questions. |  |  |  |  |
| **80.** I tend to point out other people’s mistakes. |  |  |  |  |

Thank you for your cooperation!

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FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

Depression, Anxiety and Stress Scales-21

Please read each statement and circle a number 0, 1, 2, or 3 which indicates how much the statements apply to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:
0 Did not apply to me at all - NEVER
1 Applied to me to some degree, or some of the time - SOMETIMES
2 Applied to me to a considerable degree, or a good part of the time - OFTEN
3 Applied to me very much, or most of the time - ALMOST ALWAYS

<table>
<thead>
<tr>
<th>No.</th>
<th>Statement</th>
<th>N</th>
<th>S</th>
<th>O</th>
<th>AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I found it hard to wind down.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>I was aware of dryness of my mouth.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>I couldn’t seem to experience any positive feeling at all</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>I experienced breathing difficulty (e.g., excessively rapid breathing, breathlessness in the absence of physical exertion).</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>I found it difficult to work up the initiative to do things.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>I tended to over react to situations.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>I experienced trembling (e.g., in the hands).</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>I felt that I was using a lot of nervous energy.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>9</td>
<td>I was worried about situations in which I might panic and make a fool of myself.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10</td>
<td>I felt that I had nothing to look forward to.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>I found myself getting agitated.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>I found it difficult to relax.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>I felt down hearted and blue.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>14</td>
<td>I was intolerant of anything that kept me from getting on with what I was doing.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>15</td>
<td>I felt I was close to panic.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>16</td>
<td>I was unable to become enthusiastic about anything.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>17</td>
<td>I felt I wasn’t worth much as a person.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>18</td>
<td>I felt that I was rather touchy.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>19</td>
<td>I was aware of the action of my heart in the absence of physical exertion (e.g., Sense of heart rate increase, heart missing a beat)</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td>I felt scared without any good reason.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>21</td>
<td>I felt that life was meaningless.</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

Rosenberg Self-Esteem Scale

Instructions: Below is a list of statements dealing with your general feelings about yourself. If you strongly agree, circle SA. If you agree with the statement, circle A. If you disagree, circle D. If you strongly disagree, circle SD.

1. On the whole, I am satisfied with myself. SA A D SD
2. At times, I think I am no good at all. SA A D SD
3. I feel that I have a number of good qualities. SA A D SD
4. I am able to do things as well as most other people. SA A D SD
5. I feel I do not have much to be proud of. SA A D SD
6. I certainly feel useless at times. SA A D SD
7. I feel that I’m a person of worth, at least on an equal plane with others. SA A D SD
8. I wish I could have more respect for myself. SA A D SD
9. All in all, I am inclined to feel that I am a failure. SA A D SD
10. I take a positive attitude toward myself. SA A D SD

The Six-Factor Self-Concept Scale for Adults

Below is a list of descriptions about people. For each one, please indicate how often you think the description is true of you. In making your judgments, consider all of your current life experiences, including work, family, school, and social situations.

Use the following scale to describe yourself:

Mark 1 if it is never or almost never true of you.
Mark 2 if it is usually not true of you.
Mark 3 if it is sometimes but infrequently true of you.
Mark 4 if it is occasionally true of you.
Mark 5 if it is often true of you.
Mark 6 if it is usually true of you.
Mark 7 if it is always or almost always true of you.

1. Fun to be with
2. Hard worker
3. Dominant
4. Easily embarrassed
5. A natural talent
6. Loyal
7. Strong
8. Friendly
9. Productive
10. Lacks confidence
11. Law-abiding
12. Forceful
13. Has special talents
14. Plans ahead
15. Sociable
16. Easily hurt
17. Acts as a leader
18. Truthful
19. Self-conscious
20. Works efficiently
21. Faithful
22. Aggressive
23. Easy to talk to
24. Bright and ingenious
25. Makes mistakes when flustered
26. Honest
27. Good at meeting deadlines
28. Pleasant
29. Powerful
30. Creative
31. Easily rattled when people are watching
32. Trustworthy
33. Can concentrate well on a task
34. Warm
35. Tough
36. Has innate ability
Emotion Regulation Questionnaire

Instructions and Items

We would like to ask you some questions about your emotional life, in particular, how you control (that is, regulate and manage) your emotions. The questions below involve two distinct aspects of your emotional life. One is your emotional experience, or what you feel like inside. The other is your emotional expression, or how you show your emotions in the way you talk, gesture, or behave. Although some of the following questions may seem similar to one another, they differ in important ways. For each item, please answer using the following scale:

1 strongly disagree  2 neutral  3 strongly agree

1. ___ When I want to feel more positive emotion (such as joy or amusement), I change what I’m thinking about.
2. ___ I keep my emotions to myself.
3. ___ When I want to feel less negative emotion (such as sadness or anger), I change what I’m thinking about.
4. ___ When I am feeling positive emotions, I am careful not to express them.
5. ___ When I’m faced with a stressful situation, I make myself think about it in a way that helps me stay calm.
6. ___ I control my emotions by not expressing them.
7. ___ When I want to feel more positive emotion, I change the way I’m thinking about the situation.
8. ___ I control my emotions by changing the way I think about the situation I’m in.
9. ___ When I am feeling negative emotions, I make sure not to express them.
10. ___ When I want to feel less negative emotion, I change the way I’m thinking about the situation.

ASD Appraisals (Adapted from the Illness Cognition Questionnaire)

This survey is designed to be completed by individuals who have experienced a range of different psychological health conditions. Please consider your own experience of having Asperger syndrome/high-functioning autism and respond to the statements as they apply to how you experience your symptoms. Indicate the extent to which you agree with the following questions by selecting the most appropriate answer. Do not spend too much time considering your answer as your first impression is usually the best.

1. My symptoms stop me from doing things I would enjoy
2. I can handle the problems related to my symptoms
3. I have learned to live with my symptoms
4. Dealing with my symptoms has made me a stronger person
5. My symptoms control my life
6. I have learned a great deal from my symptoms.
7. My symptoms make me feel useless at times
8. My symptoms help make life more precious to me
9. My symptoms prevent me from doing what I would really like to do
10. I have learned to accept the limitations imposed by my symptoms
11. Looking back, I can see that my symptoms have also brought about some positive changes in my life
12. My symptoms limit me in everything that is important to me.
13. I can accept my symptoms well
14. I think I can handle the problems related to my symptoms, even if the symptoms seem to get worse
15. My symptoms frequently make me feel helpless
FACTORS INFLUENCING PSYCHOSOCIAL OUTCOMES IN ASD

16. My symptoms have helped me realise what’s important in life.
17. I can cope effectively with my symptoms
18. My symptoms have taught me to enjoy the moment more.

Interpersonal Support Evaluation List

This list of questions is designed to understand the level of social support in your life. It is made up of a list of statements each of which may or may not be true about you. For each statement select: "definitely true" if you are sure it is true about you; or "probably true" if you think it is true but are not absolutely certain; or "definitely false" if you are sure the statement is false; or "probably false" if you think it is false but are not absolutely certain.

1. There really is no one who can give me an objective view of how I’m handling my problems.
2. When I need suggestions on how to deal with a personal problem, I know someone I can turn to.
3. There is really no one I can trust to give me good financial advice.
4. There is at least one person I know whose advice I really trust.
5. If I were sick and needed someone (friend, family member, or acquaintance) to take me to the doctor, I would have trouble finding someone.
6. If I were sick, I could easily find someone to help me with my daily chores.
7. If I had to go out of town for a few weeks, it would be difficult to find someone who would look after my house or apartment (the plants, pets, garden, etc.).
8. It would be difficult to find someone who would lend me their car for a few hours.
9. When I feel lonely, there are several people I can talk to.
10. I often meet or talk with family or friends.
11. I feel like I am not always included by my circle of friends.
12. I don’t often get invited to do things with others.
13. Most of my friends are more interesting than I am.
14. Most of my friends are more successful at making changes in their lives than I am.
15. I am more satisfied with my life than most people are with theirs.
16. I have a hard time keeping pace with my friends.
Cybernetic Coping Scale

These questions ask about the different ways in which people cope with stressful experiences in everyday life. Please indicate how often you use each item to help you cope with stress.

1. I tried to change the situation to get what I wanted.
2. I focussed my efforts on changing the situation.
3. I worked on changing the situation to get what I wanted.
4. I tried to fix what was wrong with the situation.
5. I told myself the problem wasn’t so serious after all.
6. I told myself the problem wasn’t such a big deal after all.
7. I tried to keep myself from thinking about the problem.
8. I tried to turn my attention away from the problem.
9. I refused to think about the problem.
10. I tried to avoid thinking about the problem.
11. I made an effort to change my expectations.
12. I tried to convince myself that the way things were was, in fact, acceptable.
13. I tried to adjust my expectations to meet the situation.
14. I tried to convince myself that the problem was not very important after all.
15. I told myself the problem was unimportant.
16. I tried to convince myself that the problem was, in fact, pretty insignificant.
17. I tried to just let off steam.
18. I tried to relieve my tension somehow.
19. I tried to get it off my chest.
20. I just tried to relax.